UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

Dual Degree B.Tech.-M.Tech.in
Converging Technologies

I to IX Semester

(2019-2024)
UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

Centre for Converging Technologies

I to IX Semester

(2019-2024)
I (FIRST)
SEMESTER
## First Semester

<table>
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<tr>
<th>Code</th>
<th>Type</th>
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<tr>
<td>CTG 101</td>
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<td>General Physics: Properties of Matter, Thermal Physics and Optics</td>
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<tr>
<td>CTG 102</td>
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<td>Basics of Physical Chemistry</td>
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<td>Human Behavior and Basic Psychological Processes</td>
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<td>CTG 113</td>
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<td>Life Science Lab</td>
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<td>CTG 114</td>
<td>Lab</td>
<td>Programming in C &amp; Visual Basic</td>
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**Dy Registrar (Academic)**

University of Rajasthan

JAIPUR
First Semester

Theory Paper

COURSE PH-01: General Physics: Properties of Matter, Thermal Physics and Optics

Properties of Matter:
- Elasticity: Hook's Law, Young's Modulus, Bulk Modulus, Shear Modulus, Poisson's ratio.
- Relations between elastic constants: Twisting couple on a Cylindrical Rod, Bending of Beams, Bending moments, Camilever.
- Poiseuille's equation: Capillarity in series and parallel, Stokes' formula.
- Surface Tension: Molecular forces, Surface energy, Shape of drops, Pressure difference across a Curved Surface, Expression for Excess Pressure on a curved surface, Film of Water between two Glass plates, Shape of liquid meniscus in a capillary tube, Capillary action, Rise of liquid in a conical Capillary tube, Vapor pressure and Surface tension.

Thermal Physics:
- Description of phase transitions, state of thermodynamics, heat and work, internal energy, first and second law of thermodynamics, concept of entropy and temperature, principle of increase of entropy, thermodynamic variables: entropy, Helmholtz potential, Gibbs free energy. Phase transformations: first order and second order, Clapeyron equation. Production of low temperature, Joule-Thomson experiment, regenerative cooling, cooling by adiabatic demagnetization.

Optics:
- Diffraction of light: Fresnel's half period zones, explanation of rectilinear propagation at light zone plate, Fresnel's diffraction at a straight edge, Fresnel's diffraction at a circular aperture, Huygens' diffraction.
- Reflection of light: Geometrical and spectral resolution, distinction between magnification and resolution, Rayleigh's criterion for the limit of resolution, resolving power of optical instruments, resolving power of a grating, diffraction gratings, resolving power of a hologram.
- Polarization of light: Concept of polarization, polarization by reflection, Brewster's law, polarization by refraction, plane of polarization, double refraction, Huygens' concept of double refraction through uniaxial crystals, Nicol prism, phase retardation plates, elliptically and circularly polarized light, detection of plane, elliptically and circularly polarized light and optical rotation, laws of rotation of plane of polarization.
- Light waves: Wave nature, coherence, interference, diffraction, Young's double slit experiment, optical interference, cavity resonators, properties of lasers, ruby laser, Helium-Neon laser, uses of laser, idea of holography.
(Qualitative treatment only)

Optical fibers: Structure and types of fibers, fiber optic communication systems.

**Recommended Books:**

1. Mechanics by J. C. Upadhyaya
2. Fundamental University Physics, Alonso & Finn.
4. Thermodynamics and Statistical Physics by L. Red.
5. Thermodynamics and Statistical Physics, S. Lakhanath and D.P. Khandelwal
6. Thermodynamics, Kinetic Theory of Gases and Statistical Mechanics, Sears
7. Optics by Ajay Ghatak
8. Optics by D.P. Khandelwal
COURSE CH-01: Physical Chemistry

Unit - I Liquid and Solid State:

(a) Liquid State:
Intermolecular forces, structure of liquid (a qualitative description), structural differences between solids, liquid and gases. Properties of liquid: Vapor pressure, viscosity and surface tension and their variation with temperature.
Liquid Crystals: mesomorphic state, classification, structure of smectic, nematic and cholesteric liquid crystals.

(b) Solid State:

Unit - II Colloidal State, and Heterogeneous Equilibrium:

(a) Colloidal State:
Difference between true and colloidal solutions, classification, lyophilic and lyophobic colloids, preparation and properties: optical and electrical (Tyndall effect, Brownian effect, electrophoresis and electrophoresis) properties, origin of charge, electrical double layer, coagulation, and protective action of colloids. Inheritance, general applications of colloids. Surfactants, micelles and their classification, critical micelle concentration (CMC). Method of determination of CMC.

(b) Heterogeneous equilibrium:
Law of mass action as applied to the decomposition of CaC2O4 CuSO4·5H2O. Phase rule, explanation of terms: phase, component, and degrees of freedom. One component system, water and sulphur. Restricted phase rule, condensed systems, two component system: lead and silver system (Panninon process for desilverisation of lead).

Unit - III Chemical Kinetics and Catalysis:
Chemical Kinetics, rate of a reaction, factors influencing the rate of a reaction on concentration, temperature, pressure, solvent, light, catalyst.
Order and molecularity of complex reactions (no mechanism): Effect of temperature on rate of reaction, effect of catalysts, Arhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypotheses). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis: Characteristics of catalyzed reactions, classification of catalysis, miscellaneous examples.

Unit – IV Electrochemistry:

(a) Electrolytic and electrochemical cells:

Gibb's free energy and cell potential. Thermodynamics of reversible and irreversible electrodes. The Nerst Equation, the single electrode potential. Sign convention, the temperature dependence of cell potential of electrodes. Metal – metal ion electrode, gas electrode, metal-insoluble met. I sah electrodes, oxidation-reduction electrode, examples. Determination of e.m.f. of a cell and cell reactions and pH fuel cells.

(b) Chemical Thermodynamics:

System (closed, isolated and adiabatic systems) surrounding, properties of systems, function of state, forms of energy and their interconversion, statement of first law, reversible expansion of ideal gas (constant volume processes, constant pressure processes), enthalpy relation between H and E, enthalpy change of reaction (combustion, acid – base neutralization, enthalpy of formation of compounds) Hess's law of constant heat of summation, bond energy and dissociation energy. Limitation of first law.

Recommended Books:

1. Physical Chemistry by Glasstone
2. Elements of Physical Chemistry by Lewis & Glasstone
3. Chemical Kinetics by K.J. Laidler
4. Chemical Kinetics by Frost and Pearson
5. Physical Chemistry by Kostian
6. Physical Chemistry by B.R. Puri, L.R. Sharma and M.S. Pathania
7. Physical Chemistry by R.C. Rikarth
8. Physical Chemistry by P.W. Atkins
9. Physical Chemistry by Gordon and Barrow.
COURSE CS-01: Programming Languages: Fundamentals and Applications

Basic concepts of programming languages: Programming domains, language evaluation criteria, and language categories. Evolution of the major programming languages. Describing Syntax and Semantics: formal methods of describing syntax, recursive descent parsing, attribute grammars, dynamic semantics.

(10)

Names, Variables, Binding, Type checking, Scope and lifetime data types, array types, record types, union types, set types and pointer types, arithmetic expressions, type conversions, relational and Boolean expressions, assignment statements, mixed mode assignment.

(10)

Statement level control structures, compound statements, selection statement, iterative statements, unconditional branching and guarded commands.

(5)

Programming in C:

Character set, variables and constants, keywords, instructions, assignment statements, arithmetic expressions, comment statements, simple input and output, Boolean expressions, Relational operators, logical operators, control structures, decision control structure, loop control structure, case control structure, functions, subroutines, scope and lifetime of identifiers, parameter passing mechanism, array and strings, structures, array of structures, Console Input and Output functions, Disk I/O functions, interaction with hardware, Interrupts and Interrupt Vector table, Unions of structures, operations on bits, usage of enumerated data types. Bit fields, Pointers to Function, Function returning Pointers.

(20)

Recommended Books:

COURSE MT-01: CALCULUS


Derivatives: Definition, differentiability, differentiation by abridges method (simple algebraic and trigonometrical functions), differentiation rules (sum, difference, product, division of two functions) differential functions and logarithmic functions, partial differentiation of functions of one or two variables.

Applications of Derivatives: Mean Value theorems Rolles, Cauchy and Lagrange’s maxima and minima of one variable, indeterminate form. 1st Hospital rule. Euler’s formula.

Integration: Integral as converse of differentiation, indefinite integral, integration by substitution, integration of product of two functions, definite integrals properties and problems, substitution in definite integrals, numerical integration (Trapezoidal, 1/3rd Simpson’s rule and 3/8th Simpson’s rules.), area of circle, parabola ex. log ex.

Recommended Books:
COURSE BS-01: Biochemistry

1. The Foundations of Biochemistry
   - Cellular foundations, Chemical foundations, Physical foundations, Genetic foundations, and Evolutionary foundations

2. Structure and Catalysis
   - Water: Weak interactions in aqueous systems, ionization of water, weak acids and weak bases, Buffering against pH change
   - The Three-Dimensional Structure of Proteins: Overview of protein structure, secondary structure, tertiary & quaternary structure
   - Carbohydrates: Monosaccharides, disaccharides, polysaccharides, glycogen, glycoconjugates
   - Lipids: Storage lipids, structural lipids, lipids as signals, cofactors & pigments

3. Bioenergetics and Metabolism
   - Principles of Bioenergetics: Bioenergetics & thermodynamics, phosphoryl group transfers & ATP, biological oxidation-reduction reactions
   - Glycolysis Pathway, fate of pyruvate
   - The Citric Acid Cycle: Acetyl CoA, reactions of Citric Acid cycle, regulation
   - Enzymes: Introduction, Kinetics, Michaelis-Menten Equation, Regulatory enzymes, Examples of enzymatic reactions
   - Photophosphorylation: Photosynthesis, ATP synthesis by Photophosphorylation
   - Carbohydrate Biosynthesis in Plants and Bacteria: Photosynthesis, C4, CAM pathways, biosynthesis of starch & sucrose, cellulose, Peptidoglycan
   - Lipid Biosynthesis: Biosynthesis of fatty acids, triacylglycerols, membrane phospholipids
   - Biosynthesis of Amino Acids: Nitrogen metabolism, biosynthesis of Amino acids
   - Secondary Metabolites: General Introduction

Recommended Books:
2. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, Biochemistry 5th
Theory Paper

COURSE BS-02: Genetics & Molecular Biology

1. Introduction to Genetics
   - Importance
   - Role in Biology
   - Brief history
   - Model organisms

2. Basic Principles of Heredity
   - Mendel’s Experiments
     - Monohybrid Cross
     - Dihybrid Cross
     - Multiple Loci Cross

3. Sex Determination and Sex-Linked Characteristics
   - Sex determination
   - Sex linked characteristics
   - X-linked color blindness
   - Dosage compensation

4. Linkage and recombination
   - Linkage and recombination between two genes
   - Linkage and recombination between three genes

5. Bacterial and Viral Genetics
   - Bacterial genetics
   - Viral genetics

6. Chromosome structure, Variation and mutation
   - The prokaryotic and eukaryotic chromosome
   - Chromosome rearrangements
   - Aneuploidy
   - Polyploidy
   - Nature of mutation, causes of mutation, study of mutation

7. DNA: The Chemical Nature of the gene
   - The molecular basis of heredity
8. Extensions and Modifications of Basic Principles
   - Birthweight and Genomic imprinting
   - Dominance Revisited
   - Pleiotropy and Expressivity
   - Lethal Alleles
   - Multiple Alleles
     - Puck Feathers
     - ABO Blood groups
   - Gene Interaction
     - Gene interaction that produce novel phenotypes
     - Gene interaction with epistasis
   - Complex genetics of coat color in dogs
   - Complementation
   - Interaction between Sex and Heredity
     - Sex-influenced and sex-limited characteristics
     - Cytoplasmic Inheritance
     - Genetic maternal effect
     - Genomic imprinting

9. Population and Evolutionary Genetics
   - Genetic variation
   - The Hardy-Weinberg law
   - Non-random mating
   - Changes in allelic frequencies

10. DNA Metabolism
    - DNA Replication: Fundamentals of DNA Replication
    - DNA synthesis by DNA Polymerase
    - Types of DNA Polymerase
    - DNA Replication in Prokaryotes
      - E. coli
    - DNA replication in Eukaryotes
    - DNA Repair
      - Types of Mutations
      - DNA Repair system
      - Types of DNA Repair

11. RNA Metabolism
    DNA-Dependent Synthesis of RNA
    - RNA synthesis by RNA Polymerases
    - Mechanism of Transcription in Prokaryotes
    - Regulation of Transcription
    - Termination of Transcription
    - Transcription in Eukaryotes
    - Types of DNA Polymerases in Eukaryotes
12. Protein Metabolism
   - The Genetic Code
   - Wobble Hypothesis
   - Site of Protein Synthesis
   - Initiation, Elongation and Termination of Protein Synthesis
   - Post Transcriptional Modification
   - Protein Folding
   - Protein Processing
   - Site of Protein Modification
   - Protein Targeting and Degradation

13. Regulations of Gene Expression
   - Principles of Gene Regulation
   - The Lac Operon: Negative and Positive Regulation of Lac-Operon

Recommended Books:
3. Principals of Genetics - Gardner
COURSE CN-01: Human Behavior and Basic Psychological Processes


UNIT-III. Sensation, Attention and Perception: Definition and Basic Principles. (3)

UNIT-IV. Psychophysiology: Concepts and Methods. (2)


UNIT-VI. Memory: Definition, Models: The Atkinson and Schiffrin Model, Neural Network Model, Forgetting and its causes. (3)

UNIT-VII. Motivation and Emotions: Motivation: Definition and Major Perspectives, Emotions: Nature, Expression and Theories. (2)


UNIT IX. Personality: Definition, Theories: Type and Trait, Measurement. (2)

UNIT-X. Psychopathology: Nature, Causes, Classification (Latest DSM) and brief outline of mental disorders, Mental Health. (1)

Recommended Books:
Theory Paper

COURSE SK-01: Communication Skills - 1


Getting Your Message Across Effectively, Principles of Effective Communication, Seven Cs of Communication, Perception, Attitudes, Beliefs, Values, Norms and Experiences and their impact on communication, Barriers to Effective Communication, Developing and Maintaining open channels of communication.


The Art Of Listening, Proven Techniques for Effective Listening, Listening Process, Types of Listening, Barriers to Listening, Verifying Comprehension Via Feedback, Differentiating between emotional Content and Message Content, Overcoming non-listening habits, Verbal Impact, Intonation, Rate of Speech (Paralinguistics), Gestures (Kinetics), Posture, Use of Space (Proxemics), Dress (Articulation), Eye Contact (Oculometrics), Listening to the whole Message.


Recommended Books:
COURSE AD-01A: Mathematics

(iii) Complex Numbers
Definition, real and imaginary parts, complex conjugate, representation of a complex number in a plane, modulus and argument of a complex number, algebra of a complex numbers, cube root of unity.

(iv) Sequences and Series
Sequences, series (finite and infinite), arithmetic progression (A.P.) sum of n terms of an A.P., arithmetic mean (A.M.), geometric progression (G.P.) sum of n terms and infinite terms of a G.P., geometric mean (G.M.), harmonic progression (H.P.), harmonic mean (H.M.), relation between A.M., G.M., H.M., series representation of exponential functions, logarithmic functions, age, e^{x} and loge (1-x).

(viii) Permutation and Combination
Fundamental principle of counting, factorial notation, Permutation as an arrangement, meaning of P (n,r). Combination—meaning of C (n,r). Applications of permutation and combinations.

(iv) Binomial Theorem

(iv) Matrices and Determinants
Concept of a matrix, Types of matrices, transpose and adjoint of a matrix, addition and multiplication of matrices, rank of matrix, element, row and column transformation, inverse of a matrix, solution of linear equations in two or three variables using inverse of a matrix, Determinants of a square matrix, properties of determinants.

(v) Co-ordinate Geometry of two-dimensional
Laws of a point, definition, cartesian system of coordinates, in a place, distance and section formula, condition for collinearity of three points in a place, equation of a straight line, slope form, intercept form, two point form, general form, parallel and perpendicular lines, intercept of a line, angle between two lines, distance of a point from a line.
Standard and general forms of circle, equation of a circle when and points of the diameters, points of intersection of a line and a circle, condition of tangency of a line and a circle, cone section: definition, focus, director, eccentricity, equations of parabola, ellipse and hyperbola.
1] Diversity in Living World
   Diversity of living organisms, Classification of the living organisms (five kingdom classification, major groups and principles of classification within each kingdom), Systematics and binomial system of nomenclature, Status of Bacteria and Virus.... (3)

2] Morphology of Plants and Animals
   Morphology, root, stem and leaf, their structure and modifications, inflorescence, flower, fruit, seed and their types.
   Internal structure of plants: tissues (meristematic and permanent), tissue systems, anatomy of root, stem and leaf of monocots and dicots, secondary growth,
   Morphology of animals: tissue systems, structure and function of tissues: epithelial, connective, muscular and nervous... (8)

3] Reproduction, Growth and Development
   Modes of reproduction in flowering plants: vegetative propagation natural and artificial, sexual reproduction: pollination, double fertilization, endosperm development, parthenogenesis and parthenocarpy.
   Characteristics of plant growth and growth regulators (phyto-hormones) auxins, cytokinins, gibberellins, ABA: Seed germination, seed dormancy.
   Types of reproduction in animals (asexual and sexual), hormonal control of growth.... (7)

4] Biomolecules
   Basic chemical constituents of living bodies.
   Structure and functions of carbohydrates, proteins, lipids and nucleic acids... (12)

5] Cell: Structure and Function
   Cell type: prokaryotic and eukaryotic, cell wall, cell membrane and cell organelles, plastids, mitochondria, endoplasmic reticulum, Golgi bodies, dictyosomes, ribosomes, lysosomes, vacuoles, centrioles and nuclear organization.... (8)

6] Genome organization
   Fine structure of the gene, Structure of Prokaryotic and eukaryotic chromosomes.... (5)

7] Biology and Human Welfare
II (SECOND) SEMESTER
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<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
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CTG-201: Advance Mechanics and Electrodynamics

Advance Mechanics:
Basic principles and applications of statistical mechanics; ideal quantum gases. Interacting systems. Theories of phase transitions, computer simulations. Elementary concepts of non-equilibrium statistical mechanics.

