

Mathematical and Bio-Statistical Techniques (MBP203)

Unit-I

[12L]

Vectors: Cross and Dot products, Vector fields: General expression for gradient, divergence, curl and orthogonal curvilinear coordinates and their explicit forms in cylindrical and spherical polar coordinates, multiple integrals, Gauss theorem, Stokes theorem.

Matrix theory: Different types of matrices, rank and its application to solutions of linear equations, eigenvalues and eigenvectors, Cayley-Hamilton theorem, diagonalization of symmetric matrices by orthogonal matrices and Hermitian matrices by unitary matrices.

Unit-II

[12L]

First order differential equation, second order linear differential equation with constant coefficients, methods of solutions and applications, series solutions, ordinary and singular points, Fourier series and transform: parseval and convolution theorems, FFT concept.

Unit-III

[12L]

Classification and diagrammatic representation of statistical data, frequency distribution, measures of central tendency, measures of dispersion including standard error.

Probability theory-events, additions, multiplication and Bayes theorems, Binomial, Poisson and Gaussian and normal distributions. correlation and regression analysis.

Unit-IV

[12L]

Sampling theory, sample size and sampling methods, concept of statistical inference-parametric tests (Z-test, unpaired t-test, paired t-test, one way analysis of variance and two way analysis of variance), non-parametric tests (Wilcoxon rank sums test, Wilcoxon sign rank test, KruskalWalli's test, Friedman test), chi-square test, p-test, p-values.

References

1. E. Kreyszig, Advanced engineering mathematics, 10th ed. Hoboken, NJ: John Wiley, 2011.
2. G. B. Arfken, Mathematical methods for physicists: a comprehensive guide, 7th ed. Amsterdam ; Boston: Elsevier, 2013.
3. J. B. Fraleigh, A first course in abstract algebra, 7th ed. Boston: Addison-Wesley, 2003.
4. D. C. Lay, Linear algebra and its applications, 4th ed. Boston: Addison-Wesley, 2012.
5. B. Rosner, Fundamentals of biostatistics, 7th ed. Boston: Brooks/Cole, Cengage Learning, 20.

Microbiology and Immunology (MBP205) (CBCS)

Unit-I

[12L]

History of microbiology, Microbial world, origin and evolution of microorganisms, Differentiating characteristics of each group of microorganisms, Functional features of cells of microorganisms, Bacterial staining- Types and significance, Microbial growth, Media for growth, Phases of growth, Control of microbial growth.

Unit-II

[12L]

Normal microflora of human body. Determinants of infectious diseases: attachment, colonization, entry, growth and multiplication. Toxigenicity: exotoxin, endotoxins, fever, shock, inflammation. Host-parasite interactions: pathogenicity, virulence, transmission. Nonspecific defense mechanisms of host: general barriers, physical barriers, chemical barriers, biological barriers. Human pathogenic microorganisms.

Unit-III

[12L]

Cells and tissues of immune system, Hematopoiesis and differentiation, Primary and Secondary lymphoid organs, (Thymus, bone marrow, lymph nodes, Spleen), Lymphoid cells, B lymphocytes, T lymphocytes, Mononuclear phagocytes, Granulocytic cells, Mast cells, Dendritic cells, and their functions. Innate and adaptive immunity, concepts of antigen, antigenicity, Immunogen and immunogenicity, Humoral and cell mediated immune response.

Unit-IV

[12L]

Structure and function of immunoglobulin, Clonal formation, Major Histocompatibility Complex (MHC) molecules, Antigen presentation, Hypersensitivity reactions (Type I-IV), Autoimmunity, Transplantation and basis of graft rejection, Antigen-antibody interactions, Monoclonal antibodies and Hybridoma technology, Radioimmunoassay (RIA), Enzyme linked immunosorbant assay (ELISA).

