UNIVERSITY OF DELHI

B.Sc. (Hons.) BIOLOGICAL SCIENCES

SCHEME OF EXAMINATION

&

COURSE OF STUDY FOR SEMESTER SYSTEM

Effective from the Academic Year 2011-2012

PREAMBLE

The on-going B.Sc. (Hons) Biological Sciences was introduced in 2005 by the University of Delhi to be effective from the academic year 2005-2006. The sole aim of introducing this course was to teach **biology as one of the integrating natural science domains** at the undergraduate level and not as phylogenic group-based sub-disciplines or functional sub-disciplines. In other words it was to teach Biology, as a single natural science domain, at a conceptual thematic level and avoid teaching it as fragments. at the UG level. With these philosophical underpinnings the curriculum was developed and the topics are being taught from a holistic view keeping the spirit of integrated disciplinary approach. This was the first integrated biology UG Programme of Delhi University.

Biology is the science of life forms and living processes. Over centuries, biological knowledge has led to many technologies benefiting humans, be it in food security, health sector or national security. One can name sericulture, medical Zoology, vaccines against viral, bacterial and parasite diseases, diagnostic methods for infectious diseases, pregnancy, cancer or genetic and nutritional disorders.

The same course is now been proposed to be changed to semester based scheme. The opportunity presented by the semester based scheme has been used for some revision to accommodate the widening horizons of the discipline of biological sciences. The present proposal includes unique papers like Microbiology, Light and Life, Evolution and Adaptation, Biomaterials and Bio-resource Management. New laboratory exercises, which are not usually taught in other biology courses, have also been designed for this course. A high light of this course is that living processes are discussed as a theme cutting across plants, animals and microbes, wherever possible.

BACHELOR OF SCIENES

B.Sc. (Hons.) Biological Sciences

THREE YEAR FULL TIME PROGRAMME

AFFILIATION

The proposed programme shall be governed by the University of Delhi, Delhi – 110 007.

PROGRAMME STRUCTURE

The B.Sc. (Hons) Biological Sciences is divided into three parts as under, Each part will consist of two semesters as given below:

		Semester – Odd	Semester-Even
Part I	First Year	Semester-1	Semester -2
Part II	Second Year	Semester-3	Semester-4
Part-III	Third Year	Semester-5	Semester-6

There shall be 4 papers in each semester.

In addition, there shall be one qualifying paper called Environmental Studies offered in Semester-2.

The schedule of papers prescribed for various semesters shall be as follows:

PART 1 : Semester – 1

Paper No.	**Course Code**	**Course Title**	**No. of periods per week**	**Maximum Marks**
Paper 1	BIST 101	Light and Life	4 + 1T*	100
Paper 2	BIST 102	Chemistry	4+1T*	100
Paper 3	BIST 103	Physics and Applications to Biology	4+1T*	100
Paper 4	**MACT-303**	**Mathematics & Statistics**	**4+1T***	**100**
Paper 5	BISP–104	Light and Life Laboratory	4	50
Paper 6	BISP-105	Chemistry Laboratory	6	50
Paper 7	BISP-106	Physics and Applications to Biology Laboratory	6	50

Note: * Size of the tutorial group as per the university norms

PART 1 : Semester – 2

Paper No.	**Course Code**	**Course Title**	**No. of periods per week**	**Maximum Marks**

Paper 8	BIST 201	Biodiversity & Bio-prospecting	4 + 1T*	100
Paper 9	BIST 202	Bio-resources and Management	4+1T*	100
Paper 10	BIST 203	Ecology:Concepts and Management	4+1T*	100
Paper 11	**ENAT 201**	**Technical writing & Communications in English**	**4+1T***	**100**
Paper 12	BISP 204	Biodiversity & Bio-prospecting Laboratory	4	50
Paper 13	BISP 205	Bio-resources and Management Laboratory	4	50
Paper 14	BISP 206	Ecology:Concepts and Management Laboratory	4	50

Note: * Size of the tutorial group as per the university norms

PART II: Semester – 3

Paper No.	Course Code	Course Title	No. of periods per week	Maximum Marks
Paper 15	BIST-301	Bio-organic & Bio-inorganic Chemistry	4+1 T*	100
Paper 16	BIST-302	Metabolism, Integration and Adaptation	4+1T*	100
Paper 17	**CBHT-301**	**Cell Biology I**	**4+1T ***	**100**

Paper 18	**MBHT-301**	**Molecular Biology I**	**4+1T ***	**100**
Paper 19	BISP-301	Bio-organic & Bio-inorganic Chemistry Laboratory	4	50
Paper 20	BISP-302	Metabolism, Integration and Adaptation Laboratory	4	50
Paper 21	**CBHP-301**	**Cell Biology I Laboratory**	**4**	**50**
Paper 22	**MBHP-301**	**Molecular Biology I Laboratory**	**4**	**50**

Note: * Size of the tutorial group as per the university norms

PART II: Semester – 4

Paper No.	Course Code	Course Title	No. of periods per week	Maximum Marks
Paper 23	BIST-401	Growth & Reproduction	4+1 T*	100
Paper 24	BIST-402	System Physiology & Behavior	4+1 T*	100
Paper 25	**CBHT-402**	**Cell Biology II**	**4+1 T***	**100**
Paper 26	**MBHT-402**	**Molecular Biology II**	**4+1 T***	**100**
Paper 27	BISP-401	Growth & Reproduction Laboratory	4	50
Paper 28	BISP-402	System Physiology & Behavior Laboratory	4	50
Paper 29	**CBHP-402**	**Cell Biology II Laboratory**	**4**	**50**

Paper 30	**MBHP-402**	**Molecular Biology II Laboratory**	**4**	**50**

Note: * Size of the tutorial group as per the university norms

PART III: Semester – 5

Paper No.	Course Code	Course Title	No. of periods per week	Maximum Marks
Paper 31	BIST 501	Defence Mechanisms	4+1 T*	100
Paper 32	BIST-502	Evolution & Adaptation	4+1 T*	100
Paper 33	BIST 503	Biomaterials	4+1 T*	100
Paper 34	**CGHT-501**	**Genetics & Genomics I**	**4+1 T***	**100**
Paper 35	BISP 501	Defence Mechanisms Laboratory	4	50
Paper 36	BISP-502	Biomaterials Laboratory	4	50
Paper 37	**CGHP-501**	**Genetics & Genomics I Laboratory**	**4**	**50**

Note: * Size of the tutorial group as per the university norms

PART III: Semester – 6

Paper No.	Course Code	Course Title	No. of periods per week	Maximum Marks
Paper 38	BIST-601	Applied Biology	4+1 T*	100
Paper 39	BIST-602	Differentiation & Morphogenesis	4+1 T*	100
Paper 40	BIST-603	Microbiology : Principles and applications	4+1 T*	100
Paper 41	**CGHT-602**	**Genetics & Genomics II**	4+1 T*	100
Paper 42	BISP-601	Applied Biology Laboratory	4	50
Paper 43	BISP-602	Differentiation & Morphogenesis Laboratory	4	50
Paper 44	BISP-603	Microbiology : Principles and applications Laboratory	4	50
Paper 45	**CGHP-602**	**Genetics & Genomics II Laboratory**	4	50

Note: * Size of the tutorial group as per the university norms

TEACHING HOURS

1. Each paper will have 4 periods of lectures plus one tutorial period per week. Each period shall be of 55 min. duration

2. Each paper will have practical of 4 periods per week (6 periods per week in cases of Physics and Chemistry papers)

3. There will be one additional tutorial period per week per paper for students who require extra help.

SCHEME OF EXAMINATIONS

1. English shall be the medium of instruction and examination

2. Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the University of Delhi.

3. Each course will carry **150 marks** and will have following components

i Theory Paper

a) Internal Assessment - **25 marks**

- Attendance - 5 marks
- Assignment(s)/Seminar(s)/Project(s) - 10 marks
- Class Test(s) - 10 marks

b) End Semester Examination **75 marks**

ii **Practical**

End Semester Examination **50 marks**

CREDIT SCHEME

Each course in a semester shall have a certain number of credits assigned to it depending upon the number of lecture, tutorial and practical periods per week.

Lecturers/Tutorials: One lecture/tutorial period per week shall be assigned one credit.

Practical: One laboratory period per week shall be assigned half credit

Computational Practical: One computational laboratory period per week shall be assigned half credit

PASS PERCENTAGE & PROMOTION CRITERIA

1. The minimum marks required to pass any paper in a semester shall be 40% in theory and 40% in Practical, wherever applicable. The student must secure 40% in the End Semester Examination and 40% in the total of End Semester Examination & Internal Assessment of the paper for both theory & practical separately.

2. A student shall be eligible for promotion from 1st year to 2nd year of the course provided she/he has passed 50% papers of I and II Semester taken together.

3. Similarly, a student (irrespective of Part 1 results) shall be eligible for promotion from 2nd year to 3rd year of the course provided she/he has passed 50% papers of III and IV Semester taken together.

4. Students who do not fulfill the promotion criteria as given above shall be declared failed in the part concerned. However, they shall have the option to retain the marks in the papers in which they have secured Pass marks as above.

5. A student who has to reappear in a paper prescribed for Semester I/III/V may do so only in the Semester examinations to be held in November/December. A student who has to reappear in a paper prescribed for Semester II/IV/VI may do so only in the examination to be held in April/May.

REAPPEARANCE IN PASSED PAPERS

1. A student may reappear in any theory paper prescribed for a semester, on foregoing in writing her/his previous performance in the paper/s concerned. This can be done in the immediate subsequent semester examination only (for example, a student reappearing in a paper prescribed for Semester I examination, may do so along with subsequent Semester III examination and not along with papers for Semester V).

2. A candidate who has cleared the papers of Part III (V & VI Semesters) may reappear in any paper of V or VI Semester only once, at the immediate subsequent examination on foregoing in writing her/his previous performance in the paper/s concerned, within the prescribed span period.

(*Note : The candidate of this category will not be allowed to join any postgraduate courses)*

3. In the case of reappearance in a paper, the result will be prepared on the basis of candidate's current performance in the examination.

4. In the case of a candidate, who opts to re-appear in any paper/s under the aforesaid provisions, on surrendering her/his earlier performance but fails to re-appear in the paper/s concerned, the marks previously secured by the candidate in the paper/s in which she/he has failed to re-appear shall be taken into account while determining her/his result of the examination held currently.

5. Reappearance in Practical examinations shall not be allowed

6. A student who reappears in a paper shall carry forward the internal assessment marks, originally awarded.

DIVISION CRITERIA

A student who passes all the papers prescribed for Semester I to Semester VI examinations would be eligible for the degree. Such a student shall be categorized on the basis of the combined result of Semester I to Semester VI examinations as follows:

60% or more	-	1st Division
50% or more but less than 60%	-	IInd Division
40% or more but less than 50%	-	IIIrd Division

SUPPLEMENTARY EXAMINATIONS

There shall be no Supplementary examinations for any Undergraduate Courses

SPAN PERIOD

The span period to complete the course shall be six years from the year of admission in the Ist Semester.

FAILED STUDENTS

Failed students shall appear in the examination as per rules prescribed for exstudents.