Electrodynamics:
Measurement of charge in motion, invariance of charge. Electric field measured in different frames. Field of a point charge moving with constant velocity. Force on a moving charge. Interaction between a moving charge and moving charges.
Ampere's circuital law with application. Ampere's law in differential form. Vector potential. Poisson's equation for vector potential. Vector potential and evaluation of B for (i) a current in an infinite solenoid; (ii) outside a current carrying long straight wire; (iii) inside a long straight wire carrying uniform current. Field of any current carrying wire. Transformation relations for different components of electric and magnetic fields between two inertial frames.

Recommended Books:
1. University Fundamental Physics - Alonso and Finn
2. Electricity and Magnetism - Berkeley Series: Vol. 2, E.M. Purcell

3 Credits (45 Hrs)

- Bonding and Delocalization
  Inductive, inductomeric, electromeric, resonance and mesomeric effects; hyperconjugation; tautomerism (difference from resonance); Aromaticity: Hückel’s \((4n+2)\) rule and its application to carbocyclic and heterocyclic rings.

- Stereochemistry
  Fischer Projection, Newmann and Sawhorse Projection Formulae and their Interconversion.

Geometrical Isomerism: E/Z and syn-anti nomenclature; configuration of geometrical isomers in oximes and alicyclic compounds.

Optical Isomerism: Optical Activity, Specific Rotation, Elements of symmetry, stereogenic centre, enantiomers, sequence rules, D/L and R/S systems of nomenclature. Prochirality: Homotopic & heterotopic ligands and faces; molecules with two chiral centres, diastereoisomers, threo, erythro and meso compounds; Racemic mixture, resolution; inversion, retention and racemization.

- Mechanism of Organic Reactions:
  Homolytic and Heterolytic fission. Types of reagents, electrophiles and nucleophiles. Energy consideration. Reactive intermediates: carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charge on intermediates and other ionic species.

Types of organic reactions and their mechanism- Substitution: Free radicle substitution, Aliphatic nucleophilic substitution (SN1, SN2, SNi) and electrophilic aromatic substitution (Activating and deactivating effect of substituent groups, directive influence and orientation); Addition: electrophilic and Free radical (peroxide effect) addition to \(\text{C} = \text{C}\) bond, Nucleophilic addition to \(\text{C} = \text{O}\) group; Elimination reaction (E1 & E2). Methods to find out the reaction Mechanism.
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- **Some important reagents in Organic Synthesis**: Synthetic uses of - Acetoacetic ester, Malonic ester, Grignard reagent and Benzene diazonium salts. (5)

- **Polymer Fundamentals**
  
  **Inorganic polymers**: Synthesis, structural aspects and applications of boranes, carboranes, silicones, phosphonitrilic halides and condensed phosphates; non-stoichiometric oxides: zeolites and clay. (5)

  **Organic polymers**: Addition and condensation polymerisation, their mechanism, copolymerization, coordination polymerization, Zeigler-Natta catalysts, thermosetting and thermoplastic polymers. Examples – Vinyl polymers, Synthetic rubber, Polycrylonitriles, Dacron, Terylene, Nylon, Bakelite, Melamine, melmac. (5)

- **Supramolecular Chemistry**: Definition, supramolecular host-guest compounds, macrocyclic effect, nature of supramolecular interactions. (5)

**Recommended Books**:

3. Concise Inorganic Chemistry, J.D. Lee, ELBS.
5. Reaction Mechanism in Organic Chemistry, Mukherjee and Singh, The Macmillan company of India Ltd.

Basic Concepts of Object Oriented Programming: Characteristics of Object-Oriented Languages.
Object, Classes in C++, Constructors, Destructors, Complex Class, Matrix class; Classes, Objects and Memory; Structures and Classes; C++ Free Store, Static Class Data, Overload Assignment Operator, Copy Constructor, Data Conversion between Objects of different classes.

Data structure through C++, Handling Data files (sequential and random), opening and closing files, stacks and queues, linked lists, trees.

Inheritance Multiple, Private and Protected Inheritance, Virtual Functions, Objects Slicing.

Input/Output in C++, User defined manipulators, Predefined Stream Objects, File I/O with Streams, Structures, Classes within classes, Smart Pointers, Templates, Exception Handling.

Recommended Books:

CTG-204: Discrete Mathematics


2. Number Systems
   - Integers, real number system, decimal number system, binary number system, octal number system, hexa-decimal system, conversion from one system to other systems, binary arithmetic.

3. Relation and Functions
   - Binary relations, Equivalence Relations, Partial order relations, total order relations, type of functions and their definitions.

4. Graph Theory
   - Graph (p.d.), edges and vertices, simple graph, multi graph, pseudo-graph, degree of a vertex in a graph, directed graph (digraph), loop, parallel edges, handshake theorem, cycle, wheel operations on graph, connectedness, Eulerian graph, trail, circuit, Hamiltonian circuit, planar graph.

5. Recurrence relations and generating functions:
   - Discrete numeric functions, generating functions, recurrence relations, linear, homogeneous and non-homogeneous recurrence relations with constant coefficients.

6. Boolean Algebra
   - Definition and elementary theorems on Boolean algebra, principal of duality, De Morgan's laws, Boolean expression, Boolean function.

7. Logic and proofs
   - Statements, proposition, compound proposition, logical connections; symbols, connecting words; truth tables for simple biconditional statements, negation for simple statements.

Recommended Books:
2. J.P. Tremblay and R. Manchon, Discrete Mathematical Structures with Applications to
University of Rajasthan, Jaipur
Dual Degree B.Tech.-M.Tech in Converging Technologies
Syllabus Second Semester Examination 2013
(Seventh Batch)

4. N. Deo, Graph Theory with Applications to Engineering and Computer Sciences. Prentice Hall of India, 1990.

CTG-205: Cell Biology

1. Life Begins with Cells
   The diversity and commonality of cells, Molecules of a cell, Work of cells, Investigating cells and their parts, A genome perspective on evolution.

2. Biomembranes and Cell Architecture
   Biomembranes: Composition, Organization, Basic function
   Organelles of eukaryotic cell: Endosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Golgi complex, Plant Vacuoles, Nucleus, Mitochondria, Chloroplasts
   Cytoskeleton: 3 types of filaments, organization, microfilaments, intermediate filaments, microtubules.

3. Molecular Transport
   Overview of Molecular transport, passive diffusion, membrane proteins mediated transport, Different classes of pumps (ATP powered pumps: Na+/H+ ATPase, Muscle Ca+ ATPase, V class, H+ATPase), Co-transport (anti porter and symporter)

4. Integrating Cells into tissues
   Cell-cell and Cell-matrix adhesion, Plant Tissues- Cellulose microfibrils in cell wall, plasmodesmata.

5. Cell Signaling
   Signaling molecules and Surface receptors, Intracellular signal transduction (secondary messengers, cellular responses), G Protein Coupled receptors, cAMP activated Protein Kinase. Tyrosine Kinase, MAP Kinase pathways.

6. Membrane Trafficking
   Moving proteins into membranes and organelles: Translocation of secretory proteins across the ER membranes, insertion, folding and quality control of proteins in ER. Sorting of proteins to mitochondria, Vesicular traffic, Molecular mechanism of vesicular trafficking.

7. Cell Cycle and Cell Growth Control
   Overview of cell cycle and control, Molecular mechanisms of regulating mitotic events
   Cell cycle control in mammalian cells: G0, G1, G2, S phase, Check points, Cyclins, Mitosis: a special type of cell division, Cell birth, Programmed cell death through apoptosis.

8. Cancer
   Tumor cells, Genetic basis of cancer, Role of p53. Failure of cell cycle check points.
Recommended Books:

CTG – 206: Semiconductor Electronic Devices and Applications

Energy band theory of crystals, energy band structure of insulators, semiconductors and metals.
Mobility and conductivity, Electrons and holes in Intrinsic Semiconductor, Elementary properties of Germanium and Silicon, Donor and Acceptor Impurities, Extrinsic semiconductor, Generation and recombination of charges, diffusion.
The p-n junction diode, depletion region, p-n junction diode as a rectifier, current components of a p-n diode, Ideal Voltage Ampere characteristics, semiconductor photodiode, photovoltaic effect, light emitting diodes.
Half-wave and Full-wave rectifiers, ripple factor, efficiency, voltage regulation, inductor filters, capacitor filters, L and pi section filters, regulated power supplies
Bipolar Junction transistors, bipolar transistor action, basic principle of operation open circuited transistor, transistor biased in the active region, current components in a transistor, characteristic curves in common emitter, common base and common collector configuration, expressions of a transistor in h-parameters. Transistor as an amplifier, characteristics of an amplifier.
Feedback concepts and Oscillators, Elementary information about Field Effect transistor, thyristors, opto-electronic devices and display devices.
Logic gates (AND, OR, NOT, XOR, NAND and NOR) Logic operation of logic gates using diodes and transistors. Introduction to integrated Circuits (IC)

Recommended Books:
3. Jacob Millman and Christos C. Halkias Integrated electronics, Tata Mc Graw Hill Publisher Company Ltd.

CTG-207: Bioresources and Ecology

Bioresources:
1. Biodiversity and Bioresources- Genetic Diversity, Species Diversity and Ecosystem Diversity. Biodiversity and its origin, Mega diverse countries and Hotspots, projecting biodiversity and Civic Society, Tribal Culture and Biodiversity and value in Biodiversity and value of Biodiversity, Business in Biodiversity.
2. Global and local trends in Biodiversity, Biodiversity in land water, mountains, oceans.
   Agricultural Bioresources and Biodiversity.
3. Diversity in Domestic animals. Microbial Diversity.
4. Biodiversity in relation to Biotechnology, Threats to Biodiversity, Human Society and loss of Biodiversity, Climate changes and Biodiversity.
5. Bioresources of plant and animal origin

Ecology
1. An Introduction to Ecology and the Biosphere: The scope of ecology, linking ecology and evolutionary biology, environmental issues, interaction between organisms and the environment, aquatic biomes, terrestrial biomes.
4. Ecosystems: Observing ecosystems, laws on energy and energy flow in ecosystem, primary production in ecosystems, energy transfer, biological and geochemical processes, human activities and ecosystem.

Recommended Books

CTG-208: DIFERENTIAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

(i) Equations of First order and first Degree
   Linear differential equations and equations reducible to linear form. Exact differential equations and equations which can be made exact.
(ii) Equations of the First order but not of first Degree Equations solvable for y, x; Equations may be homogeneous in x and y, Equations may be of first degree in x and y (Clairaut's & Lagrange's forms)
(iii) Linear Differential Equations with Constant Coefficients Complementary function, Particular integral, General solution.
(iv) Homogeneous linear Differential Equations with variable Coefficients
(v) Simultaneous Differential Equations
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Methods of solving simultaneous linear differential equations with constant coefficient, 
Simultaneous equations of the first order.

(vi) Linear Differential Equations of Second Order  
Complete solution of the differential equations, Reduction to Normal Form or Change of 
dependent variable, change of the independent variable.

(vii) Exact Linear Differential Equations of n^th order Condition of exactness, Integrating 
factors.

(viii) Total Differential Equations  
Necessary and sufficient condition for the total differential equation, Methods for solving 
the total differential equations.

(ix) Partial Differential Equations of The first order  
Derivation of partial differential equations, Types of integrals of Partial differential 
equations, Particular forms of non-linear partial differential equations of first 
order, Charpit's method.

(x) Boundary Value Problems  
Eigen values and eigen functions problems, Strum-Liouville boundary value problem, 
Laplace, Wave and Diffusion equations.

Recommended Books:
6. E.A. Coddington, An Introduction to Ordinary Differential Equations. Prentice Hall of India 
7. W.E. Boyce and R.C. Diprima, Elementary Differential Equations and Boundary Value 
Publishers & Distributors, Delhi, 1955.

Paper Code : CTG-209: Database Management Systems

Database management:
Database architectures Three levels of the architecture: external, conceptual and internal level, 
centralized and distributed. Database models: hierarchical (Concepts of a Hierarchy, IMS 
Hierarchy), relational (Concepts of relational model, relational algebra, relational calculus), 
network (Concepts of a Network: DBTG Network, DBA Scheme declaration).
Planning a database (tables, queries, forms, reports), Creating and editing database, customizing 
tables, linking tables, designing and using forms, modifying database structure, maintaining 
database, Sorting and indexing database, Querying a database and generating Reports, modifying
a Report, exporting a Report to another format.

Relational Database Management Systems-SQL:
Relational Data Structure, Database Design, Normalization, Characteristics and advantages of SQL, SQL language levels, SQL data types and Literals, SQL Operators, types of SQL commands, Tables, Indexes, Views, Nulls, Aggregate Functions. Select statement, Sub queries, Insert, Update and Delete operations, Joins, Unions, Data security, integrity and concurrency, Backup and recovery, numeric and text data in SQL, dealing with dates, Synonyms, Snapshots, Programming with SQL.

Recommended Books:
2. Date C J. Database Management Systems, Pearson Education Asia.
CTG-210: Economics Concepts and Methods, Development and Planning


Concepts of national income, circular flow of income, component and measurement of national income. Relationship between per-capita national income and economic welfare.
Economic growth, trade and development; The role of institutions in development Resource scarcity; Sustainable development; Aid capital flows and public debt; the political economy of development; social interests and development policy.

Recommended Books:
5. Elhanan Helpman, The Mystery of Economic Growth
III (THIRD)
SEMESTER


Introduction to Schrodinger wave Mechanics: Postulates of quantum mechanics Schrodinger's equation, the wave function and its interpretation, the operator position, momentum and kinetic energy in one dimension, commutator, commutation relation involving position and momentum, uncertainty relation, compatible operator, Hamiltonian operator, eigen functions and eigen values, expectation value of dynamical variables, time-dependent one-dimensional Schrodinger equation for a free particle and for a particle in a potential (x,t) V. Relationship between the well wave function of a particle and measurement of its position, normalization condition for the wave function, Boundary and continuity conditions on the wave function.

The time independent Schrodinger equation, and Stationary state solution, particle in one dimensional box, eigen function and eigen values, discrete energy levels, uncertainty product, generalization to three dimensions and degeneracy of levels. Finite potential well, Calculation of reflection and transmission coefficients. Tunnel Effect, Qualitative discussion of the application to decay. Square well potential problem calculation of transmission coefficient. Simple harmonic oscillator (One dimensional case) qualitative discussion of its eigen function, energy eigen values, Zero point energy, parity-symmetric and anti-symmetric wave functions with graphical representation.

Angular momentum: Angular momentum and their commutation relations, eigenvalues, Matrix representation of the angular momentum operators, coordinate representation of angular momentum and their eigen states (spherical harmonics).

Recommened Books:
Paper Code – CTG -302  Principle and Applications of Molecular Spectroscopy  3 Credits (45 Hrs)


Infrared Spectroscopy
Vibrational spectra of diatomics, Hook's law, effect of anharmonicity; Morse potential. Fundamental vibrations of polyatomic molecules, overtones, hot bands. Intensity and position of IR bands, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Solvent effect and effect of H-bonding on vibrational frequency.

Raman spectroscopy
Qualitative treatment of Rotational Raman effect; Effect of nuclear Spin; Raman activity of vibrations, rule of mutual exclusion; vibrational Raman spectra, Stokes and anti-Stokes lines, their intensity difference.

Ultraviolet absorption spectroscopy
Absorption laws (Beer-Lambert’s law), molar absorptivity. Types of electronic transitions, effect of solvent on transitions, effect of conjugation. Chromophores and Auxochromes. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra and application of Woodward Rules for calculation of λ_max for the conjugated ones (aromatic, heterocyclic and polyunsaturated) and enones.

Nuclear Magnetic Resonance Spectroscopy: Basic principles of Proton Magnetic Resonance, shielding and de-shielding of magnetic nuclei Anisotropic Effects in Alkene, alkynes, Cycloalkane, Carbonyl compounds and benzene; Chemical Shift and factors influencing it; chemical shift values of various chemically non-equivalent protons and correlation to protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic); Spin-Spin Coupling and Coupling constant. Study of AX, AX2, AX3, A2X3 Patterns of NMR spectra with examples of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 112-tribromomethane, ethyl acetate, toluene and acetophenone.

Electron Spin Resonance Spectroscopy: Basic principles, position of ESR absorption, g factor. Hyperfine splitting, applications of ESR spectroscopy.

Mossbauer Spectroscopy Principles, isomer shift, quadrupole effect of magnetic field, applications to iron and tin compounds.

Mass Spectroscopy
Introduction, ionization, Types of ions produced, molecular ion peak, metastable peak, general rules (isotopes effect, nitrogen rule, ring rule); typical examples of mass spectral fragmentation of organic compounds (examples- alkane, alkene, alcohol, ether, ketone). Applications of IR, UV, NMR and Mass spectroscopy for structure elucidation of simple organic compounds.
Text Books

Digital Logic Fundamentals: Boolean Algebra, Combinatorial Logic, Combinational Circuit Designs, Basic Sequential Components.

Introduction to Finite State Machines: State diagram and state tables, Mealy and Moore machines, designing state diagrams, from state diagram to implementation.

Instruction Set Architecture: Levels of Programming languages, Assembly Language Instructions, Instruction set architecture design, relatively. Simple Instruction Set Architecture. The 8085 Microprocessor Instruction Set Architecture.


