

UNIVERSITY OF RAJASTHAN
JAIPUR

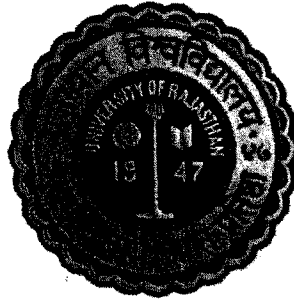
SYLLABUS

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

I to IX Semester

(2019-2024)

Raj/Taw
Dy. Registrar
(Academic)
University of Rajasthan
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SYLLABUS

Centre for Converging Technologies

I to IX Semester

(2019-2024)

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I (FIRST)
SEMESTER


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Center for Converging Technologies
University of Rajasthan, Jaipur
(Tele-0CTG 14CTG 1-2700370)

First Semester

(Batch)

Code	Type	Description	Credit
CTG 101	Thy	General Physics: Properties of Matter, Thermal Physics and Optics	3
CTG 102	Thy	Basics of Physical Chemistry	3
CTG 103	Thy	Programming Languages: Fundamentals and Applications	3
CTG 104	Thy	Calculus	3
CTG 105	Thy	Biochemistry	3
CTG 106	Thy	Genetics and Molecular Biology	3
CTG 107	Thy	Human Behavior and Basic Psychological Processes	2
CTG 109	Thy	Communication Skills	2
CTG 110	Thy	Mathematics/Biology	2
CTG 111	Lab	Electricity, Magnetism, Electromagnetism, heat and thermodynamics lab	4
CTG 112	Lab	Physical Chemistry Lab	4
CTG 113	Lab	Life Science Lab	4
CTG 114	Lab	Programming in C & Visual Basic	4


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First Semester

Theory Paper

Paper 101

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, Cantilever (5)

Viscosity: Viscosity, Critical velocity, Flow of a Liquid through a Capillary Tube, Poiseuille's equation, Capillaries in series and parallel, Stoke's Formula. (3)

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 (7)

Thermal Physics:

Concept of thermal state, the first law of thermodynamics: heat and work, internal energy, second law of thermodynamics: concept of entropy and temperature, principle of increase of entropy, thermodynamic variables: enthalpy, Helmholtz potential, Gibbs free energy, Phase transformations: first order and second order, Clausius-Clapeyron equation, Production of low temperature, Joule-Thomson experiment, regenerative cooling, cooling by adiabatic demagnetization. (11)

Optics:

Diffraction of light: Fresnel's half period zones, explanation of rectilinear propagation of light, zone plate, Fresnel's diffraction at a straight edge, Fresnel's diffraction at a circular aperture, Fraunhofer diffraction (4)

Resolving Power: Geometrical and spectral resolution, distinction between magnification and resolution, Rayleigh's criterion for the limit of resolution, resolving power of plane diffraction grating, resolving power of a prism. (4)

Polarization of light, Concept of polarization, polarization by reflection, Brewster's law, polarization by refraction, pile of plates, double refraction, Huygens explanation 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. (5)

Laser system, Spontaneous & stimulated emission, absorption, Einstein coefficients, cavity detuning, population inversion, optical & electrical pumping, cavity resonators, properties of lasers, Ruby laser, Helium-Neon laser, uses of laser, idea of holography.

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(qualitative treatment only.)

Optical fibers: Structure and types of fibers, fiber optic communication system. (3)

Recommended Books:

1. Mechanics by J. C. Upadhyaya
2. Fundamental University Physics, Alonso & Finn.
3. Berkley Physics COURSE Vol 1 & Vol. 3
4. Thermodynamics and Statistical Physics by F. Reif.
5. Thermodynamics and Statistical Physics-S. Lokanathan 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

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Theory Paper

Paper 102

COURSE CH-01: Physical Chemistry

Unit - I Liquid and Solid State:

(a) **Liquid State:**

(6)

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:**

(6)

Symmetry in crystal systems, space lattice, unit cell. Laws of crystallography: (i) Laws of constancy of interfacial angles, (ii) Law of rationality of indices, (iii) law of symmetry Bravais lattices X-ray diffraction by crystals, Bragg's equation. Determination of crystal structure by powder method, examples NaCl, KCl and CsCl.

Unit - II Colloidal State, and Heterogeneous Equilibrium:

(a) **Colloidal State:**

(6)

Difference between true and colloidal solution, Classification, lyophilic and lyophobic colloids, preparation and properties: optical and electrical (Tyndall effect, Brownian effect, electrophoresis and electro-osmosis) properties, origin of charge, electrical double layer, coagulation, and protective action of colloids. Inhibition, general applications of colloids. Surfactants, micelles and their classification, critical micelle concentration (CMC). Method of determination of CMC.

(b) **Heterogeneous equilibrium:**

(6)

Law of mass action as applied to the decomposition of CaCO_3 $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. 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 (Pattinson process for desilverisation of lead).

Unit - III Chemical Kinetics and Catalysis:

(9)

Chemical Kinetics, rate of a reaction, factors influencing the rate of a reaction on concentration, temperature, pressure, solvent, light, catalyst.

Concentration dependence of rates, mathematical characteristics of simple chemical reaction-zero order, first order, and second order reactions, pseudo order, half life and mean life. Determination of the order of reaction-differential method, method of integration, method of half life period and isolation method. Experimental methods of chemical-kinetics; conductometric, potentiometric, optical methods.

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Order and molecularity of complex reactions (no mechanism); Effect of temperature on rate of reaction, effect of catalysts, Arrhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). 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:

(α) Electrolytic and electrochemical cells: (6)

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

(β) Chemical Thermodynamics: (6)

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. Element of Physical Chemistry by Lewis & Glasstone.
3. Chemical Kinetics by K.J. Laidler.
4. Chemical Kinetics by Frost and Pearson.
5. Physical Chemistry by Kestlan.
6. Physical Chemistry by B.R. Puri, L.R. Sharma and M.S. Pathania.
7. Physical Chemistry by P.C. Rikshit.
8. Physical Chemistry by P.W. Atkins.
9. Physical Chemistry by Gordon and Barrow.

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Theory Paper

Paper 103

COURSE CS-01: Programming Languages: Fundamentals and Applications

Basic concepts of programming languages: Programming domains, language evaluation criterion 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 expression, 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, arrays 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:

1. Robert W. Sebesta: Concepts of Programming Language, Addison Wesley, Pearson Education Asia, 1999.
2. Deitel and Deitel: How to Program C, Addison Wesley, Pearson Education Asia, 1999.

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Theory Paper

Paper 104

COURSE MT-01: CALCULUS

Limits and Continuity: Definition; Rate of Change, Limit, functions of one variable, function of a function; Rules for Finding Limits (simple problems), Continuity, simple examples of discontinues functions. (6)

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 variable (12)

Applications of Derivatives: Mean Value theorems Rolles, Cauchy and Lagrange's, maxima and minima of one variable, indeterminate form: L' Hospital rule, Euler's formula. (15)

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, $1/3^{\text{rd}}$ Simpsons rule and $3/8^{\text{th}}$ Simpson's rule), area of circle, parabola ex, log ex. (12)

Recommended Books:

1. Calculus by Thomas and finny, Pearson Education Asia, 1999.

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Paper 105

COURSE BS-01: Biochemistry

1. The Foundations of Biochemistry (3)
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. (3)
 - Amino Acids and Proteins: Amino acids, Lambert-Beer's law, peptides & proteins, covalent structure of proteins, protein sequences & evolution (3)
 - The Three-Dimensional Structure of Proteins: Overview of protein structure, secondary structure, tertiary & quaternary structure (3)
 - Carbohydrates: Monosaccharide, disaccharides & polysaccharides, glycoconjugates (3)
 - Lipids: Storage lipids, structural lipids, lipids as signals, cofactors & Pigments (3)
3. Bioenergetics and Metabolism
- Principles of Bioenergetics: Bioenergetics & thermodynamics, phosphoryl group transfers & ATP, biological oxidation-reduction reactions (3)
 - Glycolysis: Pathway, fate of pyruvate (3)
 - The Citric Acid Cycle: Acetyl CoA, reactions of Citric Acid cycle, regulation (3)
 - Enzymes: Introduction, Kinetics, Michaelis-Menten Equation, Regulatory enzymes, Examples of enzymatic reactions (3)
 - Photophosphorylation: Photosynthesis, ATP synthesis by Photophosphorylation (3)
 - Carbohydrate Biosynthesis in Plants and Bacteria: Photorespiration, C4, CAM pathways, biosynthesis of starch & sucrose, cellulose, Peptidoglycan (3)
 - Lipid Biosynthesis: Biosynthesis of fatty acids, triacylglycerols, membrane phospholipids. (3)
 - Biosynthesis of Amino Acids: Nitrogen metabolism, biosynthesis of Amino acids (3)
 - Secondary Metabolites: General Introduction (3)

Recommended Books:

1. Lehninger's Principles of Biochemistry by Nelson and Cox, 4th edition, W.H. Freeman and Company.
2. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, Biochemistry 5th

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- edition. W H. Freeman and Company.
3. Donald Voet and Judith G. Voet, Biochemistry 3rd edition. John and Wiley Sons' Inc.

Theory Paper

Paper 106

COURSE BS-02: Genetics & Molecular Biology

1. **Introduction to Genetics** (2)
 - Importance
 - Role in Biology
 - Brief history
 - Model organisms

2. **Basic Principles of Heredity** (4)
 - Mendel's Experiments
 - Monohybrid Cross
 - Dihybrid Cross
 - Multiple Loci Cross

3. **Sex Determination and Sex-Linked Characteristics** (2)
 - Sex determination
 - Sex linked characteristics
 - X-linked color blindness
 - Dosage compensation

4. **Linkage and recombination** (2)
 - Linkage and recombination between two genes
 - Linkage and recombination between three genes

5. **Bacterial and Viral Genetics** (4)
 - Bacterial genetics
 - Viral genetics

6. **Chromosome structure, Variation and mutation** (5)
 - 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** (2)
 - The molecular basis of heredity

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- Structure of DNA
- Special structures in DNA

8. Extensions and Modifications of Basic Principles (6)

- Birth weight and Genomic Imprinting
- Dominance Revisited
- Penetrance and Expressivity
- Lethal Alleles
- Multiple Alleles
 - Duck-Feather patterns
 - ABO blood groups
- Gene interaction
 - Gene interaction that produce novel phenotypes
 - Gene interaction with epistasis
 - The 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 (2)

- Genetic variation
- The Hardy Weinberg law
- Nonrandom mating
- Changes in allelic frequencies

10. DNA Metabolism (4)

- 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 (5)

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

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- RNA Processing
 - Types of RNA Processing
 - Intron Splicing.

12. **Protein Metabolism** (5)

- 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** (2)

- Principles of Gene Regulation
- The Lac Operon- Negative and Positive Regulation of Lac-Operon

Recommended Books:

1. Genetics A Conceptual Approach, 2nd edition – Benjamin A. Pierce
2. Lehninger's principal of Biochemistry 4th edition -Nelson & Cox
3. Principals of Genetics – Gardner
4. Molecular cell biology, 5th edition - Lodish, Berk, Mastudaira

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Theory Paper

Paper 107

COURSE CN-01: Human Behavior and Basic Psychological Processes

UNIT-I. The Science of Psychology: Definition and Goals. Brief history and Modern perspectives: Psychodynamic, Behavioral, Humanistic, Bio- psychological, Cognitive, Socio-cultural, Evolutionary. Major subfields. Methods: Experimental, Interview, Observation, Introspection, Survey, Case-study. (4)

UNIT-II. Biological Basis of Behavior: The nervous system. Basic structure and functions (Localization of brain functions). Neurons and Neurotransmitters. Hormones and behavior. Behavior Genetics: basic principles. (4)

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

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

UNIT-V. Learning: Definition, Theories and Basic Processes: Classical Conditioning, Operant Conditioning, Cognitive Learning, Observational Learning (4)

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-VIII. Cognition: Thinking: Definition, Mental Imagery, Concepts, Problem Solving and Decision Making. Intelligence and Creativity: Definition and Theories. Language: Basic Nature, Development, Relationship with thought. (5)

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:

1. Baron, R.A. (1995). Psychology: The Essential Science. New York: Allyn and Bacon
2. Zimbardo, P.G. And Weber, A.L. (1997). Psychology. New York: Harper and Collins.

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Theory Paper

Paper 109

COURSE SK-01: Communication Skills - I

Communication as a Tool: Meaning, Purpose and Importance of Communication, Process of Communication; Types of Communication; Communication Network - Formal and Informal. (5)

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. (6)

Means of Communication: Oral, Written and Non-verbal Communication, Body Language: KOPPACT (Kinesics, Oculistics, Paralinguistics, Proxemics, Artifacts, Chronemics). (5)

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(Kinesics), Posture, Use of Space(Proxemics), Dress(Artifacts), Eye Contact(Oculistics), Listening to the whole Message. (10)

Writing Skills: Report writing, Business Letters, Preparing a Resume, Presentation Skills (4)

Recommended Books:

1. Messages: The Communication Skills Book by Matthew McKay, Martha Davis, Patrick Hanning.
2. People Skills: How to Assert Yourself, Listen to Others, and Resolve Conflicts by Robert Bolton.

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Theory Paper

Paper 110A

COURSE AD-01A: Mathematics

- (i) Complex Numbers (4)
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
- (ii) Sequences and Series (6)
Sequences, series (finite and infinite) 4th term, arithmetical 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.H, H.M, series representation of exponential functions, logarithmic functions, $\log_e (1+x)$ and $\log_e (1-x)$.
- (iii) Permutation and Combination (5)
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 (4)
Statement and proof of Binomial theorem of positive integral exponent, General and middle terms in Binomial expansions, Properties of Binomial coefficients
- (v) Matrices and Determinants (6)
Concept of a matrix, Types of matrices, transpose and adjoint of a matrix, addition and multiplication of matrices, rank of matrix, elementary 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
- (vi) Co-ordinate Geometry of two-dimensional (5)
Locus of a point: definition, cartesian system of coordinates in a plane, distance and section formula, condition for collinearity of three points in a plane, equation of a straight line slope form, intercept form, two point form, general form: parallel and perpendicular line, intercept of a line, angle between two lines, distance of a point from a lines.
Standard and general forms of circle, equation of a circle when end points of a diameter are given, points of intersection of a line and a circle, condition of tangency of a line and a circle, conic section: definition, focus, directrix, eccentricity, equations of parabola, ellipse and hyperbola

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Theory Paper

Paper 110B

COURSE AD-01B Biology

I] 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)

II] 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 monocot and dicot, secondary growth

Morphology of animal- tissue systems, structure and function of tissues- epithelial, connective, muscular and nervous (8)

III] Reproduction, Growth and Development

Modes of reproduction in flowering plants-vegetative propagation (natural and artificial), sexual reproduction, pollination, double fertilization, embryo development, parthenogenesis and parthenocarpy

Characteristics of plant growth and growth regulators (phytohormones) auxins, cytokinins, gibberellins, ABA; Seed germination, seed dormancy

Types of reproduction in animals (asexual and sexual), hormonal control of growth. (7)

IV] Biomolecules

Basic chemical constituents of living bodies

Structure and functions of carbohydrates, proteins, lipids and nucleic acids (12)

V] 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. (5)

VI] Genome organization

Fine structure of the Gene, Structure of Prokaryotic and eukaryotic chromosomes

VII] Biology and Human Welfare

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**II (SECOND)
SEMESTER**

University of Rajasthan, Jaipur
Dual Degree B.Tech.-M.Tech in Converging Technologies
Syllabus Second Semester Examination 2017
(Seventh Batch)

S. No	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			FoSE Duration (Hrs)	
					L	T	P	Thy	P
1	CTG 201	Advance Mechanics and Electrodynamics	CCC	3	3	0	0	3	0
2	CTG 202	Fundamentals of Inorganic and Organic Chemistry	CCC	3	3	0	0	3	0
3	CTG 203	Object oriented Programming Methodology	CCC	3	3	0	0	3	0
4	CTG 204	Discrete Mathematics	CCC	3	3	0	0	3	0
5	CTG 205	Cell Biology	CCC	3	3	0	0	3	0
6	CTG 206	Semiconductor electronic Devices and Applications	CCC	3	3	0	0	3	0
7	CTG 207	Bio resources and Ecology	CCC	3	3	0	0	3	0
8	CTG 208	Differential Equations and Boundary Value Problems	CCC	3	3	0	0	3	0
9	CTG 209	Database Management Systems	CCC	3	3	0	0	3	0
10	CTG 210	Economic Concepts and Methods, Development and Planning	CCC	3	3	0	0	3	0
11	CTG 211	Physics Lab	CCC	3	0	0	6	0	4
12	CTG 212	Chemistry Lab	CCC	3	0	0	6	0	4
13	CTG 213	Cell Biology & Ecology Lab	CCC	3	0	0	6	0	4
14	CTG 214	C++ Computer Programming Lab	CCC	3	0	0	6	0	4
		Total		42					

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CTG-201: Advance Mechanics and Electrodynamics

Advance Mechanics:

Constraints and generalized coordinates, Calculus of variations and Lagrange's equations Small Oscillations, Hamilton's equations, Variational principles, Central forces, Collisions and scattering, Rigid body kinematics and dynamics, Canonical transformations. Special

Relativity: empirical evidence for the constancy of c , frames of reference; Lorentz transformations: relativity of simultaneity; twin and other paradoxes. transformation laws for velocity, momentum, energy; mass-energy equivalence; force equations, kinematics of decays and collisions.