ATTENDANCE REQUIREMENTS

No student shall be considered to have pursued a regular course of study unless he/she is certified by the Principal of the College, University of Delhi, to have attended 66% of the total number of lectures and seminars conducted in each semester, during his/her course of study. Provided that he/she fulfils other conditions, the Principal, may permit a student to the next Semester who falls short of the required percentage of attendance by not more than 10% of the lectures and seminars conducted during the Semester.

COURSE CONTENT FOR EACH COURSE

Attached

LIST OF READINGS

Attached

BIST 101 : LIGHT AND LIFE

UNIT 1

Nature of light, spectrum of light useful for various biological processes in the life of plants and animals, spectrum of light which is harmful to life, unit of light energy (Photon, quantum), Photo Biological reactions. Measurement of light (Lux, Foot Candle). Pigments associated with harvesting light energy: pigments/receptors of light, chlorophylls, caroteniods, phycobilinoproteins, bacteriochlorophylls, phytochromes, Rhodopsin etc. chemistry and functional roles. **12 Periods**

UNIT 2

Photosynthesis: History, Photosynthetic equations, Light and dark reactions, mechanism of photolysis of water and oxygen evolution; C_3, C_4, CAM plants, spectrum of photoautotrophs, photoautotroph vs photoheterotrophs; Photoautotroph vs. chemoautotroph, structure of chloroplast and quantasome, Anoxygenic and oxygenic photosynthesis, reaction centers.

15 Periods

UNIT 3

Bioluminescence: definition, discovery, examples of organisms, photoreceptors – distribution, mechanism; Phytochrome mediated photomorphogenesis phenomena – seed germination etc.. Photoperiodism: LDP, SDP, DNP plants, vernalization, vernalin, etiolation and de-etiolation. Light as an ecological factor affecting distribution of plants and animals (Phyto and Zoo geography), in terrestrial and aquatic ecosystems: Morphological, Anatomical, Physiological and Behavioural adaptations to extreme light conditions by organisms. **15 Periods**

UNIT 4

Behavioural aspects: circadian rhythms, jetlag, rhythm of heart beat and other examples. Light as an inducer for biosynthesis of enzymes, hormones and other biomolecules.

8 Periods

Suggested Reading Materials:

1. Hawes C & Satiat-Jeunemaitre – 2001 Plant Cell Biology : Practical approach
2. Buchanan B, Gruissem G & Jones R – 2000 – Biochemistry and Molecular Biology of Plants.

BISP 104 : LIGHT & LIFE – LABORATORY

1. Demonstration of

   (a) etiolation and de etiolation;

   (b) Light and CO_2 are essential for photosynthesis (Moll's half leaf experiment) and measure oxygen evolution during photosynthesis

   (c) Oxygen liberation during photosynthesis; and

   (d) Measurement of light using Luxmeter, Secchi disc

2. Chemical separation of chloroplast pigments/Chromatographic separation of chloroplast pigments.

3. Demonstration of Hill's reaction and study of the effect of light intensity.

4. Demonstration of Blackman's law of limiting factors.

5. Study of the effect of red and blue light on seed germination and development of pigments during fruit ripening.

6. Photographs/slides/specimens of photoautotrophic and photosynthetic bacteria, chloroplast, quantasome, bioluminescent organisms.

7. To study the effect of light and darkness on the chromatophores of fish

8. To study the phototactic behavior of earthworm/ to determine whether insect larvae are equally attracted to different colored lights.

9. Effect of UV light on insects/Effect of photoperiod on the emergence of adult butterfly/moth/Effect of light on development of insect (*Spodoptera*)

10. To study the estrous cycle of rat.

BIST 102 : CHEMISTRY

UNIT 1

Chemical Bonding and Molecular Structure

Ionic Bonding : Lattice energy and solvation energy Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, *Covalent Bonding*: VB Approach,Lewis theory, VSEPR theory to explain the shapes of molecules, salient features of the Valence bond (VB) theory and the concept of hybridization, Concept of resonance, *MO Approach* **:** limitations of the VB approach, salient features of the MO theory.Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for s-s-, s-p and p-p combinations of atomic orbitals, nonbonding combinations of orbitals MO treatment of homonuclear diatomic molecules of 1st period and heteronuclear diatomic molecules such as CO, HF.

12 Periods

UNIT 2

Chemical Thermodynamics

Introduction of thermodynamics, state of system, state variables, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. *First Law of Thermodynamics* : Calculation of work (w), heat (q), changes in internal energy (ΔE) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w,q, ΔE, and ΔH for processes involving changes in physical states. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature Kirchhoff's equation. Second law of thermodynamics, concept of entropy, Gibbs free energy and Helmoltz free energy. Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity, Gibbs Helmholtz equation. Maxwell's relations. Statements of *Third Law of thermodynamics* : calculation of absolute entropies of substances.

12 Periods

UNIT 3

Fundamentals of Organic Chemistry

Hybridization in organic compounds, cleavage of covalent bond, homolysis and heterolysis, Electronic effects: Electronic effects and their applications – inductive, resonance and hyperconjugation effects. Structure and relative stability of reactive carbon species – carbocations, carbanions, free radicals and carbenes, Molecular Forces : types of intermolecular and intra-molecular forces and their characteristics : dipole-dipole, dipole-induced dipole and dispersion (London) forces. Hydrogen bond (both intramolecular and intermolecular), Effect of inter/intramolecular forces on physical properties such as solubility, vapour pressure, melting and boiling points of different compounds,Aromaticity: Huckel's rule and its applications to aromatic species. **12 Periods**

UNIT 4

Stereochemistry

Stereochemistry and its importance. Geometrical isomerism, cis-trans and E/Z nomenclature Optical isomerism – optical activity, plane polarized light, enantiomerism, chirality, specific molar rotation, Stereoisomerism with two chiral centrers : Diastereomers, mesoisomers, Resolution of racemic modification. Projection diagrams of stereoisomers : Fischer, Newman and Sawhorse projections. Relative Configuration: D/L designation. Absolute Configuration : R/S designation of chiral centres, Conformational isomerism – ethane, butane, energy diagrams and relative stability of conformers. Ring strain in cyclopropane, cyclobutane. Baeyer strain theory and its limitations, cyclohexane and its conformers.

14 Periods

Suggested Reading Materials:

1. J.D.Lee : A New Concise Inorganic Chemistry, E.L.B.S.
2. P.W. Atkins : Physical Chemistry, Oxford University Press
3. R.T. Morrison & R.N.Boyd : Organic Chemistry, Prentice Hall
4. James E.Huheey etl. : Inorganic Chemistry : Principles of Structure and reactivity,

BISP 105 : CHEMISTRY – LABORATORY

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture
2. Estimation of oxlic acid by titrating it with $KMnO_4$.
3. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator
4. Surface tension measurement (use of organic solvents excluded) Determination of the surface tension of a liquid or a dilute solution **using** a stalagmometer.
5. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer
6. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
7. pHmetric titration of HCl with NaOH
8. Detection of extra elements (N,S,Cl, Br,I) in organic compounds (containing upto two extra elements)
9. Determination of melting and boiling points of organic compounds
10. Separation of mixures by Chromatography; Measure the R_f value in each case (combination of two compounds to be given)

    (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

    (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Suggested Reading Materials:

1. A.I. Vogel, Vogel's Qualitative Inorganic Analysis, Prentice Hall, 7th Edition
2. A.I. Vogel, Vogel's Quantitative Chemical Analysis, Prentice Hall, 6th Edition
3. B.D. Khosla, Senior Practical Physical Chemistry, R.Chand & Co.

BIST 103 : PHYSICS AND APPLICATIONS TO BIOLOGY

UNIT 1

Mechanics: Galilean invariance and Newton's Laws of motion. Dynamics of a system of particles, Conservation of momentum and energy, work energy theorem. Conservation of angular momentum, torque, Motion of a particle in central force field. Kepler's Laws, Satellite in circular orbit and applications (Synchronous satellite, GPS, Artificial gravity, apparent weightlessness), Physiological effects of acceleration and angular motion.

Special Theory of Relativity: Constancy of speed of light, postulate of Special theory of relativity, length contraction, time dilation, relativistic velocity addition, Mass-energy momentum relations

12 Periods

UNIT 2

Waves and Oscillations: Simple harmonic motion, damped and driven harmonic oscillator, coupled oscillator, energy relation and energy transfer, normal modes, Wave equation, Travelling waves, superposition principle, pulses, Doppler effect, effects of vibrations in humans, physics of hearing, heartbeat

Modern optics: Two slit Interference, Diffraction, Resolving power, Resolution of the eye, Laser characteristics, Principle, Population inversion, Application of laser in medical science, Polarization of EM wave, Malus Law, Polarizing materials, Polarizer, Analyzer **12 Periods**

UNIT 3

Membrane Systems and Membrane Physics :Micelle and Bilayer formation, structure and function. Physicochemical characterization and analysis of micelles and bilayers. Membrane equlibria and Transport. Thermodynamics of transport process. Ficks', law, Nernst Planck Equations, Diffusion, Osmosis, Donnan effect, permeabilily coefficient. Excitable Membranes, Resting potentials, Measurement membrane conductance. Neural signals and action potentials.

Overview of Neural networks: Integrate-and-fire model, Leaky integrate-and-fire model, Hodgkin-Huxley model, FitzHugh-Nagumo model; Artificial neural network: Binary neuron, Associative memory, Hopfield model **12 Periods**

UNIT 4

Spectroscopy: Introduction to principle of U.V. visible and fluroscence spectroscopy instrumentation of UV visible and fluroscence spectroscopy. Application to Biology.

10 Periods

Suggested Reading Materials:

1. Rodney Cotterill; Biophysics : An Introduction, John Wiley & Sons (year)
2. D.S. Mathur , Mechanics, S.Chand & Company Ltd. 2000
3. N.K.Bajaj, The Physics of Waves and Oscillations, Tata McGraw Hill 1988

BISP 106 : PHYSICS AND APPLICATIONS TO BIOLOGY - LABORATORY

1. Determination of acceleration due to gravity using Kater's Pendulum
2. Determination of the acceleration due to gravity using bar pendulum
3. Determination of moment of inertia of a Fly wheel
4. Determination of the frequency of an electrically maintained tuning fork by Melde's experiment
5. Determination of the coefficient of Viscosity of water by capillary flow method (Poiseuille's method)
6. Verification of Beer Lamberts Law
7. Determination of Molar Exctinction coefficient
8. Determination of CMC for a detergent
9. Thermal Conductivity of a membrane and effect of temperature

BIST 201: BIODIVERSITY & BIO-PROSPECTING

UNIT 1:

Defining Biodiversity - Components of biodiversity. Biodiversity crisis and biodiversity loss. Importance of biodiversity in daily life. Biodiversity and climate change.