References

1. Fundamental Immunology, Editor William E. Paul, Publisher Lippincott Williams & Wilkins, 2012, ISBN 1451117833, 9781451117837.
2. Basic Immunology: Functions and Disorders of the Immune System, Authors: Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai, Publisher Elsevier Health Sciences, 2012, ISBN, 145575899X, 9781455758999.
3. Immunology: Understanding the Immune System, by Klaus D. Elgert, Publisher John Wiley & Sons, 2009, ISBN 0470081570, 9780470081570.
4. Microbiology: Principles and Explorations, by Jacquelyn G. Black, Publisher John Wiley & Sons, 2008, ISBN 0470107480, 9780470107485.
5. Alcamo's Fundamentals of Microbiology: Body Systems, Glendale Community College Jeffrey C Pommerville, Jeffrey Pommerville, Publisher Jones & Bartlett Publishers, 2012, ISBN 1449605958, 9781449605957.
6. Human genetics, A. Gardner, R.T. Howell and T. Davies, Published by Vinod Vasishtha for Viva Books private limited, 2008.

Numerical Methods and Programming (PGSD201) (Skill Development)

Unit 1: Curve plotting and fitting

Functions: polynomials, trigonometric, exponential, logarithmic and their plotting; normal, tangents, Polar coordinates, transformation of coordinates, parametric equations, tracing of polar curves, curve fitting, least-square fitting method, basic concept of interpolation & extrapolation. C programs of above methods.

Unit 2: Error and numerical solution of equations

Errors of observation and measurement, accuracy and preciseness, relative error, approximate error, bisection method, fix point iteration method, method of false position, Newton-Raphson's method, C programming of above methods.

Unit 3: System of linear equations

Matrix representation of linear system of equations, solution of system of linear equations, Gauss-elimination method, Gauss-Jordan method, Iteration method for finding solutions, Jacobi's iteration method, Gauss-siedal method. C programs of above methods.

Unit 4: Integration and differential equations

Numerical integration, Simpson's rule, trapezoidal rule, numerically calculation of area under the curve, Initial value problem (I.V.P.), Euler's method, Runge-Kutta method- second or fourth order, system of ODEs, C program for solving ordinary differential equations. C programs of above methods.

Recommended Books

- [1] C. F. Gerald and P. O. Wheatley, *Applied numerical analysis*, 4th ed. Reading, Mass: Addison-Wesley Pub. Co, 1989.
- [2] S. C. Chapra, *Applied numerical methods with MATLAB for engineers and scientists*. New York: McGraw-Hill, 2013.
- [3] S. R. K. Iyengar, R. K. Jain, and M. K. Jain, *Numerical Methods for Scientific and Engineering Computation*. New Age International Publishers.
- [4] S. S. Sastry, *Introductory methods of numerical analysis*. Place of publication not identified: Prentice-Hall Of India Pv, 2010.

Biophysical Techniques (MBP303)

Unit-I

[12L]

Reflection, absorption, emission, scattering in spectroscopy, UV-Visible absorption, fluorescence and phosphorescence spectroscopy, Circular Dichroism, dynamic light scattering, rotational and vibrational spectroscopy, study of diatomic vibrations and rotational modes, advantages of Raman spectroscopy, applications, advantages and disadvantages of these techniques to biology.

Unit-II

[12L]

General principles of NMR spectroscopy, resonance condition, relaxation phenomena and measurements, chemical shifts, coupling constants, proton decoupling (broad band), NOE effects, ¹H, ¹³C, solid state NMR, Basic principle and application of ESR, spin-labeling.

Basic principle of Mass spectroscopy, analysis and its application, importance and principle of MALDI-TOF spectroscopy and its applications.

Unit-III

[12L]

General principles of electrophoresis, Factors affecting electrophoresis, Electrophoresis of proteins, SDS-PAGE, Support media for SDS-PAGE, Native gel, Gradient gel, Isoelectric focussing gel, Molecular mass determination by electrophoresis, Two-dimensional electrophoresis, Detection of proteins in gel, Wester Blotting, Electrophoresis of nucleic acid, Agarose gel electrophoresis, Support media for agarose gel electrophoresis, Electrophoresis of RNA, Capillary electrophoresis, Microchip electrophoresis, application of electrophoresis.

