M.Sc. in Bioinformatics

Bioinformatics has emerged as an interdisciplinary thrust area in the field of science merging Biology, Computer Science and Information Technology. It applies concepts of Computer Science and Information Technology to solve complex problems of Life Science. Computer databases and algorithms are developed for the purpose of speeding up and enhancing biological researches. It has wide applications in the human Genome project. The research going on this area requires many trained professionals. The two years M.Sc. program in Bioinformatics has been designed to enhance job prospects in IT and Pharmaceutical industries for students with basic science degrees.

Program Details

Duration:
The M.Sc. program is a full time course of two-year duration consisting of four semesters.

Eligibility:
Bachelor's Degree in science (special or general with Biochemistry, Biology, Botany, Chemistry, Electronics, Computer Science, Life Sciences, Physics, Mathematics, Agriculture science, Pharmacy, Veterinary Science with at least 60% marks.

- All the candidates should have Mathematics as a subject at (10 +2) level.

Course Curriculum
The course curriculum is so designed to include training in major area of Bioinformatics. There will be four semesters and each will have five papers covering a wide range of topics.

Semester I

MB 101. Introduction to Modern Biology
MB 102. Basic Mathematics
MB 103. Introduction to computing
MB 104. Fundamentals of Bioinformatics
MB 105. Cell and Molecular Biology

Semester II

MB 201. Statistics for Bioinformatics
MB 202. Data Structures and Algorithms
MB 203. Introduction to Databases and Database Programming for Bioinformatics
MB 204. Structures of Biomolecules
MB 205. Fundamentals of Genetics

02/05/11

Semester III

MB 301. Genome Biology
MB 302. Biological Data Banks, Data Mining and Data Security
MB 303. Computational Biology
MB 304. Object Oriented Programming using Java
MB 305. Seminar based course

Semester IV

MB 401. Rational Drug Design
MB 402. Molecular Structure Prediction and Visualization
MB 403.Protein Engineering and Proteomics
MB 404. Genomics and Transcriptomics
MB 405. Project Work

Course Description

Semester I

MB 101. Introduction to Modern Biology:
Unit 1. Concepts and methods in Biology: Energy and life's organization, Evolutionary view of diversity, Nature of biological inquiry - observations, hypothesis and tests. Principles of cellular life, chemical foundation of cells, carbon compounds in cells, cell structure and function, ground rules for metabolism, source of energy for cells.
Unit 2. Principles of Inheritance, Cell division, Patterns of inheritance
Unit 3. Principles of evolution: Origin and evolution of life, Evolution and diversity, Microevolution, speciation, macro-evolutionary puzzle. Nature of Ecosystems, Biodiversity, Conservation strategies.
Unit 4. General characteristics of prokaryotic and eukaryotic life forms: bacteria, viruses, protists, plants and animals.
Unit 5. Plant structure and function: Plants tissues, nutrition and transport.
Unit 6. Animal structure and function: Tissues and organs, Sensory reception, endocrine control, circulation, immunity, respiration, digestion and nutrition, reproduction and development-sexual versus asexual reproduction, stages of reproduction, cell differentiation, morphogenesis, and pattern formation.

MB 102. Basic Mathematics:
Unit 1. Probability: Introduction to probability, conditional probability, Bayes theorem
Unit 2. Basic Statistics: Random variables, Data representation, Histogram, Ogive, Frequency polygon, Mean, Median, Mode, Variance, Standard deviation, Covariance, Correlation, Regression.
Unit 3. Matrices: Operations on Matrices, determinants, (Simple Calculations) Adjoint, Inverse of a matrix using determinant solution of Equations, Cramer's rule.

Unit 4. 3d Geometry: Equation of line in space.
Unit 5: Vectors: Definition, Addition, Dot product, Cross product.
Unit 6. Differentiation: Derivatives of important functions (Formulae), sum rule, product rule, Quotient rule, Chain rule.
Unit 7. Integration: Indefinite integrals as anti derivatives. Integration of sum of two functions, Product rule.

MB 103. Introduction to computing:
Unit 1. Introduction to Computers, Overview of DOS and Windows Operating systems
Unit 2. Introduction to a structured programming language (C language)
Unit 3. Internet principles, Basic web concepts, HTML and Scripting languages, Clint/Server model, Introduction to UNIX.

MB 104. Introduction to Bioinformatics (3,3,0)

Unit 1. What is Bioinformatics? History of Bioinformatics, Relevance and uses of Bioinformatics, Bioinformatics glossary, Future scope of Bioinformatics.
Unit 2. Biological databanks: NCBI data model, GenBank Sequence database, Structural database, Biodiversity information, and Virology information databases, Cheminformatics databases.
Practicals on data retrieval involving internet-based Bioinformatics tools,
Unit 3. Introduction to Genomic mapping and data repositories, Human genome project, Sequence assembly and finishing methods.
Unit 4. Introduction to Sequence analysis programs and structure prediction programs

MB 105. Cell and Molecular Biology:
Unit 1. Cellular architecture of prokaryotes and eukaryotes: cell wall, cell membrane, cell organelles, cyto-skeleton, nuclear organization. Cell motility and shape, Techniques for studying cells.
Unit 2. Cell cycle, cell division, programmed cell death, signal transduction, cell-cell signaling, cancer biology.
Unit 3. Recombinant DNA technology: Isolation and characterization of DNA and RNA, Vectors, DNA cloning, sequencing and mutagenesis, transformation and targeted mutagenesis, polymerase chain reaction.
Unit 4. Immunology: Overview of immune system, Immunoassays, Antibody generation.
Unit 5. Manipulating the Mouse Genome: overview, homologous recombination, mouse ES cells, chimeric mouse and knockout mouse.

Semester II

MB 201. Statistics for Bioinformatics (3,0,1):
Unit 1. Distributions (Binomial, Poisson and normal), Test of significance (x2 and t),
Unit 2. Information and Entropy representation and summary of data; Statistical distributions as models of data; parametric models, statistical inference: Likelihood; Posterial distribution; Maximum Likelihood;
Unit 3. Bios and variance trade off models of dependence: Markov chains; Boltzmann-Gibbs distribution.

MB 202. Data Structures and Algorithms:
Unit 1. Basic Concepts and algorithmic mathematical notations. Introduction to algorithm analysis for Time and Space requirements.
Unit 2. (a)Arrays and Linked lists (b) Stacks and Queues: Definitions and their usage, Sequential representation. Sorting algorithms: Insertion sort, Bubble sort, Quick sort, Merge sort, Searching Techniques: Sequential search, Indexed sequential search, Binary search (c) Trees: Definition and basic concepts linked tree representation, Binary tree traversal techniques, Binary search trees and their usage,
Unit 3. Graphs: Definition and Representations of graphs, Depth-first search, Breadth-first search
Unit 4. Divide and Conquer, Introduction to Greedy algorithms.

