SEMESTER I (17 credits)

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Work and Energy, Potential and Kinetic energy, conservation laws of momentum and energy, non-conservative forces.

Rotational motion – rotational variables, kinetic energy of rotation, rotational inertia, torque, Newton’s second law of angular motion, and conservation of angular momentum. Rigid body, its Kinetic energy, angular momentum conservation, precession of top (elementary).

Law of gravitation, Concept of temperature and its measurement, heat and work, First law of thermodynamics, Second law of thermodynamics Carnot engine and cycle, isothermal and adiabatic processes, enthalpy and concept of entropy.

Fluids at rest, pressures within fluids, upthrust, Archimedes’ principle, Surface phenomena. Fluid dynamics, streamlines, Bernoulli’s equation and its applications. Viscosity, Reynold’s number, Turbulence.

Revision of electrostatics, Applications of Gauss law, electric potential equipotential surfaces, dipole, potential calculation in simple cases. Ampere’s law and its applications, Lorentz force, cyclotron motion, magnetic force on a current carrying wire, Torque on a current.

Faraday’s law of induction, Lenz’s law, induction and induced electric field, Alternating current induction (self and mutual), L-R, C-R and L-C-R circuits, resonance energy stored in inductance and capacitance.

Maxwell’s modification of Ampere’s law, displacement current, qualitative discussion of traveling electromagnetic waves, energy transport, Poynting vector, radiation pressure and polarization.

**References:**
1. University Physics by F W Sears
2. Fundamentals of physics by Haliday, Resnick and Walke
3. Lecture series by Feynman.
4. Physics by Catnell and Johnson
5. Principles of Physics: H.C. Verma
IBT 102T  
**Fundamentals of Chemistry**  
3 credits

1. **Atomic structure** – Bohr theory, de Broglie hypothesis, Heisenberg’s uncertainty principle, atomic spectra, wavefunction and its interpretation, Formulation of Schrodinger equation, particle in a box, polar coordinates, hydrogen like atoms-spherical harmonics, polar plots, hydrogenic orbitals, many electron atoms, LS coupling

2. **Molecules**: Born Oppenheimer approximation, PE curve, Hydrogen molecule, valence bond theory, hybridization, hybrid orbitals, LCAO, homo- and hetero- nuclear molecules, bond order, bond dissociation energies, MO diagram of simple polyatomic molecules

3. **Coordination chemistry** – Werner theory, EAN rule-valence bond theory, structure and magnetic properties, inner and outer sphere complexes-crystal field theory- splitting of d orbitals in ligand environments (octahedral, tetrahedral, square planar, trigonal bipyramidal, square pyramidal, cubic etc.)- tetrahedral distortion, spectrochemical series, Jahn Teller distortion-CFSE-isomerism in coordination compounds, IUPAC nomenclature of coordination compounds.

**References:**

1. Physical Chemistry-A molecular approach by Mcquairee and Simon
2. Physical Chemistry by G M Barrow
3. Concise Inorganic Chemistry by J D Lee
4. Inorganic Chemistry by Shriven and Atkin

IBT 103T  
**Mathematics I (30L)**  
2 credits

Refreshing course on Sets & symbolic logic, Power functions & polynomials, integration & differentiation, periodic functions and conversion of different co-ordinate system.


Vector differential calculus: curves, arc length, tangent, curvature, velocity & deceleration, directional derivative, transformation of coordinate systems and vector components, divergence and curl of vector field.
Relations & Functions: Linear, periodic, logarithmic, exponential, Quadratic functions. Mapping & Cartesian product. Their application in Biology.
Graphical representations: Linear scales, nonlinear scales, Semilogarithmic, triangular, nomography, pictoral presentations

**IBT 104-T Plant Animal and microbial world**  
**3 Credits**

**General –**
5L

Origin of life: primordial soup, bioelements, biomolecules, importance of water, Cell as the unit of life, development of cell theory, cell types: prokaryotes vs. eukaryotes; from single cell to multi-cellular organism, concept of multi-cellularity, cell-cell interactions- at tissue level, cell organization,

**Animal World-**
10L
Level and organization in animal kingdom: Major animal groups and their salient features: (at Phylum level for non-chordates to chordates at class level).
Animal adaptation and trends in animal evolution.