Types of Ecosystems : India as mega biodiversity Nation. Hot spots and biodiversity in India. Biodiversity and Ecosystem functioning. Plant and Animal systematic. Species concept in biodiversity studies. **8 Periods**

UNIT 2:

Modern Tools in the study of Biodiversity : Endemism, endemic plants and animals**;** Assessment of mapping of biodiversity**;** GIS/Remote sensing**;** Biotechnology and Conservation, IUCN**;** Germplasm banks, National Parks, Botanical Gardens**;** Wildlife Sanctuaries, Bioresources **10 Periods**

UNIT 3:

Crop Diversity

Wild relatives of cultivated plant; Domesticated diversity; Spice diversity; Forest diversity and wild life

7 Periods

UNIT 4:

Representative type (one each) studies from Cryptogams, Phanerogams, Non-chordates and Chordates**;** Sacred flora and fauna **20 Periods**

Bio-prospecting

Micro organisms as a source of novel enzymes, antibiotics, antiviral agents; Immunosuppresive agents and other therapeutic agents. Botanicals for Biocontrol, Health and biodiversity. **5 Periods**

Suggested Reading Materials

1. Aber, J.D.and Melillo J.M., Terrestrial Ecosystems: 1991, W.B.Saunders
2. Ingrowille, M Diversity and Evolution of land plants 1992 chapman and Hall

BISP 204: BIODIVERSITY & BIO-PROSPECTING – LABORATORY

FAUNA

1. **Study of following specimens**: *Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus,* Hermitcrab*, Daphnia,* Millipede, Centipede, Beetle, Pila, *Chiton, Dentalium, Octopus, Asterias, and Antedon.*

2. **Dissections**: Digestive and nervous system of Cockroach; Mouth parts , salivary apparatus and ovary of cockroach; Unstained mount of Placoid scales.

3. **Study of following specimens** : *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus ,Draco, Uromastix, Naja, Viper,* any three common birds, Squirrel and Bat.

4. Study of a few endangered species of amphibians, reptiles, birds and mammals of India

5. To study the faunal composition (insects and mites) of soil samples. (Berley's funnel)

6. To study faunal composition of water samples (Lucky drop method)

7. Report on visit to National Park/Wild life sanctuary/Botanical garden.

FLORA

8. Study through specimens/photographs/slides of

   (a) Key stones species (b) Ecads, Ecotypes, Ecophenes (c) Source of Immunosuppresive and other therapeutic agents (d) Botanicals for biocontrol (e) Sacred flora (havan materials etc.)

9. Study through permanent slides and specimens (vegetative and reproductive structures) of *Coleacheate*, *Vaucheria, Polysiphonia, Fucus* (*Fucus* permanent slides only); *Rhizopus*, *Penicillium* and *Agaricus*; *Riccia, Anthoceros*, *Funaria; Psilotum*, *Selaginella*, *Pteris; Cycas, Pinus, Gnetum*

10) Study of the characteristic features of any two flowers for each family

   (a) Malvaceae/ Fabaceae/Cruciferae/Ranunculaceae (any one family), (b) Compositae

   (c) Euphorbiaceae, (d) Poaceae/Liliaceae (any one family)

BIST 202 : BIO-RESOURCES & MANAGEMENT

UNIT 1

Aquaculture

Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important fishes of India. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control; Snakes and snake venoms **13 Periods**

UNIT 2

Economic Zoology Overview of Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry

Vermiculture Introduction and scope, Species of earthworm, Characteristics features of earthworm.

Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer **12 Periods**

UNIT 3

Cultivated Plants: origin and importance with particular reference to the works of A. de Candolle and Vavilov (especially centers of diversity, primary and secondary centers, multiple origin); a brief account of Harlan and Hawkes theories; examples of major introductions; practices of floriculture, agroforestry, sericulture. BT crops (brief account).

10 Periods

UNIT 4

Definition, Classification, Names, Morphology and economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.

15 Periods

Suggested Reading Materials

1. Manju Yadav, Economic Zoology- Discovery publishing house, New Delhi

3. Lee R E,. Phycology 1999

BISP 205 : BIO-RESOURCES & MANAGEMENT - LABORATORY

1. Identification of economically important fishes of India
2. Identification of different silk moths in India
3. Setting of an aquarium
4. Breeding of aquarium fish: black molly/gambusia/sword tail or Induced breeding of fish.
5. Population enumeration of fish by Peterson's mark and recapture method (simulation exercise).
6. Field report on Apiary
7. To study the impact of salinity on seed germination.
8. Measure the primary productivity (Biomass by Fresh Weight/ Dry Weight method).
9. To determine the chlorophyll content of various species of an ecosystem.
10. To isolate bioactive components from plants of significance by various techniques (TLC/ Column chromatography/ Paper chromatography)
11. Shelf-life management of flowers of importance.
12. Isolation and culture of VAM fungi and study the features through temporary preparations.
13. Study the root nodule and preparation of bacterial slides (gram stained).
14. Study of petro-crops/ biofuel plants (specimens).
15. Study of Industrially important plants (specimens/products) morphology, botany and uses.

BIST 203 : ECOLOGY : CONCEPTS & MANAGEMENT

UNIT 1

Ecology: History, definition, ecological factors (abiotic and biotic factor), ecological range (Eury , Steno)

Stress and adaptation (Morphological, physiological, anatomical and biochemical), Biotic interaction, phenotypic and genotypic plasticity, canalization. **10 Periods**

UNIT 2:

Ecosystem: Concept, components, (e.g., aquatic, marine, forest, grassland, desert, fish tank, euxenic cultures, complete and incomplete ecosystem), energy flow(GFC, DFC), food web, niche , Gause's exclusion principle, Leibig's law, ecological pyramids, Autecology and Synecology, r- & k-selections, carrying capacity, population dynamics,(exponential & logistic growth curves),keystone species. **15 Periods**

UNIT 3

Pollution

Pollution of Soil, water, air (types of pollutants and sources), noise pollution, radiation pollution, remedial measures, bioamplification

Disaster management : Types of disasters & Management strategy

15 Periods

UNIT 4

Behavioral ecology: social, reproductive & territorial behavior, evolution of optimal life history, reproductive structure and mating system, microbial ecology

10 Periods

Suggested Reading Materials

1. Wilkenson DM – 2007 – Fundamental Processes in Ecology
2. Aber J.D. & Melillo J M 1991- Terrestrial Ecosystems

BISP 206 : ECOLOGY : CONCEPTS & MANAGEMENT – LABORATORY

1. Study through specimens/photographs/slides

   Parasitic angiosperms, Saprophytic angiosperms, VAM fungi, Root nodules, Corolloid roots, Mycorrhizal roots, Velamen roots, Lichen as pollution indicators,

2. Principle and function of Sechi disc, Atmometer, Anemometer, Hygrometer, Hair hygrometer, Luxmeter, Rain guage, Soil thermometer, Min-Max thermometer

3. Minimal quadrat

4. To determine density/frequency/abundance of the vegetation by quadrat method.

5. To determine soil texture

6. To determine soil density, bulk density, particle density and pore space.

7. To determine water holding capacity and percolation rate of soil.

8. To determine pH, Cl, SO_4 , NO_3, base deficiency, organic matter, cation exchange capacity in the soil.

9. Plotting of survivorship curves from hypothetical life table data.

BIST 301 : BIO-ORGANIC & BIO-INORGANIC CHEMISTRY

UNIT 1

Biomolecules: Diversity and distribution

Lipids: Role of lipids in cellular architecture and functions. Definition and classification of lipids. Structure and function of fatty acids, triacylglycerols, phospholipids and sterols. Carbohydrates: Biological roles of carbohydrates. Structure of monosacharides- Hexoses and pentoses. Disacharides-Sucrose, lactose, maltose. Storage and structural polysacharides-Glycogen, starch and cellulose. Nucleic acids: Role of nucleic acids in living system. Composition of nucleic acids-the purine and pyrimidine bases. Structure of nucleosides and nucleotide, deoxynucleotides, cyclic nucleotides and polynucleotides. Watson and Crick model for DNA. Different classes of RNA. **15 Periods**

UNIT 2

Proteins

Classification of proteins on the basis of composition, conformation and function-functional diversity of proteins. The amino acid building blocks-classification, structure and physical properties of the standard amino acids. Proteinaceous and non-proteinaceous, essential and non-essential amino acids. Primary, secondary, tertiary and qua ternary structure of proteins. Structure of myoglobin and hemoglobin. Molecular physiology of myoglobin and hemoglobin, Bohr effect, Hill's coefficient. Concerted and sequential models for allosteric proteins, **10 Periods**

UNIT 3

Enzymes

Enzymes as biological catalysts. Enzyme classification and nomenclature. Chemical nature of enzymes, ribozymes. Concept of active site, specificity. Coenzymes, cofactors and prosthetic groups. Kinetics of enzyme catalyzed reactions - Michaelis Menten equation. Determination of K_m and V_{max}. Factors influencing the rate of enzyme catalyzed reactions. Enzyme inhibitions- competitive, non-competitive and uncompetitive inhibitions. Catalytic mechanism of lysozyme, chymotrypsin and Hexokinase. Regulation of enzyme activity-allosteric enzymes, feedback inhibition with ATcase as an example. **15 Periods**

UNIT 4

Medicinal Chemistry and Role of Metal ions in Biology

Structure based drug design, combinatorial chemistry and high throughput screening. Combinatorial synthesis in medicinal chemistry-solid phase synthesis, Houghton's teabag method, mix split method. Introduction to pharmacology, pharmacokinetics, safety and efficacy of the candidate drugs, toxicity and adverse reactions, clinical trials; Metalloprotein, Metaloenzymes, metal base drug interaction and inhibition; metallo porphyrins, Redox carriers in mitochondrial electron transport chain.

10 Periods

Suggested Reading Materials:

1. Nelson, D. L. and Cox, M.M. (2008**).**Lehninger, Principles of Biochemistry, 5th Edition, W.H.Freeman and Company, N.Y., USA.

2. Voet, D. and Voet, J.G. (2004). Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA.

3. Patrick Medicinal chemistry

BISP 301 : BIO-ORGANIC AND INORGANIC CHEMISTRY - LABORATORY

1. Preparation of buffers
2. Determination of PK_a value for acetic acid
3. Estimation of proteins by Biuret method
4. Estimation of proteins by Lowry's method
6. Separation of sugars by Thin Layer chromatography
7. Assay of the enzyme acid phosphatase from germinated mungdal or β-amylase from Sweet potato beams
8. Effect of pH on the activity of an enzyme
9. Progress curve of an enzyme

BIST 302 : METABOLISM, INTEGRATION AND ADAPTATION

UNIT 1

Concept of Metabolism : Experimental approaches to study metabolism; Primary and secondary metabolism **8 Periods**

UNIT 2

Major metabolic pathways & Regulation : Glycolysis, the TCA cycle, Oxidative degradation of fatty acids and amino acids in animal tissues; correlation between carbohydrate, amino acids and fatty acid degradation Selected metabolic pathways (for example biosynthesis of rubber, antibiotics etc.); Regulation of metabolism and environmental cues. Metabolic inter relationships – starve feed cycle. Mechanisms involved in switching liver metabolism between the well feed and starved states. Inter relationship of tissue in nutritional and hormonal states. **15 Periods**

UNIT 3

Special aspects of metabolic regulation, Tissue specialization : Function. Intracellular communications and signal transduction mechanisms; developmental adaptations – eg: rat, C_3, C_4 plants; Metabolic basis of health and disorders – Jaundice – diabetes mellitus, exercise, alcohol abuse

10 Periods

UNIT 4

Use of microbes for specific metabolic tasks : Alternate metabolic cycles, Carbon metabolism of intracellular bacterial pathogens**;** Environmental cleaning, biotransformation of metals; Metabolic handling of xenobiotics and drug resistance; Photo and lithotrophic metabolic capabilities; myporia

15 Periods

Suggested Reading Materials

1. H.G. Sehlegal, General Microbiology 2003, Cambridge University Press Cambridge

2. Sterier, R.Y.et AL, General Microbiology 1986, Macmillan London

3. Thomas M.Devlin, Text Book of Biochemistry with Clinical Correlations, 6th edition, 2006, Wiley-Liss

4. Peter W. Hochachka, George. N. Somero, Biochemical adaptation, Amazon Publishers

BISP 302 : METABOLISM : INTEGRATION AND ADAPTATION - LABORATORY

1. Estimation of blood glucose – Glucose Oxidase method
2. Estimation of Cholesterol – Hyper Cholesteremia samples
3. Estimation of SGPT and SGOT
4. Estimation of Bilirubin
5. Estimation of creatinine
6. Identification of organelles by marker enzymes – SDH, LDH and acid phosphatase

BIST 401 : GROWTH & REPRODUCTION

UNIT 1

General growth patterns in animals and plants; hyperplasia and hypertrophy ; measurements (fresh weight, dry weight, dimension, number etc.); kinetics and kinematics; meristem (a general account) ; senescence and ageing; programmed cell death; quiescence and dormancy.