MB 203. Introduction to Databases and Database Programming for Bioinformatics:
Unit 1. Introduction to Databases: Data abstraction, data models, E-R models, E-R Diagrams and their reduction to tables, Basic concepts: Network data models, Hierarchical data models, Multimedia data models, Basic concepts of Indexing: B, B+ Tree indexed files, Static and Dynamic Hashing. Text databases, Introduction to distributed database processing.
Unit 2. Database programming using SQL and Visual basic: Data definition Data manipulation, Data control statements, Other database objects, Views, Sequences, Synonyms, Introduction to Application development using Visual Basic, Code and Forms, Variable, procedures and controlling Program executor, Data access using Data Control.
Unit 3. Perl programming: scalars, loops, sequences, arrays, hashes, references, patterns, and subroutines. Databases, Genome annotation & Gene Finding Feature (GFF), Introduction to BioPerl.

Semester II

MB 201. Statistics for Bioinformatics (3,0,1):

Unit 1. Distributions (Binomial, Poisson and normal), Test of significance (x2 and t),

Unit 2. Information and Entropy representation and summary of data; Statistical distributions as models of data: parametric models, statistical inference: Likelihood; Posterial distribution; Maximum Likelihood;

Unit 3. Bios and variance trade off models of dependence: Markov chains; Boltzmann-Gibbs distribution.

MB 202. Data Structures and Algorithms:

Unit 1. Basic Concepts and algorithmic mathematical notations, Introduction to algorithm analysis for Time and Space requirements,

Unit 2. (a)Arrays and Linked lists (b) Stacks and Queues: Definitions and their usage, Sequential representation. Sorting algorithms: Insertion sort, Bubble sort, Quick sort, Merge sort, Searching Techniques: Sequential search, Indexed sequential search, Binary search (c) Trees: Definition and basic concepts linked tree representation, Binary tree traversal techniques, Binary search trees and their usage,

Unit 3. Graphs: Definition and Representations of graphs, Depth-first search, Breadth-first search

Unit 4. Divide and Conquer, Introduction to Greedy algorithms.

MB 203. Introduction to Databases and Database Programming for Bioinformatics:

Unit 1. Introduction to Databases: Data abstraction, data models, E-R models, E-R Diagrams and their reduction to tables, Basic concepts: Network data models, Hierarchical data models, Multimedia data models, Basic concepts of Indexing: B, B+ Tree indexed files, Static and Dynamic Hashing, Text databases, Introduction to distributed database processing.

Unit 2. Database programming using SQL and Visual basic: Data definition Data manipulation, Data control statements, Other database objects, Views, Sequences, Synonyms, Introduction to Application development using Visual Basic, Code and Forms, Variable, procedures and controlling Program executor, Data access using Data Control.

Unit 3. Perl programming: scalars, loops, sequences, arrays, hashes, references, patterns, and subroutines. Databases, Genome annotation & Gene Finding Feature (GFF), Introduction to BioPerl.

MB 204. Biochemistry

Unit 1: Bioenergetics: Properties of water, Acids, Bases and Buffers. First and Second law of thermodynamics; Free energy as an indicator of spontaneity; Chemical Equilibria.

Unit 2: Structure of macromolecules: Protein structure: Amino Acids of Proteins; Optical Activity. Primary Structure Determination; Three-Dimensional Structures of Proteins: Secondary Structure; Fibrous Protiens; Globular Protiens; Quaternary Structure.

Unit 3. Polysaccharides; Glyco-proteins. Lipids and Membranes; Mechanisms of enzyme action; Substrate Specificity; Coenzymes; Regulation of Enzymatic Activity: enzyme kinetics, Inhibition; effects of pH. Catalytic mechanisms. Structure of Nucleic acids.

Unit 4. Biosynthesis of Amino acids, Lipids and Nucleotides.

Unit 5: Biochemical metabolic Pathways: Glycolysis, Pentose Phosphate pathway, reverse glycolysis, Kreb cycle.

MB 205. Fundamentals of Genetics:

Unit 1.Evolution of concept of the gene: one gene one enzyme hypothesis, defining gene by Complementation test Genetic code.

Unit 2.Genetics of prokaryotes: Genetics of viruses/phage, mapping of phage genotype, Genetic analysis of bacteria, Transformation, conjugation and Transduction,

Unit 3.Generation of genetic diversity: Mutations and DNA repair mechanisms, recombination, transposition, extra chromosomal inheritance.

Unit 4. Essential Principles of Genetics: The principles of inheritance and selection of experimental models. Extension of Mendelism: Gene action (genotype to Phenotype) Gene interaction. The genetic basis of phenotypic variation. Epistatsis. Linkage recombination and gene mapping, X linked inheritance, Sex determination, Doses compensation.

Unit 5. Techniques of genetic analysis/Genetic dissection of biological process/ discovery of pathways. Morphological/ molecular markers, Mutagenesis, Reporter genes, Mitotic recombination, Deletion mapping, Cytological mapping, Identification of a gene: phenotype to cloning.

Semester III

MB 301. Genome Biology (3,0,0):
Unit 1.Genome as the store house of information, DNA as the carrier of encoded messages. Organization and regulations of genes in prokaryotes and eukaryotes.
Unit 2. Intra-cellular transmission of genetic message and their cellular translation; Cell-cell communication and feedback; Selective transmission of genetic messages- regulation of gene expression; logic of building body plans-developmental translation of encoded messages.
Unit 3. Genome mapping at molecular levels. Techniques of DNA manipulation and engineering: EST. Minisatellites and microsatellites. SNPs and genetic screening.
Unit 4: Genomic diversity and evolution, comparative genomics.

MB 302. Biological Data Banks, Data Mining and Data security (3,2,0):
Unit 1.Biological databanks: Types. Building biological databases, Sequence and structural databases. Database similarity searches, Submitting DNA sequences to database. Sequence Analysis.
Unit 2. Data mining: Basics. Architecture for Data Mining, Differences between Data Mining & Machine Learning, Visualizing Data Mining Models, Decision Tree, Data mining applications in Bioinformatics.
Unit 3. Introductory data security concepts, Discretionary and mandatory access controls, secure database design, data integrity, secure architectures, secure transaction processing, information flow controls, inference controls, and auditing. Security of databases in a distributed environment.

MB 303. Computational Biology (3,2,0): -
Unit 1. Pairwise sequence alignment, Multiple Sequence Alignment, Practical Aspects of Multiple Sequence Alignment,
Unit 2. Phylogenetic Analysis,
Unit 3.Predictive Methods Using Protein and Nucleic Acid Sequences, Practical involving BLAST, HAMMER and other Internet-based server.