Unit-IV

[12L]

Basic principles of chromatography, paper chromatography, TLC, column chromatography, gas, liquid chromatography, ion exchange chromatography, exclusion chromatography, affinity chromatography, high performance liquid chromatography, fast protein liquid chromatography, their applications to macromolecules.

References

1. Fundamentals of Molecular Spectroscopy, 5th Edn, McGraw Hill, ISBN-10 1259062597, ISBN-13 9781259062599, 2013 May
2. Introductory Raman Spectroscopy by John R. Ferraro, Kazuo Nakamoto and Chris W. Brown, Second Edition, ISBN: 978-0-12-254105-63, Elsevier Science Publishing, 2003
3. Infrared and Raman Spectroscopy; Principles and Spectral Interpretation, by Peter Larkin, Elsevier Science Publishing Co Inc (13 July 2011), ISBN-10: 0123869846, ISBN-13: 978-0123869845
4. Introduction to Magnetic Resonance Spectroscopy ESR, NMR, NQR by D.N. Sathyanarayana (Second Edition), I K Int. Publ. House; Second Edition ISBN-10: 9382332529, ISBN-13: 978-93823325278 Nov 2013
5. Physical Biochemistry, D. Freifelder, W.H. Freeman & Co. San Francisco, 1976
6. NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, Wiley India Pvt Ltd; Second edition ISBN-10: 8126528443, ISBN-13: 978-8126528448, 12 October 2010
7. Biomolecular NMR Spectroscopy, by Jeremy N. S. Evans, OUP Oxford (11 May 1995)

Measurement and Data presentation (PGAE301) (Ability Enhancement)

Unit 1: Measurement

[12L]

Block diagram of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Repeatability, Reproducibility, Fidelity, Lag; Specifications of Instruments. Standards and calibration.

Unit 11: Data Acquisition

[12L]

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

Unit III: Presentation skills

[12L]

Elements of an effective presentation, Structure of a presentation, Presentation tools, Data types, The graph Abstract Data Type, Data Structures for Graphs, Graph Traversals Directed Graphs, Weighted Graphs, Shortest Paths, Minimum spanning Trees. Data Graphing/Plotting using Microsoft Excel, Origin

Unit IV: Advanced technical writing

[12L]

Report writing: Definition and importance of reports, qualities of reports, language and style in reports, types of reports, formats (letter, memo, project-reports). Methods of compiling data for preparing report. A computer-aided presentation of a technical project report based on survey-based or reference based topic. Technical paper-writing.

TEXT BOOKS:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

Pharmacology and Toxicology (MBP 402) (CBCS)

Unit I: General Pharmacology

Introduction, Drug discovery-a historical outline, general stages in modern-day drug discovery leads, analogues, prodrugs, some desirable properties - bioavailability, solubility, structure, stability, sources of drugs -ethnos pharmaceutical sources, plant sources, marine sources, microorganisms, animal sources, compound collections, data bases and synthesis. Methods and routes of administration: Pathology of the diseased state, the pharmaceutical phase. drug action, pharmacokinetic phase (ADME), pharmacodynamic phase.

Unit II: Drug development

Classification of drugs based on chemical structure: β -lactam antibiotics, benzodiazepine, cardiac glycosides, fibrates, thiazide diuretics. Classification based on mechanism of action: 5-alpha reductase inhibitor, Beta blockers, Nonsteroidal anti-inflammatory drugs – cyclooxygenase inhibitors, proton pump inhibitors. Classification based on mode of action- diuretic, cholinergic, dopaminergic, GABA argic, serotonergic.