5 Periods

UNIT 2

Alternation of generations and reproductive patterns in animals and plants- asexual and sexual reproduction -an overview (regeneration, apogamy, apospory, apomixis etc); Pre-fertilization events-gametogenesis – spermatogenesis and oogenesis, types of eggs in animals; isogamy, anisogamy and oogamy, relative sexuality in plants **15 Periods**

UNIT 3

Fertilization in animals, and in plants-mode of transport of gametes leading to fertilization/double fertilization;

Post fertilization events: animals-general cleavage types; cleavage in frog, chick and mammal; fate maps, morphogentic movements during gastrulation; gastrulation in frog and chick; fate of germ layers; an overview of neural tube formation, types of mesoderm, somite formation, endoderm and its derivatives; extra embryonic membranes; placenta; role of hormones during pregnancy, parturition and lactation; Post fertilization events in plants: endosperm, embryo, seed and fruit formation, dispersal of seeds **20 Periods**

UNIT 4

Organogenesis- Formation of Brain, (CNS), Heart

20 Periods

Suggested Reading Materials:

1. Gilbert, S: Developmental Biology . 9th ed. ,Sinauer Associates Inc.2010

5. Carlson, B.M. Patten;s foundations of embryology.McGraw Hill, 1996

BISP 401 : GROWTH AND REPRODUCTION - LABORATORY

1. Measurement of animal and plant cell size using ocular and stage micrometer.
2. Temporary mount preparations of Drosophila eggs and chick early embryos.
3. Study of whole mounts of frog and chick- early developmental stages
4. Study of chick development from the live eggs (window viewing)
5 Study of section of chick embryo- through selective developmental stages
6 Videos showing selective embryonic evens-n cleavage, gastrulation.
7. Micro and mega sporogenesis in higher plants-slides only
8. Pollen germination in vivo and in vitro
9. Study of gamete/sporesin algae, moss, liverwort, pteridophyte and gymnosperm
10. Embryo development in flowering plant-slides only; dissection of endosperm and embryo
11. Study of apical and lateral meristem, hypertrophy and hyperplasia
12. Study of asexual and sexual modes of reproduction in various plant groups
13. Survey of dispersal mechanisms of seeds 13)
14. Study of growth curve of any microbial culture

BIST 402 : SYSTEM PHYSIOLOGY & BEHAVIOUR

UNIT 1

Movements and Bulk Transport

Cellular movements, ciliary and flagellar structure and function**;** Introduction to musculo skeletal system; Terrestrial, aquatic and aerial locomotion**;** Locomotory cost**;** Bulk transport of water and nutrients in plants**;** General plan of circulatory system in vertebrates and invertebrates**;** Cardiovascular system ; structure and function **12 Periods**

UNIT 2

Gas exchange in organism; Generation and utilization of energy

Exchange in unicellular organisms and plants; Respiratory organs in aquatic and terrestrial systems ; Physiology of aquatic breathing and aerial breathing; Feeding patterns, digestive tract systems; Digestion of food **12 Periods**

UNIT 3

Regulatory Physiology

Regulation of water in aquatic and terrestrial animals; Water and solute excretion in organisms,; osmoregulatory organs; Transpiration in plants; Excretion of nitrogenous wastes in animals; Patterns of Thermoregulation : Ectotherms and Endotherms; Structural and functional adaptation to stress

11 Periods

UNIT 4

Integrative Physiology

An overview of neuronal structure and function; Sensory physiology –mechano, chemo, thermo, photo and electro receptors; Endocrine systems in animals and their physiological effects; Plant hormones and their physiological effects; Regulation of metabolism and response to environmental cues; Neuronal basis of behaviour; Behaviour concepts and measurements **15 Periods**

Suggested Reading Materials:

1. David Randall, Eckert's Animal Physiology, W.H.Freeman and Co.
2. Philips Withers; Comparative Animal Physiology. Books Cole Publishers

BISP 402 : SYSTEM PHYSIOLOGY & BEHAVIOUR - LABORATORY

1. Recording of simple muscle twitch with electrical stimulation
2. Enumeration of RBC using haemocytometer
3. Estimation of total and differential count of WBC using haemocytometer
4. Study of the effect of various environmental factors on transpiration in an excised twig/leaf
5. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophytes
6. Study of the mechanism of stomatal opening and closing

BIST 501 – DEFENCE MECHANISM

UNIT I

Overview: Introduction; *Defence in Plants & Animals;* Cells and organs of the immune system

Innate immunity in Plants and Animals*;* Complement system **8 Periods**

UNIT 2

Adaptive Immunity in Plants; Abiotic- Strategies and mechanisms; Biotic- Interactions with symbionts, pathogens, Biochemical host defences, Basal resistance,Gene for gene concept, Cytological protection and induced resistance; Passive defences; Active defences

17 Periods

UNIT 3

Adaptive Immunity in Animals; Antigens; Adaptive immunity; B-Cell Biology - Antibody structure, B-cell development, Receptor diversity, Monoclonl Antibodies, Humoral response ; *T-Cell Biology - T cell development ,* Structure of TCR, Thymic education, Antigen Processing and Presentation, Cell mediated immune response; Mucosal immune system; Techniques based on antigen- antibody interactions: **18 Periods**

UNIT 4

Immune Mechanism Dysfunction & Applications; Hypersensitivity; Autoimmunity; Immunodeficiency; Immune response against major classes of pathogens; Applications**:** In agriculture, Pharmaceuticals and biopest control. **7 Periods**

Suggested Reading Materials:

1. Deverall, Brain J. 1977. Defences mechanisms of plants, Cambridge University Press.

2. T .J. Kindt, R. A. Goldsby, and B.A. Osborne. 2007. Kuby Immunology, W.H. Freeman and Co, New York.

3. K. Murphy, P. Travers, M. Walport. 2008. Janeway's Immunobiology, Garland Science, Taylor and Francis Group, LLC

BISP 501: DEFENCE MECHANISM – LABORATORY

1. Characterization of diseases symptoms and identification of pathogenic organisms (at least one each from viral, fungal, pest and nematodes injection).

2. Survey of structural plants defences: viz. cuticle, wax, lignin, bark, thorns, prickles, trochomes, armour in different plants species including thigmonasty, camouflage, mimicry.

3. Survey: Quantitative and qualitative secondary metabolites in plants: alkaloids, glycosides, glycosinolates, terpinoids, phenolics, gammosis etc. in healthy and diseased plant/plant organs.

4. Partial purification of Immunoglobulin's by Ion Exchange chromatography

5. Immunodiffusion – DID and SRID.

6. Immunoelectrophoresis(IEP)

7. Countercurrent IEP, Rocket IEP

8. Spleen cell isolation and Counting.

BIST 502 : EVOLUTION & ADAPTATION

UNIT 1

History of Evolutionary thought: Pre-Darwinian concepts, Darwinism, post Darwinian concepts, Modern synthetic theory **8 Periods**

UNIT 2

Evolution as seen in Geological record: Types of fossils, dating of fossils, Evolution of Man

Evolution of Plants and Fungi : Origin of land plants, Bryophytes (alternation of generations), early vascular plants (stelar evolution, sporangium evolution), Angiosperms (Phylogeny of major forms of plants), Fungi

15 Periods

UNIT 3

Process of Evolutionary change: Concept of population, gene pool, gene frequency-conservation allele frequency (Hardy-Weinberg equilibrium), Change in gene frequencies (Genetic drift, gene flow, genetic load)

Product of Evolutionary process : Speciation, concept of species, sub species, isolation mechanisms, modes of speciation (allopatric, sympatric, peripatric), anagenesis & cladogenesis, levels of evolutionary change (micro & macroevolution)

15 Periods

UNIT 4

Adaptations and extinctions: Osmotic regulation and excretion of nitrogenous waste, protective coloration, mimicry, Extinction. Periodic and mass scale, possible causes

12 Periods

Suggested Reading Materials:

1. Ridley, M. (2004) Evolution. III Edition. Blackwell Publishing

2. Stricberger, M.W. Evolution. Jones& Bartlett, USA 1996

BIST 503: BIOMATERIALS

UNIT 1

Classification, Chemistry and characterization of biomaterials

Definition and classification of bio-materials.Structure of bio-material:Metallic implant materials, stainless steels, Co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics, carbons.

Polymeric implant materials: definition of DP, CRU, Monomer, classification of polymers, polyolefin, polyamines, Acryrilic, polymers, rubbers, high strength thermoplastics, PVC, HEMA, hydrogels.

Nanomaterials: fullerenes, carbon nanotubes, nanomembranes.

Synthesis of bio-materials,Characterization of chemical, physical, mechanical properties, visco elasticity, end group analysis, determination of molecular weight of a polymer.

15 Periods

UNIT 2

Biocompatibility

Biocompatibility of Bio-materials, wound-healing process, body response to implants, blood compatibility. Tests to assess biocompatibility of a polymer, modifications to improve biocompatibility. Reactions of biomaterials with cellular and extra cellular components

10 Periods

UNIT 3

Modified biomaterials

Biodegradative biomaterials, Bioactive polymers and biosynthetic polymers, inert biomaterials, genetically engineered biomaterials **10 Periods**

UNIT 4

Applications of Biomaterials

Tissue Replacement Implants

Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal Fractures fixation devices, joint replacements. Artificial Organs

Artificial Heart, Prosthetic cardiac Valves, Limb prosthesis, Externally Powered limb, prosthesis, Dental Implants

Other applications

Liposomes, hydrogels andNanomaterials in drug delivery. Biomaterials in diagnostics and bioanalytical techniques. **15 Periods**

Suggested Reading Materials:

1. **Sujata V. Bhat, Biomaterials** , 2 nd edition, Narosa Publishing House, New Delhi, 2006.

2. Buddy D. Ratner, B. D. Ratner,Allan S. Hoffman, Biomaterials Science: An Introduction To Materials In Medicine, 2nd Edition(2004) Publisher: Academic Press.

3. Fred W.Billmeyer, Text book of Polymer Science. 3 rd edition John Wiley and sons publications.

BISP 502: BIOMATERIALS – LABORATORY

Computational Biology Lab Exercises

1. Visualization Softwares – Rasmol, JMOL – To view 3D structures of biomolecules in various visualization packages available online.