CPU Design: Specifying a CPU, Design and implementation of a very simple CPU, Design and implementation of a Relatively simple CPU, shortcomings of the simple CPUs, Internal Architecture of the 8085 Microprocessor.

Micro sequencer Control Unit Design: Basic Microsequencer Design. (Microsequencer Operations, Microinstruction Format), Design and Implementation of a very simple Microsequencer (The basic layout, Generating the Correct Sequence and designing the mapping Logic, Generating the micro-operation using horizontal Microcode, Generating the micro-operation using Vertical Microcode, Directly Generating the control signals from the microcode), Design and implementation of a Relatively Simple Microsequencer (Modifying the State Diagram, Designing the Sequencing Hardware and Microcode, Completing the design using Horizontal Microcode). Reducing the number of Microinstructions (Microsubroutines - Microcode Jumps). Microprogrammed Control Vs Hardwired Control (Complexity of the instruction set, Ease of Modification, Clock Speed).

Computer Arithmetic: Unsigned Notation (Addition and Subtraction, Multiplication, Division), Signed Notation (Signed-Magnitude Notation, Signed-Two's Complement Notation) Binary Coded Decimal (BCD Numeric Format, Addition and Subtraction, Multiplication and Division) Specialized Arithmetic Hardware (Pipelining, Lookup Tables, Wallace Trees), Floating Point Numbers (Numeric Format, Numeric characteristics, Addition and Subtraction, Multiplication and Division.

Memory organization: Memory System, Cache Memory (Associative Memory, Cache Memory and With Associated Mapping, Cache Memory and Direct Mapping, Cache Memory and Set-Associated Mapping, Replacing Data in the Cache, Writing Data to the Cache, Cache Performance), Virtual Memory (Paging, Segmentation, fragmentation, Memory Protection), Beyond the Basis of Cache and Virtual Memory (Beyond the Basis of Cache Memory, Beyond the Basics of Virtual Memory).

Input/Output Organization: Asynchronous Data Transfers (Source-initiated Data Transfer, Destination - initiated Data Transfer, Handshaking), Interrupts (Transferring Data Between the CPU and I/O Devices, Type of Interrupts, Processing Interrupts Interrupt Hardware and Priority, Implementing Interrupts inside the CPU), Direct Memory Access (Incorporating Direct Memory Access (DMA) into a Computer System, DMA Transfer Modes, Modifying the CPU to Work With DMA), I/O Processors, Serial Communication (Serial Communication Basics, University Asynchronous Receiver/Transmitters (UARTs))

Recommended Books:
Integral Transforms:

Special Functions:
Bessel Function: Bessel equations and its solution. Generating function of Jn(x) integral expressions for the Bessel functions, Recurrence relations for Jn(x). Orthogonal properties of Bessel functions.

Functions of complex variables:

Complex Integration: Complex line integrals (simple examples). Cauchy Goursat theorem, Cauchy integral formula, orthogonal curvilinear coordinate system, scale factors, expression for gradient, divergence, curl and their applications to Cartesian and spherical polar coordinates.

Introduction to tensors: Dimensional space, Transformation of Covariant, contravariant and mixed tensors, Addition, multiplication and contraction of tensors; quotient rule; symmetric & antisymmetric tensor metric.

Recommended Books:
2. Laplace Transform: Spiegel Schaum Series.
7. Functions of Complex Variable: J.N. Sharma, Krishna Prakashan Mandir, Meerut
1. Microorganisms and Microbiology

Introduction to microbiology, microorganisms as cells, microorganisms and their natural environments, the impact of microorganisms on humans, contribution of Robert Hooke, Antony van Leeuwenhoek, Ferdinand Cohn, Louis Pasteur, Robert Koch, Martinus Beijerinck, theory of spontaneous generation, germ theory of disease and Koch postulates

2. Techniques of Microbiology

Seeing very small, magnification and resolution, phase contrast and dark field microscopy, differential interference contrast microscopy, atomic force microscopy, confocal scanning laser microscopy, scanning electron microscopy, transmission electron microscopy, general staining techniques: the Gram staining, fluorescence dyes, Negative staining, FISH

3. Microbial Diversity

Physiological diversity of microorganisms, bacteria, archaea, mycoplasma (PPLO), eukaryotic microorganisms

4. Cell structure and function in Bacteria and Archea

Cell morphology, cytoplasmic membrane in bacteria and archaea, ultrastructure of cell wall of bacteria and archaea, cell surface layers, pil, and fimbrue, cell inclusions, gas vessels, endospores, flagella and mobility

5. Microbial growth

Bacterial cell division, growth of bacterial population, measuring microbial growth, factors affecting microbial growth

6. Overview of Viruses and Virology

Virus structure and growth, viral replication, viral diversity, subviral entities

7. The phylogeny of Bacteria

Phototroph, chemolithotroph, methylotroph, aerobic and facultative anaerobic, chemooorganotroph bacteria

8. Gram Positive Bacteria

Overview, actinobacteria, cyanobacteria, green sulphur bacteria, green nonsulphur bacteria
9. Archea

Phylogeny and geneal metabolism, Extremely halophilic Archea, methane producing archea

10. Protists

Diplomonads, Euglenozoa, Alveolates, Stramenophils, Radiolarians, Amoebozoa

11. Fungi

Fungal physiology, cell wall structure, fungal reproduction and parasexuality, classification: chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, deuteromycetes

12. Algae

Basis of classification, Chlorophyceae, Rhodophyceae

13. Antimicrobial agents and Pathogenicity

Physical and chemical antimicrobial control, antiviral and antifungal drugs, antimicrobial drug resistance

14. Microbial Interactions with Humans

Beneficial and harmful microbial interactions with humans, virulence factors and toxins, host factors in infection

15. Major diseases caused by bacteria, fungi and virus.


Centre for Converging Technologies, University of Rajasthan, Jaipur

Theory paper

CON-306: Basics of Cognitive Psychology

UNIT- 1:
Attention: Nature, Information Processing Theories-Early vs. Late Attentional
Selection, Spotlight Theory, Feature Integration Theory and Guided Search, Integrated
Competition Theory

Models of Visual Recognition: Template-Matching Models, Feature-Matching Models,
Recognition by- Components Model, Configural Models, Network Feedback Models,
Bayesian approach

UNIT- 3: Executive Processes: Definition, Executive Attention, Switching Attention, Inhibition
of Response, Sequencing and Monitoring

UNIT- 4: Decision Making: Nature of Decision, Expected Utility Model, Framing Effects and
Prospect Theory, Judgments in Uncertainty, Human Decision Making and Role of Emotions

UNIT- 5: Problem Solving and Reasoning: Nature and Structure of Problem, Problem Space
Theory, Strategies and Heuristics, Analogical Reasoning, Sub-processes and Theories;
Inductive Reasoning: Nature, General and Specific Inductions; Deductive Reasoning: Nature,
Syllogism-Categorical and Conditional.

Reference Books/material:
   Pearson Education

[signature]

Dy Registrar
University of Rajasthan
JAIPUR, RAJ.
1. Brief Information of Nucleic Acid:
   Double Helix Concept, The Central Dogma, Nucleic Acid convey genetic information
2. Isolation of Nucleic Acid and Electrophoresis of Protein and Nucleic Acid
   General principle, Support Media, Electrophoresis of Proteins and nucleic acid, Capillary Electrophoresis, 2D Gel Electrophoresis (2d PAGE), Isoelectric Focusing (IEF), Southern and Western Blotting.
3. Model Organism
   Bacteriophage and Bacteria, Baker's Yeast, Nematode (C. elegans), Fruit Fly (D. melanogaster) and House Mouse (M. Musculus)
4. Structure of Nucleic Acid
   DNA structure, DNA Topology and RNA Structure
5. Replication of DNA
   DNA synthesis (Initiation, Origin Selection, Activation of the Initiator Protein and finishing or replication), Mechanism of DNA Polymerase.
6. DNA Repair and Homologus Recombination
   Replication Errors, DNA Damage and Repair of DNA, Models for Homologus Recombination, Recombination proteins, Homologus Recombination in Eukaryotes, Mating type Switching and Genetic Consequences.
7. Site-Specific Recombination and Transposition of DNA
   Conservative Site Specific Recombination and its role, Transposition, Transposition Elements and their regulations.
8. Mechanism of Transcriptome:
   RNA Polymerase and Transcriptome Cycle, Transcription in Prokaryotes and Eukaryotes
9. RNA splicing:
   Chemistry of RNA Splicing and Its Machinery, Splicing Pathways, Alternative Splicing, Exon Shuffling, RNA Editing, m-RNA Transport.
10. Translation
    m-RNA, t-RNA, Ribosome, Initiation Elongation and termination of Translation, Regulation of mRNA and Protein Stability.
11. The Genetic Code
    Degenerate Code and Rules that Govern The Genetic Code, Universal Code
12. Gene Regulation in Prokaryotes
    Principles of Transcriptional Regulation, Regulation of Transcription Initiation in Bacteria and Phase λ, Examples of Gene Regulation at Steps after Transcription Initiation.
13. Gene Regulation in Eukaryotes
    Conserved Mechanism of Transcriptional regulation from Yeast to Mammals, Interaction of Protein Complexes to genes by Euk. Activators, Signal Integration and Control, Transcriptional Repressors and Regulators, Gene Silencing by Modification of Histone and DNA, Eukaryotic Gene Regulation after Transcription Initiation and RNA in gene Regulation.

Gene Duplication and Importance of Regulatory Evolution, Ways of Gene Expression during Evolution, Experimental Manipulations, Morphological changes in Crustaceans and Insects, Genome Evolution and Human Origins.

TEXT BOOK:-

Reference Book
Gene IX: Benjamin Lewin
Molecular Biology of the cell; Alberts, Bray, Johnson, Lewis
Molecular Cell Biology; Lodish, Berk, Mastudaira

[Signature]
Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR
Programming in Java

Overview of Object Oriented Programming, Introduction to Java Development environment, Overview of Control Structures, Program Modules in Java (methods, classes, packages), Creating and executing a Java program, classes, objects and instance variables (private, public, protected), Data types (primitive types vs. reference type), GUI (using Dialog boxes), static methods, static fields, class Math, using this reference, constructors, garbage collection and method finalize, static class members, final instance variables method overloading, Java API packages, importing Java API packages, Creating Packages, Arrays in Java (declaring, creating and passing arrays to methods).

Inheritance: Composition, Superclasses and Subclasses, behavior of private, public, protected members in inheritance, relationship between superclass objects and subclass objects, constructors and finalizers in subclasses, object class.

Polymorphism: Introduction, dynamic method binding, abstract superclasses and methods, concrete classes, instance of operator and downcasting, allowed assignments between superclass and subclass variables, final methods and classes, creating and using interfaces, inner classes.

GUI components: input/output with JOption Pane, overview of swing components, displaying text and images in a window, event handling, JLabel, JText Field, JPassword Field, JTextArea, JButton, JCheckBox, JComboBox, JList, Mouse event handling, adapter classes, JPanel subclass for drawing with mouse, key-event handling, layout managers (FlowLayout, BorderLayout, Gridlayout), menus and frames.

Graphics and Java2D: Graphics Contexts and Graphics Objects, color control, font control, drawing lines, rectangles, ovals, arcs, polygons and polylines, Java2D API.

Files and Streams: Data hierarchy, files and streams, class File, sequential access and random access files.

Searching and Sorting: Linear search, Binary search, Selection sort, Insertion sort, Merge sort.

Data structures: Self referential classes, dynamic memory allocation, Linked lists, Stacks, Queues and Trees.

Java Applets: Introduction, executing an Applet in applet viewer and Web Browser, Applet lifecycle methods, initializing an instance variable with method init.

Java Multimedia: images, animation and audio.

Recommended Books:
IV (FOURTH)
SEMESTER
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<th>S. No</th>
<th>Subject Code</th>
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<td>Numerical Methods and Implementation in C++/Java</td>
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CTG-401: SOLID STATE PHYSICS

1. (a) Crystallography: Translation vectors, primitive cell, Wigner-Seitz cell, types of lattices (cubic, Tetragonal, Monoclinic, Triclinic,....). Fourier theorem, Reciprocal space, G vectors, Brillouin zone X rays, and Bragg reflection, structure and form factor examples: SC, FCC, BCC diamond, graphite, NaCl.


2. A) Phonons: Normal Mode analysis in a cluster with a simple example of dimer and timer force. Constant matrix, idea of diagonalization, linear chain, use of Fourier transform to take advantage of translational symmetry to separate modes, dynamical matrix. General treatment in 3D (acoustic and optic modes) Derivation from equation of motion and harmonic expansion, zero-point energy contribution in total energy.

b) Thermal Properties: Einstein Model, Debye Model heat conductivity, dilation and anharmonicity. 3 hours


Recommended Books:

CTG-402: QUANTUM CHEMISTRY

1. Quantum theory and its applications: Schrödinger equation for particle in a box in three dimension (boundary condition, allowed energies and wave function etc), quantum simple harmonic oscillator, energy eigenvalues and eigenstates zero point energy. Schrödinger equation for hydrogen atom in terms of polar coordinates, quantum numbers.
2. Quantum theory and molecular structure of simple molecules. Born Oppenheimer approximation, molecular orbital, LCAO approximation, expression for bonding and antibonding orbitals. Molecular potential energy curve structure of simple diatomic molecules overlap integral, importance of electron pair in chemical bonding, molecular orbital energy diagram, classification of molecular orbital and term symbol for diatomic molecules, variation principle (application to helium atom) hybridization as useful concept.

3. Huckel approximation for conjugated double bond (C2H4, alkyl system butadiene, cyclopropenyl) calculation of bond order, charge density etc. aromatic stability (benzene) delocalization of energy, valence bond theory of molecular structure of simple molecules, difference between V.B. and M.O. theories.

Recommended Books:

CTG-403: SYSTEM ANALYSIS AND DESIGN

Basics: System concepts, types of system, elements of system, different approaches to system development, function oriented, object oriented, data oriented, process oriented, DLC, Modeling Methods process Models waterfall, spiral, Prototyping, organizational chart. Methodologies and tools of SAD, Different people involved in System Analysis and Design.


Analysis - System planning & initial investigator, strategies for determining information requirement, problem definition & project initiation, background analysis, service analysis, efficiency, Fact gathering, Fact Analysis and Feasibility study.

Information gathering - Need for information gathering Information gathering tools. Onsite observation interviews and questionnaires. Review of Written documents, Types of Interview and Questionnaire, instructed, structured alternation.

Tools of Structured Analysis - What is structured analysis, various involved (Procedure, pros and cons of each tools) Data Dictionary Decision tree, structured English, Data flow diagram DFD notation, content, diagram selves in DFD, conversion from DFD to structure chart, Entity Relationship Diagram/ Entities, Attributes, Relationship).

Feasibility Study - Economic, Technical, Behavioral feasibility, steps in feasibility study.

Design -input/Output and forms design - Input design CRT screen design, Output design and Requirement of Form design file organization and database design.

System implementation - H/W selection, S/W selection, Make v/s Buy decision.
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Documentation, Project Scheduling, System Mounlenance – Security and disaster planning
and management's Modern approach to SCLC.

Recommended Books:

CTG-404: Numerical Methods and Implementation in C++/ Java

Locating Roots of Equations: Bisection Method, Newton’s Method, Secant Method, Muller’s
Method problems based on Java
Interpolation and Numerical Differentiation: Newton’s Forward Difference Interpolation,
Newton’s Backward Difference Interpolation, Formula, Cubic Spline interpolation
Numerical Integration Definite Integral, Trapezoid Rule, Simpson’s Rule Romberg
Algorithm, Adaptive Simpson’s Scheme, Gaussian Quadrature Formulas.
Systems of Linear Equations: Naïve Gaussian Elimination, Gaussian Elimination with scaled
partial pivoting, Integrative solution of linear systems, Gauss-Seidel iteration Method, Eigen
values and eigenvectors, Power methods.
Ordinary Differential Equations, Initial – Value Problem: Analytical vs. Numerical Solution,
Taylor Series Methods, Range Kutta Methods, Stability, adaptive Runge-Kutta Methods, and
Multistep Methods.
Smoothing of Data and the Method of least squares: The method of least squares Monte
Carlo Methods: Random numbers, Estimation of areas and Volumes by Monte Carlo
Techniques
Recommended Books:
1. Ward Cheney and David Kincaid, Numerical Methods and Computing, Brooks
Cole, 2004
India.

CTG-405: Electronic Data Communication

Introduction: A Communication Model, Data Communication, Data Communication
Networking (WAN, LAN), Protocols and Protocol Architecture, the OSI Model.
Data Transmission: Concepts and Terminology (Transmission Terminology, Frequency,
Spectrum, Bandwidth, Time-Domain concepts, Frequency Domain concepts, Data Rate and
Bandwidth), Analog and Digital Data Transmission (Data, Signal, Data and Signals,
Transmission of Signals), Transmission Impairments (Attenuation, Delay Distortion, Channel

Data Encoding: Digital- To-Digital Encoding (NRZ, Multilevel Binary, Biphasic, Modulation Rate, Scrambling Techniques: B8ZS, HDB3), Digital- To-Analog Encoding (ASK, FSK, PSK, QAM, Modulation Rate), Analog- To-Digital Encoding (PAM, PCM, Delta Modulation), Analog- To Analog Encoding (AM, FM, PM).


Multiplexing: Frequency-Division Multiplexing, Synchronous Time-Division Multiplexing, Statistical Time-Division Multiplexing.