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.

Electromagnetic Induction and Maxwell's Equation:-Faraday's law of electromagnetic induction. Differential form of Faraday's law, Mutual inductance, mutual inductance two circular loops, self inductance of a solenoid of finite length and winding thickness, self inductance of a straight conductor, Energy stored in an inductor and in the magnetic field, transient behaviors of LR circuit, Displacement current, Modified Ampere's law Maxwell's equations in differential and integral form, Maxwell's equations in material media, Boundary conditions for electric and magnetic fields at vacuum-dielectric and vacuum-metal boundaries.

Recommended Books:

1. University Fundamental Physics – Alonso and Finn
2. Electricity and Magnetism- Berkeley Series: Vol. 2. E.M. Purcell
3. Classical Mechanics -- H. Goldstein

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2. ~~Electricity and Magnetism - Berkeley Series. Vol. 2. E.M. Rurcell~~
3. ~~Classical Mechanics - H. Goldstein~~

Paper Code – CCT -202 Fundamentals of Organic and Inorganic Chemistry 3 Credits (45 Hrs)

- **Bonding and Delocalization** (5)
Inductive, inductomeric, electromeric, resonance and mesomeric effects; hyperconjugation; tautomerism (difference from resonance); Aromaticity: Huckel's $(4n+2)$ rule and its application to carbocyclic and heterocyclic rings.

- **Stereochemistry** (10)
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:** (10)
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 radical substitution, Aliphatic nucleophilic substitution (SN_1 , SN_2 , SN_i) and electrophilic aromatic substitution (Activating and deactivating effect of substituent groups, directive influence and orientation); Addition: electrophilic and Free radical (peroxide effect) addition to C=C bond, Nucleophilic addition to C=O group; Elimination reaction (E_1 & E_2). 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, Polyacrylonitriles, Dacron, Terylene, Nylon, Bakelite, Melamine, melmac. (5)

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

Recommended Books :

1. J. E. Huheey, E. A. Keiter, R. L. Keiter & O. K. Medhi, *Principles, Structure and Reactivity* (1st impression), Pearson Education (2006).
2. F. A. Cotton, G. Wilkinson, C.A. Murillo & M. Bochmann, *Advanced Inorganic Chemistry* (6th edn.), John Wiley (1999)
3. Concise Inorganic Chemistry, J.D. Lee, ELBS.
4. Organic Chemistry, Morrison and Boyd, Prentice-Hall of India Pvt. Ltd., New Delhi.
5. Reaction Mechanism in Organic Chemistry, Mukherjee and Singh, The Macmillan company of India Ltd.
6. Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, by Jerry March.
7. Advanced Organic Chemistry, Part A: Structure and Mechanisms, by Carry & Sundberg.
8. Stereochemistry of Organic compounds, D. Nasipuri, New Age International Publishers and Wiley Eastern Ltd., New Delhi, London.
9. P. S. Kalsi. Stereochemistry, Conformation and Mechanism (7th edn.), New Age international (2008).

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Object Oriented Programming Methodology

Necessity of Object Oriented Programming, Essentials of OOP (Encapsulation, Classes, Constructors, Inheritance, Pointers to Objects, Polymorphism)

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, Strstreams, Classes within classes, Smart Pointers, Templates, Exception Handling

Recommended Books:

1. C. Thomas Wu, An Introduction to OOP with Java, McGraw Hill.
2. Timothy Wood, An Introduction to Object Oriented Programming, Addison Wesley.
3. Deitel and Deitel: How to Program c, Addison Wesley, Pearson Education Asia, 1999.
4. John R. Hubbard, Programming with C++, McGraw Hill International.

CTG-204: Discrete Mathematics

1. **Sets and Propositions** : Cardinality, Mathematical Induction (simple problems), Principle of inclusion- exclusion, Dearthments.
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,q), 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, planer 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 is 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:

1. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hill Book Comp., 1986.
2. J.P. tremblay and R. Manchar, Discrete Mathematical Structures with Applications to

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- Computer Science. McGraw-Hill Book Co. 1997.
3. S. Wietala, Discrete Mathematics-A Unified approach. McGraw-Hill Book Co.
 4. N. Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India, 1990.
 5. P.C. Biswal, Discrete Mathematics and Graph Theory, Prentice Hall of India Pvt. Ltd. New Delhi, 2005.
 6. S. Lipschutz, M.L. Lipson and V.H. Patil, Discrete Mathematics-Schaum's outlines. Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2006.

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
Meiosis: 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.

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Recommended Books:

1. Molecular Cell Biology: Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. V Kaiser, Monty Krieger, Matthew P. Scott, Lawrence Zipursky, and James Darnell 5th edition. WH Freeman Publication.

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 semiconductors, 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 pie 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.

Feed-back 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:

1. Albert Paul Malvino, Electronic Principles, Mc. Graw Hill.
2. G.K. Mittal, Electronics Devices and circuits, khanna Publishers, Delhi, 2000.
3. Jacob Millman and Christos C. Halkias Integrated electronics, Tata Mc-Graw Hill Publisher Company Ltd.
4. R.P. Punagin, Basic Electronics, Tata McGraw Hill.
5. Jacob Millman and Christos C. Halkias: Electronic Devices and Circuits, Tata Mc-Graw Hill Publishing Company Ltd., 2000.
6. Donald A. Neamen, Semiconductor Physics and Devices, McGraw Hill, 1997.

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.

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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.
2. Population Ecology : Population density, dispersion and demographics. evolution and life history diversity. exponential and logistic model of population. factors regulating population growth, global human population and carrying capacity.
3. Community Ecology : Community intersections, and their classification-competition, predation, herbivory, symbiosis, dominant and keystone species, ecological succession, biogeographic factors affecting community ecology and human pathogens.
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
5. Conservation Biology and Restoration Ecology : Three levels of biodiversity and human welfare, three threats to biodiversity, population conservation approaches, genetic diversity and critical habitat, landscape and regional conservation, restoration ecology, bioremediation, sustainable development.

Recommended Books

1. Biology VIII ed..Campbell, Reece. Pearson International
2. A Comprehensive hand book of biodiversity AK-Gosh. TERI Press
3. Fundamentals of Ecology -Odum, Cengage Learning

CTG-208: DIFFERENTIAL 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, Sturm-Liouville boundary value problem, Laplace. Wave and Diffusion equations.

Recommended Books:

1. Frank Ayres, Theory and Problems of Differential Equations. McGraw-Hill Book Co. 1972
2. Richard Bronson, Theory and Problems of Differential Equations. McGraw-Hill Book Co. 1973.
3. W.T. Reid, Ordinary Differential Equations. John Wiley & Sons, New York, 1971.
4. Erwin Kreyszig, Advanced Engineering Mathematics. John Wiley & Sons, New York, 1999.
5. J.L. Bansal and H.S. Dhama, Differential Equations, Vol. I & II Jaipur Pub. House, Jaipur.
6. E.A. Coddington, An Introduction to Ordinary Differential Equations. Prentice Hall of India Pvt. Ltd., New Delhi, 1968.
7. W.E. Boyce and P.C. DiPrima, Elementary Differential Equations and Boundary Value Problems. John Wiley & Sons, New York, 1986.
8. H.T.H. Piaggio, Elementary Treatise on Differential Equations and Their Applications. C.B.S. Publishers & Distributors, Delhi, 1985.
9. I. Stakgold, Boundary Value Problems of Mathematical Physics. Mac Millan Book. Co., 1969.

Paper Code : CTG-209: Database Management Systems

Data Base 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

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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:

1. Ramakrishnan and Gharke, Database Management Systems, Tata McGraw Hill Pub. Co. Ltd.
2. Date C J, Database Management Systems, Pearson Education Asia.
3. Korth H and Silberschataz A, Database System Concepts, McGraw Hill.
4. Geraid V Post, Database Management Systems, Tata McGraw Hill.
5. Naveen Prakash, Introduction to Database Management Systems, Tata McGraw Hill.
6. Leon, and Leon, SQL, Tata McGraw Hill Pub. Co. Ltd.
7. Ivan Bayross, Database Technologies, Sybex Computer Books Inc.

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CTG-210: Economics Concepts and Methods, Development and Planning

Economics: Nature, scope and methodology. Micro and Macro Economics.

Basic economics problems, Assumptions in Economic analysis, Theory of Consumer Behavior - Cardinal and ordinal utility approaches, Derivation of Individual Demand Curve, Market Demand Curve, determinants of Demand, Elasticity of Demand. Prices, Income and Substitution effects, Normal, Inferior and Giffens goods. Complementary and substitute goods. Concept and Importance of Consumer Surplus.

Meaning, Factors and Scale of production, Law's of returns, producers equilibrium, Enterprises problems, Enterprises objectives and constraints. Major components of costs. Supply and Law of supply, Elasticity of supply, Revenue Analysis.

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:

1. Motc & Paul: Managerial Economics, Tata McGraw Hill, New Delhi.
2. D.M. Mithani: Fundamentals of Business and Managerial Economics, Himalaya Publishing House.
3. Paul A. Samuelson: Economics, Tata Mc Graw Hills, New Delhi.
4. M.L. Seth: Advanced Economic Theory
5. Elhanan Helpman, The Mystery of Economic Growth
6. Barbara Ingham, Economics and Development, Mc Graw Hill

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Paper Code – CTG – 301

Quantum Mechanics-I

Credits (45 Hrs)

Failure of classical physics and experimental basis of quantum mechanics: Photoelectric effect, Compton Scattering, Black body radiations, Franck-Hertz Experiment, The Bohr Atom, Electron Diffraction, de Broglie Waves, Wave-particle Duality of matter and light.

Operators in quantum mechanics: Linear operator, unitary operator, function operator, Adjoint of an operator, self adjointness, eigen values and eigen functions of self adjoint operator, Normalization of eigen functions, Completeness and closure relation.

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).

Recommended Books:

1. Feynman, Richard P, Robert B. Leighton, and Matthew L. Sands Lectures on Physics. Vol 3 Addison – Wesley
2. Arthur Beiser, Concepts of Modern Physics by, Mc-craw Hill.
3. Ashok Das and A.C. Melissinos: Quantum Mechanics – A Modern Approach, Gordon and Breach science Publishers.

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

General Principles: Interaction of light with matter, mechanism of absorption & emission of radiation. (1)

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. (7)

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. (5)

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 enes (alicyclic, homoannular and heteroannular) and enones. (6)

Nuclear Magnetic Resonance Spectroscopy: Basic principles of Proton Magnetic Resonance, shielding and de-shielding of magnetic nuclei Anisotropic Effects in Alkene, alkyne, 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, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. (10)

Electron Spin Resonance Spectroscopy: Basic principles, position of ESR absorption, g factor. Hyperfine splitting, applications of ESR spectroscopy. (4)

Mossbauer Spectroscopy Principles, isomer shift, quadrupole effect of magnetic field, applications to iron and tin compounds. (4)

Mass Spectroscopy

Introduction, ionization, Types of ions produced, molecular ion peak, metastable peak, general rules (isotops effect, nitrogen rule, ring rule); typical examples of mass spectral fragmentation of organic compounds (examples- alkane, alkene, alcohol, ether, ketone). (6)

Applications of IR, UV, NMR and Mass spectroscopy for structure elucidation of simple organic compounds. (2)

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Text Books

1. C. N. Banwell and E. M. McCash. Fundamentals of Molecular Spectroscopy, 4th edn., Tata McGraw-Hill, New Delhi, 1994.
2. R. M. Silverstein, G. C. Basseler & T. C. Morill. Spectroscopic Identification of Organic Compounds, John Wiley (1981).
3. W. Kemp. Organic Spectroscopy (3rd edn.), McMillan Press Ltd. (1991).
4. D. Williams & I. Fleming. Spectroscopic Methods in Organic Chemistry, McGraw Hill (1989).

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Paper Code – CTG -303 Computer Organization and CPU Design 3 Credits (45 Hrs)

Digital Logic Fundamentals: Boolean Algebra, Combinatorial Logic, Combinational Circuit Designs, Basic Sequential Components. (5)

Introduction to Finite State Machines: State diagram and state tables, Mealy and Moore machines, designing state diagrams, from state diagram to implementation. (4)

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. (4)

Introduction to Computer Organization: Basic Computer organization, CPU organization, Memory subsystem organization and interfacing, I/O Subsystem Organization and Interfacing, An 8085 based Computer. (5)

Register Transfer Languages: Micro-Operations and Register Transfer Language, Using RTL to specify Digital Systems. (4)

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. (5)

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). (6)

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). (5)

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). (3)

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), IO Processors, Serial Communication (Serial Communication Basics, University Asynchronous Receiver/Transmitters (UARTs)) (4)

Recommended Books:

1. John D Carpinelli: Computer Systems Organization and Architecture, Addison Wesley, Pearson Education, 2001

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Integral Transforms:

Laplace Transform: Definition and its properties, rules manipulation. Laplace transform derivatives and integrals, Properties of inverse Laplace transform, Convolution theorem, Application to solution of ordinary differential equations. **Fourier Transform:** Definition and properties of Fourier Sine, cosine and complex transform. Convolution theorem, Fourier transforms derivatives, Application to solution of partial differential equations.