MB 304.Object-Oriented Concepts and Java (3,3,0):
Unit 1. Object Oriented Concepts, Introduction to Object Oriented Programming using Java programming language.
Unit 2. Java applet basics, Simple events and inter activity, creating user interfaces with AWT, Modifiers, Exceptions, Multithreading, Streams and I/O, Data structure and Java image filters..

MB 305. Term paper and Seminar based course in an emerging area of Bioinformatics.

Semester IV

MBI 401. Rational Drug Design:

Unit 1.Aspects for a new drug like safety, effectiveness, stability, solubility, synthetic feasibility, and novelty. Notion of pharmacophore: definition, Various drug targets. Ethics and economics in drug designing.

Unit 2. Pharmacokinetics- drug absorption, distribution, metabolism, excretion, dosing. Rule of 5 for drug designing

Unit 3. Drug targeting- in vitro, in vivo. Line weaver Burke plot for competitive and non competitive inhibition, IC50, ED50, therapeutic index, LD50, high throughput screening (ELISA plate).

Unit 4. Natural and synthetic lead components. Semisynthetic, biosynthesis analogs of lead compounds.

Unit 5.Ligand based drug designing- efficient search for lead compounds. Analog synthesis, structure activity relationships (QSAR), pharmacophore deduction and modeling, lead compounds optimization/ new drug design. Target (receptor) based drug design.

Unit 6. Bioinformatics in drug designing: Efficient search for drug candidates in chemical databases- library design and virtual screening, combinatorial library, automated synthesis,

MBI 402. Molecular structure prediction and visualization:

Unit 1. Principles of Protein Folding: Calculation of conformational energy for bio-macromolecules, Methods for Prediction of Secondary and Tertiary structures of Proteins: Knowledge-based structure prediction, Fold recognition, Ab initio methods for structure prediction, threading etc.

Unit 2. Methods for structure prediction, visualization and comparison of 3D structures of proteins, nucleic acids, rRNA. Simulation of molecular mechanics and dynamics and free energy changes

Unit 3. Methods for studying molecular interactions of protein – Protein ,Protein – DNA, Protein – carbohydrate, DNA – small molecules etc.

MBI 403. Protein engineering and Proteomics:

Unit 1. Protein design and engineering: Protein Folding, Dynamics and Structural Evolution. Elementary ideas of bonding and structure, stereochemistry; Random, site directed mutagenesis; Strategies to alter catalytic efficiency; structure prediction and modeling proteins; Molecular graphics in protein engineering; Dynamics and mechanics; Drug-protein interactions and Design; applications of engineered proteins.

Unit 2. Proteomics: Protein sequencing analysis, protein and peptide sample preparation, mass spectrometry, NMR, analysis of post-translational

modifications, recombinant protein purification, protein-protein and protein-DNA interactions, structure prediction, modeling and protein folding, functional implications of protein domains and newly emerging methods for the investigation of the proteome, allowing to analyze the expression of genes.

Unit 3. Comparative proteomics, microarray and protein chips. Cis regulatory elements and microarray data analysis for CRE analysis, Artificial neural networks.

Unit 4: Proteins and metabolomics: pathways determinations and analysis.

MBI 404.Genomics and Transcriptomics:-

Unit 1.Introduction; The impact of Genomics on biological research; Identification of a large set of genes involved in a biological process; High-throughput expression analysis; Genome-wide search for interacting partners – yeast hybrid systems;

Unit 2. Identification of alternatively spliced genes; Transcription binding sites, identification of genes in prokaryotes and eukaryotes. Promoter identification.

Unit 3.Sequence variations and disease susceptibility: Pharmacogenomics; Functional Genomics in model organisms; High-throughput phenotypic analysis; Recent developments in Genomics.

MBI 405. Project Work:

NOTE: Some fine details of some of the courses may further be revised.

Advanced Post Graduate Diploma in Bioinformatics

Bioinformatics has emerged as an interdisciplinary thrust area in the field of science merging Biology, Computer Science and Information Technology. It applies concepts of Computer Science and Information Technology to solve complex problems of Life Scince. Computer databases and algorithms are developed for the purpose of speeding up and enhancing biological researches. It has wide applications in the human Genome project. The research going on this area requires many trained professionals. The one year Advanced Diploma program in Bioinformatics has been designed to enhance job prospects in IT and Pharmaceutical industries for students with basic science degrees.

Program Details:

Duration: The Advanced Post-Graduate Diploma is a full time course of one-year duration consisting of two semesters.

Eligibility:

1. Master's Degree in Life Sciences, Physics, Mathematics, Chemistry, Computer Science, Agriculture science
2. B. Pharm (Bachelor's degree in Pharmacy)
3. B. Tech (In any engineering branch)*
4. M.B.B.S, B.D.M.S, B.A.M.S

* All the candidates should have Mathematics as a subject at (10 +2) level.

Course Curriculum:

The course curriculum is so designed to include training in major area of Bioinformatics. Each semester will have six papers covering a wide range of topics.

Semester I

PBI 101*. Introduction to Modern Biology/ Basic Mathematics
PBI 102. Statistics for Bioinformatics
PBI 103. Introduction to Computing
PBI 104. Fundamentals of Bioinformatics
PBI 105. Structure of Biomolecules
PBI 106. Genetics, Cell and Molecular Biology
*Students with Biology background will opt for Basic mathematics and those with Mathematics background will opt for Introduction to Modern Biology.

Semester II

PBI 201. Genomics and Transcriptomics
PBI 202. Data Structures and Algorithms
PBI 203. Biological Data Banks, Data Mining and Computational Biology
PBI 204. Rational Drug Design
PBI 205. Proteomics and Molecular Structure Prediction
PBI 206. Object-Oriented and Database Programming for Bioinformatics

2/05/11

Credit Description per week (number of theory, practicals, tutorials)

Semester 1

PB 101. Introduction to Modern Biology/ Basic Mathematics (3,0,0):

Unit 1. Concepts and methods in Biology: Energy and life's organization, Evolutionary view of diversity, Nature of biological inquiry - observations, hypothesis and tests. Principles of cellular life, chemical foundation of cells, carbon compounds in cells, cell structure and function, ground rules for metabolism, source of energy for cells.
Unit 2. Principles of Inheritance, Cell division, Patterns of inheritance
Unit 3. Principles of evolution: Origin and evolution of life, Evolution and diversity, Microevolution, Speciation, Macro-evolutionary puzzle. Nature of Ecosystems, Biodiversity, Conservation strategies.
Unit 4. General characteristics of prokaryotic and eukaryotic life forms: bacteria, viruses, protists, plants and animals.
Unit 5. Plant structure and function: Plants tissues, nutrition and transport.
Unit 6. Animal structure and function: Tissues and organs, Sensory reception, endocrine control, circulation, immunity, respiration, digestion and nutrition, reproduction and development-sexual versus asexual reproduction, stages of reproduction, cell differentiation, morphogenesis, and pattern formation.