Unit III

General Principles of Toxicology

Introduction to toxicology, toxicity tests, acute and chronic toxicity, dose response relationship, disposition of toxicants- absorption, distribution and elimination of toxicants. Target organ toxicity- hepatotoxicity, immunotoxicity, pulmonary toxicity, reproductive toxicity, hepatotoxicity, nephrotoxicity. Toxic effects of Pesticides with special reference to Insecticides, Herbicides, Fungicides, Rodenticides, Fumigants.

Unit IV

Applications of Toxicology

Clinical toxicology- strategy for treatment of the poisoned patient; Food toxicology- safety standards for foods, food ingredients, and contaminants; Forensic toxicology- analytic role, toxicological investigation of a poison death, criminal poisoning of the living; Occupational toxicology- occupational diseases, toxicologic evaluation of occupational agents, exposure monitoring, regulations for laboratory animal care and ethical requirements, clinical trials.

Recommended Books:

1. Casarett and Doull's Toxicology: The Basic Science of Poisons/editor Curtis D. Klaassen.
2. A Textbook of Modern Toxicology by Ernest Hodgson & Patricia E Levi, III Ed. Appleton & Lange 1997.
3. A Textbook of Modern Toxicology IV Edition, edited by Ernest Hodgson Wiley, 2010.
4. Principles of Biochemical Toxicology by John Timbrell, IV Edition.
5. Principles of Toxicology, III Edition 2015 by Karen E Sine & Thomas M Brown, CRC Press Teller & Francis Group.
6. An Introduction to Medicinal Chemistry; Graham L. Patrick (Oxford University Press-2009) 4th Edition.

Semester III

MBP301: Radiation and Medical Biophysics

Unit-I

[12L]

Electromagnetic spectrum, properties of non-ionizing and ionizing radiation, radiation units, principles of detection and measurement, dosimetry of high-energy photons, electrons and ions, standardization of x-ray and high energy beams, methods of measuring radioactivity, different methods of counting and counters, biological dosimetry, properties and biological effects of UV radiation, UV in treatment of skin disorders, properties and biological effects of LASER, application of LASER in ophthalmology, surgery and dentistry, properties, biological effects and application of microwave radiation and ultrasonic waves

Unit-II

[12L]

Biological effects of ionizing radiation, cell survival assay, modification of cell survival, chromosome aberration and gene mutation, molecular aspects of radiation damage and repair, somatic and genetic effects of radiation, hazards of non-ionizing radiation and their control, medical application of radiation sources, principles of X-ray diagnosis, high kV radiography, special procedures such as topography, fluoroscopy, stereoscopy, image intensifiers and television monitoring, application of ionizing radiation in industry, agriculture and research

Unit-III

[12L]

Internally administered isotopes, radio-iodine in thyroid function analysis, principles of isotope dilution analysis, circulation time, renal, liver and lung function analysis, radioisotope scanners and cameras, medical data collection, storage and analysis of hospital data using computers, computers in medical instrumentation and diagnosis.

Unit-IV

[12L]

Ultrasound, nuclear magnetic resonance imaging and positron emission tomography, computerized axial tomography, whole body scanner, dose calibrators, gamma scintillation camera, digital imaging techniques, acquisition, analysis and processing of data from gamma camera, enhancement, tomographic reconstruction, display and recording of the image, Principle and interpretation of electro-encephalogram, electro-cardiogram, and electro-oculogram.

References

1. Roy R.R. & Nigam B.P Nuclear Physics, Theory and Experiment, Wiley.
2. Halliday D, Introductory Nuclear Physics, 2nd Edition, John Wiley.
3. Knoll G.F. Radiation detection and measurements, John Wiley.
4. Altman K.I. Gobes G.B. & Okada S. Radiation Biochemistry, Vol. I & II AP
5. Alper T. Cellular Radiology, Cambridge University Press.
6. Coggle J.E. Biological Effects of Radiation. 2nd edition, Taylor & Francis.
7. Orton C.G. Radiation Dosimetry: Physical and Biological Aspects, Plenum Press.
8. Dunn F and O'Brien, W.D. (Eds) Ultrasonic Biophysics, Dowden-Hatchinson & Ross Inc.
9. Chadwick K.H. & Leenbouts H.P. Molecular Theory of Radiation Biology, Springer Verlag.
10. McAingh T.F. (eds) Physics in Medicine and biology, encyclopedia, Pergamon Press.
11. Atlik F.H. Introduction to Radiological Physics and Radiation Dosimetry, John Wiley