(10)

Special Functions:

Legendre Function: Legendre equation and its solution. Generating function of Legendre polynomials, Rodrigues formula. Orthogonal properties and Recurrence relations for Legendre polynomials. Associated Legendre polynomial. (4)

Bessel Function: Bessel equations and its solution. Generating function of $J_n(x)$ Integral expressions for the Bessel functions, Recurrence relations for $J_n(x)$. Orthogonal properties of Bessel functions. (4)

Hermite Function: Hermite differential equations and its solution, Hermite polynomial, generating function. Orthogonal properties of Hermite polynomials. Recurrence formulae for Hermite polynomials. (4)

Functions of complex variables:

Analytic Function: Functions of a complex variable, limits, continuity, derivatives, analytic functions, Cauchy-Riemann equation. Necessary and sufficient conditions for analytic function. Harmonic functions. Conjugate functions. Construction of an analytic function.

(10)

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.

(7)

Introduction to tensors: Dimensional space, Transformation of Covariant, contravariant and mixed tensors, Addition, multiplication and contraction of tensors; quotient rule; symmetric & antisymmetric tensor metric. (6)

Recommended Books:

1. Integrals Transforms: S.P. Goyal and A.K. Goyal, Jaipur Pub. House, Jaipur
2. Laplace Transform: Spiegel Schaum Series.
3. Fourier Transform: I. No. Sneddon, Tata Mc Graw Hill
4. Complex Variable: G.N. Purohit S.L. Bhargava and S.P. Goyal Jaipur Publishing House, Jaipur.
5. Differential Equations: J.L. Bansal and H.S. Dhami Jaipur Publishing House, Jaipur
6. Functions of a complex variable: J.C. Chaturvedi and S.S. Seth Students Friends & Company, Agra
7. Functions of Complex Variable: J.N. Sharma, Krishna Prakashan Mandir, Meerut
8. Complex Variables and Applications: R.V. Churchill and J.W. Brown Mc Graw- Hill Int. Book Co. Singapore
9. Vector analysis and Introduction to tensors. Spiegel, Schaum series.
10. Mathematical Physics: B.S. Rajput, Pragati Prakashan, Meerut.

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Paper Code – CCT -305

Microbiology

3 Credits (45 Hrs)

1. Microorganisms and Microbiology 3
Introduction to microbiology, microorganisms as cells, microorganisms and their natural environments, the impact of microorganisms on humans, contribution of Robert Hooke, Antony van Leeuwenhock, Ferdinand Cohn, Louis Pasteur, Robert Koch, Martinus Beijernick, theory of spontaneous generation, germ theory of disease and Koch postulates
2. Techniques of Microbiology 5
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 2
Physiological diversity of microorganisms, bacteria, archea, mycoplasma (PPLO), eukaryotic microorganisms
4. Cell structure and function in Bacteria and Archea 3
Cell morphology, cytoplasmic membrane in bacteria and archea, ultrastructure of cell wall of bacteria and archea, cell surface layers, pili, and fimbriae, cell inclusions, gas vesicles, endospores, flagella and mobility
5. Microbial growth 2
Bacterial cell division, growth of bacterial population, measuring microbial growth, factors affecting microbial growth
6. Overview of Viruses and Virology 2
Virus structure and growth, viral replication, viral diversity , subviral entities
7. The phylogeny of Bacteria 3
Phototrophic, chemolithotrophic, methanotrophic, aerobic and facultative aerobic, chemoorganotrophic bacteria
8. Gram Positive Bacteria 3
Overview, actinobacteria, cyanobacteria, green sulphur bacteria, green nonsulphur bacteria

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|---|---|
| 9. Archea | 2 |
| Phylogeny and general metabolism, Extremely halophilic Archea, methane producing archea | |
| 10. Protists | 3 |
| Diplimonads, Euglenozoans, Alveolates, Stramenophils, Radiolarians, Amoebozoa | |
| 11. Fungi | 4 |
| Fungal physiology, cell wall structure, fungal reproduction and parasexuality, classification: chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, deuteromycetes | |
| 12. Algae | 2 |
| Basis of classification, Chlorophyceae, Rhodophyceae | |
| 13. Antimicrobial agents and Pathogenicity | 4 |
| Physical and chemical antimicrobial control, antiviral and antifungal drugs, antimicrobial drug resistance | |
| 14. Microbial Interactions with Humans | 4 |
| Beneficial and harmful microbial interactions with humans, virulence factors and toxins, host factors in infection | |
| 15. Major diseases caused by bacteria, fungi and virus. | 3 |

Text Book: Brook Biology of Microorganisms, Madigan MT, Martinko JM, Dunlap PV, Clark DP. 12th Ed. Pearson Publishers, New York

Reference Book: Microbiology-Prescott, M. Lansing, Harley, P. John, Klein, A. Donald.

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Theory paper

Cognitive Processes
CON-306: Basics of Cognitive Psychology

Credit -45 hrs

UNIT- 1:

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

UNIT- 2: Perception: Meaning, Visual Perception-Top down and Bottom up Processing. 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.

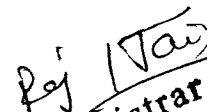
Reference Books/material :

1. Solso R.L.(2001) Cognitive Psychology Delhi: Pearson Education
2. Riegler B.R. & Riegler G.L.R. Cognitive Psychology: Applying the science of the Mind. Pearson Education
3. Smith, E.E. & Kosslyn, S.M.(2011) Cognitive Psychology: Mind and Brain. PHI Learning

4. Sternberg
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1. Brief Information of Nucleic Acid: 2
Double Helix Concept, The Central Dogma, Nucleic Acid convey genetic information
2. Isolation of Nucleic Acid and Electrophoresis of Protein and Nucleic Acid 3
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 2
Bacteriophage and Bacteria, Baker's Yeast, Nematode (*C. elegans*), Fruit Fly (*D. melanogaster*) and House Mouse (*M. Musculus*)
4. Structure of Nucleic Acid 2
DNA structure, DNA Topology and RNA Structure
5. Replication of DNA 3
DNA synthesis (Initiation, Origin Selection, Activation of the Initiator Protein and finishing or replication), Mechanism of DNA Polymerase.
6. DNA Repair and Homologous Recombination 5
Replication Errors, DNA Damage and Repair of DNA. Models for Homologous Recombination, Recombination proteins, Homologous Recombination in Eukaryotes, Mating type Switching and Genetic Consequences.
7. Site-Specific Recombination and Transposition of DNA 3
Conservative Site Specific Recombination and its role, Transposition, Transposition Elements and their regulations.
8. Mechanism of Transcriptome: 3
RNA Polymerase and Transcriptome Cycle, Transcription in Prokaryotes and Eukaryotes
9. RNA splicing: 3
Chemistry of RNA Splicing and Its Machinery, Splicing Pathways, Alternative Splicing, Exon Shuffling, RNA Editing, m-RNA Transport.
10. Translation 4
m-RNA, t-RNA, Ribosome, Initiation Elongation and termination of Translation, Regulation of mRNA and Protein Stability.
11. The Genetic Code 2
Degenerate Code and Rules that Govern The Genetic Code, Universal Code
12. Gene Regulation in Prokaryotes 4
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 4
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.


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14. Comparative Genomics and the Evolution of Animal Diversity

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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:-

Molecular Biology of the Gene; James D. Watson, Tania A. Baker, Stephen P. Bell.

Reference Book

Gene IX: Benjamin Lewis

Molecular Biology of the cell; Alberts, Bray, Johnson, Lewis

Molecular Cell Biology; Lodish, Berk, Mastudaira

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Paper Code – CTG-308 Programming in Java

3 Credits (45 Hrs)

Overview of Object Oriented Programming, Introduction to Java Development environment, Overview of Control Structures, Program Modules in java (methods, classes, packages), Crating 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). (4)

Inheritances: 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. (2)

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. (3)

GUI components: input/output with JOption Pane, overview of swing components, displaying text and images in a window, event handling, JLabel, JText Field, JPasswordField, 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. (5)

Graphics and Java2D: Graphics Contexts and Graphics Objects, color control, font control, drawing lines, rectangles, ovals, arcs, polygons and polylines, Java2DAPI. (4)

Files and Streams: Data hierarchy, files and streams, class File, sequential access and random access files. (3)

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. (4)

Java Applets: Introduction, executing an Applet in applet viewer and Web Browser, Applet life-cycle methods, initializing an instance variable with method init. (4)

Java Multimedia: images, animation and audio.

Recommended Books:

1. Deitel and deitel: Java How to Program, Sixth edition, Pearson Prentice Hall, 2007.
2. Deitel and Deitel: C How to Program, Fourth edition, Pearson Prentice Hall.

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S. No	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs)	
					L	T	P	Thy	P
1	CTG-401	Solid State Physics	CCC	3	3	0	0	3	0
2	CTG-402	Quantum Chemistry	CCC	3	3	0	0	3	0
3	CTG-403	System Analysis & Design	CCC	3	3	0	0	3	0
4	CTG-404	Numerical Methods and Implementation in C++/Java	CCC	3	3	0	0	3	0
5	CTG-405	Electronic Data Communication	CCC	3	3	0	0	3	0
6	CTG-406	Developmental Biology	CCC	3	3	0	0	3	0
7	CTG-407	Statistical Methods	CCC	3	3	0	0	3	0
8	CTG-408	Entrepreneurship	CCC	3	3	0	0	3	0
9	CTG-411	Electronics & Solid State Physics	CCC	4	0	0	6	0	4
10	CTG-412	Advance Biology Lab	CCC	4	0	0	6	0	4
11	CTG 413	LAMP Project and Numerical Methods Implementation Lab	CCC	4	0	0	6	0	4
Total				36					

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CTG-401: SOLID STATE PHYSICS

- (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.
b) Chemical Bonding : H₂ and covalent bonding, hybridization, hopping, bandwidth, population analysis. Asymmetric case H-Cl and ionic bonding, modelung energy, more general case of overlap and eigenvalue equation Tight Binding Hamiltonian Van der waals bonding, Hydrogen Bonding.
- 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 seprate 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, dlation and anharmonicity 3 hours
- Theory of Metals: Fermi-Dirac distribution function, density of states, temperature dependence of Fermi energy, specific heat, use of Fermi-Dirac statistics in the calculation of thermal conductivity and electrical conduction band, Drude theory of light, absorption in metals.
- Band Theory: Bloch theorem, Kronig Penny model, effective mass of electrons, Wigner-Seitz approximation, NFE model, tight binding method and calculation of density for a band in simple cubic lattice.

Recommended Books:

- Kittle: Introduction to Solid state physics.
- Kittle: Elementary statistical mechanics.
- Paleros: Solid State Physics.
- Levy: Solid State Physics.

CTG-402: QUANTUM CHEMISTRY

- 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. Schrodinger equation for hydrogen atom in terms of polar coordinates, quantum numbers.

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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, allyl 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:

1. Quantum Chemistry. R.K. Prasad, New age international Pvt. Ltd.
2. Introductory Quantum Chemistry, A.K. Chandra, Tata McGraw-Hill publishing Company Limited.

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 involve at in System Analysis and Design.

System Development Life Cycle – Recognition of need, Impetus for system change, feasibility study, Analysis, Design, Implements post for Implementation and Maintenance.

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 glairing 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 Maintenance – Security and disaster planning and management's Modern approach to SCLC.

Recommended Books:

1. System Analysis and Design, Elias M.Awad. Software Engineering
2. PankajJalote, Software Engineering pressman.

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
2. Rajaraman V: Computer Oriented Numerical Methods, PHI 1993,
3. K sankaraRao, Numerical Methods for Scientists and Engineers, Prentice Hall India.
4. Krishnamurthy E.V. Sen S.K.: Computer Based Numerical Algorithms, East west Press 1984.

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

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Transmission Media: Electromagnetic Spectrum for Telecommunication, Guided Transmission Media (Twisted Pair, Coaxial Cable, Optical Fiber), Unguided (Wireless) Transmission Media (Terrestrial and Satellite Microwave, Broadcast Radio, Infrared).

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).

The Data Communication Interface: Parallel Transmission, Serial Transmission (Asynchronous, Synchronous), Line Configurations (Topology, Transmission Modes), Interfacing (DTE, DCE, Characteristics of an Interface)

Data Link Control: Flow Control (Stop-and-Wait, Sliding-Window), Error Detection and Correction (Types of Errors, Redundancy, Parity Check: VRC & LRC, CRC: Polynomials, Checksum, Hamming Code), Error Control (Stop- and .Wait ARQ, Go-back-N ARQ, Selective-reject ARQ)

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
2. Behrouz Foruzan, Introduction to Data Communication and Networking, Tata McGraw-Hill.
3. Bernard Sklar, Digital Communications, Pearson Education Asia.
4. Wayne Tomasi, Electronic Communications Systems, Pearson Education Asia.

CTG – 406: Developmental Biology

Developmental Biology of Plants

1. **Vegetative Phase of Plant Development:** Meristems, Shoot, Root apical meristems, Primary, Secondary, Auxillary, Intercalary, 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, Sporogenous tissue.
6. **Development of female gametophyte:** Megasporogenesis, Pollination and fertilization, Endosperm.
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.
9. **Molecular Biology of Plant Development:** Life cycle of *Arabidopsis*. Special genes for embryogenesis, Monopteros gene. *SHR, SCR, STM, HOBBIT* and Embryo Maturation Genes, Initiation

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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 t 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:

1. S. C. Gupta, V. K. Kapoor, Fundamentals of mathematical statics, Sultan Chand & Sons.

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
2. **Growth of a Business idea:** Introduction, New Business Idea, Pre-selection Process, Sources of Business ideas, Preliminary Research, Business idea Evaluation, Other analysis
3. **Intellectual Property-** Introduction, Trademarks, Copyright, Patents, Geographical Indications (GI) of Goods, Designs, Other Laws in India Relating to IPR, Trade Secrets and Confidential Information.
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, Promotion/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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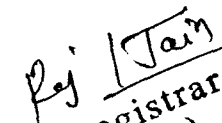
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Fifth Semester

Batch -

Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs)	
				L	T	P	Thy	P
CTG 501	Introduction to Nanotechnology	CCC	3	3	0	0	3	0
CTG 502	Introduction to Nano-electronics	CCC	3	3	0	0	3	0
CTG 503	Genetic Engineering and Recombinant DNA Technology	CCC	3	3	0	0	3	0
CTG 504	Introduction to Bio-Informatics	CCC	3	3	0	0	3	0
CTG 505	Artificial Intelligence-1	CCC	3	3	0	0	3	0
CTG 506	Functional Programming Language	CCC	3	3	0	0	3	0
CTG 507	Introduction to Cognitive Science	CCC	3	3	0	0	3	0
CTG 508	Introduction to Neuroscience	CCC	3	3	0	0	3	0
CTG 511	Electronics Workshop	CCC	3	0	1	4	0	4
CTG 512	Nanosynthesis Laboratory	CCC	3	0	1	4	0	4
CTG 513	Genetic Engineering and Recombinant DNA LAB	CCC	3	0	1	4	0	4
CTG 514	Functional Programming Language Lab	CCC	3	0	1	4	0	4
Total Credit of CCC papers			36					


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Fifth Semester

Theory Paper

Paper 501

COURSE NANO-01: Introduction to Nanotechnology

- Unit - I Emergence of Nanotechnology (10)**
Schrodinger equation
Electron confinement
Tunnelling of a particle through potential barrier
Density of states (0D, 1D, 2D, 3D)
- Unit - II Synthesis of Nanomaterials (30)**
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 microemulsions, Sol-Gel method.
- Unit - III Characterization and properties of nanomaterials (10)**
Structural characterization
Chemical characterization
Properties: Mechanical, optical, electrical and magnetic
- Unit - IV Application of Nanomaterials (8)**
Nanobots, catalysis of gold nanocrystals
Band gap Engineered Quantum devices
Carbon Nanotube Emitters
Photoelectrochemical cells
Bio Sensors

Recommended Books:

1. Introduction to Nanotechnology - Charles P. Poole Jr. et al John Wiley & Sons (Asia) Pte. Ltd.
2. Nanotechnology: Principles and Practices - Sulabha K. Kulkarni, Delhi.
3. Nanostructures and Nanomaterials: Synthesis, Properties and Application Guozhong Cao, Imperial College Press, UK.
4. Nanostructured Materials and nanotechnology, Editor Hari Singh Nalwa (Concise Edition) Academic Press.
5. Inorganic nanowires CRC Press M.Meyyappan and Mahendra K Surtkar

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Theory Paper

Paper 502

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 (10)

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. (10)

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. (10)

Unit IV The Single Electron Transistor

Single electron transistor and its logic, Carbon nanotube Transistor (FET and SET), Molecular SETs and Molecular Electronics. (10)

Recommended Books:

1. Fundamentals of Nanoelectronics by George W. Hanson Pearson Education
2. Introduction to Nanoelectronics Science, Nanotechnology, Engineering and Applications by Vladimir V. Mitin et al Cambridge University Press.