PB101. Basic Mathematics (3,0,1):

Unit 1. Matrices: Operations on Matrices, determinants, (Simple Calculations) Adjoint, Inverse of a matrix using determinant solution of Equations, Cramer's rule.
Unit 2. 3d Geometry: Equation of line in space,
Unit 3: Vectors: Definition, Addition, Dot product, Cross product.
Unit 4. Differentiation: Derivatives of important functions (Formulae), sum rule, product rule, Quotient rule, Chain rule.
Unit 5. Integration: Indefinite integrals as anti derivatives. Integration of sum of two functions, Product rule.

PB 102. Statistics for Bioinformatics (3,0,1):

Unit 1. Introduction to Probability, Conditional expectations, Bayes theorem,
Unit 2. Basic Statistics: Random variables, data representation, histogram, Ogive, Frequency polygon, Mean, Mode, Median, Variance, Standard deviation, Covariance, Regression and correlation
Unit 3. Distributions (binomial, Poisson and normal), Test of significance (x2 and t),
Unit 3. Information and Entropy representation and summary of data; Statistical distributions as models of data; parametric models, statistical inference: Likelihood; Posterial distribution; Maximum Likelihood;
Unit 4. Bios and variance trade off models of dependence: Markov chains; Boltzmann-Gibbs distribution.

PB 103. Introduction to computing (3,3,0):

Unit 1. Introduction to Computers, Overview of DOS and Windows Operating systems
Unit 2. Introduction to a structured programming language (C language)
Unit 3. Internet principles, Basic web concepts, HTML and Scripting languages, Clint/Server model. Introduction to UNIX.

PB 104. Fundamentals of Bioinformatics (3,3,0)

Unit 1. What is Bioinformatics? History of Bioinformatics, Relevance and uses of Bioinformatics, Bioinformatics glossary, Future scope of Bioinformatics.
Unit 2. Biological databanks: NCBI data model, GenBank Sequence database, Structural database, Biodiversity information databases, and Virology information databases. Cheminformatics databases.
Practicals on data retrieval involving internet-based Bioinformatics tools,
Unit 3. Introduction to Genomic mapping and data repositories, Human genome project, Sequence assembly and finishing methods.
Unit 4. Introduction to Sequence analysis programs and structure prediction programs

PB 105. Structure of Biomolecules (3,0,0)

Unit 1: Bioenergetics: Properties of water, Acids, Bases and Buffers. First and Second law of thermodynamics; Free energy as an indicator of spontaneity; Chemical Equilibria.
Unit 2: Structure of macromolecules, role of molecular forces in macromolecules: Covalent, ionic, hydrogen bonding, van der waals forces.
Unit 3: Protein structure: Amino Acids of Proteins; Primary Structure Determination; Three-Dimensional Structures of Proteins: Secondary Structure; tertiary and Quaternary Structure, Ramchandran plot, Protein folding
Unit 4: Polysaccharides; Glyco-proteins. Lipids and Membranes; fatty acids, acylglycerols; phospholipids, sphingolipids, cholesterol and membranes; isoprenoids, eicosanoids, and their biological importance.
Unit 5. Enzymes: Mechanisms of enzyme action; Substrate Specificity; Coenzymes; Regulation of Enzymatic Activity: enzyme kinetics, inhibition; Effects of pH and temperature. Catalytic mechanisms. Allosteric enzymes.
Unit 6. Structure of Nucleic acids. Replication, transcription and translation

PB 106. Genetics, Cell and Molecular Biology (3,0,0):

Unit 1. Cellular and tissue architecture: cell membrane, cell organelles, Cell nucleus: chromosome structure and packaging, cyto-skeleton, cell motility and shape, Techniques for studying cells, Cell signaling, signal transduction.

Unit 2.Genetics: Genetics of viruses/phage, Genetic analysis of bacteria: Transformation, conjugation and Transduction, Generation of genetic diversity: Mutation and their repair, recombination, transposition, extra chromosomal inheritance. Linkage and recombination analyses, Gene mapping- classical and reverse genetics.
Unit 3.Recombinant DNA technology: Isolation and characterization of DNA and RNA, Hybridization, Northern and Southern Blotting, DNA cloning, sequencing and mutagenesis, polymerase chain reaction. DNA protein interactions: assays. Yeast Hybrid systems.
Unit 4. Immunology: Overview of immune system, Immunoassays, Antibody generation.
Unit 5. Cell cycle, Programmed cell death, Cancer biology

Semester II

PB 201. Genomics and Transcriptomics (3,2,0):

Unit 1. Introduction to genome biology: Prokaryotic and eukaryotic gene organization and regulation. Genomic diversity. RNA processing and splicing. Gene prediction in microbial genome, promoter prediction in *E.coli*, Gene prediction in eukaryotes. Genome annotation.
Unit 2. Functional Genomics in model organisms, Identification of a large set of genes involved in a biological process; High-throughput expression and phenotype analysis; Genome-wide search for interacting partners; Sequence variations and disease susceptibility; Clinical genomics, Pharmaco genomics;
Unit 3. Transcriptomics: Identification of alternatively spliced genes, transcription factor binding sites. Cis regulatory elements and microarray data analysis for CRE analysis.
Unit 4: Recent developments in Genomics. The impact of Genomics on biological research

PB 202. Rational Drug Design (3,2,0)

Unit 1.Aspects for a new drug like safety, effectiveness, stability, solubility, synthetic feasibility, and novelty.
Unit 2.Notion of pharmacophore: definition, Various drug targets. Pharmacokinetics- drug absorption, distribution, metabolism, excretion, dosing. Rule of 5 for drug designing
Unit 3. Drug targeting- in vitro, in vivo. Line weaver Burke plot for competitive and non competitive inhibition, IC50, ED50, therapeutic index, LD50, high throughput screening (ELISA plate).
Unit 4. Natural and synthetic lead components. Semisynthetic, biosynthesis analogs of lead compounds.
Unit 5.Ligand based drug designing- efficient search for lead compounds. Analog synthesis, structure activity relationships, pharmacophore deduction, lead compounds optimization/ new drug design.
Unit 6. Target (receptor) based drug design.
Unit 7. Bioinformatics in drug designing.