Recommended Books:
1. William Stallings, Data and Computer Communications, Prentice. Hall of India

CTG – 406: Developmental Biology

Developmental Biology of Plants

1. Vegetative Phase of Plant Development: Meristems, Shoot, Root apical meristems, Primary, Secondary, Auxiliary, IntercaIary, Floral and Inflorescence meristems
2. Leaf development: Arrangement of Leaf primordia and their genetic programming.
3. Root Development: Root tip: developmental zones, Root apical meristems and cell differentiation
4. Structure of flower and floral characteristics: Floral architecture, types, Floral transition, Development of sepals and petals.
5. Development of male gametophyte: Microsporogenesis, Anther wall, Sporangogenous tissue.
7. Embryo development: Embryogenesis in Monocotyledons and Dicotyledons, establishment of the essential features of the mature plant, Axial and radial patterning.
8. Seed-structure and development: Monocot and Dicot seeds and their development.
Additive property of Moment Generation function.
Binomial, Poisson and Normal Distributions, Additive properties of Binomial and Poisson distribution (Statimraver only), Normal Probability curve.
Curve fitting and principle of least squares, fitting of a straight line and second degree parabola.
Correlation, Karl Pearson coefficient of correlation, Rank correlation coefficient. Regression, Regression coefficients, Properties of Regression Coefficients.
Sampling distributions: Chi square Distribution, students to distribution, F and Z Distribution, confidence coefficient. Maximum Likelihood estimates.
Hypothesis testing, statistical hypothesis (simple and Composites), null hypothesis. Alternative hypothesis. critical Region, Two types of errors, level of significances. Power of the test, Two tailed and one tailed tests, large sample tests.
Time series and forecasting components of time series, Measurement of trend, Measurement seasonal variations, smoothing of curves, forecasting models. Analysis of variance one way and two way analysis, ANOVA-table.

Recommended Books:

CTG-408: Entrepreneurship

1. Understanding Entrepreneurship: Introduction, Definition, Reasons for Growth of entrepreneurship, Age of an Entrepreneurial Firm, Why start a Business Entrepreneurial Characteristics and skills, Types of Entrepreneurs, Entrepreneurial Failure
4. Marketing: Assessment of market demand for potential product(S) of Interest, Market conditions, segments, Prediction of market changes, Identifying needs of customers including gaps in the market, packaging the product, market linkages, branding issues, developing distribution channels, Pricing/Policies/Competition. Promotions/Advertising, services Marketing.
5. Human Resource development (HRD): Leadership skills, Managerial skills, Organization structure, pros & cons of different structures, Team building, teamwork, Appraisal, Rewards in small scale set up.
6. Inventory control and management: Purchase of material, Re order level, re-order quality, minimum stock level, maximum stock level, material issue : FIFO. LIFO, Average price method, loss of material : wastage, scrap, spoilage, defectives treatment of losses.
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SEMESTER
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<thead>
<tr>
<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
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<th>Contact Hours Per week</th>
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<td>Introduction to Nanotechnology</td>
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<td>Introduction to Cognitive Science</td>
<td>CCC</td>
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<td>Introduction to Neuroscience</td>
<td>CCC</td>
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<td><strong>Total Credit of CCC papers</strong></td>
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Fifth Semester

Theory Paper

Paper 501

COURSE NANO-01: Introduction to Nanotechnology

Unit - I Emergence of Nanotechnology
- Schrodinger equation
- Electron confinement
- Tunneling of a particle through potential barrier
- Density of states (0D, 1D, 2D, 3D)

Unit - II Synthesis of Nanomaterials
- Physical method: Introduction, mechanical method, method based on evaporation, sputter deposition, CVD, Electric arc deposition, ion beam techniques, Nanolithography
- Chemical method: Introduction to colloids in solution, growth of nanoparticles, synthesis of metal and semiconductor, nanoparticle by colloidal route, L B, methods micrometals, Sol-Gel method

Unit - III Characterization and properties of nanomaterials
- Structural characterization
- Chemical characterization
- Properties: Mechanical, optical, electrical and magnetic

Unit - IV Application of Nanomaterials
- Nanobots, synthesis of gold nanocrystals
- Band gap Engineered Quantum devices
- Carbon Nanotubes Emitters
- Photodetector chemical cells
- Bio Sensors

Recommended Books:
5. Inorganic nanowires CRC Press M.Meyyappan and Mahendra K Surikan
COURSE NANO-02: Introduction to Nanoelectronics

Unit I Free and Confined electrons
Free electrons in 1D and 3D. Electrons confined to a bounded region of space and quantum numbers. Partially confined electrons in finite potential well: finite rectangular well and parabolic (H.O.) well. Quantum dots, wires, and wells.

Unit II Tunnel Junctions and their applications
Tunneling through a potential barrier; potential energy profiles for material interfaces between metal-insulator, metal-semiconductor and metal-insulator-metal junctions; Application of tunneling in field emission, double barrier tunneling & Resonant Tunneling Diodes.

Unit III Coulomb Blockade
Coulomb blockade in a nanocapacitor, tunnel junctions. Tunnel junction excited by a Current source, Coulomb blockade in a quantum Dot Circuit.

Unit IV The Single Electron Transistor
Single electron transistor and its logic, Carbon nanotube Transistor (FET and SET, Molecular SETs and Molecular Electronics.

Recommended Books:
1. Fundamentals of Nanoelectronics by George W. Hanson Pearson Education
Recombinant DNA Technology and Genetic Engineering

Course - 503

Recombinant DNA Technology (2)

1.) Introduction to Recombinant DNA technology: Why gene cloning and DNA analysis are important? Vectors for gene cloning—Plasmids and Bacteriophages.

2.) Purification of DNA from living cells, Manipulation of purified DNA, Introduction of DNA into living cells, Cloning vectors for E.coli, Cloning vectors for eukaryotes (fungi, higher plants, animals)

3.) Polymerase Chain Reaction (PCR), Gel Electrophoresis

4.) Studying gene expression and function, Production of proteins from cloned genes, Gene cloning and DNA analysis in medicines, agriculture, forensic science and archaeology

BOOK-GENE CLONING & DNA ANALYSIS
AUTOR: T.A. BROWN

Genetic Engineering (3)


2.) Genetic manipulation of animals. Production of transgenic mice. ES cells for gene targeting in mice. Applications of GM mice

3.) Nuclear transfer technology and animal cloning. Gene transfer in Xenopus Oocytes, Fish and Drosophila.


BOOK-Principles of Gene Manipulation and Genomics
AUTOR: Primrose and Twyman

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COURSE BIO-02: Introduction to Bioinformatics

1. Overview of Bioinformatics
   History, scope and application, Internet and World Wide Web.

2. Bioinformatics Resources and Information Retrieval
   Bibliographic databases, Nucleic and sequence database, Genome Database, protein sequence database, structure database, Specialized database, Expression and proteomics database, Database of metabolic pathways, Information Retrieval Systems (Entrez, SRS), NCBI, ExPASy and Ensembl.

3. Sequence Comparison and Alignment
   Introduction, sequence alignment reveals function, structure and evolutionary information, principal methods of pairwise sequence alignment, scoring matrices and gap penalties in sequence alignment.
   Dotplot analysis, measures of sequence similarity: Scoring schemes, Dynamic programming Needleman-wunsch algorithm, Significance of alignment, BLAST and FASTA programs, Variants of BLAST and FASTA.

4. Multiple Sequence alignment and Phylogenetic Analysis
   Introduction, multiple sequence alignments as starting points for phylogenetic analysis, global multiple sequence alignment-CLUSTALW, hidden Markov models of a global, local multiple sequence alignment.

5. Phylogenetics analysis
   Phylogeny, its definition and understanding, Phylogeny and bioinformatics for evolution.

6. Protein structure: Analysis and prediction
   Overview of protein structure, levels of protein structure, super secondary structures. Structure - based protein classification, protein structure database, CASP, protein structure alignment tools (VAST, DALI), protein identification and characterization, primary & secondary structure analysis and prediction, scoring for motifs, profiles and patterns, 3-D structure visualization and modeling.

7. Bioinformatics in Drug Discovery
   Drug discovery and development-the lead compound, bioinformatics in drug discovery and development.
   Chemical sketching (ISIS Draw, Chemsketch).

Recommended Books:
- Fundamental Concepts of Bioinformatics, Dan E Krane, Elaine Nicpon Marieb, Michael L Raymer, Benjamin Cummings Publication (Indian Edition)
COURSE ICT-01: Artificial Intelligence

Introduction: What is AI?, the Turing Test approach, the cognitive modeling approach, the "laws of thought" Approach and the rational agent approach, foundations of Artificial Intelligence.


Informed search and Exploration: Informed (Heuristic) search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Memory-bounded heuristic search, Heuristic Functions, the effect of heuristic accuracy on performance, Inventing admissible heuristic functions, Learning heuristics from experience, Local Search Algorithms and Optimization Problems, Hill-climbing search, Simulated annealing search, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Online search Agents and Unknown Environments, Online search problems, Online search agents, Online local search.

Constraint Satisfaction Problems: Constraint Satisfaction Problems, Backtracking search for CSPs, Variable and value ordering, Propagating information through constraints, Forward checking, Constraint propagation, Handling special constraints, Intelligent backtracking: looking backward, Local Search for Constraint Satisfaction Problems.

Adversarial Search: Optimal Decisions in Games, Optimal strategies, the minimax algorithm, optimal decisions in multiplayer games, Alpha-Beta Pruning, Imperfect, Real-Time Decisions, Evaluation functions, Cutting off search Games that include an Element of Chance, Position evaluation in games with chance nodes, complexity of expectiminimax, Card games, State of the Art Game Programs.

First-Order Logic: Syntax and Semantics of First-Order Logic, Models for first-order logic, Atomic sentences, Complex sentences, Quantifiers, Universal quantification, existential quantification, nested quantifiers, Connections between For all and Exists. Using First Order Logic Assertions and queries in first-orders logic. The electronic circuits domain, Identify the task, Assemble the relevant knowledge. Decide on a vocabulary. Encode general knowledge of the domain. Encode the specific problem instance. Pose queries to the inference procedure. Debug the knowledge base.


Knowledge Representation: Ontological Engineering, Actions, Situations, and Events, the ontology of situation calculus. Describing actions in situation calculus. Solving the representational frame problem solving the inferential frame problems. Time and event calculus. Generalized events, Processes, Intervals, Fluctus and objects, Mental events and mental objects, a formal theory of beliefs, knowledge and beliefs, knowledge, time, and action, the Internet Shopping World Comparing offers. Reasoning with Default information open and closed worlds, Negation as failure and stable model semantics, Circumscription and default logic, Truth Maintenance Systems.

Recommended Books:


(The COURSE is based on first ten chapters of the book)
COURSE ICT-02: Functional Programming Language

Fundamental Concepts: Sessions and scripts, evaluations, values, function, definitions, types, specifications.

Simple Data Types: Booleans, Characters, Enumerations, Tuples. Other types, Type Synonyms, Strings.

Numbers: Natural Numbers, Induction, the Fold Function, Haskell numbers and examples: The rationals, linear and binary search, Church numbers.

Lists: Notations, operations, map and filter, Zip, the Fold functions, laws of fold. Examples: Converting numbers to words, producing class lists, arbitrary precision arithmetic, printing a calendar, text processing.

Trees: Binary trees, Binary search trees, Binary heap trees, Rose trees. Example: Huffman trees, meertens number.

Efficiency: Lazy evaluations, Asymptotic analysis, Accumulating parameters, Tupling, Controlling space, Fusion, finite differencing and deforestation.

Abstract Data Types: Modules, Sets, Bags, Flexible arrays, Queues.

Infinite lists: Infinite lists as limits, properties of infinite lists, cyclic structures, Example: the paper-rock-scissors game.

Monads: Monadic interaction, Variations on an evaluator, Monad laws, combining monads.

Parsing: Sequencing, Alternation, Repetition, Efficiency.

An automatic Calculator: Basic considerations, expressions, laws and calculations, matching and substitutions, subexpressions and rewriting, testing the calculator.

Recommended Books:


(The scope of COURSE based on all chapters of the above referred book)
COURSE CON-507: Introduction to Cognitive Science

UNIT-1. Introduction (6)

UNIT-2. Interdisciplinary relevance (6)
With psychology, philosophy, neuroscience, linguistics, anthropology, Computer Science, sociology & biology.

UNIT-3. Exploring mind (6)
Multiple approaches, The representational theory of mind and theories of mental representation, Criteria for evaluating theories of mental representation.

UNIT-4. Approaches to Cognitive science (6)

UNIT-5. Cognitive Development (6)
Life span development, Piagetian perspective, Core knowledge perspective, Vygotskian perspective, Information processing perspective.

UNIT-6. Consciousness (6)
Consciousness as a scientific construct, Kinds and aspects of consciousness, Theories and functions of consciousness.

Bodies, The world, Dynamic Systems and Societies.


References Books:

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UNIT-1.
Phylogeny of the Nervous System from Invertebrates to Vertebrates (3)

UNIT-2.
Development of the Nervous System in Man (4)

UNIT-3.
Cell Membrane – Structure and Function (Principles of Trans – Membrane Potentials and Conduction, Graded or Electrotonic and Action Potentials, Myelin and its Role. (5)

UNIT-4.
Ionics Channels and Pumps (Voltage and Ligand Gated Channels, Mechanisms of Blocking and Inactivation, Restoration of Resting Potential – Ionic Pumps) (5)

UNIT-5.
Synaptic Transmission – (synaptic Transmission – Second Messengers and Related Modifications in Function and Shape of Neurons and Dendrites (6)

UNIT-6
Gross Anatomy and Physiology of nervous system : Corpus Callosum, Basal Ganglion, Cerebellum, Limbic System, Thalamus, Hypothalamus, Pituitary, Reticular Formation, Brain Stem, Spinal Cord. (6)

UNIT-7
Autonomic Nervous System. (2)

UNIT-8.
Movements ( Different Aspects of Motor Functions – Principles of Regulation, the Passage from initiation to Realization of a movement, Modulation of an ongoing Movement – the Role of the Cerebellum) (6)

UNIT-9.
Sleep Neurophysiology including Electroencephalogram (EEG), Biological Rhythms and dreaming (4)

UNIT-10.
Introduction to Neuro-economics (Behavior and Decision making under Economical aspects, marketing and neurobiology of Emotions) (2)
Reference Book:

3. Bear M.F., Connors B.W., Paradiso M.A. Neuroscience exploring brain, Lippincott-Williams & Wikins

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VI (SIXTH) SEMESTER

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# VI Semester SYLLABUS

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<td>601</td>
<td>Synthesis and Characterization of Nanomaterials</td>
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<td>602</td>
<td>Nanophotonics</td>
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<td>603</td>
<td>Metabolic Engineering</td>
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<td>605</td>
<td>Basic of Quantum Computing</td>
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<td>Transmission Control Protocol / Internet Protocol</td>
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<td>608</td>
<td>Brain Mapping &amp; Imaging</td>
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<tr>
<td>612</td>
<td>MATLAB Programming</td>
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</table>
Course: NANO-03 Synthesis and Characterization of Nano materials

Physical growth of Solid Surface
Surface energy, Chemical potential as a function of surface curvature, Electrostatic stabilization, Surface charge density, Electric potential at the proximity of solid surface, Van der Waals attraction potential. Interactions between two particles: DL VO theory.

Nanoparticles: Homogeneous and Heterogeneous Nucleation
Fundamentals of Homogenous Nucleation, Growth of nuclei controlled by diffusion and surface process, synthesis of metallic, semiconductors and oxide nanoparticles.
Fundamentals of Heterogeneous nucleation, synthesis of nanoparticles, kinetically confined synthesis of nanoparticles (microemulsions, aerosol, growth termination, spray pyrolysis, template based synthesis).

Transmission Electron Microscopy and Scanning Probe microscopy of Nanoparticles
A transmission electron microscope, High resolution TEM lattice imaging (Image formation, Contrast mechanisms, Image interpretation, Image simulation), Scanning Probe Microscope: Fundamentals of the techniques, Experimental approaches and data interpretation (Scanning tunneling microscopy (STM)/ Scanning Tunneling Spectroscopy (STS), Scanning Force Microscopy (SFM), Scanning near-field microscopy (SNOM))

Optical Spectroscopy of Nanophase Material and Magnetic properties of Nanomaterials
Experimental, Metal nanostructures (Size and shape dependence of the Plasmon absorption on gold nanoparticles, Electron dynamics in gold nanoparticles), Semiconductor nanostructures (CdS quantum dots and interfacial charge transfer dynamics, Core - shell heteronanostructures: CdS nanoparticles capped with Cd(OH)₂, CdS nanoparticles capped with ZnS, CdS nanoparticles capped with an outer CdS cladding), Origin of magnetism, Single domain versus multi-domain behaviour, Coercivity of nanoparticles, Superparamagnetism in nanomaterials, Magnetic anisotropy energy.
Electrical and Electrochemical analysis of Nanophas Materials
Preparation of nanostructures electrode (Powder microelectrode, Electrodeposition or electrophoretic deposition, formation of nanoparticles in polymers, Electrochemical self-assembly, Mesoporous electrodes, Composite electrodes consisting of nanoparticles), Principles of electrochemical techniques (Impedance spectroscopy, Potential sweep method, Potential step method).

References:
Course: NANO-04 Nanophotonics

Foundations for Nanophotonics

Quantum-Confined Materials
Quantum Wells, Quantum Wires, Quantum Dots, Quantum Rings, Manifests of Quantum Confinement: Optical Properties, Examples, Quantum-Confined Stark Effect, Dielectric Confinement Effect, Quantum-Confined Structures as Lasing Media.

Phhotonic Crystals

Nanophotonics for Biotechnology and Nanomedicine
Near-Field Bioimaging, Nanoparticles for Optical Diagnostics and Targeted Therapy, Semiconductor Quantum Dots for Bioimaging, Up-Converting Nanophores for Bioimaging, Biosensing, Nanoclincs for Optical Diagnostics and Targeted Therapy, Nanoclinc Gene Delivery, Nanoclincs for Photodynamic Therapy.