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40 Recombinant DNA Technology and Genetic Engineering

Course - 503

Recombinant DNA Technology (20)

- 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 (23)

- 1.) Gene transfer to animal cells. Strategies for gene transfer. Physical transfection techniques (electroporation and ultra sound). Selectable markers for animal cells. Bacterial and Viral Vectors.
- 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.
- 4.) Gene Transfer to plants. Plant tissue culture techniques—callus culture, protoplast culture. Regeneration of fertile plant—organogenesis and embryogenesis.

BOOK-Principles of Gene Manipulation and Genomics
AUTOR- Primose and Twyman

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COURSE BIO-02: Introduction to Bioinformatics

1. **Overview of Bioinformatics** (10)
History, scope and application, Internet and World Wide Web.
2. **Bioinformatics Resources and Information Retrieval** (8)
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** (10)
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** (7)
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** (8)
Phylogeny its definition and understanding, Phylogeny and bioinformatics for evolution.
6. **Protein structure: Analysis and prediction** (10)
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, searching for motifs, profiles and patterns, 3-D structure visualization and modeling.
7. **Bioinformatics In Drug Discovery** (8)
Drug discovery and development-the lead compound, bioinformatics in drug discovery and development.
Drug discovery process, The lead compound, Chemical file formats.
Drug databases and Resources (Pubchem, Drug Bank, Super Drug, Chemfinder).
Chemical sketching (ISIS Draw, Chemskech).

Recommended Books:

- Fundamental Concepts of Bioinformatics, Dan E Krane, Elaine Nicpon Marieb, Michael L Raymer, Benjamin Cummings Publication (Indian Edition)

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- Bioinformatics: Sequence and Genome Analysis, David W Mount, Cold Spring Harbour Laboratory Press. (Indian Edition)
- Introduction to Bioinformatics, Arthur M Lesk, Oxford University Press

Theory Paper

Paper 505

COURSE ICT-01: Artificial Intelligence

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

Intelligent Agents: Agents and Environments, Good Behavior: The concept of Rationality, Performance measures, Rationality, Omniscience, learning, and autonomy, Nature of Environments, the task environment, structure of agents, agent programs, simple reflex agents, Model - based reflex agents, Goal - based agents, Utility- based agents, Learning agents. (A)

Solving Problems by Searching: Problem - Solving Agents, Well defined problems and solutions, Formulating problems, Toy problems, Real Word problems, searching for Solutions, Measuring Problems - solving performance, uniformed search strategies, Breadth - first search, Uniform - cost search, Depth - first search, Depth - limited search, Iterative deepening depth - first search, Bidirectional search, Comparing uninformed search strategies, Avoiding Repeated States, searching with partial information, sensor less problems, Contingency problems. (A)

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. (A)

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. (A)

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. (A)

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Logic Agents: Knowledge - Based Agents, Wumpus World, Propositional Logic, Reasoning Patterns in Propositional Logic, Effective propositional inference, A complete backtracking algorithm, Local - search algorithms, Hard satisfiability problems, Agents Based on Propositional Logic, Finding pits and wumpuses using logical inference, Keeping track of location and orientation, Circuit - based agents. (●)

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. (●)

Inference in first-orders logic: Propositional vs. First Order Inference, Inference rules for Quantifiers, Reduction to propositional inference, Unification and Lifting, A first-order inference rule, Unification, Storage and retrieval, Forward Chaining, First-order definite clauses, a simple forward-chaining algorithm, Efficient implementation of logic programs, Redundant inference and infinite loops, Constraint logic Programming, Resolution, Conjunctive normal form for first-order logic, the resolution inference rule, Completeness of resolution, Dealing with equality, Resolution strategies, Theorem provers, Design of a theorem provers, Theorem provers as assistants, Practical uses of theorem provers. (●)

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, Fluents and objects, Mental events and mental objects, a formal theory of beliefs, knowledge and belief, 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:

"Artificial Intelligence: A Modern Approach" (second edition) by Stuart Russell and Peter Norvig, Prentice Hall of India Pvt. Ltd., New Delhi 2008

(The COURSE is based on first ten chapters of the book)

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COURSE ICT-02: Functional Programming Language

- Fundamental Concepts:** Sessions and scripts, evaluations, values, function, definitions, types, specifications. (4)
- Simple Data Types:** Booleans, Characters, Enumerations, Tuples, Other types, Type Synonyms, Strings. (6)
- Numbers:** Natural Numbers, Induction, the Fold Function, Haskell numbers and examples: The rationals, liner and binary search, Church numbers. (4)
- Lists:** Notations, operations, map and filter, Zip, the Fold functions, laws of fold. Examples: Converting numbers to words, producing class liast, arbitrary precision arithmetic, pritting a calendar, text processing. (6)
- Trees:** Binary trees, Binary search trees, Binary heap trees, Rose trees, Example: Huffman trees, meertens number. (6)
- Efficiency:** Lazy evaluations, Asymptotic analysis, Accumulating parameters, Tupling Controlling space, Fusion, finite differencing and deforestation. (6)
- Abstract Data Types:** Modules, Sets, Bags, Flexible arrays, Queucs. (6)
- Infinite lists:** Infinite lists as limits, properties of infinite lists, cyclic structures, Example: the paper-rock scissors game. (6)
- Monads:** Monadic interaction, Variations on an evaluator, Monad laws, combining monads. (6)
- Parsing:** Sequencing, Alteration, Repetition, Efficiency. (6)
- An automatic Calculator:** Basic considerations, expressions, laws and calculations, matching and substitutions, subexpresssions and rewriting, testing the calculator. (6)

Recommended Books:

"Introduction to Functional Programming by Richard Bird, Prentice Hall of India Pvt. Ltd., New Delli-2008."

(The scope of COURSE based on all chapters of the above referred book)

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Theory paper

Credit -45 hrs

COURSE CON-507: Introduction to Cognitive Science

- UNIT- 1. Introduction** (6)
Introduction, Cognition: Beginning Concepts, Historical and Futuristic perspectives.
- 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)
Logic, Rules, Concepts, Analogies, Images, Connections.
- 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.
- UNIT- 7. Cognitive Science** (4)
Bodies, The world, Dynamic Systems and Societies.
- UNIT- 8. Research Methods in Cognitive Science** (5)

References Books:

1. Thagard P. (2005) Mind: Introduction to Cognitive Science. MIT Press.
2. Kolak, D. et. al (2006) Cognitive Science : an introduction to Mind & brain
3. Solso R.L. (2001) Cognitive Psychology Delhi: Pearson Education
4. Berk, L.E. (2003) Child development Delhi: Pearson Education
5. Matlin, M.W. (2002). Cognition, USA, Wadsworth, Thomson Learning

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Credit -45 hrs

COURSE CON-508: Introduction to Neuroscience

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.

Ionic Channels and Pumps (Voltage and Ligand Gated Channels, Mechanisms of Blocking and Inactivation, Restitution 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. (8)

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)

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Reference Book:

1. Guyton A.C., Hall J.E. Textbook of Medical Physiology, 11th Edition, Elsevier, 2006.
2. Kiernan J. A. Barr's The Human Nervous System: An Anatomical Viewpoint, Lippincott-Raven.
3. Bear M.F., Connors B.W., Paradiso M.A. Neuroscience exploring brain, Lippincott-Williams & Wilkins
4. Kandel ER, Schwartz JH, Jessell TM. Principals of eural Science, 4th edition ,Newyork: McGrawHill, 2000.

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**VI (SIXTH)
SEMESTER**

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CENTRE FOR CONVERGING TECHNOLOGIES
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VI Semester SYLLABUS

Paper	Description	Credit
601	Synthesis and Characterization of Nanomaterials	3
602	Nanophotonics	3
603	Metabolic Engineering	3
604	Structural Bioinformatics omics science	3
605	Basic of Quantum Computing	3
606	Transmission Control Protocol / Internet Protocol	3
607	Cognitive Neurology	3
608	Brain Mapping & Imaging	3
609	Nanomaterial Synthesis Lab	4
610	Psychology Lab	4
611	Bioinformatics Lab	4
612	MATLAB Programming	4

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Theory Paper

Paper No – 601

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 del' 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 $\text{Cd}(\text{OH})_2$, 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 selfassembly, Mesoporous electrodes, Composite electrodes consisting of nanoparticles), Principles of electrochemical techniques (Impedance spectroscopy, Potential sweep method, Potential step method).

References:

1. Nanostructures and Nanomaterials: Synthesis: Synthesis, Properties and Applications, Guozhong Cao, Imperial College Press.
2. Characterization of Nanophas Materials , Zhong lin Wang, Wiley-VCH Verlag.
3. Introduction to Magnetic Materials, B.D. Cullity and C.D. Graham; Wiley, A John Wiley & Sons, Inc. Publications, USA.

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Theory Paper

Paper No – 602

Course : NANO-04 Nanophotonics

Foundations for Nanophotonics

Photons and Electrons: Similarities and Differences: Free-Space Propagation, Confinement of Photons and Electrons, Propagation Through a Classically Forbidden Zone: Tunneling, Localization Under a Periodic Potential: Bandgap, Cooperative Effects for Photons and Electrons, Nanoscale Optical Interactions: Axial Nanoscopic Localization, Lateral Nanoscopic Localization.

Quantum-Confined Materials

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

Photonic Crystals

Basic Concepts, Theoretical Modeling, Features, Methods of Fabrication, Photonic Crystal Optical Circuitry, Nonlinear Photonic Crystal, Photonic Crystal Fibers, Photonic Crystal and Optical Communications, Photonic Crystal Sensors.

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, Nanoclinics for Optical Diagnostics and Targeted Therapy, Nanoclinic Gene Delivery, Nanoclinics for Photodynamic Therapy.

References :

1. Nanophotonics - Paras N. Prasad Wiley Inter Science 2004
2. Nanophotonics - Edited by Herice Rigneault, Jean-Michel Lourtiz, Claude Delalande, Ariel Leuenson ISTE

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Theory Paper

Paper No - 603

Course : BIO-03 Metabolic Engineering

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 Process (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

Enhancement of product yield and productivity (Ethanol, Amino acids, Solvents), Extension of Substrate Range (Metabolic Engineering for Pentose Metabolism for Ethanol production, Cellulose-hemicellulose depolymerisation, Lactose and Whey utilization, Sucrose utilization, Sucrose Degrading microorganisms), Extension of Product Spectrum and Novel Products (Antibiotics, Polyketides, Vitamins, Biopolymers, Biological Pigments, Hydrogen, Pentoses: Xylitol), Improvement of Cellular Properties (Alteration of Nitrogen Metabolism, Enhancement of Oxygen utilization, Prevention of overflow metabolism, Alteration of Substrate uptake, Maintenance of Genetic Stability), Xenobiotic Degradation (Polychlorinated Biphenyls (PCBs), Benzene, Toluene, p-Xylene mixtures (BTX))

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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. Stephanopoulos, Aristos A. Aristidou, Jens Nielsen.

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VI SEMESTER

Paper CTG 604

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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Theory Paper

Paper No - 605

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, opticalcavity quantum electrodynamic, Ion traps, Nuclear Magnetic resonance.

References :

- 1 Quantum Computation and quantum information by Michael A. Nielsen and Isaac L. Chuang, Cambridge Press, (200)
- 2 Quantum Computing by Vishal sahani, Tata Mgraw Hill (2008)

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Theory Paper

Paper No – 606

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 :

1. W.R. Stevens – Unix Programming, Vol. I, II, 2nd ed. Pearson/Prentice Hall of India
2. Douglas E. Comer – Internet working with TCP/IP vol. I, II, III, Pearson/PHI
3. W.R. Stevens – TCP/IP illustrated Vol. I, II III pearson/prentice Hall of India.

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Paper No-607
Course:COGNO-03 Cognitive neurology

- Module-I Evolution and Development of the nervous system: (4)
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: (9)
Neural Coding and Decision-Making Mechanisms, Functional Subdivisions and Processing streams of
Primate Cortex, Neuronal Correlates of Visual Attention and Perception. Short Term Memory for the Rapid Deployment
of attention.
- Module-III Motor Systems: (10)
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, Sensorimotor Transformation Transformations in the posterior parietal
cortex, Motor Learning and Memory For Reaching and Pointing.
- Module-III Perception: (3)
Origin of perception (Retinal Ganglion Diversity and the Creation of Parallel Visual Pathways)
- Module-IV Brain Mechanisms of Emotion: (3)
Theories of Emotion, Limbic System Concept, The amygdala & associated brain Circuits.
- Module-V Memory Systems: (6)
Types of Memory and amnesia.
The search for the engram.
The temporal lobes and declarative memory.
The striatum and procedural memory.
The neocortex and Working memory.
- Module-VI Molecular mechanisms of learning and memory: (6)
Procedural learning.
Simple Systems: Invertebrates models of learning.
Vertebrate models of learning.
The molecular basis of long term memory.
- Module-VII Cognitive Neuroimaging: History, Developments and Direction. (4)

References:

Kandel ER, Schwartz JH, Jessell TM. Principles of Neuroscience, 4th edition Newyork:McGraw-Hill,2000. Michael S.
Gazzaniga, The Cognitive Neurosciences III, 3rd edition.
Bear M.F, Connors B.W, Paradiso M.A , Neuroscience Exploring the brain, Third edition, Lippincott, Williams &
Wilkins.

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Theory Paper

Paper - 608

COURSE COGNO-04: Brain Mapping and Imaging

- I. **Nerve conduction & Electromyography** (8)
- o History of Clinical Neurophysiology,
 - o Introduction to electro diagnostic signals & their measurement
 - o Principal of Nerve conduction study
 - o Introduction to Electromyography
 - o Technique of Electromyography
- II **Electroencephalography** (12)
- Historical Perspective, Technical aspect of EEG recording and reporting
- III **Cerebral Computed Tomography** (10)
- Introduction to Computed Topography (CT), Principals & Techniques of image reconstructions with CT, Performance of CT scanning
- IV **Magnetic Resonance Imaging (MRI)** (10)
- Introduction to MRI, MRI Techniques: MRI, DWI & PWI, MR Spectroscopy in diagnosis & Neurological Decision - Making
- V **Brain Mapping** (5)
- Introduction & History, Definition & Terminology, Methodology, Data Acquisition & Signal Analysis.