2. Molecule Builder – 2D and 3D using softwares like ISIS Draw and Hyper Chem

3. Databases - Protein databank (PDB): File format, Structure, Sequence of proteins, Retrieval of protein structure & sequences Nucleic acid database (NDB): Structure, GenBank: Whole Genome sequences of bacterial (*E.coli*, Mycobacterial) , viral, plant genomes (Rice, Cotton) , their retrieval from databases

4. Sequence Alignment - Pairwise and Multiple sequence alignment using BLASTn, BLASTp, CLUSTALW

5. Gene Finding Tools - Gene Prediction Softwares like GenScan, GLIMMER

6. Introduction to Proteomics – Primary sequences analyses (Protparam) Secondary Structure Prediction Softwares like GOR, nnPredict, Tertiary structure Prediction Softwares like SWISSMODEL, Transmembrane Protein Prediction (TMPred)

7. Phylogenetic Analyses

Suggested Reading Materials:

1. David W. Mount, Bioinformatics: Sequence and genome analysis

2. Teresa K. Attwood, David J. Parry-Smith Introduction to Bioinformatics

BIST 601 : APPLIED BIOLOGY

UNIT 1

Climate and Adaptations of Agricultural Crops: Beneficial Soil Organisms: VAM Fungi and Mycorrhizae, Weed Ecology and Management, Crop Practices (Crop Rotation, Cover Crops, Intercropping, Conservation Tillage, Mulches, Organic Amendments, Irrigation and Salinity): Sustainable Agricultural Practices, Crop Biodiversity. **12 Periods**

UNIT 2

Biofuels, Biofertilizers, Biocides, Tissue Culture Techniques and Biotechnology-Applications, Practices of Conservation of Plant Genetic Resources, Intellectual Property Rights, Restoration Ecology, Important Indigenous Medicinal Plants (Eg. Brahmi, Ashwagandha), Multipurpose Trees, Non Timber Forest Produce Management, Industrial Botany. **12 Periods**

UNIT 3

Economic importance of insects .Insects as agents of human diseases (Mosquito, Flea and Lice). Stored grain insects and their control. Various strategies for Integrated Pest Management: Mechanical, Physical, Cultural, Biological, Chemical, Physiological, Regulatory etc.

12 Periods

UNIT 4

Reproductive Health and Human Welfare

Infertility in male and female: causes, diagnosis and management

Assisted reproductive technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT ,ICSI, PROST

Modern contraceptive technologies;

Demographic terminology used in family planning

14 Periods

Suggestive Reading Materials:

1. Chaudhary, S.K. Practice of fertility control. B.I. Churchill Livingston Pvt. Ltd.

2. Atwal,A.S. Agricultural pests of India and South East Asia. Kalyani Pub. N Delhi 1993

BISP 601 : APPLIED BIOLOGY – LABORATORY

1. Specimens of cereals (rice, wheat, maize), legumes (arhar, soybean, alpha alpha, mung, urad, chana, melilotus), fruits and vegetables (mango, apple, banana, guava, bringal, potato, sweet potato, tomato), spices and condiments (clove, ginger, pepper, turmeric, cardamom), beverages (tea, coffee), oils and essential oils (mustard, groundnut, sesame, sunflower, carnola, lemongrass, jasmine, rose, vetiver, sandalwood), drugs (cinchona, poppy, *Rauwolfia*, *Ocimum*, *Atropa, Digitalis*, *Cannabis*, tobacco), timber (teak, shisham, pine, cedrus, oak, sandalwood), fibers (cotton, jute, flax, coir, hemp).

2. Microchemical tests for starch, sugar, glucose, oils, proteins using sections/preparations of materials- wheat, maize, soybean, chana, sweet potato, clove pepper, groundnut, mustard.

3. Identification of the following pests :Mosquito, Flea, Louse, Heliothis, Locust, Termite, Leptocorisa, Trogoderma, Sitophilus, Callosobruchus. Determination of LD_{50} or LC_{50} of insecticides

4. Study of modern contraceptive devices, Project on topics associated with human reproduction. Visit to centres of proficiency in reproductive physiology and ART.

BIST 602 : DIFFERENTIATION AND MORPHOGENESIS

UNIT 1

Morphogens; epithelial and mesenchymal cells; mophogenetic gradients,; cell specifications; determination and differentiation; pattern formation with reference to animal/plant tissue and organ formation ; cell wall, plasmodesmata and chloroplast- as unique component of plant cells in relation to development **12 Periods**

UNIT 2

Cell adhesion (role of cadherins); cell affinity; cell interactions; cell matrix; signal transduction-RTK signal transduction pathway; juxtacrine signaling-Notch path way; c-AMP pathway; embryonic induction.; body coordinates in drosophila **13 Periods**

UNIT 3

Role of plant growth substances (auxin, gibberellins, cytokinins, ethylene, abscisic acid, jasmonates, brassicosteroids), light and temperature in plant development; floral development and homeotic genes in lower and in higher plants, apical dominance, abscission;

13 Periods

UNIT 4

Stem cells ; therapeutic cloning; teratogenesis; cancer-types, oncogenes and treatment ; genetic transformations using pollen grain/embryological systems; Nodule and Gall formation in plant systems.

12 Periods

Suggested Reading Materials:

1. Davis, P,J: Plant hormoneses, Biosynthesis, signal transduction, action. 3rd ed. Kluwer Academic Pub., 2004
2. Gilbert, S: Developmental Biology . 9th ed. ,Sinauer Associates Inc.2010

BISP 602 : DIFFERENTIATION & MORPHOGENESIS - LABORATORY

1. Life cycles of the model organisms –Dictyostelium, Coenorhabditis, Sea urchin, Drosophila, Zebra fish, Xenopus, Arabidopsis and Maize, Chromosome squash from salivary gland of Drosophila.

2 Lab rearing of Drosophila cultures. Study of the eggs-through cleavage under microscope.

3. Study of tissues-parenchyma, collenchyma, sclerenchyma, xylem, phloem, epidermis, leaf primordia, lenticel, stomata, plasmodesmata etc.- through hand sections/maceration/permanent slides.

4 Study of floral apex

5 Polarity in plant development - from photographs

6 Auxin mediated initiation of roots in plant twigs (demonstration)

7 Bolting by gibberellin (demonstration)

8 Microchemical tests for cellulose, lignin, pectin, hemicellulose, suberin in cell walls of different plant materials.

9) Study of different kinds of plastids from different plant sources- under light microscope/ and EM photographs

BIST 603: MICROBIOLOGY : PRINCIPLES & APPLICATIONS

UNIT I

Early history of Microbiology and Microbial Diversity

Discovery of microorganisms, contributions of scientists, spontaneous generation v/s Biogenesis, discovery of antibiotics. Physiological diversity, microbial classification (prokaryotes: Bacteria and Archaea, eukaryotes: Fungi, Algae, Protozoa, Helminthes) Binomial nomenclature, Whittaker's and Carl Woese's classification. General characteristics of viruses, host range, Lytic and lysogenic cycle of T4 and Lambda bacteriophages, cultivation of viruses, RNA viruses, reverse transcription.

10 Periods

UNIT 2

Microbial Nutrition, Growth and Control

Nutritional requirements (macro and micronutrients), Temperature, pH, osmotic pressure, Types of culture media, uptake of nutrients, Maintenance of pure cultures. Bacterial division, growth curve, generation time, measurement of growth. Asepsis, sterilization with physical and chemical agents.

8 Periods

UNIT 3

Harmful and beneficial microbes

Normal microflora of human body, host-pathogen interaction, bacterial, viral, protozoan and fungal diseases (with reference to symptoms, pathogenesis, transmission, prophylaxis and control) of plants and animals. Phytotoxins, antimicrobial agents, drug resistance, interferons. Microorganisms and fermentation; Bioremediation; Bio-indicators.

15 Periods

UNIT 4

Microbial Biotechnology

Types of restriction enzymes, methylation, cloning vectors (plasmids, phage-based etc), selection of recombinants, screening cDNA/genomic DNA libraries with probes, optimization of heterologous protein expression in *E.coli,* site-directed mutagenesis, PCR. Manipulating DNA in microbes, plants and animals - overviews, Application of recombinant DNA technology – Therapeutic proteins (human disease) transgenics-herbicide, resistance, metabolic engineering, production of vaccines

15 Periods

Suggested Reading Materials

1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J.(2008). Prescott, Harley and Klein's Microbiology.7th edition. McGraw Hill Higher Education.

2. Tortora, G.J., Funke, B.R. and Case, C.L.(2008) Microbiology: An Introduction. 9th edition. Pearson Education.

3. Primrose and Twymann, Principles of Gene Manipulation and Genomics. 7th edition(2008), Blackwell Publishing.

BISP 603: MICROBIOLOGY : PRINCIPLES & APPLICATIONS - LABORATORY

1. Identification of an unknown microbe using Bergey's manual.
2. MPN for potable water
3. Conjugation
4. Determination of Antibiotic sensitivity
5. Calculation of Phage titre
6. Transformation of E.coli with plasmid DNA

B.Sc. (H) INSTRUMENTATION

THREE-YEAR FULL-TIME PROGRAMME

(Six-Semester Course)

COURSE CONTENTS

(Effective from the Academic Year 2011-2012)

UNIVERSITY OF DELHI

DELHI – 110 007

Syllabus Structure for Semester I-VI {B.Sc (H) Instrumentation} Semester Mode

Paper No.	Semester-I	L-I	Paper No.	Semester-II	L-I
INHT 101	Network Analysis	4-1	INHT 201	C and Data Structures	4-1
INHT 102	Applied Physics	4-1	INHT 202	Introduction to Instrumentation	4-1
INHT 103	Mathematics I	4-1	INHT 203	Mathematics II	4-1
INHT 104	Chemistry	4-1	INHT 204	Biology	4-1
INHP 105	***Instrumentation Practical - I(INHT 101)***	***8 periods per week***	***INHP 205***	***Instrumentation Practical – III (INHT 202)***	***8 periods per week***
INHP 106	***Instrumentation Practical - II (INHT 102 and 104)***	***8 periods per week***	***INHP 206***	***Instrumentation Practical – IV (INHT 201and 204)***	***8 periods per week***

Paper No.	Semester-III	L-I	Paper No.	Semester-IV	L-I
INHT 301	Digital Electronics	4-1	INHT 401	Industrial Instrumentation	4-1
INHT 302	Analog Electronics-I	4-1	INHT 402	Analog Electronics II	4-1
INHT 303	Biochemistry	4-1	INHT 403	Statistical methods and Reliability	4-1
INHT 304	Signal & Systems		INHT404	Electronics Instrumentation	4-1
INHP 305	***Instrumentation Practical – V(INHT 301 and 303)***	***8 periods per week***	***INHP 405***	***Instrumentation Practical – VII(INHT 401 and 404)***	***8 periods per week***
INHP 306	***Instrumentation Practical -V I (INHT302 and 304)***	***8 periods per week***	***INHP 406***	***Instrumentation Practical – VIII(INHT 402)***	***8 periods per week***

Paper No.	Semester-V	L-I	Paper No.	Semester-VI	L-I
INHT 501	Microprocessor	4-1	INHT 601	Analytical Instrumentation-II	4-1
INHT 502	Analytical Instrumentation-I	4-1	INHT 602	Biomedical Instrumentation-II	4-1
INHT 503	Electrical Machines & Control Systems	4-1	INHT 603	Statistical Quality Control	4-1
INHT 504	Biomedical Instrumentation-I	4-1	INHT 604	Microcontrollers and its applications	4-1
INHP 505	***Instrumentation Practical – IX (INHT502 and504)***	***8 periods per week***	***INHP 605***	***Instrumentation Practical - XI(INHT601 and 603)***	***8 periods per week***
INHP 506	***Instrumentation Practical – X(INHT 501 and503)***	***8 periods per week***	***INHP 606***	***Instrumentation Practical - XII(INHT 604)***	***8 periods per week***

L-Lecture **I-Interactive** **P-Practical**

Courses with 4L and 1I : 4 Credits

Courses with Periods Practicals : 4 Credits (2Periods lab equivalent to 1 Credit)

SEMESTER I

INHT-101: Network Analysis

THEORY **Marks: 100**

40 Lectures

Unit 1

Basic Circuit Concepts: Voltage and current sources, Resistance, Capacitance, Inductance, Mutual Inductance, Series and Parallel elements, Duality, voltage division and current division.