References:
1. Nanophotonics - Paras N. Prasad Wiley Inter Science 2004
2. Nanophotonics - Edited by Herice Rigneault, Jean-Michal Lourtiriz, Claude Delalance, Ariel Leuenson ISTE
1. The Essence of Metabolic Engineering
   Importance of Metabolic Engineering, General overview of the book references

2. Review of Cellular Metabolism
   An overview of Cellular metabolism, Transport Processes (Passive Transport, Facilitated Diffusion, Active Transport), Fueling Reactions (Glycolysis, Fermentative Pathways, TCA cycle and oxidative phosphorylation, Anaplerotic Pathways, Catabolism of fats, organic acids and amino acids), Biosynthetic Reactions (Biosynthesis of Amino acids, Biosynthesis of Nucleic acids, Fatty acids and Other Building Blocks), Polymerization, Growth Energetics

3. Comprehensive Models for Cellular Reactions
   Stoichiometry of Cellular Reactions, Reaction Rates, Dynamic Mass Balance, Yield Coefficients and Linear Rate Equations

4. Regulation of Metabolic Pathways
   Regulation of Enzymatic Activity (Overview of Enzymatic Kinetics, Simple Reversible Inhibition Systems, Irreversible inhibition, Allosteric enzymes: Cooperativity, Regulation of Enzyme Concentration (Control of Transcription Initiation, Control of Translation), Global Control: Regulation at the whole cell level, Regulation of metabolic networks (Branch Point Classification, Coupled Reactions and the role of Global currency Metabolites)

5. Examples of pathway manipulations: Metabolic Engineering in Practice

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6. Metabolic Pathway Synthesis
Metabolic Pathway synthesis algorithm, Overview of the Algorithm, A case study: Lysine biosynthesis (The role of oxaloacetate, Other Alternatives, Restrictions on the maximum yield, Discussion of the algorithm)

7. Metabolic Flux analysis
Theory, Overdominated systems, Underdetermined systems: Linear Programming, Sensitivity analysis

References:
Metabolic Engineering, Principles & Methodologies, Gregory N. Stephanopopulas, Aristos A. Aristidov, Jens Nielsen.

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BIO-02: The Omics Science

1. **Genomics**: Introduction to the concept of genome, gene networks: basic concepts, prediction of genes, promoters, splice sites, regulatory regions: basic principles, application of methods genome projects. Human Genome Project. Large scale genome sequencing strategies, Genome assembly and annotation. Genome databases of Plants, animals and pathogens, Metagenomics: Concept and applications.

2. **Proteomics**: Concept of proteome, protein array, Methods of protein analysis: PAGE (Native, SDS), Mass Spectrometry, X-ray crystallography, nuclear magnetic resonance (NMR), Deriving function from sequence, Proteomics in drug discovery and toxicology.

3. **Transcriptomics**: Basic tools, DNA microarray, Understanding of microarray data, detecting differential gene expression, correlation of gene expression data to biological process and computational analysis tools, DNA microarray databases: Gene Expression Omnibus (GEO), ArrayExpress, SAGE databases.

4. **Interactomics**: Protein-protein interaction (Two hybrid interaction screening, Immunoprecipitation). Tools for analysis Protein-protein interaction, Current endeavours and future challenge. Protein-protein interactions databases such as STRINGs, DIP, PPI server and tools for analysis of, protein-protein interactions. Nucleic acid-Protein interactions – Concept of epigenomics, nuclear receptors, orphan nuclear receptors.

5. **Metabolomics**: Introduction to metabolomics, technology in metabolomics, structure and evolution of biological networks, Importance of metabolic engineering, Metabolic pathway databases (EcoCyc, MetaCyc, LIGAND, ENZYME, BRENDA, KEGG).

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Course: ICT-03 Basic of Quantum Computing

Overview of quantum computing: History, qubits, qubit gates, quantum circuits, quantum algorithms.

Introduction to computer science: Models for computation, Turing machines and circuits, analysis of computational problems, computational complexity, complexity classes, energy and computation.

Quantum circuit: quantum algorithms, qubit operations, measurement, qubit gates, universal gates and operations, quantum computational complexity, quantum circuit, models, simulation of quantum systems.

Quantum Computer: physical realization, conditions for quantum computation, introduction to various types of quantum computers: Harmonic oscillator quantum computer, optical photon quantum computer, optical cavity quantum electrodynamics, ion traps, Nuclear Magnetic resonance.

References:

Course: ICT-04 Transmission Control Protocol / Internet Protocol

Review of concepts and protocols in TCP/IP: Introduction, internet working, concepts and architecture, ARP, RARP, internet protocol (datagram delivery, routing, ICMP) HELLO, NAT, VPN, client server model, BOOTP, DHCP, NFS.

Socket Programming: Socket fundamentals, elementary TCP and UDP sockets, I/O multiplexing, socket options, elementary name and address conversion.

Advanced Sockets: Introduction to (IPV6, IPV4 and IPV6) interoperability, advanced name and address conversion, daemon process and inetd, advanced I/O and non-blocking I/O broadcasting, threads and IP options.

Advanced Topics: Interprocess communication introduction, POSIX IPC and system V IPC, introduction to pipes and FIFOS, doors and sun RPC (introduction only).

References:

Module I: Evolution and Development of the Nervous System:
- Adult Neurogenesis, Genesis and patterning of Primate Cerebral Cortex,
- Neuronal Migration and Adult Neurogenesis, Stem Cell plasticity, Structural Functional Plasticity of Hippocampus and Sex and Stress hormones.

Module II: Sensory System:

Module III: Motor Systems:
- Cortical Mechanisms Sub-serving Object Grasping, Action Understanding and Imitation, Neurobiology of Coordinate transformations, Basal ganglia and Cerebellar Circuits within the Cerebral cortex, Basal Ganglia and the Control of Action, Representation of Action, Sensomotor Transformation Transformations in the posterior parietal cortex, Motor Learning and Memory For Reaching and Pointing.

Module III: Perception:
- Origin of perception (Retinal Ganglion Diversitiy and the Creation of Parallel Visual Pathways)

Module IV: Brain Mechanisms of Emotion:

Module V: Memory Systems:
- Types of Memory and amnesia.
- The search for the ingram.
- The temporal lobes and declarative memory.
- The striatum and procedural memory.
- The neocortex and Working memory.

Module VI: Molecular mechanisms of learning and memory:
- Procedural learning.
- Vertebrate models of learning.
- The molecular basis of long term memory.

Module VII: Cognitive Neuroimaging: History, Developments and Direction.

References:
COURSE COGNO-04: Brain Mapping and Imaging

I. Nerve conduction & Electromyography
   - History of Clinical Neurophysiology
   - Introduction to electro diagnostic signals & their measurement
   - Principal of Nerve conduction study
   - Introduction to Electromyography
   - Techniques of Electromyography

II. Electroencephalography
    Historical perspective, Technical aspect of EEG recording and reporting

III. Cerebral Computed Tomography
     Introduction to Computed Topography (CT), Principals & Techniques of image reconstructions with CT, Performance of CT scanning

IV. Magnetic Resonance Imaging (MRI)
     Introduction to MRI, MRI Techniques: MRI, DWI & PWI, MR Spectroscopy in diagnosis & Neurological Decision – Making

V. Brain Mapping
   Introduction & History, Definition & Terminology, Methodology, Data Acquisition & Signal Analysis

Recommended Books:
2. Clinical Electroencephalography, VK Mishra & J Kalita, Elsevier Publication
VII (SEVENTH) SEMESTER
<table>
<thead>
<tr>
<th>Code</th>
<th>Course Category</th>
<th>Description</th>
<th>Credit</th>
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<tbody>
<tr>
<td>CTG701 N</td>
<td>Thy</td>
<td>Optoelectronics Devices</td>
<td>3</td>
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<tr>
<td>CTG702 N</td>
<td>Thy</td>
<td>Polymer Engineering</td>
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<td>CTG 703 N</td>
<td>Thy</td>
<td>Computational Nanotechnology</td>
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<td>CTG 704 N</td>
<td>Thy</td>
<td>Nanocomposites</td>
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<td>CTG 701 B</td>
<td>Thy</td>
<td>Agricultural Biotechnology</td>
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<td>CTG 702 B</td>
<td>Thy</td>
<td>Bioprocess Engineering and Technology</td>
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<td>CTG 703 B</td>
<td>Thy</td>
<td>Bioinformatics</td>
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<td>CTG 704 B</td>
<td>Thy</td>
<td>Molecular Biotechnology</td>
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<tr>
<td>CTG 701 I</td>
<td>Thy</td>
<td>Computer Graphics</td>
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<td>CTG 702 I</td>
<td>Thy</td>
<td>Optical Fiber Communication</td>
<td>3</td>
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<td>CTG 703 I</td>
<td>Thy</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
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<td>CTG 704 I</td>
<td>Thy</td>
<td>Machine Learning</td>
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<td>CTG 701 C</td>
<td>Thy</td>
<td>Philosophy of Mind</td>
<td>3</td>
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<tr>
<td>CTG 702 C</td>
<td>Thy</td>
<td>Principle &amp; Techniques of Neuroscience</td>
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<tr>
<td>CTG 703 C</td>
<td>Thy</td>
<td>Introduction to Dynamical systems for Neuroscience</td>
<td>3</td>
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<tr>
<td>CTG 704 C</td>
<td>Thy</td>
<td>Introduction of Computational Neuroscience</td>
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<tr>
<td>CTG 704</td>
<td>Thy</td>
<td>Fundamentals of Accounting</td>
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<tr>
<td>CTG 711 N</td>
<td>Lab</td>
<td>Nanomaterial Fabrication and Characterization Lab</td>
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<td>CTG 712 N</td>
<td>Lab</td>
<td>Computational Nanotechnology Lab</td>
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<tr>
<td>CTG 711 B</td>
<td>Lab</td>
<td>Biotechnology Lab</td>
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<td>CTG 712 B</td>
<td>Lab</td>
<td>Bioinformatics Lab</td>
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<td>CTG 711 I</td>
<td>Lab</td>
<td>Algorithm Implementation Lab</td>
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<td>CTG 712 I</td>
<td>Lab</td>
<td>Server installation and Configuration Lab</td>
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<tr>
<td>CTG 711 C</td>
<td>Lab</td>
<td>Cognitive Lab</td>
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<td>CTG 712 C</td>
<td>Lab</td>
<td>Neuroscience Lab</td>
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<tr>
<td>CTG 713</td>
<td>Lab</td>
<td>NBIC-Research Review Project</td>
<td>8</td>
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</tbody>
</table>
Theory Paper

COURSE NANO-05: Optoelectronics Devices

1. SEMICONDUCTOR SCIENCE AND LIGHT EMITTING DIODES -15

2. STIMULATED EMISSION DEVICES LASERS -10

3. PHOTODETECTORS -10

4. PHOTOVOLTAIC DEVICES AND MODULATION OF LIGHT -10

Recommended Books:

POLYMER TECHNOLOGY AND APPLICATIONS

Unit I


Unit II

Specific technology of polymerisation - polystyrene, HDPE, LLDPE, nylons, butyl rubber, polypropylene, PVC and PET - copolymerisation techniques - SBR and ABS. Polymer processing - processing of thermoplastics and thermosetting plastics - compositing - fillers, plasticisers, coupling agents - antioxidants, cross-linking agents, stabilisers, lubricants, catalysts, and antioxidants - machines used for compounding.

Unit III

Processing technology of elastomers - processing of natural and synthetic rubbers - vulcanisation, mastication and cyclisation - moulding - calendaring and extrusion techniques - injection moulding - sintering - solution casting - SMC and DMC - fibre spinning and drawing.

Unit IV Polymers Applications


Polymers for biomedical applications - polymers in dentistry - tissue adhesives - dialysis membrane - blood oxygenators - bone cement - prostheses - biodegradable sutures - control drug delivery systems.

Reference books

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Paper CCT-703N  
Computational Nanotechnology

Part - I

Electronic Structure problem of matter, electronic correlation, many-body theory of electronic system, computational simulations, ab-initio, semi empirical and molecular dynamic method, monte-carlo simulations, one-electron approximation. And post HF methods.

Part - II

Thomson's fermi model, density functional theory, approximations, DFT, LDA, GGA, Hybrid, Basis sets, LMTO, plane wave methods, SCF process, simulation codes.

Ref. Books:
2. R.A. Evarestov, Quantum Chemistry of Solids, Springer-Verlag (Berlin) 2007

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COURSE NANO-10: Nanocomposites

Unit-I Bulk Metal and Ceramics Nanocomposites


Unit-II Introduction to Polymer Science and Nanocomposites


Unit-III Polymer-based and Polymer-filled Nanocomposites

Nanoparticle/Polymer Composite Processing, Direct Mixing, Solution Mixing, In-Situ Polymerization, In-Situ Particle Processing - Ceramic/Polymer Composites and Metal/Polymer Nanocomposites, Polymer Coatings, Inorganic Coatings, Properties of Composites, Mechanical Properties, Modulus and the Load-Carrying Capability of Nanofillers, Failure Stress and Strain - Toughness, Glass Transition and Relaxation Behavior, Abrasion and Wear Resistance, Thermal Stability and Flammability, Electrical and Optical Properties, Resistivity, Permittivity, and Breakdown Strength, Optical Clarity, Refractive Index Control, Light-Emitting Devices.

[Signature]
Unit IV  Natural Nanobiocomposites, Biomimetic Nanocomposites, and Biologically Inspired Nanocomposites

Natural Nanocomposites Materials, Biologically Synthesized Nanoparticles and Nanostructures, Biologically Derived Synthetic Nanocomposites, Protein-Based Nanostructure Formation, DNA-Templated Nanostructure Formation, Protein Assembly, Biologically Inspired Nanocomposites, Liquid-Crystal Templating of Thin Films, Block-Copolymer Templating.

Recommended Books:
- Polymer Physics – Ulf W. Gedde, Chapman & Hall.
- Nanocomposites Science and Technology– P.M. Ajayan, L.S. Schadler, P.V. Braun.

Theory Paper

COURSE BIO-05: Agricultural Biotechnology

1. Agricultural Research preparedness
   Genetics resources and allele mining
   Biofortification, nanotechnology
   Policy & regulatory issues to agricultural biotechnology

2. Plant Genomes : the organization and expression of plant genes
   Introduction
   DNA, Chromatin and Chromosome structure
   An introduction to gene structure and gene expression
   Regulation of gene expression
   Implication for plant transformation
   Protein targeting
   Heterologous promoters
   Genome size and organization
   Arabidopsis and the new technologies
3. **Plant Tissue culture**
   - Introduction
   - Culture types
   - Plant regeneration
     - Case study: cereal regeneration via somatic embryogenesis from immature or mature embryos
     - Integration of plant tissue culture into plant transformation protocol

4. **Techniques for plant transformation**
   - Introduction
   - Agrobacterium mediated gene transfer
   - The Ti plasmid
     - The process of T-DNA transfer and integration
   - Practical application of Agrobacterium mediated plant transformation
     - Case study- Agrobacterium mediated transformation of tobacco
     - Transformation
     - Direct gene transfer methods

5. **Vector for plant transformation**
   - Introduction
   - Desirable feature of any plasmid vector
   - Basic features of any plasmid vector
   - Optimization
   - Clean gene technology

6. **The genetic manipulation of herbicide tolerance**
   - Introduction
   - The use of herbicides in modern agriculture
   - Strategies for engineering herbicide tolerance
     - Case study- Glyphosate tolerance, Phosphinothricin, Engineering
     - imidazolinone tolerance by targeted modification of endogenous plant genes
     - The environmental impact of herbicide tolerant crops

7. **The genetic manipulation of pest resistance**
Introduction
The nature and scale of insect pest damage to crops
GM strategies for insect resistance: the Bacillus thuringiensis
Case study - Resistance of Bt maize to the European corn borer and other pests

The copy nature strategy
Case study - Cowpea trypsin inhibitor
Insect resistant crops and food safety
Bt Brinjal: risk and benefits, beyond Bt-Brinjal

8. Plant disease resistance
	Introduction
	Plant-pathogen interactions
	Existing approaches to combating disease
	Natural disease resistance pathways: overlaps between pests and disease
	Biotechnological approaches to disease resistance
	Case study - The BASF potato
	Developments for the future
	Case study - Xanthomonasspp

9. Reducing the effects of viral disease
	Introduction
	Types of plant virus
	Entry and replication: points of inhibition
	How was the agricultural community dealt with viruses?
	Case study - Developments in the sugar beet industry
	The transgenic approach: PDR
	Case study: Arabis mosaic virus
	Some non PDR approaches
	Case study: DNA virus
	What has been commercialized in Western agriculture?

10. Strategies for engineering stress tolerance

Introduction
The nature of abiotic stress
The nature of water deficit stress
Case study: Glycine betaine production
Targeted approaches to manipulating tolerance to specific water-deficit stresses
Case study: The COR regulon
Secondary effects of abiotic stress - the production of RDS

11. The improvement of crop yield and quality
Introduction
The genetic manipulation of fruit ripening
Case study: The genetic manipulation of fruit softening
: The genetic modification of ethylene biosynthesis
: Modification of colour
: Golden rice
Engineering plant protein composition for improved nutrition
The genetic manipulation of crop yield by enhancement of Photosynthesis

12. Molecular farming
Introduction
Carbohydrates and lipids
Case study: Starch
: Polyfructans
: Bioplastics
Molecular farming of proteins
Case study: the olein system: hirudin and insulin production
: Custom made antibodies
: Edible vaccines
Economics and regulatory consideration for molecular farming

13. Science and society: public acceptance of genetically modified crops
Introduction
Public concerns
The current state of transgenic crops, Transgenic crops approved for commercial use
List of transgenic crops likely to be commercialized in the next five years
STATUS OF APPROVAL AND DEVELOPMENT OF GMOs
(Approved recombinant therapeutics in USA, EU AND INDIA)
List of companies dealing with recombinant therapeutics
Companies producing rDNA therapeutics in India and their products
Research institutions and companies engaged in transgenic crop research in India

14. Beyond genetically modified crops
   Introduction
   Greener genetic engineering
   Genetic manipulation of complex agronomic traits
   Identification of genes associated with desirable traits
   Investigating gene function by reverse genetics
   Understanding gene function within the genomics context: function
Genomics

Recommended Books:
- Basic biotechnology by: Colin Ratledge and Bjorn Kristiansen Publication: Cambridge.