Recommended Books:

1. Clinical Neurophysiology: VK Mishra & J Kalita, Elsevier publication 2nd edition
2. Clinical Electroencephalography, V.K. Mishra & J Kalita. Elsevier Publication.
3. Cerebral Computed Tomography - A Text Atlas. Weisberg, Nice & Katz, 2nd edition, 1984.
4. Atlas of Brain Mapping, Topographic Mapping of EEG & Evoked Potentials, Konrad Maurer & Thomas Dierks, Springer - Verlag.
5. Seminars in Neurology, (2008) Vol-28, No 4, Neurology Essentials for the clinician. Thieme Medical Publishers, New York

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**VII (SEVENTH)
SEMESTER**

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Center for Converging Technologies
University of Rajasthan, Jaipur
(Tele-0CTG 14CTG 1-2700370)
Seventh Semester
(2017-18)

Code	Course Category	Description	Credit
CTG701 N	Thy	Optoelectronics Devices	3
CTG702 N	Thy	Polymer Engineering	3
CTG 703 N	Thy	Computational Nanotechnology	3
CTG 704 N	Thy	Nanocomposites	3
CTG 701 B	Thy	Agricultural Biotechnology	3
CTG 702 B	Thy	Bioprocess Engineering and Technology	3
CTG 703 B	Thy	Bioinformatics	3
CTG 704 B	Thy	Molecular Biotechnology	3
CTG 701 I	Thy	Computer Graphics	3
CTG 702 I	Thy	Optical Fiber Communication	3
CTG 703 I	Thy	Open Course System Design and Analysis of Algorithm	3
CTG 704 I	Thy	Machine Learning	3
CTG 701 C	Thy	Philosophy of Mind	3
CTG 702 C	Thy	Principle & Techniques of Neuroscience	3
CTG 703 C	Thy	Introduction to Dynamical systems for Neuroscience	3
CTG 704 C	Thy	Introduction of Computational Neuroscience	3
CTG 704	Thy	Fundamentals of Accounting	3
CTG 711 N	Lab	Nanomaterial Fabrication and Characterization Lab	8
CTG 712 N	Lab	Computational Nanotechnology Lab	8
CTG 711 B	Lab	Biotechnology Lab	8
CTG 712 B	Lab	Bioinformatics Lab	8
CTG 711 I	Lab	Algorithm Implementation Lab	8
CTG 712 I	Lab	Server installation and Configuration Lab	8
CTG 711 C	Lab	Cognitive Lab	8
CTG 712 C	Lab	Neurosciences Lab	8
CTG 713	Lab	NBIC Research Review Project	8

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Theory Paper
COURSE NANO-05: Optoelectronics Devices

Paper 701 N

①

1. SEMICONDUCTOR SCIENCE AND LIGHT EMITTING DIODES -15

Semiconductor Concepts and energy Bands, Direct and Indirect Bandgap Semiconductors : E-k Diagrams, PN Junction Principles, PN Junction Band Diagram, Light Emitting Diodes, LED Materials, Heterojunction High intensity LEDs, LED Characteristics, LEDs for Optical Fiber Communications.

2. STIMULATED EMISSION DEVICES LASERS -10

Principle of the Laser Diode, Heterostructure Laser Diodes Elementary Laser Diode Characteristics, Steady State Semiconductor: Rate Equation, Light Emitters for Optical Fiber communications, Single Frequency Solid State Lasers, Quantum Well Devices, Vertical Cavity Surface Emitting lasers (VCSELs), Optical Laser Amplifiers.

3. PHOTODETECTORS -10

Principle of the PN Junction Photodiode, Ramo's Theorem and Internal Photocurrent, Absorption Coefficient and Photodiode Materials, Quantum Efficiency and Responsivity. The pin Photodiode, Avalanche Photodiode, Heterojunction Photodiodes, Photoconductive Detectors and Photoconductive Gain.

4. PHOTOVOLTAIC DEVICES AND MODULATION OF LIGHT -10

Solar Energy Spectrum, Photovoltaic Device Principles, PN Junction Photovoltaic I-V Characteristics, Series Resistance and Equivalent Circuit, Temperature Effects, Solar Cells Materials, devices and Efficiencies, Electro-Optic Effects, Integrated Optical Modulators, Acousto-Optic Modulator, Magneto-Optic Effects.

Recommended Books:

1. Optoelectronics and photonics : Principles and Practices, Safa O. Kasap, University of Saskatchewan.

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POLYMER TECHNOLOGY AND APPLICATIONS

Unit I

Raw materials – petroleum, natural gas, biogas and coal sources of monomers – manufacture of acetylene, ethylene, propylene, vinyl chloride, toluene, phenol and styrene. Polymerisation reaction engineering – homogeneous and heterogeneous polymerisation – classification – bulk, dispersion, solution, suspension and emulsion polymerisations – reactors for polymerisation.

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 – compounding – fillers, plasticizers, coupling agents –antidegradants, cross-linking agents, stabilisers, lubricants, colourants, 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 – reaction injection moulding – sintering – solution casting – SMC and DMC – fibre spinning and drawing.

Unit IV Polymers Applications

Engineering plastics – polymers in electrical and electronics industry – electro conducting polymers – polymer batteries – electrets - polymers with piezoelectric, pyroelectric and ferroelectric properties- photo conducting polymers. Polymers for high temperature resistance- fluoro polymers – aromatic polymers- heterocyclic polymers – polymers as building materials – ultrahigh fibres – aramids – technora – carbon fibres.

Polymers in lithography – photoresist – positive resists – negative resists – solution inhibition resists – image reversal process – Ion exchange resins – polymer membrane –polymer complexes for water treatment.

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

Reference books

1. A. Brydson, Plastic materials, 4th edition, Butterworth – Heinemann Ltd., London, 2002
2. John Murphy, Additives for Plastics Handbook, 2nd edition, Elsevier Advanced Technology, 2003.
3. J.A. Biesenberger and H. Sebastian, Principles of Polymerisation Engineering, Wiley- Interscience Publication, New York, 1988.
4. D.H. Morton and Jones, Polymer Processing, Chapman and Hall, London, 1989. Stephen L. Rosen, Fundamental Principles of Polymeric Materials, 2nd edition, John Wiley and Sons Inc., New York, 1993.
5. H.F. Mark (Ed), Encyclopedia of Polymer Science and Engineering, Wiley – Interscience, New York, 1991
6. L. ... Chapoy (Ed), Recent Advances in Liquid Crystalline Polymers, Chapman and Hall, London, 1985
7. R.W. Dyson, Speciality Polymers, Chapman and Hall, New York, 1987.
8. C.P. Wong, Polymers for Electronic and Photonic Applications, Academic Press, New York, 1992

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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

Thomas- Fermi model, density functional theory, approximations, DFT, LDA, GGA, Hybrid, Basis sets, LMTO, plane wave methods, SCF process, simulation codes.

Ref. Books :- 1. J. Kohanoff :- Electronic Structure Calculations for Solids and Molecules : Theory and Computational Methods Cambridge University Press (UK) 2006

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

3. K. J. Ramachandran, G. deepa and K. Namboori, Computational Chemistry and Molecular Modeling , Springer-Verlag (Berlin) 2008.

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COURSE NANO-10: Nanocomposites**Unit-I Bulk Metal and Ceramics Nanocomposites**

15

Ceramic/Metal Nanocomposites, Nanocomposites by Mechanical Alloying, Sol-Gel Synthesis, and Thermal Spray Synthesis, Metal Matrix Nanocomposites, Bulk Ceramic Nanocomposites, Thin-Film Nanocomposites: Multilayer and Granular Films, Carbon Nanotube-Based Nanocomposites, Functional Low-Dimensional Nanocomposites, Applications of Nanocomposite Wires and Particles, Inorganic Nanocomposites for Optical and Electrical Applications, Nanoporous Structures and Membranes: Particle-Dispersed Magnetic Nanocomposites, Magnetic Multilayer Nanocomposites, Microstructure and Thermal Stability of Layered Magnetic Nanocomposites.

Unit-II Introduction to Polymer Science and Nanocomposites

10

Fundamental Definitions, Configurational States, Homopolymers and Copolymers, Molecular Architecture, Molar Mass, Polymerization, Thermal Transitions and Physical Structure, Polymer Materials, Nanoscale Fillers, Carbon Nanotubes, Processing of Polymer Nanocomposites, Nanotube/Polymer Composites, Layered Filler-Polymer Composite Processing, Polyamide Matrices, Polyimide Matrices, PMMA/PS Matrices.

Unit-III Polymer-based and Polymer-filled Nanocomposites

12

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.

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Unit-IV Natural Nanobiocomposites, Biomimetic Nanocomposites, and Biologically Inspired Nanocomposites 8

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

Paper 701 B

COURSE BIO-05: Agricultural Biotechnology

- 1. Agricultural Research preparedness** 2
 - Genetics resources and allele mining
 - Biofortification, nanotechnology
 - Policy & regulatory issues to agricultural biotechnology
- 2. Plant Genomes : the organization and expression of plant genes** 3
 - 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

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3. Plant Tissue culture	3
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	3
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	3
Introduction	
Desirable feature of any plasmid vector	
Basic features of any plasmid vector	
Optimization	
Clean gene technology	
6. The genetic manipulation of herbicide tolerance	3
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	

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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

3

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- *Xanthomonas* spp

9. Reducing the effects of viral disease

4

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

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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 4

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 4

Introduction
 Carbohydrates and lipids
 Case study: Starch
 : Polyfructans
 : Bioplastics
 Molecular farming of proteins
 Case study: the olefin systems: 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 3

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 year

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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

3

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:

- Plant Biotechnology – The Genetic Manipulation of Plants, 2nd edition by Adrian Slater, Nigel W. Scott and Mark R. Fowler, Oxford University Press.
- Handbook of Plant Biotechnology, Vol. 1, 2 editors-in-chief Paul Chris Cou and Harry Klee. Wiley India Pvt. Ltd. Reprint-2010.
- Basic biotechnology by: Colin Ratledge and Bjorn Kristiansen Publication : Cambridge.

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Theory Paper

Paper 702 B

COURSE BIO-06: Bioprocess Engineering and Technology

1. Microbial process kinetics	4
Introduction, Kinetic modeling of cell growth, Mass balance for ideal Bioreactor	
2. Bioreactors	4
Introduction, Bioreactor design features, Specific Consideration	
3. Mass transfer in Bioreactors	4
Steps, Equations, Mass transfer coefficients, Effect of scale on mass transfer	
4. Downstream Processing	5
Cell disruption, Clarification, Filtration, Concentration, precipitation, ultrafiltration Purification, crystallization, Sequencing	
5. Bioprocess measurement, monitoring, modeling and control	2
6. Bioprocess economics	2
7. High throughput screening and bioprocess optimization	2
8. Bioprocess engineering for the industrial production of	3
Amino acids, Organic acids, Microbial polysaccharides and single cell oils	
9. Bioprocess environmental application	5
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	2
11. Strategies for cultivation of cells	3
Batch and continuous culture, Fed batch culture	
12. Enzyme Biotechnology	2
13. High value recombinant proteins	

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14. Plant cell culture in bioreactors 2
15. Biotransformations 3
Biocatalyst, Chemical synthesis

Recommended Books:

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

Theory Paper

Paper 703 B

COURSE BIO-07: Bioinformatics

1. Experimental methods for Biomolecular structure determination

X-ray and NMR, Identification/assignment of secondary structural elements from the knowledge of 3-D structure of macromolecule using DSSP and STRIDE methods. Prediction of secondary structure: PHD and PSI-PRED Methods.

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 ProsaII, 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 CHIME 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

Algorithms viz. Chou Fasman, GOR methods; nearest neighbor and machine learning based methods, analysis of results and measuring the accuracy of predictions, 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/comparative Modeling, fold recognition, threading approaches, and ab initio structure prediction methods

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. Bourne

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Theory Paper

Paper 704 B

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, phytoremediation. 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.

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UNIT 10: REGULATING THE USE OF BIOTECHNOLOGY: regulating recombinant DNA technology, deliberate release of genetically modified micro-organisms, regulating food and food ingredients, patenting biotechnology. 3

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. 3

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. 5

UNIT 13: BIOSAFETY: IBSC, its composition, functions, Checklist of IBSC-Scientific considerations, Molecular biology details, Human health considerations, Containment facilities, General considerations. Status of Biosafety regulations: Regulatory framework in various countries, Cartagena protocol on biosafety, international guidelines, regulatory framework in India, Government rules for GMOs, Six competent authorities of biosafety (RDAC, IBSC, RCGM, GEAC, SBCC, DLC), Recombinant DNA Guidelines, 1990; Guidelines for research in transgenic plants, 1998; Drugs and Cosmetics Rules (8th Amendment) 1988; Guidelines for generating preclinical and clinical data for rDNA therapeutics, 1999; Drug Policy, 2002; Seed Policy, 2002; Biosafety concerns, Risk assessment and management. 8

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.

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Paper 701 I

Computer Graphics

Graphics display devices, Input devices, Rendering pipeline, Raster Graphics: Line and Circle drawing algorithms, Windowing, Clipping: Cohen and Sutherland line clipping, Cyrus-beck clipping method, 2D and 3D Geometrical Transformations, Viewing Transformations: parallel and perspective projection, Curves and Surfaces: Cubic splines, Bezier curves, B-splines, Tensor product surfaces, Surface of revolution Sweep surfaces, Fractal curves and surfaces, Hidden line/surface removal methods, Illumination model, Polygon Shading: Gouraud, Phong, Introduction to Ray-tracing, Animation.

Suggested texts and reference materials

1. Computer Graphics (Principles and Practice) by Foley, van Dam, Feiner and Hughes, Addison Wesley (Indian Edition).
2. Computer Graphics by D Hearn and P M Baker, Prentice Hall of India (Indian Edition).
3. Mathematical Elements for Computer Graphics by D F Rogers, McGraw Hill (Indian Edition).
4. Procedural Elements for Computer Graphics by D F Rogers, McGraw Hill (Indian Edition).
5. Interactive Computer Graphics, A top-down approach with OpenGL by Edward Angel, Addison Wesley.
6. Curves and Surfaces for Computer Aided Geometric Design by G Farin, Academic Press.

Theory Paper

Paper 702 I

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. 7

Transmission Losses: Dispersion, attenuation & scattering in fibers, link analysis

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Fiber Measurement: Measurement of Fiber attenuation, bandwidth, power, & cut-off wavelength, OTDR. 7

Opto electronic devices:-Introduction to LEDs, Lasers, Photo-diodes, PIN diodes etc. 4

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. 9

SONET: frame format, overhead channels, payload pointer, Virtual tributaries, multiplexing hierarchy. 6

SDH: Standards, frame structure and features. 4

Optical switching, WDM networks, Fiber Amplifiers 4

Recommended Books:

1. Fiber Optics and Optoelectronics – R.P. Khare
2. Optical Communication - Keiser
3. Optical fiber communication - J.M. Senior
4. Optical fibers & Fiber Optical Communication Systems - Subir Kumar Sarkar.

DESIGN AND ANALYSIS OF ALGORITHMS Paper 703 I

Algorithm Analysis: Time, space, lower, upper bounds, asymptotic complexity, summation, recurrence.
Design Strategies: Divide-and-conquer, Dynamic Programming, Greedy methods, Backtracking, Branch-and-Bound Technique.
Graph Algorithms: Minimum Spanning Trees, Single-Source Shortest Paths, All-

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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, PHI

2. V. Aho, J. Hopcraft, 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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Theory Paper

Machine Learning

704
Paper 302-I

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, Futility of Bias free Learning.