Semester IV

MBP401: Nanobiotechnology

Unit-I

[12L]

0D, 1D, 2D structures, quantum confinement & size effects, fraction of surface atoms, specific surface energy and surface stress, effect on the lattice parameter, density of states, reactivity of nanomaterials, general methods for nanomaterial synthesis viz. sol-gel, hydrothermal/solvothermal methods, synthesis of metallic, semiconducting and oxide nanoparticles, homo- and hetero-nucleation & growth, template-based synthesis (electrochemical, electrophoretic, melt and solution, CVD, ALD), gas phase Synthesis of nanopowders, vapor (or solution), liquid-solid (VLS or SLS) growth

Unit-II

[12L]

Fundamentals of nucleation growth, controlling nucleation & growth, size control at nanometric scale, aggregation, stability of colloidal dispersions, spontaneous condensation of nanoparticles: homogeneous nucleation, spinodal decomposition, other undesirable post-condensation effects, nanoparticles' morphology, quantum Wells, doping of a nanoparticle, excitonic binding and recombination energies, capacitance in a nanoparticle, correlation between diffusion and crystallite growth, brief overview of optical properties, mechanical, properties including superplasticity phenomena, reactivity of nanoparticles

Unit-III

[12L]

Overview of natural bionanomachines, thermal motion of biomolecules, water environment and their importance in bionanomachines modern biomaterials, structure and functional properties of biomaterials, quantum dot structures & their integration with biological structures, nano-biometrics, lipids as nano-bricks & mortar: self-assembled nanolayers, DNA based nanostructures, hybrid conjugates of gold nanoparticles, DNA oligomers, protein-nanoparticles based recognition groups, nanoparticles as carrier for genetic material, nanotechnology in agriculture, fertilizer and pesticides, nanomedicine, drug delivery, DNA computing, molecular design using biological selection, harnessing molecular motors, artificial life, hybrid materials, biosensors

Unit-IV

[12L]

Fundamentals of techniques, experimental approaches and data interpretation, applications/limitations of X-ray characterization: X-ray sources, wide angle, extended X-ray absorption technique, SEM/TEM, high resolution imaging, defects in nanomaterials, X-ray photoelectron spectroscopy, UV-Visible, fluorescence, circular dichroism spectroscopy, MALDI-TOF spectroscopy, DLS, electron filtered imaging, atomic force microscopy, prospects of scanning probe microscopes, optical spectroscopy of metal/semiconductor nanoparticles

References

1. C. M. Niemeyer, C. A. Mirkin, Nanobiotechnology: Concepts, Applications and Perspectives, Wiley – VCH, (2004).
- 2 T. Pradeep, Nano: The Essentials, McGraw – Hill education, (2007).
3. Challa, S.S.R. Kumar, Josef Hormes, Carola Leuschner, Nanofabrication Towards Biomedical Applications, Techniques, Tools, Applications and Impact, Wiley–VCH, (2005).
4. Nicholas A. Kotov, Nanoparticle Assemblies and Superstructures, CRC, (2006).
5. David S Goodsell, Bionanotechnology, John Wiley & Sons, (2004).

MBP402: Neurophysics

Unit-I

[12L]

Cellular structure and molecular organization of neurons, cellular neurophysiology of brain, neural signalling, basic systems and their organization, electrophysiological properties, neural cells, specialized communications, neuron firing

Unit-II

[12L]

Biomolecules in brains, neurochemistry, signalling in nervous system, need, structure, properties and function of ion channels, I-V plots of ion channels, resting membrane potential, action potential, Hodgkin-Huxley model (HH) model, integrate and fire (IF) model, leaky-integrate and fire neuron (LIF) model.