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Theory Paper

COURSE BIO-06: Bioprocess Engineering and Technology

1. Microbial process kinetics
   Introduction, Kinetic modeling of cell growth, Mass balance for ideal Bioreactor

2. Bioreactors
   Introduction, Bioreactor design features, Specific Consideration

3. Mass transfer in Bioreactors
   Steps, Equations, Mass transfer coefficients, Effect of scale on mass transfer

4. Downstream Processing
   Cell disruption, Clarification, Filtration, Concentration, precipitation, ultrafiltration
   Purification, crystallization, Sequencing

5. Bioprocess measurement, monitoring, modeling and control

6. Bioprocess economics

7. High throughput screening and bioprocess optimization

8. Bioprocess engineering for the industrial production of
   Amino acids, Organic acids, Microbial polysaccharides and single cell oils

9. Bioprocess environmental application
   Wastewater treatment, Organic slurries, Solid waste water treatment
   Soil remediation, Treatment of ground water, Treatment of waste gases

10. Fermentation technology and production of antibiotics

11. Strategies for cultivation of cells
    Batch and continuous culture, Fed batch culture

12. Enzyme Biotechnology

13. High value recombinant proteins

Paper 702 B

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14. Plant cell culture in bioreactors

15. Biotransformations
   Biocatalyst, Chemical synthesis

Recommended Books:
Basic biotechnology by: Colin Ratledge and Bjorn Kristiansen Publication: Cambridge.

Theory Paper
COURSE BIO-07: Bioinformatics

1. Experimental methods for Biomolecular structure determination

   Tertiary Structure prediction:
   Fundamentals of the methods for 3D structure prediction (sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding etc.) Homology Modeling, fold recognition, threading approaches, and ab-initio structure prediction methods.

   Structure analysis and validation:
   PDBsum, WHATCHECK, Procheck, Verify3D and Prosali, Critical assessment of Structure prediction (CASP) Structures of oligomeric proteins and study of interaction interfaces.

4. Molecular modeling and simulations
   Macro-molecular force fields, salvation, long-range forces Geometry optimization, algorithms: Steepest descent, conjugate gradient Various simulation techniques: Molecular mechanics, conformational searches, Molecular Dynamics, Monte Carlo, genetic algorithm approaches, Rigid and Semi-Flexible Molecular Docking.

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5. 3-D structure visualization and simulation
Visualization of structures using Rasmol or SPDBV or CHIMERA or VMD. Basic concepts in molecular modeling: different types of computer representations of molecules, External coordinates and Internal Coordinates. Non-Covalent Interactions and their role in Biomolecular structure and function, Fundamentals of Receptor-ligand interactions.

6. Classification and comparison of protein 3D structures:
Purpose of 3-D structure comparison and concepts, Algorithms: CE, VAST and DALI, concept of coordinate transformation, RMSD, Z-score for structural comparison. Databases of structure-based classification: CATH, SCOP, and FSSP.

7. Secondary structure prediction

8. Drug discovery process
Role of Bioinformatics in drug design. Target identification and validation and lead optimization. Different systems for representing chemical structure of small molecules like SMILES etc. Generation of 3D coordinates of small molecules. Structure-based drug design: Identification and Analysis of Binding sites and virtual screening. Ligand based drug design: Structure Activity Relationship - QSARs and QSPRs. QSAR Methodology, Pharmacophore mapping, In silico prediction, ADMET properties for Drug Molecules.

9. Vaccine design
Reverse vaccinology and immunoinformatics. Databases in Immunology, Principles of B-cell and T-cell epitope prediction.

References books: Structural Bioinformatics - Philip E. Bourre
COURSE BIO-08: Molecular Biotechnology

UNIT 1: THE DEVELOPMENT OF MOLECULAR BIOTECHNOLOGY:
emergence of molecular biotechnology, recombinant DNA technology, commercialization of molecular biotechnology, concerns and consequences. 3

UNIT 2: DIRECTED MUTAGENESIS AND PROTEIN ENGINEERING:
directed mutagenesis procedures, protein engineering. 2

UNIT 3: MOLECULAR DIAGNOSTICS:
immunological diagnostic procedures, monoclonal antibodies, bio-fluorescent and bio-luminescent systems, nucleic acid diagnostic systems, molecular diagnosis of genetic disease. 3

UNIT 4: PROTEIN THERAPEUTICS:
pharmaceuticals, enzymes, lactic acid bacteria, monoclonal antibodies, recombinant antibodies. 2

UNIT 5: NUCLEIC ACIDS AS THERAPEUTIC AGENTS:
antisense RNA, ribozymes, chimeric RNA-DNA molecules, aptamers, interfering RNA’s, antibody genes, nucleic acid delivery. 3

UNIT 6: VACCINES:
subunit vaccines, peptide vaccines, genetic immunization-DNA vaccines, attenuated vaccines. 2

UNIT 7: SYNTHESIS OF COMMERCIAL PRODUCTS BY RECOMBINANT MICRO-ORGANISMS:
restriction endonucleases, lipase, small biological molecules, antibiotics, bio-polymers. 3

UNIT 8: PLANT GROWTH PROMOTING BACTERIA:
growth promotion by free living bacteria, bio-control of pathogens, nitrogen fixation, hydrogenase, nodulation, phyto-remediation. 3

UNIT 9: Human Molecular Genetics:
Modes of human inheritance, Genetic Linkage and Gene Mapping, Detection and Estimation of Genetic Linkage in humans, Genetic Mapping of Human Chromosomes, Comprehensive human linkage maps, Whole genome BAC map, human genome sequence, detection of mutation in human genes, determining gene function. 5

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UNIT 10: REGULATING THE USE OF BIOTECHNOLOGY: regulating recombinant DNA technology, deliberate release of genetically modified microorganisms, regulating food and food ingredients, patenting biotechnology.  

UNIT 11: SOCIETAL ISSUES IN BIOTECHNOLOGY: concerns about the safety of consuming genetically modified foods, concerns about the impact of genetically modified organisms on the environment, economic issues.  

UNIT 12: REGULATING AND PATENTING MOLECULAR BIOTECHNOLOGY: regulating recombinant DNA technology, regulating food and food ingredients, deliberate release of GMO’s, controversy about GMO’s, patenting, patenting in different countries, patenting DNA sequences, patenting multicellular organisms, patenting and fundamental research.  


Recommended Books:  
- Molecular Biotechnology: Principles and applications of Recombinant DNA (4th edition) by: Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten, Publisher: Amer Society for Microbiology.  
- Handbook for IBSC members, prepared by Department of Biotechnology, Ministry of Science And Technology.  
- Biosafety Guidelines, rules, regulations and Protocol, prepared by Department of Biotechnology, Ministry of Science And Technology.
Computer Graphics


Suggested texts and reference materials


Theory Paper

COURSE ICT-06: Optical Fiber Communication

Introduction: Principles of light propagation in fibers, step index and graded index fibers, mono mode & multimode fibers; connectors, splices, bends.

Transmission Losses: Dispersion, attenuation & scattering in fibers, link analysis.
Fiber Measurement: Measurement of Fiber attenuation, bandwidth, power, & cut-off wavelength, OTDR.

Opto electronic devices: Introduction to LEDs, Lasers, Photo-diodes, PIN diodes etc.

Multiplexing in fibers, Optical Networks & Components: WDM, DWDM, optical couplers, Mach-Zehnder interferometer multiplexer, optical add/drop multiplexers, isolators, circulators, optical filters, tunable sources and tunable filters, arrayed waveguide grating, diffraction grating.

SONET: frame format, overhead channels, payload pointer, Virtual tributaries, multiplexing hierarchy.

SDH: Standards, frame structure and features.

Optical switching, WDM networks, Fiber Amplifiers

Recommended Books:
1. Fiber Optics and Optoelectronics - R.P. Khare
2. Optical Communication - Keiser
3. Optical fiber communication - J.M. Senior

**DESIGN AND ANALYSIS OF ALGORITHMS**

Algorithm Analysis: Time, space, lower, upper bounds, asymptotic complexity, summation, recurrence.


Graph Algorithms: Minimum Spanning Trees, Single-Source Shortest Paths, All-
Pairs
Shortest Paths, Maximum Flow.
String Matching, Computational Geometry.
Problem Classification: P and NP class, NP-completeness and reducibility, NP-complete
problems. 28
Text Book/Reference Books:
1. T. Cormen, C. Leiserson, R. Rivest. Introduction to Algorithms, Indian Reprint, PH.
2. V. Aho, J. Hopcroft, J. Ulmann. The Design and analysis of computer Algorithms. Addison
Wesley
3. S. Basse, A. V. Gelder, Computer Algorithms: Introduction to design and Analysis, 3rd,
Pearson Education Asia Pvt. Ltd.

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Machine Learning

Introduction: Definition of learning systems, forms of learning, machine learning, examples of machine learning applications, goals of machine learning, designing a learning system, issues in machine learning.

Concept Learning: Introduction, the concept learning task, concept learning as a search through a hypothesis space, version space, and the candidate elimination algorithm, inductive bias, utility of bias-free learning.

Supervised Learning: Introduction, learning a class from examples, Vapnik-Chervonenkis dimension, probably approximately correct (PAC) as learning, learning multiple classes, dimensions of a supervised machine learning algorithms.

Decision Tree Learning: Representing concepts as decision trees, recursive induction of decision trees, picking the best splitting attribute: entropy and information gain, searching for simple trees and computational complexity, Occam’s Razor, overfitting, noisy data and pruning.

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypothesis, comparing learning algorithms: cross-validation learning curves, statistical hypothesis testing.

Bayesian Learning: Introduction, Bayes theorem and concept learning, Gibbs algorithm, Bayes optimal classifier, Naive Bayes classifier, Bayesian belief networks, the EM algorithm.


Instance Based Learning: Constructing explicit generalizations versus comparing to past specific examples, k-nearest neighbor algorithm, case-based learning.


Reinforcement Learning: The learning task, Q-learning, limitation & extensions of Q-learning, temporal difference learning, non-deterministic rewards & actions, relationship to dynamic programming, passive reinforcement learning, active reinforcement learning, direct utility estimation.

Recommended Books:
2. Introduction to Machine Learning, Ethem Alpaydin.
<table>
<thead>
<tr>
<th>Theory Paper</th>
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<tbody>
<tr>
<td>COURSE COGNO-05: Philosophy of Mind</td>
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<tr>
<td><strong>Module 1: Conceptual and Historical Perspectives:</strong> Introduction to philosophy of mind.</td>
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<tr>
<td>Major philosophers: Plato, Aristotle, St. Thomas Aquinas, Rene Descartes, David Hume, and Immanuel Kant.</td>
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<td>Schools of thought: rationalism, empiricism, idealism, realism, and skepticism.</td>
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<tr>
<td><strong>Module 2: Cognitive Science and philosophy of mind:</strong> Epistemic and meta physical issues of mind in Cognitive science.</td>
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<tr>
<td><strong>Module 3: Consciousness:</strong> General introduction to consciousness. The phenomenal and psychological concepts of mind. The knowledge and Modal arguments. The explanatory gap. Higher order thoughts and representationalism.</td>
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<td><strong>Module 4: Indian Theories of Mind:</strong> Ancient, AdiShankara, Buddhism.</td>
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Module 5: Western Theories of Mind: Dualism, Behaviorism, Materialism, Eliminativism, Functionalism, Physicalism, Phenomenology, Representational theory of mind, Modularity of mind and Identity theory. (8)

Module 6: Neurobiological Approaches to Mind: Patricia churchland arguments, the binding problem, the problem of Mary’s knowledge, Connectionism. (7)

Module 7: Computational Approaches to Mind: Searle's Chinese room argument, Intentionality, the problem of intelligence and the representational nature of mind. (7)

Recommended Books:

Theory Paper

Paper 702 C

COURSE COGNO-06: Principle & Techniques of Neuroscience

Module 1: Neuroanatomy & Neurophysiology
Neuroanatomy and Neurophysiology of cerebral cortex including lobes, corpus callosum, limbic system basal ganglia, Thalamus, hypothalamus, pluitary, cerebellum, brain stem, spinal cord, various nerves, muscles, plexuses and autonomic nervous system.

Module 2: Blood Circulation - Arterial and venous system pertinent to brain and spinal cord including circle of willis and venous sinuses.
Module 3: Electro physiology
1. Introduction to electro diagnostic signals and their measurement
2. Principles of nerve conduction study.
3. Assessment of individual nerves in upper and lower limbs
4. Introduction and techniques of EMG and various abnormal EMG findings.

Module 4: Electroencephalography
1. Basic principles and techniques of EEG recording.
2. Normal EEG pattern
3. Various artifacts
4. Paroxysmal EEG abnormalities
5. Normal aging & transient cognitive disorders in the elderly
6. Digital EEG

Module 5: Brain Mapping
Module 6: Introduction & principle of X-rays,
Properties of x-ray, production of x-rays, interaction of X-rays with matter, radiography imaging techniques, Film & processing image, spectroscopy, digital imaging.

Module 7: Introduction & principles of CT
Conventional tomography, Principles of CT imaging, detector assembly, pixel-voxel concept, image display, spiral CT, Multi slice.

Module 8: Introduction & principles of MRI
Basic principles & physics of MRI, MRI hardware, parameter of image processing, T1, T2 concept, imaging protocols, MRI spectroscopy.

Module-9: Basic principles & physics of ultrasound and Doppler
Ultrasound acoustics transducers, imaging process, Doppler principles, Doppler ultrasound, 2D, 3D echo ultrasound.

Module-10 Neurons & Glial Cells
Introduction to neurons, The neuron doctrine, Components of neurons.

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Classification of neurons, The Nissl and Golgi stains, Types of Neurons, Cytology of neurons, Dendrites structure and function, Axons structure and functional aspects, ultrastructure, Myelination and synapses. Structure and function of glial cells, Different types of glial cells: astrocytes, type I & II astrocytes, fibrous and protoplasmic astrocytes. Function of other glial cells: oligodendrocyte and microglial cells. Overview of glial and neuronal relationship in the CNS, importance of astrocytes in glutamate metabolism and blood brain barrier, Microglial phenotypes, Glial-neuronal interplay in the CNS.

Recommended Books:
1. Grays Anatomy
2. Guy ton
3. Clinical neurophysiology - U K Misra
5. Atlas of Brain mapping
6. Radio physics by Christenson
7. Aids in the exam of PNS by MRC
8. Elect rodeing in clinical Neurology by MJ Amino ff
9. EEG- basic principles, clinical applications & related fields by Hirst niedermeyer & F L Da Silva
10. Electro physiology by Jun Kimura

Theory Paper

COURSE COGNO-07: Introduction to Dynamical Systems for Neuroscience

Part A: Introduction to Dynamical Systems

Nonlinear Oscillators: Lorenz and Rossler equations; Iterated maps: Logistic and Henon maps; Period doubling, Intermittency and other routes to Chaos; Fractal geometry;

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Strange

Chaotic and Nonchaotic Attractors: Characterization of Regular and Chaotic motions:
Lyapunov exponent, Power spectrum, Autocorrelation, and Dimension. (9)

Part B: Dynamical Systems in Neuroscience
Electrophysiology of neural cells, Hodgkin-Huxley (HH) and Morris-Lecar models:
derivation, action potential, rhythmic firing, 2D reduction of the HH system of equations,
FitzHugh-Nagumo model, Slow-fast decomposition. (9)

Applications of the bifurcation theory to classification and analysis of neuronal excitability.
Bursting: models of bursting neurons, classification, and analysis. (9)

Recommended Books:

Theory Paper

Paper 704 C

COURSE COGNO-10: Introduction to Computational Neuroscience

Mathematical background and computational techniques: Introduction to dynamical Systems, review of basics of differential equations, introduction to phase plane analysis, elements of bifurcation theory, Introduction to relevant computer software such as XPP and Matlab. {14}

Models of single neurons: Derivation of the Hodgkin-Huxley (HH) equations and various reductions such as the FitzHugh-Nagumo (FHN), Hindmarsh–Rose (HR), Morris–Lecar, and Integrate and Fire models. {14}

Small network dynamics: Focus on understanding and characterizing the dynamics of small networks of excitatory, inhibitory or mixed-type neurons, detailed analysis of conditions leading to complete synchronization, phase locking or chaotic behavior in such networks. [8]

Recommended Books:


VIII (EIGHTH)
SEMESTER
## Center for Converging Technologies
**University of Rajasthan, Jaipur**  
(Tele: 0CTG 14CTG 1-2700370)

<table>
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COURSE NANO-08: Molecular Nanoelectronics

Unit-I Introduction

Unit-II Quantum Electronics Devices
Quantum electronic devices (MOS Transistor, EWT, EST, QCA, QDA), Tunneling element (TD, RTD, 3-terminal RTD), Digital circuit design based on RTDs and RTBT, Principle of SET circuit design, Comparison between FET and SET circuit design.

Unit-III Spintronics
Generation of spin polarization (Optical spin orientation, Theories of spin injection), Spin relaxation and spin dephasing, Spintronics devices and applications (Spin filters, Spin diodes and Spin transistors).