PB 203. Biological Data Banks, Data Mining and Computational Biology (3,3,0)

Unit 1. Introduction to databases, types of databases and data model. E-R models, E-R Diagrams and their reduction to tables. Building of Biological databases, Database similarity searches, Submitting DNA sequences to databases.
Unit 2. Data mining and Sequence Analysis.
Unit 3. Pair wise sequence alignment, Multiple sequence alignment, Practical Aspects of Multiple Sequence Alignment, Phylogenetic Analysis.
Unit 4: Mini Project work

PB 204. Data Structures and Algorithms (3,2,0):

Unit 1. Basic Concepts and algorithmic mathematical notations, Introduction to algorithm analysis for Time and Space requirements
Unit 2. (a)Arrays and Linked lists (b) Stacks and Queues: Definitions and their usage, Sequential representation. Sorting algorithms: Insertion sort, Bubble sort, Quick sort, Merge sort, Searching Techniques: Sequential search, Indexed sequential search, Binary search (c) Trees: Definition and basic concepts linked tree representation, Binary tree traversal techniques, Binary search trees and their usage,
Unit 3. Graphs: Definition and Representations of graphs, Depth-first search, Breadth-first search,
Unit 4. Divide and Conquer, Introduction to Greedy algorithms.

PB 205. Molecular structure prediction and Proteomics (3,2,0)

Unit 1. Principles of Protein Folding, Calculation of conformational energy for bio-macromolecules, Methods for Prediction of Secondary and Tertiary structures of Proteins: Knowledge-based structure prediction, Fold recognition, Ab initio methods for structure prediction, threading etc.
Unit 2. Molecular structure prediction and visualization: Methods for comparison of 3D structures of proteins, nucleic acids, rRNA. Methods for studying molecular interactions of Protein – Protein, Protein – DNA ,Protein – carbohydrate, DNA – small molecules etc. Simulation of molecular mechanics and dynamics and free energy changes.
Unit 3. Comparative proteomics, microarray and protein chips,
Unit 4: Proteins and metabolomics: pathways determinations and analysis.

PB 206. Object-Oriented and Database Programming for Bioinformatics (3,2,0)

Unit 1. Object Oriented Concepts, Introduction to Object Oriented Programming using Java programming language,
Unit 2. Introduction to databases, Visual Basic, Introduction to application development using Visual Basic, Code and Forms, Variable, Procedure and controlling program executor, Data access using Data Control.

Unit 3. Perl programming: scalars, loops, sequences, arrays, hashes, references, patterns, and subroutines, Use in Databases, Genome annotation & Gene finding feature (GFF).

NOTE: Some fine details of some of the courses may further be revised.

M.Sc. Electronics (Previous)

Paper – I

Classical and Quantum Mechanics

1. The Lagrangian formulation and equations of motion. The calculus of variations and its applications, Hamilton's principle. Derivation of Lagrange's Equations from Hamilton's principle.
2. The Hamiltonian formulation and equation of motion. The modified Hamilton's principle and the principle and the principle of least action. Normal coordinates and application to coupled oscillators.
3. Origin of Quantum theory, Time dependent Schrodingerequation and wave packets, some potential barrier problems.
4. Hydrogen atom, Time independent perturbation theory –first and second orders perturbation theory, simple applications.
5. Matrix formulation of quantum mechanics, Harmonic oscillator, Quantization of an LC circuit with a source, Radiation field, interaction with matter.

Reference:

1. Gupta, Kumar and Sharma/Classical Mechanics/Pragati Prakashan
2. Satya Prakash/Advanced Quantum Mechanics/Kedar Nath Ram Nath

Paper –III

Mathematical and computational Methods in Electronics

1. Differential equations and their solutions : Special functions and their properties, Bessel legendre polynomials
2. Transforms : Laplace, Fourier and z-transforms, their properties and applications in Electronics.
3. Signal and System modelling Concept : Examples of systems, Signal models, Energy and Power Spectral densities, Introduction to System modelling concepts, Impulse response of a fixed linear system.
4. Methods of Numerical Analysis : Finite difference with equal and unequal intervals, Interpolation formulae. Errors and accuracy tests in numerical Analysis, Therative algorithms. Solving equations and finding roots, Methods of finding roots of Effects.
5. Practical Consideration : Convergence rate accuracy, Introduction to linear systems, Triangular system, Factorization methods for solving AX : b: partial pivoting strategy. Solving Linear system using Gaussian Elimination, methods for solving differential equations.

Reference:

1. H.K.Das/Advance engineering mathematics/PHI
2. B.S.Grawal/Advance Engineering Mathematic

Paper – III

Network Analysis and Synthesis

Network Analysis

1. Review of Network theorems, two and four terminal pair Networks; T-circuit, π-circuit; L-circuit; Lattice network; Symmetrical network.
2. Time Domain response of Linear R,L,C circuits and combinations. Frequency domain networks; Transformation of R,L,C mutual inductances and Combination networks infrequency domain;Phasor diagram; Driving point Impedances; Magnitude and Phase response curves in S-Plane ;Poles and Zeroes.
3. Methods of partial fractions; Inverse transformation; Impulse response and transfer function of two port networks.
   Network response to complex wave of excitations, Excitations by Fourier series and Fourier integrals; Power and energy relationship in Network by Fourier method.

Network Synthesis

4. Positive real functions;Hurwitz Polynomials,Realizability condition of network; Synthesis of one port network, Faster and cauer form; Two port synthesis by ladder network.

5. Filter approximation and frequency transformation; Butter-worth,Chebychev and Bessal response; Transformation to highpass,band pass and band –elimination.

Reference:

1. Narsingh Deo Graph theory
2. M.E. Valkenburg Network Analysis

Paper- IV

Semiconductor- Devices

1. Physics of metal-metal, metal-semiconductor, semiconductor-semiconductor junction.

2. Effect of transverse electric field(field effect); current through junctions; I-V characteristics; junction capacitance;

3. Varactor; PIN, Bipolar junction t5ransistor; Field Effect Transistor; junction, Schottky, MOSFET, MESFET, transferred electron and avalanche devices;

4. Devices and semiconductor lasers; Photo-detecting and photo-voltaic devices;

5. Galvanomagnetic devices; Noise in solid state devices.

Reference:

1. Boylstad & Neshishky, "Electronic Devices & Circuits", PHI
2. Moris, Mano, "Digital Computer Design" PHI
3. Milliman, J. Halkias, Integrated Electronics", TMH.
4. Malvino & Leach "Digital Principles & Application".