Circuit Analysis: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node analysis, Mesh analysis, Star-Delta conversion.

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, Maximum power transfer theorem.

14 Lectures

Unit 2

DC Transient Analysis : Initially charged RC circuit, RL circuit with initial current, time constant, RL and RC circuits with sources, DC response of series RLC circuits (using differential equations).

6 Lectures

Unit 3

AC circuit analysis: Sinusoidal voltage and current, Definition of instantaneous, peak, peak to peak, root mean square and average values. Voltage-current relationship in resistor, inductor and capacitor. Phasor, complex impedance, power in AC circuits: instantaneous power, average power, reactive power, power factor. Sinusoidal circuit analysis for RL, RC and RLC circuits. Mesh analysis, node analysis and network theorems for AC circuits.

Resonance in series and parallel RLC circuits, frequency response of series and parallel RLC circuits, Quality (Q) factor and bandwidth. Passive filters: low pass, high pass, band pass and band stop.

14 Lectures

Unit 4

Two Port Networks: Impedance (Z) parameters, Admittance (Y) parameters, Transmission (ABCD) parameters, Hybrid (h) parameters.

6 Lectures

Suggested Books:

1. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)
2. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
3. M. Nahvi and J. Edminister, Electric circuits, Schaum's outline series, Tata McGraw Hill (2005)
4. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
5. C. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2009)
6. John. D. Ryder, Networks, Lines and Fields, Prentice Hall of India (2002)

INHT-102: Applied Physics

Theory **Marks: 100**

40 Lectures

Unit 1

Thermodynamics: Heat and Temperature, Zeroth law of thermodynamics: thermal equilibrium, thermometry and temperature scales, First law of thermodynamics, Thermodynamic systems and processes, Internal energy and heat capacity, adiabatic processes. Second law of thermodynamics, Reversible and irreversible processes.

8

Lectures

Unit 2

Optics: Interference**:** Interference of light, Bi prism experiment, displacement of fringes, interference in thin films- wedge shaped film, Newton's rings.

Diffraction - Single, Double & N- Slit, Diffraction grating, Grating spectra, Rayleigh's criterion and resolving power of grating.

Polarization- Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Fresnel's theory of optical activity, Polarimeters.

Laser applications-Spontaneous and stimulated emission of radiation, Einstein's Coefficients, construction and working of Ruby, He-Ne lasers and laser applications. Basic principles, different types of laser

14 Lectures

Unit 3

Nuclear Physics

Nucleus, constituent of nucleus, Properties of Nucleus size, mass, density, energy, charge, binding energy, nuclear angular momentum, Nuclear force, Radiation. detector- types of detectors, gas filled detectors, Ionization Chamber, Proportional Counter, GM Counter, Scintillation Detector and Semiconductor Detectors.

8

Lectures

Unit 4

Fluid Mechanics

Fluid properties; Surface Tension, Viscosity, equation, Bernoullis equation; Navier-Stokes Equations; Differential form of Energy equation. Reynold number, Incompressible and compressible Flow, Laminar and turbulent flows, Flow through pipes

10 Lectures

Text books

Ajoy Ghatak -Optics - (TMH)

M.W. Zemansky and R.H. Dittman- Heat and Thermodynamics (Mc-Graw Hill)

Nuclear physics by Cohen

Fox and Mc Donald- Introduction to Fluid Mechanics

Ghatak and Thayagrajan-Optoelectronics

Suggested Books:

Aurthur Beiser -Concepts of Modern Physics - (Mc-Graw Hill)

Anuradha De. -Optical Fibre & Laser (New Age)

Resnick, Halliday & Walker -Fundamental of Physics - (Wiely)
R.A. Serway & J.W. Jewett -Principles of Physics
H.Callen-Thermodynamics and an Introduction to Thermo statistics (Wiley, New York).

INHT-103: Mathematics-I

THEORY **Marks: 100**

40 Lectures

Unit 1

Sequences and series: Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series, Necessary condition for Convergence, Standard Infinite Series: Geometric Series and Harmonic series, Tests for Convergence and Divergence, Comparison Test: Only for Series with Positive Terms, Cauchy's Integral Test, D'Alembert's Ratio Test, Cauchy's nth Root Test, Raabe's Test (Higher Ratio Test), Logarithmic Test, De Morgan's and Bertrand's Test, Alternating Series Leibnitz's Theorem, Absolute Convergence and Conditional Convergence, Power Series .

Mean Value Theorems: Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Generalized Mean Value Theorem.

10 Lectures

Unit 2

Partial Differentiation: Functions of Several Variables: Limit and continuity, Partial Differentiation, Variable Treated as Constant, Total Derivative, Partial Differentiation of Composite Functions: Change of Variables, Differentiation of an Implicit Function, Euler's Theorem, Jacobian, Functional Dependence.

Maxima and Minima: Taylor's Theorem for Functions of Two Variables, Maxima and Minima of Functions of Two Variables: with and without Constraints, Lagrange's Method of Undetermined Multipliers.

Curve Tracing: Curves in Cartesian Form, Polar Curves, Parametric Curves.

10 Lectures

Unit 3

Application of Integration: Length of Plane Curve: Rectification, Volume of solids of Revolution, Area of the Surface of a Solid of Revolution.

Multiple Integrals: Introduction, Double Integral, Evaluation of a double Integral, Application of double Integral, Change of Order of Integration: Double Integral, General Change of Variable in double Integral, Change Of Variable: Cartesian to Polar Coordinates, Triple Integrals, General Change of Variable in Triple Integral.

10 Lectures

Unit 4

Vector Differential Calculus: Scalar and Vector, Vector Differentiation, Directional Derivative, Gradient of a Scalar Function and Conservative Field, Divergence, Curl, Related Properties of Gradient, Divergence and Curl of Sums, Second-Order Differential Operator, Curvilinear Coordinates: Cylindrical and Spherical Coordinates.

Vector Integral Calculus: Vector Integration: Integration of a Vector Function of a Scalar argument, Line Integrals: Work Done, Potential, Conservative field and Area, Surface Integrals: Surface area and Flux, Volume integrals, Green's Theorem in a Plane: Transformation between Line integral and Double integral Area in Cartesian and Polar Coordinates, Stokes's Theorem, Gauss Divergence Theorem.

10Lectures

Suggested Books:

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India (2008)
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)
3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
4. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)

INHT 104: Chemistry

Theory **Marks: 100**

40 Lectures

Unit 1

Chemical bonds and molecules: Recapitulation of general characteristics of ionic & covalent bonds and shapes of molecules.,van der Waal forces of attraction (ion-dipole, dipole-dipole, dipole-induced dipole, and dispersion forces), polar covalent bond, hydrogen bond, effects of hydrogen bonding on physical properties, structure of water. metallic bond, lattice energy, Born Haber cycle, Fajan's rule, bond length, bond angle.

Periodic Table;Atomic, ionic and covalent radii, ionization energy, electro negativity and its scales, electron affinity, Lanthanide contraction, Inert pair effect, Slater rules.

10 Lectures

Unit 2

Acid and Bases: Bronsted-Lowry theory, concept of leveling and differentiating solvents.
Organic reactions and their mechanisms, Types of reactions -,Mechanism of S_N1 and S_N2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group).Keto-enol tautomerism and its distinction from resonance. Structure and stability of reactive carbon species - carbonium ion, carbanion, free radical, carbenes. Electronic effects in molecules (inductive, hyperconjugation and resonance effects); cleavage of covalent bonds – homolysis and heterolysis. Electrophilic disubstitution in benzene. Reaction mechanisms of Aldol condensation, Hoffman bromamide rearrangement, Cannizzaro reaction, Friedel Craft reaction, Pinacol-pinacolone rearrangement, Beckmann rearrangement.

10 Lectures

Unit 3

Stereochemistry: Optical activity and optical isomerism, specific molar rotation, asymmetric carbon atom, chirality, enantiomerism, relative configuration (R/S nomenclature of chiral centres, sequence rules), absolute configuration (D/L designation in carbohydrates), geometrical isomerism (cis/trans and E/Z nomenclature in olefins) isomers of lactic acid and tartaric acid
Aromaticity**:**Concept of aromaticity, Huckle's rule as applied to benzene, naphthalene, anthracene, phenenthrene, thiophene, furan, pyrrole, pyridine, quinolene and cyclic cations & anions.

8Lectures

Unit 4

Pharmaceuticals:Synthesis of aspirin, paracetamol, sulphanilamide, their uses and drug action. Reagents for organic synthesisActive methylene compounds - preparation, properties and synthetic applications of ethylacetoacetate and diethylmalonate. Grignard reagents – preparation and reactions.
Chemical equilibrium**:**Reversible reactions, law of mass action, equilibrium constant, ionic equilibrium, theory of indicators, factors influencing equilibrium states, relation between Kp & Kc, buffer solution, hydrolysis of salt, pH, Ksp, common ion effect and its applications in mixture analysis**.**
ElectroChemistry; Standardc electrode potential, electrochemical series, Nernst equation, Indicator andreference electrodes, phand its measurementsby glass electrode. Potentiometric determination of pH

12 Lectures

Text Books

J. D. Lee, *Concise Inorganic Chemistry*, ELBS.

I.L. Finar, Volume I, II, *Organic Chemistry*, ELBS.

M. Barrow, *Physical Chemistry*, Tata McGraw-Hill.

Suggested Books:

R.T. Morrison and R.N. Boyd, *Organic Chemistry*, Prentice Hall.

T.W.G. Solomon, *Organic Chemistry*, John Wiley and Sons.

E.L. Eliel, *Stereochemistry of Carbon Compounds*, Tata McGraw-Hill.

G.W. Castellan, *Physical Chemistry*, Narosa Publishing House.

Biochemistry by Lehninger

J.E. Huheey, *Inorganic Chemistry – Principles of Structure and Reactivity*, Pearson Publication.

INHP 105: Instrumentation Practical – I **Marks:100**

8 classes/week

1. Introduction to Basic Electronic Components (resistor, capacitor, inductor, diode and transistors).
2. Introduction to Test and Measurement Instruments (power supply, signal generator, multimeter, CRO, DSO)
3. Verify the Thevenin, Norton and Superposition Theorem.
4. Verify the Maximum Power Transfer Theorem.
5. RC Circuits: Time constant, differentiator, integrator.
6. Design a Low Pass RC Filter and study its frequency response.
7. Design a High Pass RC Filter and study its frequency response.
8. To study the generation of Lissajous figures.
9. To Measure the Z-parameters of a two-port network.
10. To study the frequency response of a Series LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.
11. To study the frequency response of a Parallel LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

SOFTWARE BASED SIMULATIONS

1. Verify the Thevenin, Norton and Superposition Theorem
2. Verify the Maximum Power Transfer Theorem
3. RC Circuits: Time constant, differentiator, integrator.
4. Design a Low Pass RC Filter and study its frequency response.