Unit-III

[12L]

Neurogenetics and immunology, bioenergetics, metabolism of brain development, regeneration of nervous system, learning and remembrance, information processing in brain, coordination system and GPS in brain.

Unit-IV

[12L]

Clinical neurochemistry, propagation of nerve impulses & transfer of information between nerve cells, effect of drug on transfer of information brain sensory (olfaction, vision, light into neural signal, travel & process of light signal in to the brain and motor system, regulatory system, learning memory and cognition

References

1. Fundamental neuroscience, Third edition, Edited by Larry Squire, Darwin Berg, Floyd Bloom, Sascha du Lac, Anirvan Ghosh, Nicholas Spitzer, Academic Press is an imprint of Elsevier, ISBN 978-0-12-374019-9
2. Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting, Eugene M. Izhikevich, The MIT Press, ISBN 978-0-262-09043-8
3. Neuroscience, Third edition, Edited by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel Lamantia, James O. Mcnamara, S. Mark Williams, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts U.S.A, ISBN 0-87893-725-0

MBP403: Medicinal Chemistry and Drug Design

UNIT-I

[12L]

Historical perspectives, current view of pharmacogenetics, pharmacogenetics; biomarkers, promise of personalized medicine, genetic drug response profiles, effect of drug on gene expression, drug metabolism, drug targets, drug solubility, natural resources of lead compounds, pharmacokinetics & drug metabolism, biological testing and bioassays, preclinical testing and clinical trial, synthesis, patenting and manufacture. contour of drugs, development of new drugs, chemical & physicochemical parameters in drug design, design of enzyme inhibitors, computation techniques in drug design process.

Unit-II

[12L]

Pharmacological screening of herbal drugs- introduction and evaluation of herbal drugs for antidiabetic, hepatoprotective, diuretic, anti-diarrhoeal, antiulcer, wound healing, cardiovascular, anti-inflammatory, analgesic, antipyretic, antifertility, anti-oxidant, anti-viral & cyto-toxic properties, combinatorial chemistry technologies & libraries, solution phase synthesis, high-throughput synthesis and screening, development of new drugs, procedures followed in drug design, concept of lead compound and lead modification.

Unit-III

[12L]

Basic principles of modelling, modelling software: Sali-modeller, Swiss-modeller, gen-threader, Ab-initio modelling, combined modelling, minimization of a peptide energy using appropriate Force field; Ramachandran plot, torsional space minimization, energy minimization in cartesian space, visualization of macromolecular structures by software such as RasMol, Cn3D, SPDBV etc.

Unit-IV

[12L]

Basic concept of drug design, prodrugs, bioprecursor & carrier linked prodrugs, hard and soft drugs, analog based drug design, designing of analogs, structure based drug design, drug design on structure based, molecular docking, drug likeness, introduction to 1D, 2D and 3D QSAR, tools & techniques, physicochemical parameters, quantitative models, drug metabolism- phase-I & phase-II metabolic reactions, introduction to drug designing on the basis of metabolic pathways.

Suggested Books

1. Foyes Principles of Medicinal Chemistry, Editors Thomas L. Lemke, David A. Williams, Publisher: Lippincott Williams & Wilkins, 2012, ISBN 1609133455, 9781609133450.
2. An Introduction to Medicinal Chemistry, Author Graham L. Patrick, Publisher Oxford University Press, 2013, ISBN 0199697396, 9780199697397.
3. Drug Design: Cutting Edge Approaches, by Darren R. Flower, Publisher Royal Society of Chemistry, 2002, ISBN 0854048162, 9780854048168.