**Plant World-**
10L
Plant forms and classification- Algae, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms
- Plant forms and anatomy
- Plant reproduction: asexual and sexual, life cycles, and alterations of generation
- Plant evolution (Evolutionary trends like – increase in complexity of sporophyte and reductions in gametophytes, seed development, conducting elements etc.)

**Microbial World-**

Definition, scope, impact and future of microbiology, beneficial and harmful microbes – food industry, agriculture, medical field
1L

History of Microbiology –Major discoveries and contributions of different scientists (Leewenhoek, Joseph Lister, Robert Koch, Louis Pasteur etc.)

2L

Nutritional classification of microorganisms on the basis of carbon, light: (Photoautotrops, Photoorganotrops, Chemolithotrops (sulfur, hydrogen, iron oxidizers), chemoorganotrophs, nitrogen: (nitrifying, nitrogen fixing, denitrifying microorganisms), oxygen (aerobes, facultative anaerobes, microaerophiles, aerotolerant anaerobes, anaerobes)
3L
Physical factors influencing growth – Temperature (hyperthermophiles, thermophiles, mesophiles, psychrophiles), pH (acidophiles, neutrophiles, alkaliophiles) Osmotic pressure (extreme, moderate, mild halophiles, osmophiles, xerophiles)

Techniques in microbiology: staining (monochrome, negative, Gram, capsule, endospore, acid fast), media preparation, cultivation, isolation, preservation

Ultrastructure of prokaryotes, flagella, pili, capsules, cell wall, cell membrane, genomes, plasmids, cytoplasmic inclusions, endospores, magnetosomes, carboxysomes, chlorosomes, gas vesicles, Volutin granules.

Introduction to viruses (bacteriophages, plant, animal), Archea (thermophiles, halophiles, methanogens) Fungi, algae, protozoa

IBT-123P Laboratory Exercises in Biology I (Minimally Any 10 practical) 2 credit

General:
1. Microscopy – simple, compound, dark field, phase contrast and florescence
2. Methods for washing glassware and plastic wares and laboratory safety practices
3. Study of Instruments – Autoclave, hot air oven, Laminar air flow, incubator, mBOD, incubator, centrifuge, pH meter, membrane filter and colorimeter, spectrophotometer, balance

Microbiology:
1. Concept of sterility, existence of microorganisms and their control
3. Enumeration of cell: use of haemocytometer
4. Simple staining: Monochrome, negative
5. Differential staining: Gram, Capsule and Endospore staining
6. Motility Demonstration: Hanging drop preparation, wet mount, dark field microscopy

Plants:
1. Plant morphology and anatomy of major plant groups namely
   Algae, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms
2. Field Trip
3. Cell types of plants: Maceration of various tissue explants, Identification of xylem vessels, trachieds, stomata, root hairs etc.

Animals:
1. Membrane permeability
2. Osmosis
3. Pinoocytosis

**Laboratory Exercises in Physics I**  
*111P 2 Credits*

1. Moment of inertia of disc – torsional pendulum
2. ‘g’ by resonance pendulum
3. Velocity of sound by resonance tube
4. Thermal conductivity of insulator – Lee’s method
5. ‘γ’ and ‘η’ by flat spring spiral
6. Total energy conservation (Kinetic Energy + Potential Energy = Constant)

**Laboratory Exercises in Chemistry**  
*112P 2 credits*

*(Minimally Any 10 practical)*

1. Standardization of NaOH with primary standard KHP.
2. Determine redox potential of Fe+2/ Fe3+ systems by titrating it with standard K2Cr2O7
3. To determine hydrolysis constant of aniline hydrochloride by pH measurements.
4. Determine pKa of glycine by pH measurements
5. Determine the concentration of KCl solution by titrating with standard AgNO3 conductometrically
6. Investigate the conductometric titration of strong acid and strong base
7. Determination of Jobs method (Ferro salicylate)
8. Synthesis of chloro, nitro, nitito pentamino cobalt (III) complexes
9. Techniques such as TLC, crystallization, distillation etc.
10. Synthesis of potassium tri-oxalate ferrate.
SEMESTER II (21 Credits)

IBT- 201T Applied Physics (Fundamentals of Electronics and Instrumentation)2 Credits

Electronics

Analog Electronics

1. Basic electricity and Network Theorems- Kirchoff’s voltage law, Kirchoff’s current law, voltage divider formula, superposition theorem and examples, Thevenin’s theorem, Norton’s theorem and examples, Maximum power transfer theorem and examples. (5L)