Unit-IV Non-equilibrium and Ballistic Transport and Nanodevices
Non-equilibrium effects in tunnel barriers, Ballistic transport in vertical and planar structures, Introduction to green's function, Thermopower in nanostructures, Electron temperature, Hot carriers in quantum dot, Landauer-Buttiker formula, Scaling the MOSFET, Concept of scattering matrix and its application in quantum simulation.

Recommended Books:
1. Nanoelectronics and Nanosystems, From Transistors to Molecular and Quantum Devices, by Karl Goser, Peter Gloseknoter, Jan Dienstuhl. Springer.
COURSE NANO-09: Nanodevices & Nanosensors

Unit I: MEMS & NEMS Devices (part I)

Unit II: MEMS & NEMS Devices (Part II)

Unit III: Inorganic Nanotechnology Enabled Sensors

Unit IV: Organic Nanotechnology Enabled Sensors

Recommended Books:
1. Handbook of Nanotechnology (Springer), Bharat Bhushan.
COURSE: Applications of Nanoscience and Technology

NANO BIOMATERIALS
Introduction - Biocompatibility - anti bacteria activity - principles involved - Applications, Biomaterial nanocircuitry, Protein based nanocircuitry; Neutrons for network formation, DNA nanostructures for mechanics and computing and DNA based computation; DNA based nanomechanical devices.

NANO-BIOTECHNOLOGY

NANOMEDICINES
Developing of Nanomedicines Nanosystems in use, Protocols for nanodrug administration, Nanotechnology in Diagnostics applications, materials used in Diagnostics and Therapeutic applications - Molecular Nanomechanics, Molecular devices, Nanotribology, studying tribology at nanoscale, Nanotribology applications.

NANOFIUIDICS
TRANSPORTS OF ION, DNA POLYMERS AND MICROTUBULES IN THE NANOFIUIDS REGIME: Ionic transport - polymer transport - microtubule transport in nanotube channels driven by Electric Fields Biomolecular Motors - Electrophoresis of individual nanotubules in microfluidic channels.

HUMAN EXPOSURE TO ANNOSIZED MATERIALS
Biological Activities of nanomaterials and Nanoparticles - Respiratory Tract - Efficient deposition of inhaled NSPs - Disposition of NSPs in the respiratory - Epithelial translocation - Translocation to the circulatory system - Neuronal uptake and translocation - Translocation of NSPs in the blood circulation to bone marrow in mice - Studies of neuronal translocation of UFPs from respiratory tract - Exposure via GI Tract and Skin.

RISK ASSESSMENT AND EXECUTION
Portals of entry and target tissue - Risk assessment - Ethical - Legal and Social Implications - Nanoparticle Toxicology and Ecotoxicology: The Role of Oxidative Stress - Development of Test Protocols for Nanomaterials - Regulation of Engineered Nanomaterials in Europe, USA & India.
Paper Code – N-804  Advanced Materials Characterization  4 Credits

Unit I: Microscopy: Motorized sample holders, accurate x-y-z specimen need for digital microscopy.
Co-site microscopy experiment, in-situ chemical etching, study of the etching kinetics, confocal microscope.

Unit II: Spectroscopic Technologies
Introduction to principles and applications of (a) spectroscopic methods (UV, Vis, IR) Fluorescence, NMR, ESR & Mass spectrometry. Use of radioactive and stable isotopes and their detection in nanobiological system.

Unit III: Instrumentation
Optical Instruments and Spectral Analyses
Spectrographs and Spectrophotometers for UV, VIS, and IR regions; Absorption and Emission spectra; Temperature dependent spectra; Axial, Sigma and Pi polarization measurements.

Unit IV: Ion Beam Techniques
RBS, ERDA, NRA and PIXE, Ion channeling, defect analysis, lattice location and lattice strain measurements. Quantum well intermixing and band-gap tuning. Ion beams in nanotechnology: Ion irradiation of surfaces, surface roughness, formation of nanochannels, hillocks and self-assembled nanodots, embedded nanoparticles and their applications in optoelectronics. Focused ion beams, nanoscale fabrication, ion beam milling and nanolithography.

Reference books:
3. Nanostructures and Nano Materials G. Cao Publisher, Imperial College Press.

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COURSE BIO-09: Animal Cell Culture

1. Introduction 1
   Historical Background, Advantages of Tissue Culture, Limitations, Major Differences in vitro Types of Tissue Culture.

2. Biology of Cultured Cells 3

3. Defined Media and Supplements 2
   Development of Media, Physical and Chemical properties, Balanced Salt Solution, Complete Media, Serum, Selection of Medium and Serum, Other Supplements.

4. Serum Free Media 2
   Advantages & Disadvantages of Serum Free Media, Replacement of Serum, Selection of Serum Free Media, Preparation of Serum Free Media, Protein Free Media.

5. Preparation and Sterilisation 2

6. Primary Culture 1
   Types of Primary Culture, Isolation of Tissue, Primary Culture.

7. Subculture and Cell Lines 2
   Subculture and Propagation, Terminology, Culture Age, Cell line Designations, Choosing Cell line, Procedure Maintenance, Subculture.

8. Cloning and Selection 4

9. Characterization 5
   The Need, Record Keeping, Provenance & Authentication, Cell Morphology, Chromosome Content, DNA Content, RNA & Protein Expression, Enzyme Activity, Antigenic Markers, Differentiation, Expression of in vivo Phenotype, Stages of Differentiation, Proliferation, Commitment, Lineage, Stem Cell Plasticity, Markers of Differentiation, induction, Differentiation, Malignancy, Practical Aspects.

10. Transformation and Immortalisation 2
    Role in Cell Line Characterisation, Transformation, Genetic Instability, Immortalisation, Averant Growth Control, Tumorigenicity.

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UNIT I

Introduction and scope of Proteomics, Protein structure and function, Protein modifications—(phosphorylation, ubiquitination, acetylation, methylation, glycosylation etc.)

UNIT II

Protein Purification: Introduction to protein purification, methods of protein purification—Chromatography (Gel filtration, Ion exchange, High-resolution reverse phase chromatography, Hydrophobic interaction chromatography, Immobilized metal-ion affinity chromatography, Covalent Chromatography, Affinity Chromatography), Electrophoresis (Electrophoresis in Gels, Isoelectric focusing, Two dimensional Electrophoresis, Capillary electrophoresis, Protein elution and blotting techniques) Other separation methods and optimization (membrane separations, refolding of inclusion body proteins, Purification of PEGylated Protein, High throughput screening techniques in protein purification).

UNIT III

Strategies for Protein identification, Introduction to Mass spectrometry, different ionization methods (MALDI) Protein sequencing, Qualitative and quantitative proteome analysis, Shotgun proteomics for proteome profile (whole proteome and sub-proteome analysis), expression proteome analysis (isotope labeling and label-free approaches).

UNIT IV

Protein engineering: Protein chips and functional proteomics; Clinical and biomedical applications of Proteomics, Applications of proteome analysis to drug; Protein-protein interaction) Two hybrid interaction screening

UNIT V

Bioinformatics and proteomics: Protein Data base, Database search tools, Proteomics Industry, World Wide Web, Bioinformatics resources, Network-based data analysis.

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VIII SEMESTER

BIO-10: Chemoinformatics & Drug Designing

1. Role of Chemoinformatics in pharmaceutical/chemical research; Integrated databases; HTS analysis; Ligand based design of compounds; Structure based design of compounds.

2. Structure representation systems, 2D and 3D structures; General introduction to chemical structure-hybridization, tetrahedron geometry etc.; The degeneracy of isomeric SMILES and introduction to unique SMILES; Reaction transformations notation like SMIRKS.

3. Introduction to graph theory, vertex partitioning algorithms- Morgan's and CANGEN algorithms and canonical labeling of the symmetrical vertex; Introduction to conformation generating methods. Various ring conformation (sugar) and ring closure problem. Method to identify SSR (smallest subset of ring); Internal co-ordinates and introduction to calculation of 2 matrix of simple small organic molecules.


5. Search techniques, similarity searches and clustering; Introduction to molecular pattern finding language- SMARTS; Introduction to distance measurement methods from the bit-strings of fingerprints- Tanimoto index and Tversky Index; General introduction to clustering- K means and Hierarchical clustering of chemical database; Diversity analysis- BCUT descriptors.

6. Modeling of small molecules and methods for interaction mapping; Chemical properties 2D and 3D; Introduction to adjacency, distance matrix and use of these matrices for calculating Weiner Index, Hosoya Index, Balaban Index, Shultz Index, Randic Index.


8. Design & Analysis of combinatorial libraries; Reagent and product base combinatorial library generation; Focus library and HTS library.

9. Chemoinformatics tools for drug discovery; Integration of active drugs: Optimization techniques; Filtering chemicals.

10. In silico ADMET, QSAR approach, Knowledge-based approach.
1. Advanced Genomics I: Gene networks: basic concepts, Prediction of genes, promoters, splice sites, regulatory regions: basic principles, application of methods to prokaryotic and eukaryotic genomes and interpretation of results. Identification of SNPs, SNP database (DbSNP). Role of SNP in Pharmacogenomics.

2. Advanced Genomics II: Large scale genome sequencing strategies, Genome assembly and annotation, Use of HMM and Bayesian networking in genome wide analysis. Genome databases of Plants, animals and pathogens, Metagenomics: Concept and applications.

3. Transcriptomics: DNA microarray: Basic tools, understanding of microarray data, normalizing microarray data, detecting differential gene expression, correlation of gene expression data to biological process and computational analysis tools DNA microarray databases: Gene Expression Omnibus (GEO), ArrayExpress, SAGE databases; Standalone analysis of publicly available microarray expression data: GEO database, TM4analysis suite, Assembly of EST: CAP3 program

4. Advanced proteomics: Protein arrays—basic principles, Computational methods for identification of polypeptides from mass spectrometry, bioinformatics—based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools.

5. Structural Proteomics: X-ray crystallography, nuclear magnetic resonance (NMR) spectroscopy and computational methods such as comparative and de novo approaches, molecular dynamic simulations, Structure prediction from sequence, Deriving function from sequence, Application of structural proteomics.

6. Interactomics: Protein-protein interaction (Two hybrid interaction screening, Immunoprecipitation). Tools for analysis Protein-protein interaction, Current endeavours and future challenge. Protein-protein interactions databases such as STRINGS, DIP, PPI server and tools for analysis of, protein-protein interactions. Nucleic acid-Protein interactions – Concept of epigenomics, nuclear receptors, orphan nuclear receptors.


8. Metabolomics: Introduction to metabolomics, technology in metabolomics, structure and evolution of biological networks, Importance of metabolic engineering, Metabolic pathway databases (EcoCyc, MetaCyc, LIGAND, ENZYME, BRENDA, KEGG).

Suggested reading:
1. Genomes – TA Brown
2. Human Molecular Genetics – TA Brown
3. Introduction to genomics – AM Lask
4. Introduction to proteomics: Tools for new Biology – DC Luehr
Advanced Immunology

1. Innate immunity – complement activation, antimicrobial peptides, and phagocytes in innate immunity. Phagocytic receptors and mechanisms of pathogen killing inside phagosomes.

Toll-like receptors – overview, structure, specificity, signaling and adjuvant role in the induction of adaptive immunity.

Dendritic cells – immunobiology and activation.

Natural killer cells – NK activation, NK cell mediated cytotoxicity, and NK cell cross talk with other cells.

2. Lymphocyte development – hematopoietic stem cell biology, the development of central tolerance.

Lymphocyte trafficking.

Antigen presentation – antigen processing, antigen loading, MHC binding selection, and cross presentation.

T cell subsets – Th1, Th2, Th17 and Treg differentiation, molecular characteristics, effector mechanisms.

3. Tumor Immunology

Vaccine Immunology

Immunological Aspects of Immunodeficiency Diseases

Immunological Aspects of Infection

Immunological Aspects of Skin Diseases

4. Production of monoclonal antibodies—Hybridoma Technology

Analysis of different cell types using Flow Cytometry (Immunophenotyping)

Reference Books

Essential Clinical Immunology – John B. Zabrowski, CAMBRIDGE UNIVERSITY PRESS

Instant Notes—Immunology, Garland Science/BIOS Scientific Publishers Limited.

Kuby Immunology

Janeway Immunology
Theory Paper

COURSE ICT-08: Microwave Communications

Introduction to microwave communication, microwave frequency spectrum: advantages and applications, Rectangular wave guides: Wave equations and its solution, TE and TM modes, Dominant modes and choice of wave guide dimensions, Methods of excitation of wave guide.

Microwave sources:
(i) Tube based: Klystron, Magnetron, TWT.
(ii) Solid state devices: Gun oscillator and REA Diode, Tunnel diode

Microwave components: S-parameter analysis of the microwave circuits; Microwave passive components: Attenuator, phase changers, E&H plane Tees, Hybrid Junctions, Directional coupler.

Microwave measurements: Microwave detectors, Power measurements, Frequency measurement, VSWR measurement, Attenuation measurement and Input impedance measurement.

Microstrip antennas and arrays: Rectangular and circular patch microstrip antennas: design equations, Calculations of antenna parameters, radiation patterns in different planes and polarization conditions, Microstrip arrays: Array factor, Linear and planer arrays, radiation patterns in different planes and conditions.


Recommended Books:
1. Solid state Electronic Devices by B.G. Streetman and S. Banerjee, PHI
3. Microwave devices & circuits by S.Y. Liao, PHI
5. Introduction to microwave theory by Atwater (McGraw Hill).
6. Microwave electronics by RE Soothoo (Addisen Westey public company)
9. Microwave Engineering Passive Circuits by P.A. Rizzi, PHI
Module-I

Module-II

Module-III

Module-IV

Module-V

Module-VI

Module-VII
Module-VIII


Recommended Books:


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Theory Paper

- COURSE: Parallel Computing

Unit I: Introduction to Parallel Computing
Basic concepts about program/process/thread concurrent execution Parallel Execution. Need of Parallel Computation Levels of parallel processing Dataflow Computing concept, Applications of parallel processing - Scientific Applications / Image processing Engineering Application Database query / Answering applications AI Applications, Mathematical simulations and modeling.

Unit II: Operating System for Parallel Computers

Unit III: Classifications of Parallel Computers
Types of Classification – Flynn’s Handler classification, UMA / NUMA / COMA, Loosely coupled/tightly coupled, types of pipelining.

Unit IV: Interconnection Network
Need of Interconnection Network-Concept Bandwidth Node degree diameter bisection bandwidth, In degree and Out degree, Static and Dynamic Interconnection network, Omega, hypercube.

Unit V: Parallel Computer Architecture
Introduction to various computer architecture, Pipeline processing, Vector / Array processing.

Unit VI:
Shared memory Message passing, Data Structures for parallel algorithms, Link list, Arrays pointers, Hypercube network, Introduction to Parallel Programming, Types of parallel programming.

References Books:
TECHNIQUES IN ARTIFICIAL INTELLIGENCE

Unit I: Logic: Logic, Propositional Logic, Syntax and Semantics, Inference, Equivalence, validity and satisfiability, Reasoning patterns and resolution in propositional logic, forward and backward chaining, A complete backtracking algorithm, First-Order logic, Syntax and Semantics of First-Order logic, propositional vs. First-order inferences, Quantifiers, simple forward chaining algorithm, efficient forward chaining, backward chaining algorithm, resolution in first-order logic.

Unit II: Planning: Planning Problem, planning vs. Problem-solving, Planning with state space search, Forward state-space search, Backward state-space search, Heuristic state-space search, Partial order planning, Planning Graphs for heuristic estimation, The GRAPHPLAN algorithm, Planning with propositional logic, Conditional Planning, Continuous planning, Multiagent planning.

Unit III: Uncertainty: Acting under uncertainty, Basic probability notation, prior probability, conditional probability, Axioms of probability, Independence, Bayes rule and its use.


Unit V: Decision Making under uncertainty: Decision theory, Axioms of decision theory, decision network, MDP (markov decision process), the value iteration algorithm, policy iteration, partially observable MDPs.


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Sensation and Perception

Theory Paper

Unit 1: Coding of Sensory

Unit 2: The Bodily Senses

Unit 3: Touch

Unit 4: The Perception of Pain

Unit 5: Constructing the Visual Image

Unit 6: Visual Processing
UNIT- 1. Basic concepts


UNIT- 2. THE NATURE OF LINGUISTIC COMPONENTS


UNIT- 3. THE BIOLOGICAL BASIS OF LANGUAGE

SPECIES SPECIFICITY OF LANGUAGE, UNIVERSALITY OF LANGUAGE IN HUMANS, NATURE VS NURTURE ISSUES OF LANGUAGE, LANGUAGE ACQUISITION AND DEVELOPMENTAL SCHEDULE, ANATOMICAL AND PHYSIOLOGICAL CORRELATES FOR LANGUAGE, LANGUAGE LATERALIZATION, NEUROANATOMICAL CORRELATES OF LANGUAGE PROCESSING, GENETIC BASIS FOR LANGUAGE, READING AND WRITING AS CULTURAL ARTIFACTS.

UNIT- 4. THE ACQUISITION OF LANGUAGE

BIOLOGICAL PREDISPOSITION FOR LANGUAGE, CHARACTERISTICS OF THE LANGUAGE IN THE ENVIRONMENT, DEVELOPMENTAL STAGES: FROM BEFORE BIRTH TO 12 MONTHS, FROM 12 TO 24 MONTHS, THE PRESCHOOL YEARS, LATER LANGUAGE DEVELOPMENT: DISCOURSE ABILITY AND METALINGUISTIC AWARENESS, SECOND LANGUAGE ACQUISITION.