Paper –# I

Electronic Materials

1. Lattice Dynamics : Lattice heat capacity, Einstein model, Debye model, Heat capacity of glasses and amorphous solids, An harmonic crystal interaction, Thermal expansion, Thermal conductivity, Lattice Thermal resistivity, Imperfection, Heat capacity of Amorphous materials.
2. Dielectrics, Ferroelectrics and Magnetic Properties : Frequency of dielectric function, polarization, Dielectric losses, Ferro electric crystals, Anti-Ferro electricity, Ferro electric domains, Piezoelectricity, Ferro elasticity. Diamagnetism, Para magnetism and Ferromagnetism, Ferrites and their behavior at high frequencies.
3. Semiconductors : Lattice properties of fourth group elements, structure, Physical constants, influence of impurities and lattice defects, Fermi level, electron-hole distribution in energy bands, Temperature dependence of Fermi level, Hall effect in semiconductors, constant Energy surfaces and effective mass in Si & Ge, Amorphous semiconductors, Rectification.
4. Superconductivity and Liquid Crystals : Meissner effect, London equations, BCS Theory, Josephson Effect, High tc superconductors. Types of Liquid crystals and their mesonorphous phases, General discussion on thermo dynamical and electro optical properties, Application of liquid crystals.
5. Defects and Alloys : Point ,line and planar defects, Dislocation stress and strain, substitutional solid solution, Order-disorder transformation, Phase diagrams, Elementary theory of order, Transition metal alloys and Kondo effects.

References:

1AJ Dekker. 'Electrical Engineering Materials', Prentice Hall of India, India
2.C. S. Indulkar & Thiiruvengadam ~ An introduction to Electrical Engineering Materials', S. Chand &.Co., India.
3. Gupta,Kumar/Solid State Physics/K.Nath & Co.

Paper-V II

Electromagnetics, Antennas & Propagation

1. Maxwell's equations, constitutive relationships; the wave equation, wave in perfect dielectric,awves in lossy matter, Reflection of waves; Duality theorem; Uniqueness theorem; Image theory; equivalence principle; Induction and reciprocity theorem; Plane wane functions.

2. Rectangular wave guide, alternative mode sets, partialy filled waveguide, Dielectric slab guide; surface guided waves; Model expansions of field currents in wave guides.

3. Antenna parameters; radiation from simple dipoles; Concept of antenna arrays, End fire and Broadside array.

4. Ground wave propagation, plane earth propagation, space wave and surface wave, wave tilt of surface wave, spherical earth propagation, troposphere wave.

5. Ionospheric reflection and refraction of waves by ionosphere, regular and irregular variation of ionosphere, attenuation factor of ionospheric propagation; skywave transmission, effect of earth's magnetic field, wave propagation in ionosphere; Faraday's rotation, other ionospheric phenomena.

References :

,I. Jordan Edwards C. and Balmain Keith Electromagnetic Waves and Radiating Systems/ PHI
2. Hayt Jr. William H Engineering Electromagnetics/TMH
3. Krauss,J.D./A-ntennas/TMH

Paper-VII III

Linear and Integrated Circuits with Technology

1. Laplace transform and their application to circuit analysis, Linear circuit elements, RC Network, High pass and low pass RC Circuits, response to various waveforms, Integrating and differentiating circuits.

2. DC-Amplifiers, Differential amplifiers, Long tail pairs, High frequency amplifiers , Broad band amplifiers, methods of achieving broad banding, Emitter followers at high frequencies, Bode plots, Power amplifiers ,Complementary emitter followers and its applications, Cascode amplifiers.

3. Electronically regulated IC. Power supplies, High and low voltage supplies. Inverters for high voltage application of Silicon Controlled rectifiers in regulating power supplies, Switching mode power supply.

4. Active filters, Operational amplifiers and their applications, Thermal noise, transistor noise, Noise calculations and measurements. Signal to noise ratio figure and its calculation.

5. Basic monolithic integrated circuits. Epitaxy masking, Etching, Monolithic circuit layout, Large scale and medium scale integration Monolithic semiconductor contacts, study of few Ics (741 and 723).

Reference:

1. Boylstad & Neshishky, "Electronic Devices & Circuits", PHI
2. Moris, Mano, "Digital Computer Design" PHI
3. Milliman, J. Halkias, Integrated Electronics", TMH.
4. Malvino & Leach "Digital Principles & Application".

Paper [redacted] IV.

Digital Electronics
(Students who have passed B.Sc. without Electronics as one of the subjects)

1. Transistor as a switch , Boolean Algebra , Truth Tables , Boolean Expression , Algebric Simplification , Karanaugh map simplification , Logic Gates : OR , AND , NOT gates . The universal NOR and NAND gates .

2. Arithmetic circuits : XOR and XNOR gates , Parity check . The half-adder , the full- adder , A parallel binary adder , Half and full subtractors , A paraliel binary subtractor .

3. Number System : Binary numbers , Binary addition , binary subtraction , multiplication and division , Binary to Decimal and Decimal to Binary conversion , Octal numbers . Octal-Binary conversion , Hexadecimal number system . Hexadecimal to Binary and Binary to Hexadecimal conversion . Hexadecimal to Decimal and Decimal to Hexadecimal conversion ,The gray code , binary to gray and gray to binary conversion.

4. Multivibrator : Astable , Monostable and Bistable multivibrators , Schmitt Trigger . Latches . The R-S Flip / Flop The D Flip / Flop , T Flip / Flop . clocked Flip / Flop , J-K Flip / Flop , Master / slave J-K Flip / Flop .

5. Counter Techniques : Binary ripple counter , modulus of a counter , modified counters using feedback , parallel counters, modified parallel counters using feedback combination counters , Binary decade counter with decoding gates .

References:

1. Boylstad & Neshishky, "Electronic Devices & Circuits", PHi
2. Moris, Mano, "Digital Computer Design" PHI
3. Digital electronics ;Bignill & Donovan
4. Taub & schilling /Digital Integrated circuits - Mc Graw international Edition.
5. Malvino & Leach Digital Electronics and circuit design

M.Sc. Electronics (Final)

Paper – I

Quantum Electronics and Lasers

1. Laser Theory, Einstein coefficients, Line Broadening, Principle of Laser Population inversion in three and four level lasers, Rate equations of the laser, Laser amplification.
2. Optical Resonators, frequency of laser oscillation; oscillation build- up, relaxation Oscillation, Q-Switching, Mode Locking, Mode Selection, free electron laser systems.
3. Basic principle of Holography, Fourier transform Holograms, holographic Optical Elements, Holographic interferometry, Holographic storage and Display. Basic idea of coherent optical data processing.
4. Classical and Quantum coherence functions. Interference experiments Quantum Theory of interferometry, counting rates, one and n atom photon detectors, correlation functions and its properties, orders of coherence and Photon coincidences. Coherent states of field.
5. Basic idea of Second Harmonic Generation, Coupling of three waves to produce Sum or difference frequencies. Parametric processes. Significance of phase matching conditions. Basic idea of self focusing, optical Phase conjugation.