(MIBS102)

Fundamentals of Computing

(3 Credits=100 Marks)

Unit I: Concepts in Computing

Computer system: components, Characteristics & capabilities; classification; computer storage and memory, preliminary concept of software, hardware, Software evolution, Computer Languages: High-level and Low-level Languages, Language translators: Assemblers, Compilers, Interpreter and Editor; Concepts of flowcharting, algorithm development, pseudo codes etc. Basic concepts of programming languages: Programming domains, Operating Systems: Linux operating systems

Unit II: C Programming: Part I

Program Compilation, Running of a Program; Header file concept Basic elements: Variables and Constants, Rules for naming the Variables/Identifiers; Basic data types of C, int, char, float, double; Storage classes; Operators and Expressions: Assignment Operator, Arithmetic Operator and Arithmetic exp., Relational Operator and Relational exp., Logical Operator, Expression Evaluation (Precedence of Operators); statements, simple I/O statements. Control structures, if, if else, switch-case, for, while, do-while, break, continue.

Unit III: C Programming: Part II

One and two dimensional arrays, declaration, initialization and processing; Strings: String handling functions; Pointers: The & and * Operators, pointer declaration, assignment and arithmetic, visualizing pointers, array & pointer relationship, dynamic memory allocation, pointer to arrays, array of pointers. Functions: Library, User defined functions, declaration, definition & scope, recursion, call by value, call by reference. File handling: text and binary files,

Unit IV: Databases and Data Mining Techniques

Evolution of database systems, DBMS concepts and architecture, classification of database management systems, Database Models, Data modeling using ER models, Relational data model, Database languages; Data Mining: Basic Concept of Knowledge Discovery and Data Mining, Exploration of Data Mining tools for Biodata analysis, Pattern Mining. Association Analysis, Classification methods, Cluster Analysis methods, Computational Modeling of Biological Networks, Applications of Data Mining to Bioinformatics

Reference books:

1. Introduction to Information Technology – ITL Education Solutions Limited, Pearson Education
2. Introduction to Computers - Peter Norton, TMH

Unit-I: Spectroscopic Techniques

Absorption spectroscopy (UV-Vis), Fourier transform-infra-red (FT-IR) spectroscopy, Fluorescence, Phosphorescence, Raman and micro Raman spectroscopy, dynamic light scattering spectroscopy, Circular dichroism, mass spectroscopy and MALDI, NMR (theory and applications), cyclic voltametry, impedance spectroscopy and its applications, X-Ray photoelectron spectroscopy. X-ray energy dispersion analysis, Microwave spectroscopy, X-Ray diffraction.

Unit-II: Microscopic Techniques

Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), scanning tunneling microscopy, atomic force microscopy as versatile tools for fabrication - characterization and nanomanipulation of biomolecules, SNOM, Phase contrast, focal and Con-focal microscope, fluorescence microscopy, confocal microscopy, SNOM microscopy, magnetic resonance imaging (MRI) etc.

Unit-III: Biophysical techniques

Surface tension and surface free energy, Dynamic surface tension, Contact angle: Young's Equation, Contact angle hysteresis, Refractive index for solute-solvent interactions, Lorentz-Lorentz equation for *polarizability*, Electrophoresis, Electroosmosis, Calorimetry: Differential Scanning calorimetry, Isothermal titration calorimetry, TGA.

Unit-IV: Biochemical Techniques

Methods of disruption of cells, Estimation of proteins by various methods, SDS-PAGE and 2D electrophoresis, Chromatography: ion-exchange: cation exchange, anion exchange, gel filtration, affinity, HPLC, reverse phase HPLC, FPLC, VLC. Concentration of proteins: lyophilization, ultra filtration: column-based concentration of proteins, dialysis, thin layer and column chromatography.

Recommended Books:

- [1] C. N. Banwell, *Fundamentals of molecular spectroscopy*, 4th ed. London ; New York: McGraw-Hill, 1994.
- [2] P. W. Hawkes and J. C. H. Spence, Eds., *Science of microscopy*. New York: Springer, 2007.