Supervised Learning: Introduction, Learning a class from examples, Vapnik-chervonenkis dimension, Probably Approximately Correct (PAC) as learning, Learning Multiple class, Dimensions of a supervised machine learning algorithms.

Decision Tree Learning: Representing Concepts as decision trees, Recursive induction of decision tree. 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 Algorithm: 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, Naïve Bayes classifier, Bayesian Belief Networks, The EM Algorithm.

Computational Learning Theory: Models of learnability: Learning in the limit, PAC Learning, Sample Complexity: Finite Hypothesis spaces, Infinite Hypothesis spaces, Vapnik-chervonenkis dimension, Optimal Mistake Bound, Weighted -Majority Algorithm.

Instance Based Learning: Constructing explicit generalizations versus comparing to past specific examples, K-nearest neighbor Algorithm, Case-based learning.

Clustering and Unsupervised Learning: Unsupervised learning, Clustering Methods: Method based on Euclidean Distance, Method based on probabilities, Hierarchical clustering methods.

Reinforcement Learning: The Learning Task, Q-Learning, Limitation & Extensions of Q-Learning, Temporal Difference Learning, Nondeterministic Rewards & Actions, Relationship to dynamic programming, Passive reinforcement learning, Active reinforcement learning, Direct utility estimation.

Recommended Books:

1. Machine Learning, McGraw Hill, Tom M. Mitchell.
2. Introduction to Machine Learning, Ethem Alpaydm.
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig.

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Theory Paper

Paper 701 C

COURSE COGNO-05: Philosophy of Mind

Module 1: Conceptual and Historical Perspectives: Introduction to philosophy of mind.

Major philosophers: Plato, Aristotle, St. Thomas Aquinas, Rene Descartes, David Hume, and Immanuel Kant.

Schools of thought: rationalism, empiricism, idealism, realism, and skepticism.

(10)

Module 2: Cognitive Science and philosophy of mind: Epistemic and meta physical issues of mind in Cognitive science.

(2)

Module 3: Consciousness: General introduction to consciousness. The phenomenal and psychological concepts of mind. The knowledge and Modal arguments. The explanatory gap. Higher order thoughts and representationalism.

(7)

Module 4: Indian Theories of Mind: Ancient, AdiShankara, Buddhism.

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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:

1. Bechtel, W 1988. Philosophy of Mind: an overview for Cognitive Science. Hillsdale, NJ: Erlbaum.
2. Chalmers, D. J. 1986, 'The Conscious Mind: In search of a Fundamental Theory, Oxford: Oxford University Press.
3. Churchland, P.M. 1985b, Matter and Consciousness. Cambridge, MA: MIT Press.
4. David Chalmers, Philosophy of mind: Classical and Contemporary Reading.
5. Kolak, D. et al.(2006), Cognitive Science: an Introduction to Mind and Brain

Theory Paper

Paper 702 C

COURSE COGNO-06: Principle & Techniques of Neuroscience

Module 1: Neuroanatomy & Neurophysiology (6)

Neuroanatomy and Neurophysiology of cerebral cortex including lobes, corpus callosum, limbic system basal ganglia, Thalamus, hypothalamus, pituitary, 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.

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Module 3: Electro physiology

(6)

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

(8)

1. Basic principles and techniques of EEG recording.
2. Normal EEG pattern
3. Various artifacts
4. Puroxysmal EEG abnormalities.
5. Normal aging & transient cognitive disorders the elders.
6. Digital EEG.

Module 5: Brain Mapping

(4)

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.

(4)

Module 7: Introduction & principles of CT

conventional tomography, Principles of CT imaging, detector assembly, pixel-voxel concept, image display, spiral CT, Multi slice.

(2)

Module 8: Introduction & principles of MRI

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

(4)

Module-9: Basic principles & physics of ultrasound and Doppler

Ultrasound acoustics transducers, imaging process, Doppler principles, Doppler ultrasound, 2D, 3D echo ultrasound.

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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. (6)

Recommended Books:

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

Theory Paper

Paper 703 C

COURSE COGNO-07: Introduction to Dynamical Systems for Neuroscience

Part A: Introduction to Dynamical Systems

The qualitative analysis of nonlinear dynamical flows: Stability of fixed points, existence of limit cycles, The Poincare-Bendixson theorem, linearization and phase-plane analysis of nonlinear systems. Elements of the bifurcation theory: saddle-node, Andronov-Hopf, and homoclinic bifurcations.

(18)

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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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:

1. S. H. Strogatz, Nonlinear Dynamics and Chaos, Perseus, 2000 (Levant Books, 2007)

2. H.M. Izhikevich, Dynamical Systems in Neuroscience, The MIT Press, 2007

3. P. Dayan and L.F. Abbott, Theoretical Neuroscience, The MIT Press, 2001

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 the 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]

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Models of synaptic interactions: Description of synapses and neurotransmitter release. Mathematical models for excitatory and inhibitory synapses, Excitability and bursting of neurons. [9]

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:

Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems, by Peter Dayan and Larry F. Abbott. The MIT Press, 2001. ISBN 0-262-04199-5

Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting, by Eugene M. Izhikevich. The MIT Press, 2007. ISBN 0-262-09043-8

Simulating, Analyzing, and Animating Dynamical Systems: A Guide to XPPAUT for Researchers and Students, by Bard Ermentrout, SIAM 2002 ISBN 0-89871-506-7

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Center for Converging Technologies
University of Rajasthan, Jaipur
(Tele-0CTG 14CTG 1-2700370)

Eight semester B.Tech. Curriculum

2017-2018

Code	Subject	Credit	Description	Preference	Allo
CTG 801 N	Nano	3	Molecular Nano electronics		
CTG 802 N	Nano	3	Nano devices and Nano sensors		
CTG 803 N	Nano	3	Applications of Nano science		
CTG 804 N	Nano	3	Advanced Material Characterization		
CTG 801 B	Bio	3	Animal Cell Culture		
CTG 802 B	Bio	3	Proteomics		
CTG 803 B	Bio	3	Chemoinformatics & Drug Designing		
CTG 804 B	Bio	3	Advance Immunology		
CTG 801 I	Info	3	Microwave Communications		
CTG 802 I	Info	3	Network Security and Cryptography		
CTG 803 I	Info	3	Parallel Computing		
CTG 804 I	Info	3	Techniques in Artificial Intelligence		
CTG 801 C	Cogno	3	Sensation and Perception		
CTG 802 C	Cogno	3	PsychoNeurolinguistics		
CTG 803 C	Cogno	3	Clinical Neuroscience		
CTG 804 C	Cogno	3	Neuroimaging and Cognition		
CTG 811 N	Nano	8	Nanocomposite Lab		
CTG 812 N	Nano	8	Microscopy and Diffraction Lab		
CTG 811 B	Bio	8	Animal Cell Culture Lab		
CTG 812 B	Bio	8	Computational Biology Lab		
CTG 811 I	Info	8	Network Security Lab		
CTG 812 I	Info	8	Artificial Intelligence Lab		
CTG 811 C	Cogno	8	Neurolinguisitc Lab		
CTG 812 C	Cogno	8	Brain Imaging Lab		
CTG 813	NBIC	8	Review of Research Papers		

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B.Tech – M.Tech. Courses in the Four Streams of Converging Technologies
Theory Paper

Paper 801 N

COURSE NANO-08: Molecular Nanoelectronics

Unit-I Introduction 8
Molecular Electronics: Switches based on fullerenes and nanotubes, Polymer electronics, Self assembling circuits, Optical molecular memories.
Nanoelectronics: Electromagnetic fields and photons, Quantization of action, charge, and flux, Interaction of photons with electron in solids, Diffusion Processes, Information theory.

Unit-II Quantum Electronics Devices 15
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 7
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 Nano devices 15
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 Glosekotter, Jan Dienstuhl. Springer.
2. Spintronics: Fundamentals and Applications, Igor Zutic, Jaroslav Fabian, S. Das Sarma.
3. Transport in Nanostructures, David K. Ferry, Stephen M. Goodnick and Jonathan Bird. Cambridge University Press.

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COURSE NANO-09: Nanodevices & Nanosensors

Unit I: MEMS & NEMS Devices (part I)

12

MEMS Devices and Applications: Pressure Sensor (Piezoresistive Sensor, Capacitive Sensor), Inertial Sensor (Accelerometer), Optical MEMS (Visual Display, Precision Optical Platform, Optical Data Switching), RF MEMS (MEMS Variable Capacitors, Micromachined Inductors, MEMS Switches, MEMS Resonators), NEMS Devices and Applications.

Unit II: MEMS & NEMS Devices (Part II)

12

Tribological Issues in MEMS/NEMS, Tribological Studies of Silicon and Related Materials, Lubrication Studies for MEMS/NEMS, Component-Level Studies, MEMS Packaging (MEMS Packaging Fundamentals, Contemporary MEMS Packaging Approaches), Hermetic and Vacuum Packaging (Integrated Micromachining Processes, Post-Packaging Processes, Localized Heating and Bonding), Thermal Issues and Packaging Reliability (Thermal Issues in Packaging, Packaging Reliability, Long-Term and Accelerated MEMS Packaging Tests).

Unit III: Inorganic Nanotechnology Enabled Sensors

12

Gas Sensing with Nanostructured Thin Film, Adsorption on Surfaces, Effect of Gas Sensitive Structures and Thin Films, Effects of Deposition Parameters and Substrates, Metal Oxides Modification by Additives, Surface Modification, Filtering, Post Deposition Treatments. Nanotechnology Enabled Mechanical Sensors, Oscillators based on nanoparticles, One-Dimensional Mechanical Sensors, Bulk Materials and Thin Films Made of Nano-Grains, Nanotechnology Enabled Optical Sensors, The Optical Properties of Nanostructures.

Unit IV: Organic Nanotechnology Enabled Sensors

9

Adsorption, Physical Entrapment, Chemical Entrapment, Self-Assembly, Layer-by-Layer Assembly, Proteins in Nanotechnology Enabled Sensors, The Structure of Proteins, The Analysis of Proteins, The Role of Proteins in Nanotechnology, Using Proteins as Nanodevices, Antibodies in Sensing Applications, Antibody Nanoparticle Conjugates, Enzymes in Sensing Applications, Enzyme Nanoparticle Hybrid based Sensors, Motor Proteins in Sensing Applications.

Recommended Books:

1. Handbook of Nanotechnology (Springer), Bharat Bhushan.
2. Nanotechnology-Enabled Sensors, Kourosh Kalantar-Zadeh, Benjamin Fry.

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Theory Paper

Paper 803 N

COURSE: Applications of Nanoscience and Technology

NANO BIOMATERIALS

Introduction-Biocompatibility – anti bacterial activity – principles involved – Applications, Biomaterial nanocircuitry; Protein based nanocircuitry; Neurons for network formation, DNA nanostructures for mechanics and computing and DNA based computation; DNA based nanomechanical devices.

NANO-BIOTECHNOLOGY

Interaction between biomolecules and nanoparticle surface, Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, Application of nano in biology, nanoprobes for Analytical Applications-A new methodology in medical diagnostics and Biotechnology, Current status of nano Biotechnology, Future perspectives of Nanobiology, Nanosensors.

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.

NANOFLUIDICS

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

BIOMOLECULE SEPARATION, CONCENTRATION AND DETECTION USING NANOFLUIDIC CHANNELS Introduction – Fabrication techniques for Nanofluidic channels – Biomolecules separation using nanochannels – Biomolecules Concentration using Nanochannels – Confinement of Biomolecules using Nanochannels.

HUMAN EXPOSURE TO ANNO SIZED 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.

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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 Nano-biological 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 nano-technology: Ion irradiation of surfaces, surface, roughness, formation of nanopores, hillocks and self assembled nanodots, embedded nanoparticles and their applications in optoelectronics, Focused ion beams, nano-scale fabrication, ion beam milling and nanolithography.

Reference books:

1. Introduction to Nanotechnology Charles P. Poole Jr. & Frank Owens Wiley & Sons, Inc. Edition.
2. Nanotechnology: Principles and Practices by Sulabha K. Kulkarni, Capital Publishing Company.
3. Nano structures and Nano materials G. Cao Publisher, Imperial College Press.

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Theory Paper

Paper 801 B

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
The Culture Environment, Cell Adhesion, Cell Proliferation, Differentiation, Cell Signaling, Energy Metabolism, Initiation of the Culture, Evolution of the Cell Lines, The Development of Continuous Cell Lines, Origin of Cultured Cells.
3. Defined Media and Supplements 2
Development of Media, Physiochemical 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
Media of Reagents and Materials, Sterilisation of Apparatus and Liquids, Apparatus, Reagents and Media, Control Testing and Storage of Media.
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
Cell Cloning, Stimulation of Plating Efficiency, Suspension Cloning, Isolation of Clones, Replica Plating, Selective Plating, Isolation of Genetic Variants, Interaction with Substrate, Cell Separation, Cell Density and Isopycnic Sedimentation, Cell Size & Sedimentation Velocity, Antibody Based Techniques, Fluorescence Activated Cell Sorting, Other Techniques, Beginner's Approach to Cell Separation.
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 the 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, Aberrant Growth Control, Tumorigenicity.

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Theory Paper

COURSE BIO-09 PROTEOMICS

Paper 802 B

UNIT I

5 hours

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

UNIT II

18 hours

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

10 hours

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

6 hours

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

6 hours

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

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B-803

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 Z matrix of simple small organic molecules.
4. Chemical Databases – Design, Storage and Retrieval methods; Introduction to database filters, property based & (drug-like)-Lipinski Rule of Five.
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 Wiener Index, Hosoya Index, Balaban Index, Shultz Index, Randic Index.
7. Introduction to shape indices- Kappa Shape index and calculation of molecular shape. Characterization of chemicals by Class & by Pharmacophore. Introduction to pharmacophore Identification of pharmacophore features. Building pharmacophore hypothesis; Searching databases using pharmacophores.
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.

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Paper Code: CCT-803B

STRUCUTRAL BIOINFORMATICS

4 Credits

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.
7. **Modificomics:** Understanding post-translational modifications by using proteomic techniques: What are post-translational modifications?, PTMs as a challenge for proteomics and bioinformatics, Techniques for characterization of PTMs, Gel electrophoresis and staining procedures for PTM identification, Identification and quantification of PTMs by Mass Spectrophotometry.
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 Lesk
4. Introduction to proteomics: Tools for new Biology – DC Liebler

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Theory Paper

Paper 804 B

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. Zabriskie, CAMBRIDGE UNIVERSITY PRESS
Instant Notes—Immunology, Garland Science/BIOS Scientific Publishers Limited.
Kuby Immunology
Janeway Immunology

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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. (3)

Microwave sources: (7)

(i) Tube based: Klystron, Magnetron, TWT.