2. Electronic components – Active, passive, resistor, thermister, LDR, capacitor, Inductor, transformer, switches, relay types, symbols, applications, working of each. (1L)

3. Semiconductor devices – Single stage amplifier, i/p, o/p impedance, impedance matching, freq. Response, bandwidth, fidelity, power amplifiers (2L)

4. Power supplies – AC to DC conversion, rectifiers, filters, designing, highpass, low pass, regulator series (block dia.), shunt zener working, zener breakdown, avalanche reakdown. (3L)

5. OPAMP- Differential amplifiers, Inv., Ninv.inputs, opamp characteristics, application-adder, subtractor, integrator, differentiator. (3L)

Digital Electronics

1. Number systems- decimal no. System, binary no system, hexadecimal, octal, inter-conversions, binary codes, binary addition, subtraction. (4L)

2. Logic gates-basic gates, derived gates, universal building blocks, Boolean algebra, truth tables, proving logical equations, examples, De Morgan’s theorem, Half adder, Full adder, Binary adder, subtractor, (5L)

3. Combinational logic- (1L)
4. Counters- multivibrators, RS flip-flop, JK flip-flop, T flip-flop, 4-bit binary counter, decade counter, up-down counter, shift registers and applications. (2L)

**Instrumentation (15)**

1. **Transducers** - primary & secondary transducers, temperature, pressure, displacement, velocity transducers. (3)
2. **ADCs and DACs** - Digital to analog convertors, analog to digital convertors, examples (3)
3. **Instrumentation systems** – data acquisition systems (3)

**Reference Books:**

1. Electronic Principles by Malvino, Bates
2. Digital principles and Applications by Leach, Malvina, Saha

**References:**

1. University Physics by F W Sears
2. Fundamentals of physics by Haliday, Resnick and Walke
3. Lecture series by Feynman.
4. Physics by Catnell and Johnson
5. Principles of Physics : H.C. Verma

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**IBT 202T Applied Chemistry 2 credits**

1. Adsorption, chemisorption, adsorption isotherms
2. Thermodynamics – second law of thermodynamics, entropy, spontaneous change, free energy, enthalpy, adiabatic demagnetization, reactions at equilibrium, interpretation of equilibrium constants, acid and bases, solubility equilibria, biological activity, thermodynamics of ATP
3. Electrochemistry – electrochemical cells, half cell reactions, reduction potentials, the electrochemical series, thermodynamic functions from cell potential measurements, liquid junction potentials, Debye Huckel Theory, over voltage

**References:**
1. Physical Chemistry by P W Atkins
2. Physical Chemistry by Venullapalli
3. Physical Chemistry for life sciences and biosciences by R Chang

**IBT 207 T-Statistics (30L) 2 credits**

Frequency distribution and associated measures

Probability Theory, Sample mean, Sample variance, mean and variance of a distribution, random numbers, random sampling.

Probability Distributions: Applications of probability and standard distributions, estimation, standard error and confidence interval, t-tests, F-test, single tail & double tail.

Confidence intervals, goodness of fit, pairs of measurements, fitting straight lines, curves, polynomials etc.

Test of hypothesis associated with correlation and regression.

**References:**

1. Biostistics:: A foundation for analysis in Health Science. 7 th Edition Wayne Daniel
2. Fundamental and University Mathematics by Colin McGregor
3. Statistical methods in Biology by Norman Bailey
4. Biostatistics by Striecke
5. Mathematical models in biology by Allama
6. Engineering Mathematics- M-1, M-2, M-3
7. Advanced Engineering Mathematics : Kreyzig
8. Introduction to Mathematics for Life Scientists by Edward Batschalet, Springer
9. Mathematics for the Biological Sciences by J.C. Acharya and R. Lardner, Prentice Hall

**IBT 108 T+P Introduction to Computer Science & Programming Languages 2 credits**

**Theory (1 credit)**

Introduction (2L)

History and generation of computers (2L)

Structure of a computer (2L)

Computer operation: keyboard, mouse, screen, printer, and other I/O devices (2L)