UNIT- 5. THE SPEAKER: PRODUCING SPEECH

A MODEL FOR LANGUAGE PRODUCTION, PRODUCTION IN BILINGUALS AND SECOND LANGUAGE LEARNERS, PLANNING OF SPEECH: ACCESSING THE LEXICON, BUILDING SIMPLE SENTENCE STRUCTURE, CREATING AGREEMENT RELATIONS, BUILDING COMPLEX STRUCTURE, PREPARING A PHONOLOGICAL REPRESENTATION, PRODUCING SPEECH: THE SOURCE–FILTER MODEL OF VOWEL PRODUCTION, ACOUSTIC CHARACTERISTICS OF CONSONANTS, COARTICULATION, WORDS IN SPEECH.

UNIT- 6. VISUAL WORD RECOGNITION

VISUAL WORD RECOGNITION AND ITS MODELS, TECHNIQUES FOR VISUAL WORD RECOGNITION, EYE MOVEMENTS IN VISUAL WORD RECOGNITION, EEG EVIDENCES OF VISUAL WORD RECOGNITION.

UNIT- 7. THE HEARING: SPEECH PERCEPTION AND LEXICAL ACCESS


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UNIT-8. The Hearer: Structural Processing

The Psychological Reality of Syntactic Structure: The clause as a processing unit, Structural ambiguity,
Building Structure: The parser's preference for simple structures, Attaching new constituents, Filling gaps,
Locating pronominal referents, Information Used to Build Structure: Lexical information, Prosody, Non-
linguistic information.


UNIT-10. The Neural correlates of Language Production


Reference Books:

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COURSE COGNO-09: Clinical Neuroscience

1. Electrophysiology: clinical application of EMG and Nerve conduction
   EMG in neurogenic and myopathic disorders; H-Reflex, F-wave and Blink Reflex, Brachial plexus study, Repetitive nerve stimulation study

2. Electroencephalography
   EEG in Status Epilepticus, EEG in Dementia and Degenerative Diseases, EEG in Psychiatric Disorders, Transient cognitive impairment during epileptiform discharges

3. Applications of USG in medical diagnosis, contrast media, tissue harmonic imaging intraoperative ultra sonography

4. C-arm image intensifier, contrast media, computer radiography, digital radiography, automatic film processing, laser dry camera image processing, PACS

5. F-MRI, MRI contrast media, MRI hazards and safety

6. Amino acids neurotransmitters
   Excitatory and inhibitory neurotransmitters: GABA, glycine, glutamate and their receptors
   Agonists and antagonists, AMPA, Kainate and NMDA receptors; Glutamate mediated synaptic transmission;
   Glutamate excitotoxicity; NMDA receptor and LTP; Neurodegeneration

7. Catecholamines, Opiate and Peptide Neurotransmitters
   Dopamine receptors structure; Function; Agonist and antagonists; Dopaminergic pathways;
   Dopamine transporters; MPTP, Parkinson’s disease; Schizophrenia; Amphetamine cocaine and their mode of action, Opiate and their receptors; Agonist and antagonists; Drug addiction tolerance and withdrawal; Morphine pain relief; Neuropeptides: precursors’ structure, common features, synthesis, processing and regulation; Sinocholamines and serotonin: structures, classifications and their receptors

Recommended Books:
5. Clinical neurophysiology - UK Mishra.
8. EEG- basic principles, clinical applications & related fields by Ernst niedermeyer & F L Da Silva.
9. Electro physiology by Jun Kimura
Neuroimaging of Cognition

UNIT 1: History and Methods
1. Functional neuroimaging: A historical & Physiological perspective
2. Functional neuroimaging: Basic principle of fMRI
3. Functional neuroimaging: Experimental Design & Analysis

UNIT 2: Cognitive Domains
1. Functional neuroimaging of attention
2. Functional neuroimaging of skill learning
3. Functional neuroimaging of semantic memory
4. Functional neuroimaging of language
5. Functional neuroimaging of episodic memory
6. Functional neuroimaging of working memory
7. Functional neuroimaging of executive function

UNIT 3: Application of functional neuroimaging
1. Early cognitive development
2. Cognitive aging
3. Emotion & social cognition
4. Neuropsychologically impaired patients

References Books:
IX (NINETH) SEMESTER

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<td>NANO-911</td>
<td>Advanced Nanomaterials Lab</td>
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<td>911 B</td>
<td>Lab</td>
<td>BIO-911</td>
<td>Advanced Biotechnology Lab</td>
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<td>911 L</td>
<td>Lab</td>
<td>IGT-911</td>
<td>Advanced Informatics Lab</td>
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<td>911 C</td>
<td>Lab</td>
<td>CON-911</td>
<td>Advanced Cognitive Science Lab</td>
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<td>912</td>
<td>Lab</td>
<td>912</td>
<td>Special NBIC Laboratory Exposure</td>
<td>8</td>
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901 N Quantum Transport

Transmission in Nanostructure


The quantum Hall effects

The integer quantum Hall effect in 2D electron systems. Shubnikov-de-Haas effect and the integer quantum Hall effect: Edge state propagation in nanostucture. Selective population of edge states. Generalized introduction to the fractional quantum Hall effect, the many body picture: fractional states.

Ballistic transport in quantum wires


Weakly disordered systems


Temperature decay of fluctuations


Soft Matter Physics

Introduction to liquid crystals: Terminology and nomenclature, molecular considerations, liquid crystal phases. Liquid crystals in biology.

Oriental order and phase transitions: Definition of order and order parameters. Types of phase transitions and implications for materials properties.

Optics and anisotropic physical properties of liquid crystals: Birefringence and dielectric properties. Selective reflection from chiral nematic phases.


Liquid crystal devices: Electro-optic effects, nematic liquid crystal devices. Concepts to increase switching speed for new display and photonics applications. The glass transition: General phenomenon and theoretical models. Experimental determination

Liquid crystal polymers: Main-chain polymers, side-group polymers, polymer networks.


Experimental methods for probing the structural/dynamical properties at different spatial/temporal regions of soft matter

- Neutron properties • Fermi pseudo-potential • The scattering cross section
- The Born approximation • Coherent and incoherent scattering
- Structure factors and pair distribution functions • Small angle scattering and surface scattering • Inelastic scattering and dynamical structure factors

Inelastic Scattering & Formal Theory of Scattering

Experimental methods for probing the structural/dynamical properties at different spatial/temporal regions of soft matter

Neutron, Small Angle Scattering & X-Ray Scattering: Part 1

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Static Light Scattering & X-Ray Scattering: Part II Neutron Reflectometry
Polarized Neutrons Quasi-elastic Neutron Scattering Neutron Spin Echo
Applications to Soft Matter: Macromolecular Dynamics

Recommended Text(s)
5. P. Collings, M. Hird - Introduction to Liquid Crystals Soft-Matter
6. Characterization Borsali, Redouane, Pecora, Robert (Eds.) Springer-Verlag
7. Soft Condensed Matter Physics in Molecular and Cell Biology Series; Scottish
   Graduate Series Published: January 13, 2006 by Taylor & Francis
   Editor(s): W. C. K. Poon, David Andelman

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CARBON NANOTECHNOLOGY

UNIT I - THE GEOMETRY OF NANOSCALE CARBON (9 hours) Introduction - Carbon molecules nature of the carbon bond - new carbon structures - discovery of C60 - structure of C60 and its crystal - From a Graphene Sheet to a Nanotube - Single wall and Multi walled Nanotubes - Zigzag and Armchair


UNIT V - APPLICATIONS OF CARBON NANOMATERIALS (9 hours) Application of Fullerene, CNT, Graphene and other carbon nanomaterials - Mechanical, Thermal Applications, Electronic Applications and biological Applications.

TEXT BOOKS

REFERENCES
1. Introduction
   Chemical constituent of foods, their properties and function. Characteristic feature of Natural and Processed Food

2. The Structure and Habit of Microorganisms
   Microorganisms associated with foods, The Origin of names. Microbial classification

3. Factors Affecting the Growth, Survival and Death of Microorganisms
   Some important characteristics of food contaminant microorganisms. The characteristic of microbial growth

4. Fundamentals of the Microbial Ecology of Foods I
   Food Spoilage and Foodsborne Illness. Microbial contamination-sources, routes and control. The role of Microorganisms in food. The consequences of microbial growth in foods

5. Fundamentals of the Microbial Ecology of Foods II
   Food Preservation and Fermentation. Controlling shelf life by preservation systems. Microbial Fermentation and biotechnology

6. Applications of Microbiology in the Food Industry

7. Enzymes in food technology-introduction
   Production of industrial enzymes. Enzymes in dairy product manufacture, Enzymes in bread making

8. Methods for food preservation
   Biodegradation of food products, flavor, aroma and other additives in processed foods. Case studies of a few specific food processing sectors. Cereals, protein foods, meat, fish and poultry, vegetables and fruits, milk products

9. Legislation, safety and quality control

Text Book:
1. Microbial Examination of Foods: Frances, Keith, American Public Health Association
2. Enzymes in Food Technology- R.J. Whitehouse, M. van Oort, Willey Blackwell Publishers
3. Food Microbiology and Laboratory Practice- Bell, Neaves, Wiltnes, Blackwell Publishing

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Paper Code - BIO-902  Industrial Biotechnology  4 Credits

1. History of Industrial Biotechnology

2. Industrial Systems Biology
   - Introduction, Industrial Biotechnology, Market Drivers for Industrial\n   - Biotechnology, Industrial Systems Biology, Metabolic Models, Reconstructed\n   - Metabolic Network Models, Industrial Systems Biology Case Studies, Conclusion\n   - and Future Perspectives.

3. Directed Evolution of Industrial Biocatalysts
   - Introduction, Strategies for Protein Design, Assembly Systems, selections, Examples.

4. Applied Biocatalysis: An Overview

5. Nanobiotechnology
   - Setting the Stage, Industrial Perspective, Nanotechnology in Biology and\n   - Biochemistry, Biomimicry, Materials and Products, Processes and Devices.

6. Downstream Processing in Industrial Biotechnology
   - Introduction, Separations in Industrial Biotechnology, Examples of Downstream\n   - Processing of Different Product Groups.

7. Industrial Biotechnology in the Chemical and Pharmaceutical Industries
   - Bioanalytical Processes: Scientific and Technological Perspectives, Bioanalytic\n   - Processes: Business and Commercial Perspective, Safety, Health, and the\n   - Environmental Perspective.

8. Industrial Biotechnology in the Food and Feed Sector.
   - Food Applications, Food and Feed Applications, Feed Applications.

9. Industrial Biotechnology in the Paper and Pulp Sector

10. Biofuels: Production and Application
    - A Renewed Interest in Biofuels, Present Conversion Pathways, Biorefiner Production from Vegetable Oils and Fats, Ethanol and ETHE Production, The\n    - Need for New Developments, Lignocellulosic Biomass Resources, Production of\n    - Ethanol from Lignocellulosic Biomass, Production of Biofuels Through the\n    - thermochemical Pathway, Biorefineries, Biofuels and Sustainability.

11. Environmental and Economic Aspects of Industrial Biotechnology
    - Introduction, Methodology, Overall Results.

12. Societal Issues in Industrial Biotechnology
Text book
Industrial Biotechnology: Sustainable Growth and Economic Success by Wim Socionet and Erick J. Vandamme

Reference book
Industrial Microbiology by Wailes, John S. Rogkey and Gary Higton

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29
Bio - 903: Advanced Tools and Techniques of Bioinformatics

1. Quality of Biological Data & Data Accuracy: General issues regarding biological databases, Representation of errors due to machines, 3D structural and sequence data of protein and nucleic acid.


DIGITAL SIGNAL PROCESSING

OBJECTIVE

This course provides the idea on design of analog and digital filters, and their classifications. Also, it provides a good knowledge of error correction in signal processing systems, which is then enriched with the applications to the image and speech processing.

UNIT - I  SIGNALS AND SYSTEMS
Basic elements of DSP - concepts of frequency in Analog and Digital Signals - sampling theorem - Discrete - time signals, systems - Analysis of discrete time LTI Systems - Z transform - Convolution - Correlation

UNIT - II  FREQUENCY TRANSFORMATIONS

UNIT - III  IIR FILTER DESIGN
Structures of IIR - Analog filter design - Discrete time IIR filter from analog filter - IIR filter design by Impulse Invariance, Bilinear transformation. Approximation of derivatives - (LPF, HPF, BPF, BRF) filter design using frequency translation

UNIT - IV  FIR FILTER DESIGN

UNIT - V  APPLICATIONS

UNIT VI  Image Processing

TEXT BOOKS:

REFERENCES:

OPERATING SYSTEMS Engineering

OBJECTIVE

Gives an idea about process synchronization, inter-process communication, scheduling, deadlock handling, and memory management.

UNIT - I OPERATING SYSTEMS OVERVIEW

Introduction to operating systems - Computer system organization, architecture - Operating system structure, operations - Process, memory, storage management - Protection and security - Distributed systems - Computing Environments - Open-source operating systems - OS services - User operating-system interface - System calls - Types - System programs - OS structure - OS generation - System Boot - Process concept, scheduling - Operations on processes - Cooperating processes - Inter-process communication - Examples - Multithreading models - Thread Libraries - Threading issues - OS examples

UNIT - II PROCESS MANAGEMENT

Basic concepts - Scheduling criteria - Scheduling algorithms - Thread scheduling - Multiple-processor scheduling - Operating system examples - Algorithm Evaluation - The critical-section problem - Peterson's solution - Synchronization hardware - Semaphores - Classic problems of synchronization - Critical regions - Monitors - Synchronization examples - Deadlocks - System model - Deadlock characterization - Methods for handling deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock detection - Recovery from deadlock

UNIT - III STORAGE MANAGEMENT

Memory Management - Swapping - Contiguous memory allocation - Paging - Segmentation - Example: The Intel Pentium - Virtual Memory: Background Demand paging - Copy on write - Page replacement - Allocation of frames - Thrashing

UNIT - IV I/O SYSTEMS


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MOBILE AND PERVERSIVE COMPUTING

OBJECTIVE

To study the details of lower layers of mobile architectures in the context of pervasive computing and mobile applications.

UNIT – I  PERVERSIVE COMPUTING  

Basics and vision – Applications and requirements – Smart devices and services – Smart mobiles, cards and device networks.

UNIT – II  MOBILE APPLICATIONS  


UNIT – III  MEDIUM ACCESS AND TELECOMMUNICATIONS  


UNIT – IV  WIRELESS NETWORKS  

Infrared vs radio transmission – Infrastructure and ad hoc networks – IEEE 802.11 – HIPERLAN – Bluetooth – WiMAX.

UNIT – V  MOBILE NETWORK AND TRANSPORT LAYERS  

Mobile IP – DHCP – Mobile ad hoc networks – TCP improvements – TCP over 2.5/3G.

TEXT BOOKS:

COURSE CON-901: Neurotoxicology and Neuropharmacology

General principles of neurotoxicology, the cell and molecular mechanisms and health impacts of specific neurotoxicants and the contribution of neurotoxic compounds to complex neurodevelopmental disorders and neurodegenerative diseases.

Primary objectives: 1) To understand the basic methods and models used to evaluate and study neurotoxicity; 2) To understand the factors that influence the vulnerability of the nervous system to environmental agents; 3) To learn about the cellular and molecular mechanisms by which toxicants perturb neurological function and how these may contribute to human disorders and diseases; and 4) To learn how to critically evaluate the primary scientific literature in the field of neurotoxicology.

UNIT 1: Neurotoxicity-I

UNIT 2: Neurotoxicity-II

UNIT 3: Neuropharmacology of Neural systems and Disorders-I
Autonomic Nervous System, Neural and Neuroendocrine control of internal milieu, Pain and inflammation, Sleep and Arousal, stroke and Migraine.

UNIT 4: Neuropharmacology of Neural systems and Disorders-II

References Books:
1. Dubois M.R., Clinical Neurotoxicology
2. Cheung W., William Stilliker Jr., Developmental Neurotoxicology Research
3. Eric Nestler, Steven Hyman, Molecular Neuropharmacology: A Foundation for Clinical Neuroscience

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26-C NEUROLOGICAL and PSYCHIATRIC DISORDERS

Unit-I: Mental Disorder: Meaning, Symptomatology and Classification (APA and WHO Classifications).


Unit-VIII: Disorders of Childhood and Adolescence: Nature, Types, Clinical Picture and Causal Factors of Mental Retardation, Learning and Motor Skills Disorders, Attention Deficit and Disruptive Behaviour Disorders, Pervasive Developmental and Communication Disorders.


Books Recommended:


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JAIPUR, 2006
COMPUTATION AND MODELING IN NEUROSCIENCE

Unit 1 MATLAB FUNDAMENTALS
Introduction and Basic concept, Graphics and visualization, Functions and Script.

Unit 2 DATA COLLECTION WITH MATLAB
Visual Search and Pop Out, Attention, Psychophysics, Signal Detection Theory

Unit 3 DATA ANALYSIS WITH MATLAB

Unit 4 DATA MODELING WITH MATLAB

References books:
MATLAB in neurosciences: an introduction to scientific computing in MATLAB / Pascal Wallisch ... [et al.]

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<th>Unit</th>
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<tr>
<td>II</td>
<td>Patents: Introduction to patent law and conditions for patentability, Procedure for obtaining patents, Rights of a patentee, Patent infringements, Biotechnology patents and patents on computer programs, Patents from an international perspective</td>
</tr>
<tr>
<td>III</td>
<td>Trademark and Geographical Indications: Statutory authorities and registration procedure, Rights conferred by registration, Licensing, assignment and transfer of trademark rights, Trademark infringement, Geographical Indication of Goods &amp; Appellations of Origin</td>
</tr>
<tr>
<td>IV</td>
<td>Copyright: Registration procedure and copyright authorities, Assignment and transfer of copyright, Copyright infringement and exceptions to infringement, Software copyright</td>
</tr>
<tr>
<td>V</td>
<td>Designs: Introduction to the law on Industrial Designs, Registration and piracy, International perspective, Introduction to the law on semiconductor layout design, Registration, commercial exploitation and infringement</td>
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