(ii) Solid state devices: Gun oscillator and ~~READ~~ 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. (8)

Microwave measurements: Microwave detectors, Power measurements, Frequency measurement, VSWR measurement, Attenuation measurement and Input impedance measurement. (8)

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. (10)

Microwave propagation in ferrites, Faraday rotation, Devices employing Faraday rotation, Ferrite based components: isolator, Gyrator, Circulator, Microwave absorbers. (9)

Recommended Books:

1. Solid state Electronic Devices by B.G. Streetman and S. Banerjee, PHI
2. Foundations to microwave engineering by R.E. Collins, McGraw Hill
3. Microwave devices & circuits by S.Y. Liao, PHI
4. Solid State physical electronics by A. Vanderziel, (PHI, India).
5. Introduction to microwave theory by Atwater (McGraw Hill).
6. Microwave electronics by RE Soohoo (Addisen Westey public company)
7. Theory and application of microwaves by A.B. Brownwell & RE. Beam (McGraw Hill)
8. Optoelectronics and photonics: Principles and Practices by Safa O Kasap, Pearson,
9. Microwave Engineering Passive Circuits by P.A. Rizzi, PHI

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Theory Paper

Paper 802 I

COURSE ICT-10: Network Security and Cryptography

Module-I

Attacks on Computers and Computer Security: Introduction, the Need for Security, Security Approaches, Principles of Security, Types of Attacks. 2

Module-II

Cryptography: Concepts and Techniques: Introduction, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key range and Key Size, Possible Types of Attacks. 6

Module-III

Symmetric Key Algorithms and AES: Introduction, Algorithm Types and Modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC4, RC5, Blowfish, Advanced Encryption Standard (AES). 5

Module-IV

Asymmetric Key Algorithms, Digital Signatures and RSA: Introduction, Brief History of Asymmetric Key Cryptography, An Overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm, Some Other Algorithms. 5

Module-V

Digital Certificates and Public Key Infrastructure (PKI): Introduction, Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography Standards (PKCS), XML, PKI and Security, Creating Digital Certificates Using Java. 5

Module-VI

Internet Security Protocols: Introduction, Basic Concepts, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Hyper Text Transfer Protocol (SHTTP), Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), SSL versus SET, 3-D Secure Protocols, Electronic Money, Email Security, Wireless Application Protocol (WAP) Security, Security in GSM, Security in 3G. 10

Module-VII

User Authentication and Kerberos: Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based Authentication, Kerberos, Key Distribution Center (KDC), Security Handshake Pitfalls, Single Sign on (SSO) Approaches.

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Module-VIII

Network Security, Firewalls and Virtual Private Networks (VPN): Introduction, Brief Introduction to TCP/IP, Firewalls, IP Security, Virtual Private Networks (VPN), Intrusion. 4

Recommended Books:

1. A. Kahate - Cryptography and Network Security, 2nd Edition, Tata McGraw Hill Publication, New Delhi, 2007.
2. B.A. Foronzan - Cryptography & Network Security, TMH, New Delhi, 2007.
3. S. Stalling - Cryptography and Network Security, Pearson Edition, New Delhi, 2006

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Theory Paper

Paper 803 I

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

Basic issues of Operating Systems for Parallel Computers, Process Management, Resource Management, Memory management, I/O Management, Inter-Processor Communication.

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:

1. Computer Organization and Architecture: Designing for performance, W. Stallings, 4th Ed. PHI, 1996.
2. Computer Architecture: A Quantitative Approach, J.H. Hennessy and D.A. Patterson, 2nd Ed., Morgan Kaufmann, 1996.
3. Advanced Computer Architecture: Parallelism, Scalability and Programmability, Kai Hwang, McGraw-Hill Inc, 1993.
4. Parallel Computer Architecture: A Hardware/Software Approach, D.E. Culler, J. Pal Singh, and A. Gupta, Harcourt Asia Pte Ltd., 1999.

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, Acomplete 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 IV : Probabilistic Reasoning : Representing knowledge in an uncertain domain, Semantics of Bayesian Networks, Clustering algorithms, Exact inference in bayesian network, complexity of exact inference, Approximate inferences in bayesian networks, Inference by Markov chain simulation, Rule-based methods for uncertain reasoning, Dempster - Shafer theory, Fuzzy sets and fuzzy logics, Inferences in Temporal Model, Dynamic Bayesian networks, kalman filters, Applicability of kalman filters, Hidden Markov model.

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.

Unit VI : Statistical Learning methods : Statistical learning, Learning with complete data, Learning with hidden variables, The EM Algorithm, Unsupervised clustering, Learning hidden markov models, Learning Bayesian network with hidden variables, Instance - Based learning, Nearest-neighbor models, kernel models, Neural networks, network structure, single layer feed-forward neural networks, multi-layer feed forward neural networks.

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Sensation and Perception

Theory Paper

Paper 801 C

Unit 1: Coding of Sensory

Sensory Systems, Sensory Modality is Encoded, Receptors Transduce, Each Receptor Responds, The Spatial Distribution, The Receptive Fields, The sensory, Neurons, Intensity, Psychophysical Laws, Stimulus Intensity, Sensory Thresholds, The Duration of a Sensation, Sensory Systems, Sensory Information, Sensory System Process, Inhibitory Interneurons

Unit 2: The Bodily Senses

The Dorsal Root, Touch is Mediated, Mechanoreceptors Differ, Mechanoreceptors in the Superficial, The Spatial Resolution, Vibration Sense, Mechanoreceptors Differ in Adaptation, The Spatial Characteristics, Other Somatic Sensations, Warmth and Cold, Pain is Mediated, Proprioception is Mediated, The Viscera. Afferent Fiber, The Dorsal Column-Medial, The Anterolateral System.

Unit 3: Touch

Tactile Information, The Primary Somatic Sensory Cortex, Extracellular Recordings, Cortical Neurons, The Properties of Cortical Receptive Fields, Inputs to the Somatic Sensory Cortex, The Body Surface, Spatial Resolution, The Cortical Representation, Cortical Receptive Fields, Inhibitory Networks, Lateral Inhibition, Spatial Detail, Neurons in Higher Cortical Areas, Stimulus Features, The Behavioral Relevance, Lesions in Somatosensory.

Unit 4: The Perception of Pain

Noxious Insults, Nociceptive Afferent Fibers Terminate, Nociceptive Afferent Fibers Use Glutamate Hyperalgesia, The Hyperexcitability, Nociceptive Information, Along Five Ascending Pathways, Thalamic Nuclei Relay, The Cerebral Cortex Contributes, Pain can be Controlled, The Balance of Activity, Direct Electrical Stimulation, Opiate-Induced Analgesia, Opioid Peptides Contributes, Endogenous Opioid, Asensory Illusion, Activation of Opioid Receptors, Tolerance and Addiction, Stress Induces Analgesia.

Unit 5: Constructing the Visual Image

Visual Perception, Visual Information, Different Cortical Areas, Frames of Reference, Parallel Pathways Convey Information, Visual Attention, The Analysis of Visual Attention.

Unit 6: Visual Processing

The Retina Contains, Types of Photoreceptors, Rods Detect Dim Light, Cones Mediate Color Vision, Light Is Absorbed, Phototransduction Results, Light Activates Pigment, Activation of Pigment The Dark Current, Calcium and Light Adaptation, The Reduction in Cyclic, Photoreceptors Slowly Adapt, The Output of the Retina, The Receptive Field of the Ganglion Cell, The Center-Surround Receptive Field, Ganglion Cells, Specialized Ganglion Cells, Signals Form Photoreceptors, Bipolar Cells, The Receptive Fields of Bipolar, Different Classes of Bipolar.

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Theory paper

Credit -45 hrs

802

COURSE CON-801: Psycho-NeuroLinguistics

UNIT- 1. Basic concepts (6)

The Creativity of Human Language ,Language as Distinct from Speech, Thought and Communication,characteristics of the Linguistic System ,History, Language structure, Psycholinguistics and crosslinguistics, Recent advancements in methods and theory of Psycholinguistics,The Distinction between Descriptive and Prescriptive Grammar .The Universality of Human Language, Implications for the Acquisition of Language, Pairing of Sound and Meaning by Language, Linguistic Competence and Linguistic Performance,The Speech Signal and Linguistic Perception, Origins of Contemporary Psycholinguistics .

UNIT- 2. The nature of linguistic components (4)
The Universality of Human Language, The Speech Signal ,The Phonological Component, The Morphological Component ,The Syntactic Component ,Metalinguistic Awareness and the Psychological Reality of Linguistic Structure ,The Lexicon.

UNIT- 3. The biological basis of language (3)
Species Specificity of Language , Universality of Language in Humans, Nature versus 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 (2)
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 (6)
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 (6)
Visual word recognition and its models, Techniques for visual word recognition, Eye movements in visual word recognition, EEG evidences of word recognition, Current models of visual word recognition.

UNIT- 7. The Hearer: Speech Perception and Lexical Access (4)
The phonemic inventory and speech perception, Constructive speech perception and phonological illusions, Bottom-up and top-down information, Suprasegmental information in the signal,The Role of Orthography, Accessing the Lexicon: Types of priming, Bound morphemes ,The cohort model of lexical access ,Lexical Access in Sentence Comprehension: Lexical frequency ,Lexical ambiguity.

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- UNIT- 8. The Hearer: Structural Processing (4)
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- 9. (3)
Language, Mind and Brain: Experience Alters Perception.
- UNIT- 10. (3)
The Neural correlates of Language Production
- UNIT- 11. (4)
The Computational Modelling and Neural Architecture of Language disorders.

Reference Books:

1. Eva M. Fernández and Helen Smith Cairns (2011). Fundamentals of Psycholinguistics
2. Gaskell, M. G. (2007). The Oxford Handbook of psycholinguistics.
3. Guhe, M. (2008). Incremental Conceptualization in Language Production.
4. Gazzaniga . The New Cognitive Neurosciences.

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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 [8]
2. **Electroencephalography**
EEG in Status Epilepticus, EEG in Dementia and Degenerative Diseases, EEG in Psychiatric Disorders, Transient cognitive impairment during epileptiform discharges [8]
3. Applications of USG in medical diagnosis, contrast media, tissue harmonic imaging intraoperative ultra sonography [5]
4. C-arm image intensifier, contrast media, computer radiography, digital radiography, automatic film processing, laser dry camera image processing, PACS [6]
4. F-MRI, MRI contrast media, MRI hazards and safety [5]
5. **Amino acids neurotransmitters** [6]
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; Neurolethyrism
6. **Catecholamines, Opiate and Peptide Neurotransmitters** [7]
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; atecholamines and serotonin: structures, classifications and their receptors

Recommended Books:

1. Siegel et al, Basic Neurochemistry, 6th Edition, Lippincott - Williams-Wilkins.
2. Kandel et al, Principles of Neural science, 4 Edition, McGraw-Hill Medical, 2000.
3. Zegmond, Fundamentals of Neuroscience, 1st Edition, Academic Press, 1999.
4. Bear: Neuroscience: Exploring the Brain, 2nd edition, Lippincott Williams & Wilkins, 2001.
5. Clinical neurophysiology - UK Mishra.
6. Clinical Electroencephalography - UK Mishra & J Kalita.
7. Electrorecording in clinical Neurology by MJ Amino ff.
8. EEG- basic principles, clinical applications & related fields by Ernst niedermeyer & F L Da Silva.
9. Electro physiology by Jun Kimura

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Paper Code 804

4 Credits

Neuroimaging of Cognition

UNIT 1: History and Methods

1. Functional neuroimaging: A historical & Physiological perspective
2. Functional neuroimaging: Basic principle of f-MRI
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
1. Cognitive aging
2. Emotion & social cognition
3. Neurophysiologically impaired patients

References Books :

Text Book: Handbook of functional neuroimaging of cognition, 2nd edition, edited by Roberto Cabeza and Alan Kingstone, MIT Press

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NINTH SEMESTER

#	Course Category	Code	Description	Credit
901 N	Thy	NANO-901	Quantum Transport	4
902 N	Thy	NANO-902	Soft Matter Physics	4
903 N	Thy	NANO-903	Carbon Nanotechnology	4
901 B	Thy	BIO-901	Food Biotechnology	4
902 B	Thy	BIO-902	Industrial Biotechnology	4
903 B	Thy	BIO-903	Advance Tool and Techniques	4
901 I	Thy	ICT-901	Digital Communication & Signal Processing	4
902 I	Thy	ICT-902	Operating Systems Engineering	4
903 I	Thy	ICT-903	Mobile and Pervasive Computing	4
901 C	Thy	CON-901	Neuropharmacology and Neurotoxicology	4
902 C	Thy	CON-902	Neurological and Psychiatric Disorders	4
903 C	Thy	CON-903	Computational and Modeling in Neuroscience	4
904	Thy	904	IPR, Innovation and Case study	4
911 N	Lab	NANO-911	Advanced Nanomaterials Lab	8
911 B	Lab	BIO-911	Advanced Biotechnology Lab	8
911 I	Lab	ICT-911	Advanced Informatics Lab	8
911 C	Lab	CON-911	Advanced Cognitive Science Lab	8
912	Lab	912	Special NBIC Laboratory Exposure	8

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901 N Quantum Transport

Transmission in Nanstructure

Tunneling in planar barrier structure, Current in resonant tunneling diode: Introduction to coherent and incoherent tunneling: Landauer formula. The generalized multi channel case.

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 nanostructure: Selective population of edge states: Generalized introduction to the fractional quantum hall effect, the many body picture: fractional states.

Ballistic transport in quantum wires

Conductance quantization in quantum point contacts: Adiabatic transport model Conduction quantization in quantum Hall regime Non-integer conductance plateaus in ballistic transport, ballistic device concepts: The y branch switch and other ballistic junctions.

Weakly disordered systems

Disordered semiconductors: Localized and extended states: Conductivity: Scaling the conductivity, Weak localization: semi classical treatment of conductance, size effects in quantum wires, Universal conductance fluctuations.

Temperature decay of fluctuations

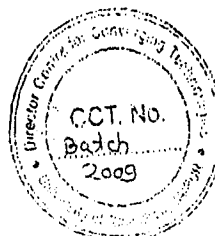
Temperature decay of coherence. The role of temperature on fluctuations: Fluctuation amplitude. Electron-electron interaction effects: electron energy loss in scattering, Introduction to screening and plasmons.

Text book: Transport in Nanostructure, David K.Ferry, Stephen M.Goodnick, Jonathan Bird, Cambridge university press.

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Paper N- 902

Soft Matter Physics



②

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

Orientalional 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.

Elasticity and the Freedericksz transition: The meaning of elasticity in a fluid. Definitions of elastic constants in nematic liquid crystals. Balancing free energy and the Freedericksz transition.

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

Dispersion colloids: Stability and forces, DLVO-theory, gels, emulsions and foams, Association colloids: Amphiphiles, micells and critical micell concentration, Langmuir-Blodgett films biological systems

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

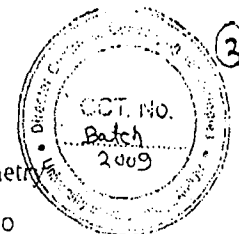
Inelastic Scattering & Formal Theory of Scattering

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

Neutron, Static Light Scattering & X-Ray Scattering: Part I

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Paper N-902



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)

1. J.W. Hamley - Introduction to Soft Matter, Wiley, Chichester, 2000
 2. M. Kleman, O.D. Lavrentovich - Soft Matter Physics, Springer, Berlin, 2003
 3. M. Daoud, C.E. Williams - Soft Matter Physics, Springer, Berlin, 1999
 3. R.A.L. Jones - Soft Condensed Matter, Oxford University Press, Oxford, 2002
 4. P. Collings, M. Hird - Introduction to Liquid Crystals Soft-Matter,
 5. Characterization Borsali, Redouane, Pecora, Robert (Eds.) Springer-Verlag
 6. 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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N-903

IX SEM

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 II – FULLERENES (9 hours) Structure and Bonding- Nomenclature, The Structure of C60, Structure of Higher Fullerenes - Growth Mechanisms; Production and Purification- Fullerene Preparation by Pyrolysis of Hydrocarbons, Partial Combustion of Hydrocarbons, Arc Discharge Methods, Production by Resistive Heating,

UNIT III - CARBON NANOTUBES (9 hours) The Structure of Carbon Nanotubes- Nomenclature, structure of Single-Walled Carbon Nanotubes and Structure of Multiwalled Carbon Nanotubes; Structure and Production of Further Tubular Carbon Materials- Spectroscopic Properties of Carbon Nanotubes- Raman and Infrared Spectroscopy of Carbon Nanotubes, Absorption and Emission Spectroscopy of Carbon Nanotubes, Properties of Carbon Nanotubes.