5. Design a High Pass RC Filter and study its frequency response.
6. To study the generation of Lissajous figures.
7. To Measure the Z-parameters of a two-port network.
8. To study the frequency response of a Series LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.
9. To study the frequency response of a Parallel LCR circuit and determine its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

INHP 106: Instrumentation Practical - II **Marks:100**

Practical based on paper Applied Physics **4 classes /week**

1. To determine the thermal conductivity of a good conductor by searl's method.

2. Determination of J, mechanical equivalent of heat by calendar and Barne's method.

3. To determine the temperature coefficient of PRT (Platinum Resistance Thermometer).

4. To determine the dispersive power of prism using spectrometer and mercury source.

5 .To determine the refractive index of a prism using spectrometer

6. To determine the wavelength of sodium light by Newton's Ring.

7. To find the wavelength of He-Ne Laser using transmission diffraction grating.

8. To find the thermal conductivity of poor conductors by Lee Disc Method

9. To determine the coefficient of discharge of an orifice of a given shape.

10. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.

Practical based on paper Chemistry **4 classes/ week**

1. To estimate iron (II) ions by titrating with potassium permanganate.

2. To determine melting points and boiling points of organic compounds.

3. To detect extra elements (N, S, Cl, Br, I) in organic compounds (containing not more than one extra element).

4. To analyze the following functional groups in the given organic compound: Carboxylic acids, alcohols, phenols, aldehydes & ketones, carbohydrates (monosaccharide's), amides, nitro compounds and primary amines.

5. To determine surface tension of a liquid using a stalagmometer.

6. To determine viscosity of a liquid using an Ostwald viscometer

SEMESTER II

INHT 201: C Programming and Data Structures

THEORY **MARKS: 100**

40 Lectures

Unit 1

Introduction-Algorithm / pseudo code, flowchart, program development steps, structure of C program, identifiers, basic data types and sizes, Constants, variables, Operators, expressions, Input-output statements, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels**.** Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor, example C programs.

10 lectures

Unit 2

Arrays- concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments, C program examples.

10 lectures

Unit 3

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, C program examples. Input and output - concept of a file, text files and binary files, streams, standard I/o, Formatted I/o, file I/o operations, error handling, C program examples. Searching - Linear and binary search methods, sorting - Bubble sort, selection sort, Insertion sort, Quick sort, merge sort.

10 lectures

Unit 4

Introduction to data structures- singly linked lists, doubly linked lists, circular list, representing stacks and queues in C using arrays and linked lists, infix to post fix conversion, postfix expression evaluation. Trees- Binary tress, terminology, representation, traversals, graphs- terminology, representation, graph traversals (dfs & bfs)

10 lectures

Suggested Books:

1. Computer science - A structured programming approach using C, Behrouz A. Forouzan and Richard F. Gilberg, Third edition, Thomson.
2. A. S. Tanenbaum, Y. Langsam, and M.J. Augenstein, Data Structures Using C, Pearson education.
3. P. Padmanabham, C & Data structures, B.S. Publications.
4. B.W. Kernighan, Dennis M.Ritchie, The C Programming Language, Pearson Education
5. J.A. Jones & K. Harrow, C Programming with problem solving, Dreamtech Press
6. Stephen G. Kochan, Programming in C, III Edition, Pearson Education.
7. R. Kruse, C.L. Tondo, BP Leung, Shashi M, Data Structures and Program Design in C, Second Edition, Pearson Education.

INHT- 202: **Introduction to Instrumentation**

Theory **Marks: 100**

40 Lectures

Unit 1

Basic concepts of instrumentation, generalized instrumentation systems block diagram representation, scope of instrumentation in Industrial organization. **4 Lectures**

Unit 2

Measurement systems- static (accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, dead band, backlash, drift) ,impedance matching and loading, dynamic characteristics (types, fidelity, speed of response , dynamic error).

6 Lectures

Unit 3

Definition of errors: systematic errors, instrumental errors, environmental errors, random errors, loading errors, random errors, source of errors in measuring instruments, Uncertainities types, propagation of uncertainties) **4 Lectures**

Unit 4

Transducers - Classification, Active, Passive, Mechanical, Electrical, their comparison**.** Selection of Transducers**:** Desirable characteristics of transducers .

Principle and working of following types:

Displacement transducers - Resistive (Potentiometric, Strain Gauges – Types, Gauge Factor, bridge circuits, Semi-conductor strain gauge) Capacitive (diaphragm), Inductive (LVDT-Principle and characteristics, Hall effect sensors, magneto-strictive transducers), Piezoelectric (Element and their properties, Piezo Electric coefficients. Equivalent circuit and frequency response of P.E. Transducers**)**, light (photo-conductive, photo emissive, photo voltaic, semiconductor, LDR), Temperature (electrical and non-electrical). Pressure (force summing devices-load cell)

26

Lectures

Text Books:

Measurement Systems, 4/e Doeblin McGraw Hill, New York, 1992.

Electrical Measurements & Electronic Measurements by A.K. Sawhney

Suggested Books:

Instrumentation- Devices and Systems By Rangan, Sarma, and Mani, Tata-McGrawHill
Electronic Instrumentation by H.S Kalsi, McGrawHill
Instrumentation measurements and analysis by Nakra & Choudhary
Measurement & Instrumentation- DVS Murthy

INHT-203: Mathematics –II

THEORY **Marks: 100**

40 Lectures

UNIT 1

vector space and linear transformation: vector spaces, subspaces, bases and dimensions, linear transformations, linear operator equations.
matrices: introduction to matrices, System of Linear Algebraic Equations, Gaussian Elimination Method, Gauss-Seidel Method, LU decomposition, Solution of Linear System of LU decomposition, LU decomposition from Gaussian Elimination, LU decomposition by Gaussian Elimination, Solution to Tridiagonal Systems, Crout Reduction for Tridiagonal Linear Systems.

10 lectures

UNIT 2

Eigen Values and Eigen Vectors: Linear Transformation, Eigen Values and Eigen Vectors, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Diagonalization. Powers of a Matrix.

Real and Complex Matrices: Real Matrices: Symmetric , Skew Symmetric , Orthogonal Quadratic Form, Canonical Form: or sum of the squares form, Transformation (reduction) of Quadratic Form to Canonical Form, Complex Matrices: Hermitian, Skew Hermitian, Unitary Matrices, Sylvester's Law of Inertia.

10 lectures

UNIT 3

Complex Functions: Complex Function, Continuity, Differentiability, Analyticity, Cauchy-Riemann (C-R) Equations: In Cartesian Coordinates, Harmonic and Conjugate Harmonic Functions, Cauchy-Riemann Equations.

Elementary Complex Functions: Exponential Function, Trigonometric Functions, Hyperbolic Functions.

Complex Integration: Line Integral in Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivative of Analytic Functions.

Complex Power Series: Sequences: Series and Power Series, Taylor's Series (Theorem), Laurent Series, Zeroes and Poles.

Theory of Residues: Residue, Residue Theorem, Evaluation of Real Integrals.

10 lectures

UNIT 4

Ordinary Differential Equations (First Order and First Degree): Basic Definitions, First Order first Degree Differential Equations, Variables Separable or Separable Equation, Homogeneous Equation- Reduction to Separable Form, Non homogeneous equation: Reducible to Homogeneous Form, Exact Differential Equations, Reduction of Non-exact Differential Equations: using Integration factors, Linear Differential Equation: First

Order, Bernoulli Equation, Formation of Differential Equation by Elimination of Arbitrary Constants, Geometrical Applications, Orthogonal Trajectories of Curves.

10 lectures

Suggested Books:

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India (2008)
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)
3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
4. C. R. Wylie and L.C. Barrett, Advanced Engineering Mathematics, Tata McGraw Hill (2004)

INHT-204: Biology

Theory **Marks: 100**
40 Lectures

UNIT 1

***Life*:**Definition and characteristics of life*,* Chemical organisation of cell**:** Molecular basis of life, inorganic and organic constituents, micro and macromolecules in the cell.

Techniques of Study Microscopy (Simple, Compound, Electron-TM), Cell fractionation, Tissue Culture methods

06 lectures

UNIT 2

Cell Structure and Function General structure of prokaryotic and eukaryotic cell, cell wall, plasma membrane, protoplasm and its colloidal nature. Endoplasmic reticulum, lysosome, Golgi apparatus, centriole, basal granule, cillia, flagellum and microtubules, microfilaments, storage bodies and ribosomes. Elementary concepts of cell permeability and endocytosis, cellular motility, cellular secretion, cellular excitability, cellular aging and cell death.

Chloroplast: structure, biogenesis,of chloroplast , function and mechanism of photosynthesis.

Mitochondria: Structure, biogenesis, function and mechanism of aerobic and anaerobic respiration, fermentation.

Nucleus: Structure, nucleosome organization of chromatin, chromosome structure, specialized chromosomes (polytene, lampbrush), Nuclear Division-cell cycle, mitosis, meiosis, cytokinesis.

10Lectures

UNIT3

Genetics: History of Genetics, Mendel's laws of inheritance, Deviations from Mendelian laws, dominance, relationships, lethal genes, epistasis, complementary, supplementary, duplicate and inhibitory genes. **Linkage and crossing over:** Discovery, incomplete linkage, coupling and repulsion hypothesis, crossing over, mechanism of recombination, a three point test cross, gene mapping.

Inheritance: Chromosome theory of Inheritance**,** Sex determination – Sex linked inheritance, extra chromosomal Inheritance

Chemical basis of heredity: DNA and RNA structure, DNA replication, transcription and translation.