Operating systems: introduction e.g., Linux, Windows (2L)
System handling, system commands, introduction to computer languages and utilities (6L)
File formats and directory structure (2L)
Data organization on a computer (2L)
Connecting and Communicating Online: The Internet, Websites, and Media (3L)
Programs and Apps: Productivity, Graphics, Security and Work (2L)
Digital Security, Ethics, and Privacy: Threats, Issues, and Defenses (3L)
Glossary of important terms (2L)

**Practical (1 credit)**

Hands-On experience and regular usage: Tutorials (Typing, Windows 98/XP, Internet, Unix (LINUX), applications and utilities of Windows 98/XP, Browsers (I.E., Netscape) (1P)
Internet, Search Engines, using E-Mail/Web mail, ftp (1P)
Basic Unix commands (1P)
Working with Tables & Charts, Inserting Files (Pictures, Databases, Spreadsheets)
Spreadsheet Applications (Microsoft Excel): Worksheet Basics (Entering information in a worksheet, Saving & Opening a worksheet, Editing, Copying & Moving data, Inserting, Deleting & Moving Columns & Rows, Clearing Cells & Formatting cells), Working with workbooks, Working with formulae and functions, Printing worksheets, An introduction to the use of advanced spreadsheet concepts, Database Management (Sorting records, Finding records, Adding & Deleting records, Filtering records in a worksheet), Working with Macros, Creating and using multiple worksheets (1P)
Creation of Computer Presentations with graphics (Microsoft Power Point): Creation of slides, Rapid Presentation design using wizards, Inserting graphs & charts Action buttons, Transitions, Build and Animation effects (1P)

**References:**
2. Fundamentals of Computers by Rajaraman V., PHI.
References:
2. Fundamentals of Computers by Rajaraman V., PHI.
6. Computer Network by Andrew S. Tanenbaum, PHI.
7. Inter Networking With TCP/IP: Principles, Protocol And Architecture by D.E. CornerVol1,

Reference:
1. Garrett & Grisham, Biochemistry, Saunders Publishing.
2. Voet and Voet. Biochemistry, second edition, Prentice-Hall,
4. Zubay. Biochemistry
Prokaryotic cell cycle: Binary fission, multi-fork replication, role of FtsZ, MreB, Z ring divisome, addiction modules for plasmid transfer to progeny 4L
Population growth: Growth phases - Generation time, Kinetics of growth 4L
Growth patterns: Synchronous, Batch, Continuous, Diauxic 4L
Control of Microorganisms: Sterilization, disinfection, cidal, static agents 2L

Control of microbial growth by physical methods: Dry heat, moist heat, filtration, radiation (mode of action, applications) 4L
Chemical control – dyes, alcohol, acid, alkali, halogen, heavy metals, phenol, phenol derivatives, formaldehyde, ethylene oxide, detergents (mode of action, applications) 3L

Control of Pathogens and chemotherapy: History and development of chemotherapy, principal groups of antibacterial agents, and mechanism of action, drug resistance: origin, mechanisms, and transmission, antiviral and antifungal agents. 6L

Reference:
5. Madigan, M.T., Martinc J.M., Parker, J.Brock Biology of Microorganisms (Pearson prentice Hall)

IBT 221 P Laboratory Exercises in Physics II 2 credits
(Minimally Any 10 practical)
1. Determination of frequency of A.C Mains using sonometer box and LCR circuit- Series and Parallel resonance
2. Force acting on a current carrying conductor in a magnetic field
3. Verifying Biot Savart law of Magnetism & Tangent law of magnetism
4. Understanding Mutual Inductance using transformer
5. Surface tension – Jaeger’s method (temperature variation)
6. Viscosity and Reynolds number of liquid by continuous flow method

**IBT 222 P Laboratory Exercises in Chemistry II 2 credits**

*(Minimally Any 10 practical)*

1. Kinetics-order reaction
2. Determine simultaneously dichromate and permanganate ions in the given acid solution by colorimetric measurements
3. Study the hydrolysis of an ester in presence of hydrochloric acid
4. Determine the viscosity of a given liquid by Ostwald’s viscometer
5. Potentiometry – Halide estimation of mixtures
6. To study the absorption of acetic acid on activated charcoal
7. Estimation of Van’t Hoff factor
8. Solvent extraction -8 hydroxy quinoline
9. Preparation of 2, 4 Dinitrophenylhydrazine derivatives of carbonyl compounds