UNIT IV – GRAPHENE (9 hours) Structure of graphene; Preparation of graphene – synthesis of graphene by various physical and chemical methods and Purification; Electronic Properties - Band Structure of Graphene - Mobility and Density of Carriers - Quantum Hall Effect - Spectroscopic Properties of graphene - Raman Spectroscopy, Infrared Spectroscopy, Absorption and Photoluminescence Spectroscopy.

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

1. Arne Krueger, "Carbon Materials and Nanotechnology" Wiley-VCH, 2010.
2. Gary Coops, "Carbon Nanomaterials", Taylor and Francis, 2006.

REFERENCES

1. Liming Dai, "Carbon Nanotechnology", Elsevier, 2006.
2. Saito R. and G. Dresselhaus, "Physical Properties of Carbon Nanotubes", Imperial College Press, 1998

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Paper Code - BIO. Food Biotechnology
901

4 Credits



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 Food-borne illness. Microbial contamination-sources, routes and control. The Fate 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 fermentations and biotechnology
6. **Applications of Microbiology in the Food Industry**
Hazard Analysis Critical Control Point (HACCP) - based systems and microbiology, Risk assessment and microbiology, Raw food material/ingredients and microbiology, Hygiene monitoring and microbiology, Process monitoring and microbiology, Finished products and microbiology. Trouble-shooting, crisis management and microbiology
7. **Enzymes in food technology-Introduction**
Production of Industrial enzymes, Enzymes in dairy product manufacture, Enzymes in bread making
8. **Methods for food preservation**
Rheology 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, vegetable and fruits, milk products.
9. **Legislation, safety and quality control**

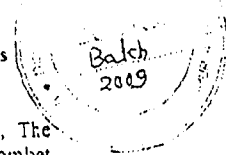
Text Book:

1. Microbial Examination of Foods- Frances. Keith, American Public Health Association
2. Enzymes in Food Technology- R.J. Whitehurst, M. van Oort, Wiley Blackwell Publishers
3. Food Microbiology and Laboratory Practice- Bell, Neaves, Williams, Blackwell Publishing

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Paper Code - BIO-902 Industrial Biotechnology

4 Credits



1. **History of Industrial Biotechnology**
Early History, The Penicillin Story, The Coming of the Cephalosporins, The Waksman Era, Strain Improvement, Semi-Synthetic Antibiotics to Combat Resistant Microbes, The Primary Metabolites, The Shift from Antibiotics to Pharmacological Agents, The Biopharmaceutical Revolution, Recombinant Hosts, Enzymes, Bioconversions, Vaccines, Systems Microbiology.
2. **Industrial Systems Biology**
Introduction, Industrial Biotechnology, Market Drivers for Industrial Biotechnology, Industrial Systems Biology, Metabolic Models, Reconstructed Metabolic Network Models, Industrial Systems Biology Case Studies, Conclusion and Future Perspectives.
3. **Directed Evolution of Industrial Biocatalysts**
Introduction, Strategies for Protein Design, Assay Systems, selections, Examples.
4. **Applied Biocatalysis: An Overview**
Introduction, The Design of the Bioconversion System, Bioreactors, Rationalizing and Speeding Up the Development and Characterization of a Bioconversion Process.
5. **Nanobiotechnology**
Setting the Stage, Industrial Perspective, Nanotechnology in Biology and Biochemistry, Biomimicry, Materials and Products, Processes and Devices.
6. **Downstream Processing in Industrial Biotechnology**
Introduction, Separations in Industrial Biotechnology, Examples of Downstream Processing of Different Product Groups.
7. **Industrial Biotechnology in the Chemical and Pharmaceutical Industries.**
Biocatalytic Processes: Scientific and Technological Perspectives, Biocatalytic Processes: Business and Commercial Perspective, Safety, Health, and the 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**
Enzymes for the Pulp and Paper Industry, Enzymes as Process Aids, Enzymes for Product Design, Biorefinery Concepts
10. **Biofuels: Production and Applications**
A Renewed Interest in Biofuels, Present Conversion Pathways, Biodiesel Production from Vegetable Oils and Fats, Ethanol and ETBE Production, The Need for New Developments, Lignocellulosic Biomass Resources, Production of Ethanol from Lignocellulosic Biomass, Production of Biofuels Through the Thermochemical Pathway, Biorefineries, Biofuels and Sustainability.
11. **Environmental and Economic Aspects of Industrial Biotechnology**
Introduction, Methodology, Overall Results.
12. **Societal Issues in Industrial Biotechnology**
Introduction, The Impact of Industrial Biotechnology, Public Perceptions of Industrial Biotechnology, Societal Issues in Industrial Biotechnology, Conclusions and Discussion: A Joint Agenda for the Smooth Introduction of Acceptable Sustainable Industrial Biotechnology.

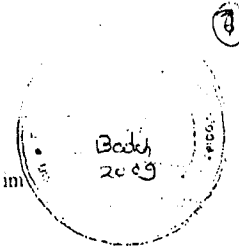
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Text book

Industrial Biotechnology: Sustainable Growth and Economic Success by Wim
Socraert and Erick J. Vandamme

Reference book

Industrial Microbiology by Waites, Jhon S. Rogkey and Gary Higton



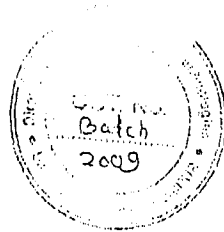
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Bio – 903: Advanced Tools and Techniques of Bioinformatics

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
2. Clustering & Classification Algorithms- Hierarchical and non-hierarchical clustering, K-Means Clustering, Grid based clustering, Analysis of MD trajectories, Microarray and Protein Array data analysis and its errors.
3. Foundations for Machine learning Techniques: Bayesian modeling, The Cox Jaynes Axioms, Support Vector machine & Ant colony optimization applied to MSAs.
4. Biomolecular Structure Prediction- Fuzzy logic system & its application in Clustering and classification; Phylogenetic Analysis- Methods of construction-Maximum parsimony method, The maximum likelihood, Distance methods; Statistical evaluation of phylogenetic trees and its software(PHYLIPS,PAUP,MEGA), Bootstrap methods
5. Python Basics-Overview, Installation and Environment Variables, Python Basic Syntax, Variable Types, Decision Making, Loops, Strings, Lists, Tuples, Functions and import statement, Python Classes/Objects, Exceptions, files and Database access.

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DIGITAL SIGNAL PROCESSING



Paper I-901

9

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

Introduction to DFT - Properties of DFT - Circular Convolution - Filtering methods based on DFT - FFT Algorithms - Decimation - in - time Algorithms, Decimation - in - frequency Algorithms - Use of FFT in Linear Filtering - DCT - Use and Application of DCT.

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

Structures of FIR - Linear phase FIR filter - Fourier Series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques - Finite word length effects in digital Filters: Errors, Limit Cycle, Noise Power Spectrum.

UNIT - V APPLICATIONS

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor - Adaptive Filters: Introduction, Applications of adaptive filtering to equalization, echo cancellation, interference cancellation - Speech Recognition Systems, Speech Synthesis Systems - Image Enhancement.

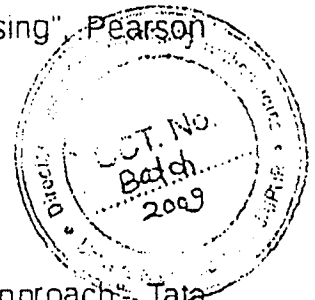
UNIT VI Image Processing

Image Processing, Introduction Digital Image Formation, Image enhancement, Image restoration, Image segmentation, Pattern recognition.

TEXT BOOKS:

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2. Emmanuel C. Ifeachor, & Barrie W. Jervis, "Digital Signal Processing", Pearson Education / Prentice Hall, Second edition, 2002.



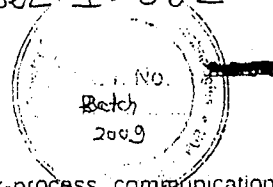
REFERENCES:

1. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, Third Edition, 2007.
2. Alan V. Oppenheim, Ronald W. Schaefer & John R. Buck, "Discrete Time Signal Processing", Pearson Education, Second Edition, 2001.
3. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006.

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Paper I- 802

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

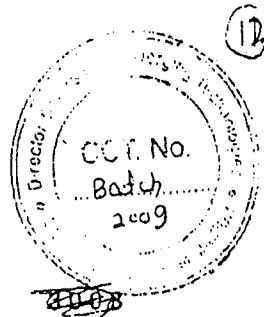
Memory Management - Swapping - Contiguous memory allocation - Paging - Segmentation - Example: The Intel Pentium - Virtual Memory: Background - Demand paging - Copy on write - Page replacement - Allocation of frames - Thrashing.

UNIT - IV I/O SYSTEMS

File concept - Access methods - Directory structure - File-system mounting - Protection - Directory implementation - Allocation methods - Free-space management - Disk scheduling - Disk management - Swap-space management - Protection

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Paper I - 903



MOBILE AND PERVASIVE COMPUTING

OBJECTIVE

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

UNIT - I PERVASIVE COMPUTING

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

UNIT - II MOBILE APPLICATIONS

History - Mobile Ecosystem - Designing for context - Mobile strategy - Mobile applications - Information Architecture - Design - Mobile Web apps vs Native Apps - Adapting to devices - Supporting devices - Application development on Android and iPhone.

UNIT - III MEDIUM ACCESS AND TELECOMMUNICATIONS

Frequencies - Signals - Antennas - Signal propagation - Media Access Control: Motivation, SDMA, FDMA, TDMA, CDMA - GSM: Mobile services, System architecture, Protocols, Localization and calling, Handover - GPRS.

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

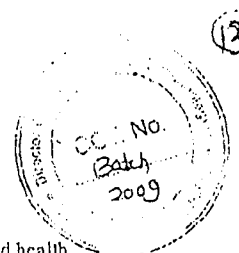
Mobile IP - DHCP - Mobile ad hoc networks - TCP improvements - TCP over 2.5/3G.

TEXT BOOKS:

1. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions". Wiley, 2009.
2. Brian Fling, "Mobile Design and Development", O'Reilly, 2009.
3. Jochen Schiller, "Mobile Communications", 2nd ed., Pearson Education, 2003

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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 (15)

Principles of cellular neurobiology, Overview of the chemistry of neurotransmission, Introduction to neurotoxicology, Introduction to developmental neurotoxicology, Neurobehavioral testing, Imaging, Physiological approaches, Animal models, Transmission toxicity, Axonopathies, Excitotoxicity.

UNIT- 2: Neurotoxicity-II (10)

Structural neuropathological endpoints of Neurotoxicity; including Ultrastructural changes, Dose-Response Evaluation with reference to neurological effects, Neurochemical Endpoints of Neurotoxicity Assessment by Alterations in synthesis, release, uptake and degradation of neuro-Transmitters.

UNIT- 3: Neuropharmacology of Neural systems and Disorders-I (10)

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 (10)

Higher Cognitive function and Behavioral control, Mood and Emotion, Reinforcement and Addictive Disorders, Schizophrenia and other Psychoses, Neurodegeneration, Seizure Disorders.

References Books:

1. Dabbs M.R., Clinical Neurotoxicology.
2. Chéu wang, William sliker Jr., Developmental Neurotoxicology Research.
3. Eric Nestler, Steven Hyman, Molecular Neuropharmacology: A Foundation for Clinical Neuroscience.

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902C NEUROLOGICAL and PSYCHIATRIC DISORDERS

- Unit-I: Mental Disorder: Meaning, Symptomatology and Classification (APA and WHO Classifications).
- Unit-II: Theoretical Models: Bio-medical, Psychodynamic, Cognitive behavioural, Humanistic, Existential, Family systems, Integrative and Biopsychosocial Model, Diathesis-Stress Model
- Unit-III: Anxiety and Mood Disorders: Nature, Types, Clinical Picture and Causal Factors
- Unit-IV: Schizophrenia and other Psychotic Disorders, Nature, Types, Clinical Picture and Causal Factors
- Unit-V: Somatoform and Dissociative Disorders: Nature, Types, Clinical Picture and Causal Factors
- Unit-VI: Personality Disorders: Nature, Types, Clinical Picture and Causal Factors
- Unit-VII: Substance-Related Disorders: Nature, Types, Clinical Picture and Causal Factors
- 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
- Unit-IX: Neurological Disorders: Nature, Types, Clinical Picture and Causal Factors

Books Recommended:

- Kaplan, H.J. and Sadock, B.J. (2004). Comprehensive Textbook of psychiatry. Baltimore, Williams and Wilkins
- Diagnostic and statistical manual of mental disorders (DSM-IV-TR 2000) Washington, D.C. APA Publication
- Sarason, E.G. and Sarason, B.R. (2005) Abnormal Psychology: The Problem of Maladaptive Behaviour, Delhi, Pearson Education
- Carson, R.C., Butcher, J. N., Mineka, S. and Hooley, J.M. (2007). Abnormal Psychology. Pearson

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Paper code 903C

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

Frequency Analysis Part I: Fourier Decomposition, Frequency Analysis Part II: Nonstationary Signals and Spectrograms, Wavelets, Convolution, Introduction to Phase Plane Analysis, Exploring the Fitzhugh-Nagumo Model, Neural Data Analysis: Encoding, Principal Components Analysis, Information Theory, Neural Decoding Part I: Discrete Variables, Neural Decoding Part II: Continuous Variables, Functional Magnetic Imaging

Unit-4 DATA MODELING WITH MATLAB

Voltage-Gated Ion Channels, Models of a Single Neuron, Models of the Retina, Simplified Model of Spiking Neurons, Fitzhugh-Nagumo Model: Traveling Waves, Decision Theory, Markov Models, Modeling Spike Trains as a Poisson Process, Synaptic Transmission, Neural Networks Part I: Unsupervised Learning, Neural Network Part II: Supervised Learning

References books:-

MATLAB for neuroscientists: an introduction to scientific computing in MATLAB / Pascal Wallisch et al.].

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IX SEM Paper 904

Name of Subject : INTELLECTUAL PROPERTY RIGHTS 904	
Unit	Contents
I	Basic Concepts of Intellectual Property: Introduction to intellectual property rights, Intellectual property laws and the Internet, Trade Related Aspects of Intellectual Property Rights
II	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
III	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 & Appellations of Origin
IV	Copyright: Registration procedure and copyright authorities, Assignment and transfer of copyright, Copyright infringement and exceptions to infringement, Software copyright
V	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
VI	International organizations and Treaties (pre-TRIPs era): Paris Convention, Berne Convention, Rome convention, IPIC Treaty, Budapest Treaty, CBD, UPOV convention, WIPO, GATT, FAO, UNCTAD The Patent Act of India 1911 and the Indian Patent Act of 1970.

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