Reference:

1. Keiser, G., "Optical Fiber Communications", 2nd Ed., McGraw Hill, 1991.
2. Agrawal, G.P., "Optical Communication Systems", John Wiley, 1992.
3. Gupta, Kumar and Sharma/Classical Mechanics/Pragati Prakashan
4. Satya Prakash/Advanced Quantum Mechanics/Kedar Nath Ram Nath

Paper II

Science and Technology of Material Growth

1. Crystal Growth, Bulk crystals, Substrates Epitaxy (VPE,MDE,MOCVD).
2. Growth of Thin and Thick Films. Technology of diffusion and doping in semiconductors.
3. Energy Band of Specific semiconductors (Ge, Si, III-V, II-VI and IV-VI compounds), ternary and quarter nary.
4. Electrical ,thermal and optical properties of Industrial semiconductors, Effect of High magnetic field.
5. Properties of thin and thick film; application in electronics; Ohmic and rectifying contacts in Industrial semiconductors, Techniques for device fabrication (annealing, Photolithography).

References:

1AJ Dekker. 'Electrical Engineering Materials', Prentice Hall of India, India
2.C. S. Indulkar & Thiiruvengadam ~ An introduction to Electrical Engineering Materials', S. Chand &.Co., India.
3. Gupta, Kumar/Solid state physics/K.Nath & Co.

Paper III

COMMUNICATION ELECTRONICS

1. Antenna and Arrays: - Current and voltage distribution on antennas, Directive radiation and radiation pattern, Resonant and non resonant antennas, Arrays- Broad side and End fire arrays, Directors and reflectors, Yagi Uda antenna, Antenna feeding and impedance matching.
2. Modulation:- Amplitude modulation, its Spectrum, Sideband and carrier power, Generation of AM signal, Superheterodyne AM receiver, Ring modulator. Frequency modulation- Analysis and frequency spectrum, noise Suppression, Capture effect, Pre-emphasis and De-emphasis, Reactance modulator, Varactor modulator , FM generation using VCO IC, Armsstrong's indirect method, Principle of an FM receiver. Foster-seely Discriminator and Ratio detector, PLL FM demodulator, Automatic Frequency control.
3. Television –T.V.Camera tubes,Image Orthicon,Vidicon and Plumbicon, Interlaced Scanning, Transmitter/Receiver Synchronization ,Resolution, T.V. Signal, Vestigial Sideband Modulation, B/W T.V. Receiver Block Diagram, Varacter Tuning, Sync. Separator and vertical/horizontal circuits, principle of colour Television, Colour Sub-Carrier and Chroma Modulation. Colour Picture Tube.
4. Microwaves – Characteristics and production, Klystron ,Magnetron, and Gunn Effect Device, Microwave components, Microwave measurements, application of Microwaves, Transmission Lines, Microwave Communication.
5. Digital Communication : Pulse Amplitude Modulation ,Pulse Width Modulation, Pulse Position Modulation, Time Division Multiplexing, Digital signal bit transmission, signaling rate, Error Probability, Digital filtering, Pulse Code Modulation, Delta Modulation, Coding code transmission, two-tone modulation, Amplitude ,frequency and Phase-shift keying, differential phase shift keying.

References:

1. Simon Haykin /Digital Communication /JohnWiley
2. Communication systems: A.B. Carlson, Mc-Graw-HW.
3. Modern Analog & Digital Communication Systems : B.P. Lathi; Oxford Univ. Press.
4. Analog Communication Systems: Pchakrabarti Dhanpat Rai.
5. R.R. Gulati/ Monochrome Television
6. George Kennedy/Communication System

Paper IV

COMPUTER PROGRAMMING IN FORTRAN

1. Introduction: Digital computer organization-flow chart symbols, methods and usage.
   FORTRAN programming principles: Low level and high level language, the FORTRAN language organization and character.
   Arithmetic operation: FORTRAN constants and variables – type declaration for integers and reals. Arithmetic operation and modes language defined and user-defined arithmetic trigonometry, Hyperbolic and logarithmic function-single and double precision.
2. Input – output statements : List directed and format directed control statements relational operators- logical IF Statement- go to statement nested logical IF and arithmetic IF statement . The DO statement-Do Loop-nested DO loops – repeat – while structure.
3. Subscripted variables: Multiple subscribes – subscript expressions dimension statement – Do loops with Subscripts.
   Format specifications: Read and write format free statement – Format description for print statement, Multirecord format – holerith field declaration - A Format generalized input –out - statements.
4. Logical expression and decision tables: Logical constants, variables and expressions. Boolean algebra – non-algebraic simplification procedures. Functions and subroutines. Statement functions-function Sub-programs-syntax rules –subroutines - COMMON declaration and its users – Equivalence declaration – Block data declaration.
5. File Processing in Fortran: Creating, searching , updating and merging of sequential files. Direct access files.
   Character Manipulation: Character constants and variables string expressions examples.

Reference:

Balaguruswamy/computer programming in Fortran/PHI

Paper IV

ELECTRONIC INSTRUMENTATION & CONTROL SYSTEM

1. Meters:- Basic galvanometer, conversion to voltmeter, ammeter and ohmmeter, Multimeter, digital Multimeter, A/D converters- Single slope and dual slope types.
   Bio-Medical instruments: - ECG and EEG.
2. Instrument amplifiers & Oscillators: - OPAMP, Chopper type amplifiers, Lock in amplifiers, Oscillators: - RF oscillator ,AF oscillator Function generators. Pattern generators and sweep generators and their uses.
3. CRO& Counters: Simple low freq. oscilloscopes. High freq. oscilloscopes. Storage oscilloscopes –Sampling oscilloscopes, Frequency counter, Universal counter, Period frequency, time interval, Ratio and multiple ratio measurements.Error in frequency counters.
4. Transducer and Recorders: Temperature transducers- thermocouple, Thermistor. Pressure transducer, Piezo-electric type, Light and color transducer- Photo cell, Photo volatile cells, Photo multiplier, Recorders- Galvanometer recorders, Strip recorder, X-Y recorder.
5. Control Systems:- Transfer function, Block diagram reduction techniques, Signal flow graph, Basic control components, Transient and steady state response analysis. Stability of linear system, Routh hurwitz criterion, Root loci, Frequency response, Nyquist criterion, Bode Plot, Nichol's chart, PID controller, Compensation techniques.

Reference:

1. KUO B.CJ Automatic control system/ Pill.
2. Ogata Kj, Modern control Engineering / PHI.
3. Nagrath 1. J. & Gopal, M/ Control Systems Engineering / New Age International.
4. W.F. Ganong/Review of medical physiology/8th Asian Ed/ Medical Publishers,1977.
5. J.G. Webster ed/ Medical instrumentation/ Houghton Mifflin,1978.
6. A.M.Cook & J.G. Webster, eds/Therapeutic Medical devices/PHI,1982.