**IBT 223 P Laboratory Exercises in Biology II 2 credits**

*(Minimally Any 10 practical)*

**I – Biomolecules (2C)**
1. Measurement of pH
2. Estimation of carbohydrates – reducing / Non-reducing sugars
3. Estimation of proteins
4. Molar extinction coefficient of molecules
5. Extraction and estimation of lipids

**II – Microbiology (2 C)**
1. Growth curve of *Escherichia coli* by turbidometric method, calculation of specific growth rate and generation time

   1P

2. Isolation of bacteria by streaking

   1P
3. Spread plate technique
4. Pour plate, Total viable count
5. Cultivation of fungi: on Saborauds, Czapek Dox, Potato Dextrose agar
6. Slide culture technique for morphological characterization of fungi
7. Determination of thermal death rate of *Escherichia coli* and *Bacillus*
8. Determination of thermal death rate of *Escherichia coli* and *Bacillus*
9. Determination of antimicrobial activity by paper disc and well diffusion method
10. Determination of Minimal inhibitory concentration (MIC) by microtitre plate assay

**IBT-225 P  Practical in Statistics  1 credit**

1. Sampling technique (simple random sampling, stratified sampling, probability proportional sampling, sampling procedures). Introduction to R
2. Model sampling from continuous distribution (such as uniform, exponential and normal)
3. Test of significance.
   - T test,
   - F test,
   - Pair T test,
   - Test of proportionality
4. Fitting of straight lines, curves (growth curve models, polynomials). Test of significance associated with correlation and regression
5. Goodness of fit test. (Distribution fitting and model validation)

**Note:**

a) Each practical duration -3 hours
b) The practical problem sheets are to be prepared in conclusion with life science teacher/instructions.
IBB Intg. M.Sc (Biotechnology) Elective courses

Sem II

Syllabus: E01- Introduction to Laboratory Instrumentation and Safety (T+P) 2 credit

Theory (1 credit=15L)

1. Laboratory facilities in biotechnology (1L)
2. Handling and Use of Physics laboratory (1L)
3. Handling and Use of Chemistry laboratory (1L)
4. Microbiology laboratory (2L)
5. Molecular biology laboratory (2L)
6. Animal and plant cell culture laboratory (2L)
7. High end instrumentation (1L)
8. Laboratory operations and SOP (1L)
9. Hazards in laboratories (1L)
10. Laboratory safety measures and safe disposal of laboratory wastes (1L)
11. How to handle emergency conditions in the laboratory? (1L)
12. Personal and protective equipments and measures (1L)

Practical (1 credit)

1. Handling of glass and digital Pipettes
2. Handling of weighing machine
3. pH measurement through litmus paper and pH machine
4. Handling of tabletop centrifugal devices
5. Use of laminar flow and bio safety cabinet
6. Use of autoclaves
7. Using small laboratory equipments like stirrer, vortex, sonicator, nanodrop, waterbath, incubators, shakers
8. Operations and Maintenance of deep freezers
9. Storage and handling of general chemicals/acids, solvents
10. Safe disposal of laboratory wastes
11. Use of fume hood and personal safety measures
12. Laboratory safety demonstrations, fire extinguishers and first aid

**Syllabus: E02: Introduction to Ecosystems and Ethology (T+P) 2 credit**

**Theory (1 credit)**

1. Ecology (bio network, fundamental operations, energy flow, food-chain, food-webs including trophic levels, ecological niche, abiotic and biotic factors, characteristics and regulation of population, ecological succession) (2L)
2. Types of Ecosystems and its components (1L)
3. Community, ecosystem and biomes (1L)
4. Ecosystem services and the economics of ecosystems (1L)
5. Ecological pollution (the sources, types and control of environmental pollution) (1L)
6. Conservation (1L)
7. Population dynamics and regulation (2L)
8. Behaviour ecology (1L)
9. Basic ethological concept (1L)
10. External stimuli (1L)
11. Temporal and hierarchical organization of behaviour (2L)
12. Case studies (1L)

**Practical (1 credit)**

1. Methods to study ecosystems
2. Study of local ecosystem(s)
3. Study of the abiotic components of ecosystems (water, soil, air)
4. Identification and data collection of plant/insect/amphibian/reptile/bird species in a nearby area (checklists)
5. Monitoring the monthly changes in the biotic and abiotic components of an ecosystem
6. Identification of threats to the ecosystem