Unit 1: Descriptive Statistics and Distribution

Measures of location and spread; symmetry of data (moments, skewness and kurtosis). Probability, law of probability, conditional probability, Baye's Rule and Screening Tests; ROC curves, Prevalence and Incidents. Random variable, probability distribution, binomial, poisson and normal distributions.

Unit2: Hypothesis Testing

Hypothesis, z-test, t-test, **One-sample hypothesis**: hypothesis concerning the mean, confidence limit for population mean, sample size and estimation of population mean, hypothesis limit for the population variance, hypothesis concerning the variance. **Two-sample hypothesis**: difference between two mean, testing for difference between two variance. **Pair-sample hypothesis**: mean comparison of pair sample. Multiple hypotheses: mean comparison more than two groups (ANOVA).

Unit 3: Non-parametric methods and Category data analysis

Nonparametric statistics, The Sign Test, Wilcoxon Signed-Rank Test, The Wilcoxon Ranks-Sum Test, two sample test for binomial properties, Fisher's Exact Test, McNemar's Test, $R \times C$ Contingency tables, chi-square goodness of fit test, Data Transformation, clustering analysis.

Unit 4: Regression and Correlation methods

Fitting regression line- method of least squares, inference about parameters from regression lines, interval estimation for linear regression, assessing the goodness for fit of linear regression lines, correlation coefficient, inference of correlation coefficient, and multiple regressions, partial and multiple correlation and rank correlation.

Recommended Books:

- [1] B. Rosner, *Fundamentals of biostatistics*. Boston: Brooks/Cole, Cengage Learning, 2011.
- [2] J. H. Zar, *Biostatistical analysis*, 4th ed. Upper Saddle River, N.J: Prentice Hall, 1999.
- [3] P. N. Arora, P. K. Malhan, *Biostatistics*, Himalaya Publishing House, 2006.
- [4] S. C. Gupta, V. K. Kapoor, *Fundamental of mathematical statistics*, Sultan chand and Sons New Delhi.
- [5] V. K. Rohatgi, A. K. Md. Ehsanes Saleh, *An introduction to probability and statistics*, 2nd ed., John Wiley and Sons (Asia) Pte. Ltd.

Unit I: Tools and Techniques in Molecular Biology Part I:

Enzymes used in recombinant DNA technology: DNA and RNA polymerases, ligases, methylases, endonucleases and exonucleases. DNAases and RNAases. Principle of restriction digestion, Star activities, Development of DNA based marker, Restriction Fragment Length Polymorphism (RFLP), DNA fingerprinting, Genotyping, Mutation analysis.

Unit II: Tools and Techniques in Molecular Biology Part II:

DNA isolation from different sources; Nucleic acid separation techniques: Agarose gel electrophoresis of DNA. Radio labeling of DNA, Nick translation, Kinase reaction, random primer labeling, Blottings: Southern and Northern blotting techniques. Nucleic acid amplification protocols; DNA sequencing.

Unit III: Tools and Techniques in Molecular Biology Part III:

Sterilization and disinfection. Radioimmunoassay (RIA) and Enzyme Linked Immunosorbant Assay (ELISA). Western blotting techniques, Immunohistochemistry, Fluorescence in situ hybridization (FISH), Gene localization, Germ line genetics, Somatic cell genetics approaches, Formation of heterokaryones.

Unit IV: Tools and Techniques in Molecular Biology Part IV:

Basic principle of cloning, Vectors: Basic requirements for a suitable cloning vector. Recombinant DNA. Competent cell preparation and transformation protocols. Cloning and selection transformants and recombinants. Characterization of recombinant clone.

Recommended Books:

- 1) Brown TA; Gene Cloning and DNA analysis: An Introduction (Fifth Edition); Blackwell Publishing.
- 2) Primrose SB & Tyman RM, 2006. Principles of gene manipulation and genomics. Seventh Edition. Blackwell Publishing.
- 3) Sambrook and Russell; Molecular Cloning A Laboratory Manual; Third edition; Cold Spring Laboratory Press International Edition, Cold Spring, New York, USA.