Paper II

MICROPROCESSOR

1. Advanced Topics in combinational design: - Transient response of combinational networks , Fault detection and fault location of single faults by fault table method, Path sensitizing method, method of Boolean difference and SPOOF method, Two level circuit fault detection, Multi-level circuit fault detection.
   Design of sequential Circuits using sequential machine flow chart:- Sequential machine flow chart, reading reduced- dimension maps, output-function synthesis, Next-state function synthesis, State assignment.
   Fault Detection and location in sequential circuits:- Circuit test approach, initial- state identification, final state identification, design of fault detection experiment for diagnosable machine.
2. Semiconductor memories and technology:- ROM, PROM, EPROM, EEPROM, DRAM, PLA.
3. Microprocessor Architecture and system operation:- Architecture of a basic microcomputer, some general microprocessor system concepts, Memory, I/O ports, and Buses, internal architecture of a microprocessor, Comparison of architecture of 8085, Z80, 6800, 6502, Microprocessor fetch, decode and execute cycle, memory mapped and I/O mapped ports, I/O controls, Test and fault finding devices for digital systems like Logic probes, logic pulser, current tracer, logic analyzer, signature analyzer.
4. Microprocessor programming:- Introduction to the instruction set, data transfer operation, arithmetic operations, logical operations, shift and rotate instructions, status flag testing and conditional instruction, Introduction to addressing modes, Implicit Addressing, Register Addressing, Immediate Addressing, absolute Addressing, page zero Addressing, Indirect Addressing, Writing Assembly and Machine code programs.
5. Interfacing Concepts: - Interfacing memory, Interfacing data converters, 8155/8156 and 8355/8755 multipurpose programmable device, 8279 controller.

eference:

1. Doug'as V.Hall/8086 Microprocessor Architecture
2. R.Gaonker/8085 Microprocessor
3. Leu Gibson/Microprocessor

Paper VII (a) IT

Computer Hardware (For students who have passed B.Sc with out Electronics as one of the subject)

1. Logic Circuits: - Active and Passive logic circuits, R.L., D.L., RTL, DTL, TTL and CMOS logics.
   Displays : - Nixie tubes, Seven segment displays, LED and LCD displays.
2. Registers: - Buffer registers, Shift Register, Ring counter, Three stage shift counter, Four stage shift counter, controlled shift registers, tristate switches, tristate registers.
3. Computer Memories:- Memory concept, addressing of memories, volatile and nonvolatile memories, semiconductor memories, static and dynamic RAMs, ROMs, PROMs and EPROMs.
   Magnetic memories, Magnetic bubble memories.
4. Central Processing Unit :- CPU-Microprocessor, Organization of microprocessor, instruction set, programming, fetch cycle and execute cycle, Timing and control Unit, Instruction and data flow.
5. Application of Digital Electronics: - D/A and A/D converters, Simultaneous method of A/Ds conversion, Counter method, single slope and dual slope A/D converters, frequency counter, digital voltmeter and Multimeter.

References:

1. Boylstad & Neshishky, "Electronic Devices & Circuits", PHI
2. Moris, Mano, "Digital Computer Design" PHI
3. Digital electronics ;Bignill & Donovan
4. Taub & schilling /Digital Integrated circuits - Mc Graw international Edition.
5. Malvino & Leach Digital Electronics and circuit design

Paper [redacted] IV (a)

MICROWAVE ELECTRONICS

1. Limitations of conventional tubes at VHF and UHF : Tube reactance effects and transit time effects, Remedies and examples of microwave triodes based on these remedies, concept of induced current, velocity modulation, and bunching of electrons, L-cavity Klystron, amplifying operation and analysis, power and efficiency, Multicavity Klystron, Reflex Klystron, operation and analysis, Electronic admittance, Electronic tuning, power output and efficiency, application.
2. Magnetrons: - Operation and diagram
   Traveling wave tubes: - Operation of O-Type TWTs, gain band-width, coupling and focusing methods, BW's applications.
3. Avalanche diode :- Gunn effect and Gunn diode oscillator, Microwave components, attenuator, phase shifter, slotted lines, Frequency meter, directional couplers, E-plane Tee, H-Plane Tee, Magic Tee and Ferrite devices.
4. Basic Microwave Measurements of frequency, SWR, Independence power etc.
5. Principle of Microwave communication, Principles of satellite communications, Introduction to Radar.

References

1. Reich, "Microwave Principles", CBS, 1996.
2. Collin, "Foundations of Microwave Engineering", 2nd ed., McGraw Hill, 1992.
3. Watson, "Microwave Semiconductor Devices and Their Circuit Applications", McGraw Hill, 1969.
4. Lio, Y, "Microwave Devices and Circuits", Prentice Hall of India, 1990.

Paper [redacted] IV (b)

Computer communication

1. Introduction; brief review of need and uses of computers networks, network structures and architectures. The ISO reference model, network services, network standardization.
   Physical layer: Fourier analysis, band limited signals, the max. of a chanr el. Magnetic media, twisted pair, base band cable. Fiber optics line of dissent transmission, communication, satellites. Telephone system, random, RS-282c and RS-449.
2. Encoding systems, the x21 digital interface. Circuit switching , packet switching , hybrid switching, isdn services, evolution of ISDN, ISDN system architecture, the digital PBX, the isdn interface, perspective on ISDN, polling, the medium access sub layer; static channel allocation in LANs and MANs , dynamic channel allocation in LANs and MANs.
3. 3- pure ALOHA and slotted ALOHA, finite population ALOHA, persistent nonpersistent CDMA, CDMA with collision detection, collision free protocols, BRAP MLMA, binary countdown, limited contention protocol, the adaptive free work protocol, the Urn protocol,IEEE standard 802.2 and Ethernet, IEEE standard 802.4; token bus, IEEE standard 802.5; token ring,comparision of local area n/ws. Fiber optics n/w, SPADFE, reservation ALOHA, the university of Hawaii ALOHA system, design for pocket radio n/ws.
4. The data link layer; Services provided to the network layer, framing error control ,flow control , link management , error correcting codes, error detecting codes, an unrestricted simplex protocol, a simplex stop and wait protocol, a simplex protocol for a noisy channel, sliding window protocol ,A one bit sliding window protocol single go back to n , A protocol using selective repel.

5. The network layer : services provides to transport layer ,internal organization and network layer ,Routing ,congestion internetworking shortest path routing ,multipath routing centralized routing ,isolated routing Flooding ,Distributed routing ,Flow based routing Hierarchal routing broadcast routing pre-allocation of buffer pocket discarding, congestion control flow control choke packet dead zones OSI model internet working Bridge, gateways comparison of connection oriented and connection less inter-ways Brief study of transport layer session layer ,File transfer protocol

References

1. Tanenbam / Computer Networks/ PHI.
2. Data Networks: Bertsekas & Gallager