10Lectures

UNIT 4

Human Physiology Introduction to functional organization of human body, control of internal environment, Animal tissue

Body Fluid: Blood, Blood cell, lymph composition & function, erythropoiesis, blood groups, Rh factor, blood coagulation, blood pressure, regulation of blood pressure

Cardiovascular physiology: physiology of cardiac muscles, structure & function of heart, circulation, origin & conduction of cardiac impulses, cardiac cycle & cardiac output

Nerve Physiology: Nervous system, structure of nerve cell, origin & conduction of membrane potential, excitation of nerve fiber, basic function of nerve synapses, Saltatory nerve transmission

Respiration: mechanism of breathing, transport of gases, regulatory mechanism,O_2 dissociation curves , chloride shift, Bohr effect, Haldane effect, artificial respiration

Excretion: structure of excretory organs, urine formation, counter current principle, controlling factors, micturition, regulation of body fluids & acid base balance

14Lectures

Text Books:
Cell Biology by Darnell & Baltimore
Human Physiology by Guyton
Suggested Books:
Principles of Cell Biology by Kleinsmith & Kish
Physiology by Ganong
Cell Biology by Power(CB) 3rd edition

Principles of genetics by Gardener

Genetics by Stantsfield

Gentics a molecular approach by T.A.Brown

Recombinant DNA technology by Watson

Human Genetics by Jenkins

INHP 205: Instrumentation Practical - III

Practical based on paper Introduction to Instrumentation **Marks: 100**

8 classes/week

Practical based on different types of transducers (any eight)-

1. Measurement of pressure, strain and torque using strain gauge.
2. Measurement of speed using Electromagnetic transducer.
3. Measurement of speed using photoelectric transducers and compass
4. Measurement of angular displacement using Potentiometer.
5. Experiment of Opto coupler using photoelectric transducers.
6. Measurement of displacement using LVDT.
7. Measurement using load cells.
8. Measurement using capacitive transducer.
9. Measurement using inductive transducer.
10. Measurement of Temperature using Temperature Sensors/RTD
11. Characteristics of Hall effect sensor.
12. Measuring change in resistance using LDR

INHP 206: Instrumentation Practical – IV **Marks: 100**

4 classes/ week

C Programming and Data Structures

Implement programs in C exemplifying:

1. Arithmetic operations
2. If-else construct
3. Switch construct
4. While, do while and for loop
5. Arithmetic operations for n x m matrices
6. Passing by reference and passing by value in functions
7. Inline parameter passing
8. Pointers and pointer arithmetic
9. String operations using pointers and arrays explicitly.
10. Bitwise operations
11. Invoking a few DOS routines such as interrupts using C procedures.
12. Structures

Practical based on paper Biology **4classes/week**

Cell Biology

1. Study of various plant cell-types
2. To carry out gram staining for identifying bacteria
3. To prepare squash mounts from onion root-tips to study mitosis
4. To demonstrate the activity of enzyme amylase, urease and catalase and to study the effect of temperature and pH.
5. Micro chemical tests for the identification of Protein, Starch, Sugar, Fats
6. To study meiosis through permanent slides.

Human Physiology

1. Determination of ABO Blood Group & Rh factor
2. Preparation of blood smear observartion of blood cell
3. RBC count and Haemoglobin estimation
4. Determination of ESR,PCV and DLC
5. To observe permanent slides of heart, Pituitary gland, spinal cord, Cerebellum,
6. lung s & trachea
7. To record systemic Arterial Blood Pressure

SEMESTER III

INHT 301: **Digital Electronics**

Theory **Marks: 100**
40 Lectures

Unit 1

Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, conversion of one code to another, Complements (one's and two's), Signed and Unsigned numbers, Addition and Subtraction, Multiplication Gray and Hamming Codes.

Logic Gates and Boolean Algebra: Truth Tables, OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates, Boolean Theorems, DeMorgan's Theorems, Principle of duality.

Digital Logic families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Current and Voltage parameters, RTL, DTL, TTL, ECL, HTL, MOS, CMOS.

10lectures

Unit 2

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Quine McCluskey minimization. Multiplexers (2:1, 4:1) and Demultiplexers (1:2, 4:1), Implementing logic functions with multiplexer, Adder (half and full) and subtractor, Encoder (8 to 3) and Decoder (3 to 8).

10lectures

Unit 3

Sequential logic design: Latch, Flip flop (FF), S-R FF, J-K FF, T and D type FFs, Clocked FFs, Registers, Counters (ripple, synchronous and asynchronous, ring, modulo-N), State Table, State Diagrams and Sequential Machines.

10lectures

Unit 4

A/D and D/A Converters: Successive Approximation ADC, R/2R Ladder DAC.

Memories: General Memory Operation, ROM, RAM (Static and Dynamic), PROM, EPROM, EEPROM, EAPROM.

10lectures

Suggested Books:

1. R.L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw-Hill (1994)
2. Donald P. Leach, Albert Paul Malvino, Digital Principles and Applications, Tata McGraw Hill (1995)
3. M. Morris Mano, Michael D. Ciletti, Digital Design, Pearson Education Asia, (2007)
4. Thomas L. Floyd , Digital Fundamentals, Pearson Education Asia (1994)
5. S.P. Bali , Solved Problems in Digital Electronics, Sigma Series, Tata McGraw-Hill, (2005)
6. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India (2000)
7. R.P. Jain , Modern Digital Electronics, Tata McGraw-Hill (2003)

INHT 302 Analog Electronics-I

THEORY **Marks: 100**

Unit 1

Diode Circuits: Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point. Positive, negative and biased clipper circuits, clamping circuits. Half wave rectifier, center tapped and bridge fullwave rectifiers, calculation of efficiency and ripple factor.

DC power supply: Block diagram of a power supply, qualitative description of shunt capacitor filter, Zener diode as voltage regulator, temperature coefficient of Zener diode.

10lectures

Unit 2

The BJT: Transistor current components and amplification. Transistor configurations: Common Base (CB), Common Emitter (CE) and Common Collector (CC) configuration, I-V characteristics and hybrid parameters, regions of operation, dc load line, Q point.

CE amplifier: Self bias arrangement of CE, dc and ac load line analysis. Hybrid equivalent of CE, Quantitative study of the frequency response of CE amplifier, effect on gain and bandwidth for cascaded CE amplifier (RC coupled).

Power Amplifiers: Heat sink, Classification of power amplifiers: A, B, C and AB, analysis of Class B push pull amplifiers (efficiency, power dissipation).

Single tuned amplifiers.

10lectures

Unit 3

Feedback Amplifiers: Concept of feedback, negative and positive feedback, Negative feedback: advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, derivation of gain, input and output impedances for feedback amplifiers. Positive feedback: Barkhausen criteria for oscillations, Study of phase shift oscillator and Colpitts oscillator . Colpitts Crystal oscillator.

10lectures

Unit 4

The MOSFET: The three configurations: Common Gate (CG), Common Source (CS) and Common Drain (CD), I-V characteristics, regions of operation, small signal equivalent circuit, dc load line, Q point.

CS amplifier: CS amplifier circuit analysis, Qualitative study of frequency response of CS amplifier.

10lectures

Suggested Books:

1. R. L. Boylestad, L. Nashelsky, K. L. Kishore, Electronic Devices and Circuit Theory, Pearson Education (2006)
2. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
3. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)

INHT 303: Biochemistry

Theory **Marks: 100**

40 Lectures

Unit 1

Aqueous Solution: Properties of Water, Acids, Bases and Buffers, Biological Buffer.**Biomolecules:** Amino acids, optical activity, "Nonstandard" peptides, Physiology active peptide. **Techniques of protein purification**: Protein Isolation, Solubility's of proteins IEF, Chromatographic Separations, Electrophoresis-SDS PAGE, Ultra centrifugation.**Covalent Structures of Proteins:** Primary structures determination, Polypeptide Synthesis **Three Dimensional structures of proteins**Secondary structure: Fibrous proteins, Globular proteins, Proteins stability, Quaternary structure, Denaturation of proteins, Hoffmeister series, Bohr's Effect of hemoglobin

10Lectures

Unit 2

Sugars and Polysaccharides Monosaccharides,desaccharide's,Glycoproteins, Mucopolysaccharides, Important chemical reaction of monosaccharides. **Lipids:**Lipid classification, simple lipid, compound lipit, glycolipid, Lipid linked protein & lipoprotein, aminolipids, Phospholipids, Sphingolipid, Steroids, Gangliosides, Cerebrosides, Important test, Derived lipid, Prostaglandin's Properties of lipid aggregates. **Introduction to Enzymes and Enzyme action:**Mechanism of Enzyme action: Introduction to Enzymes, substrates specification, coenzymes, Regulation of Enzymatic activity, enzyme nomenclature. Rates of Enzymatic Reaction: Chemical Kinetics, Enzyme Kinetics, inhibition effects of pH, Derivation of Michael's Menten Equation, allosteric enzymes.

10Lectures

Unit 3

Biochemical Communication: Hormones, Molecular mechanism of signal Transduction. C-AMP, C-AMP as a second messenger for number of regulator molecule, C-GMP also act as secondary messenger, Insulin receptor, Ca^{2+} as second messenger, Ion channels gated by ligand and membrane potential, Steroid and thyroid hormones, Neurotransmission. **Membrane and Membrane Transport:** Biological membrane, Membrane proteins, Passive transport a downhill process, Glucose permease of Erythrocytes, Chloride and Bicarbonate are cotransported across Erythrocyte membrane. Active transport result in solution movement against a concentration gradient, Active transport of Na^{+}, K^{+} ion gradient provide the energy for secondary active transport ion selective channels act in signal transcution.

10Lectures

Unit 4

Metabolism: Introduction to metabolic compartment of cell, Metabolism Pathways, overview of Intermediary metabolism, Experimental Approaches to the study of metabolism, Thermodynamics of phosphate compound, Oxidation Reduction reaction, Thermodynamics of life **Glycolysis:** Glycolytic pathways, utilization of Glucose,

Reaction of Glycolysis, Fermentation: The anaerobic fate of Pyruvate, Control of metabolic flux, Metabolism of Hexoses other than Glucose, Feeder's pathway, Gluconeogenesis.**Glycogen Metabolism:** Glycogen breakdown, Glycogen Synthesis, control of glycogen metabolism, Glycogen storage diseases (Vongerk's syndrome) **Citric Acid Cycle:** Cycle overview, Metabolic sources of Acetyl CoA, enzymes of TCA, Regulation of TCA, Amphibolic nature of TCA. Other pathways of Carbohydrate Metabolism, *Glucogenesis, Glyoxylate Pathway,* Pentose Phosphate Pathway, Regulation of blood glucose concentration, Diabetic mellitus, conversion of carbohydrates into fats.,**Introduction to** Lipid Metabolism, Amino Acid Metabolism,Nucleotide Metabolism

10Lectures Suggested Books:

1. Zubey,Biochemistry
2. Stryer ,Biochemistry
3. Lehninger ,Biochemistry

INHT 304: Signals and Systems

THEORY **Marks: 100**

Unit 1

40 Lectures

Signals and Systems: Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Unit impulse and unit step functions, Continuous-Time and Discrete-Time Systems, Basic System Properties. **10 Lectures**

Unit 2

Linear Time-Invariant Systems (LTI): Discrete time LTI systems, the Convolution Sum, Continuous time LTI systems, the Convolution integral. Properties of LTI systems, Commutative, Distributive, Associative, LTI systems with and without memory, Invertibility, Causality, Stability, Unit Step response. Differential and Difference equation formulation, Block diagram representation of first order systems. **10 Lectures**

Unit 3

Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Convergence of the Fourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series. Frequency-Selective filters, Simple RC highpass and lowpass filters, Discrete-Time filters, Recursive, Non-recursive filter.

Fourier Transform: Aperiodic signals, Periodic signals, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties, Properties of Fourier transform and basic Fourier transform Pairs. **10 Lectures**

Unit 4

Laplace Transform: Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Solving Differential Equations with Intial conditions, Laplace Transform Methods in Circuit Analysis, Step response of RL, RC and RLC circuits, Impulse response of series RC, Sinusoidal response of RL circuit. **10 Lectures**

Suggested Books:

1. A. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007)
2. S. Haykin and B. V. Veen, Signal and Systems, John Wiley & Sons (2004)
3. H. P. Hsu, Signals and Systems, Tata McGraw Hill (2007)
4. M. Roberts, Fundamentals of Signals and Systems,Tata McGraw Hill (2007)
5. S. T. Karris, Signal and Systems: with MATLAB Computing and Simulink Modelling, Orchard Publications (2008)
6. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)

INHP 305: Instrumentation Practical – V **Marks: 100**
Digital Electronics **4 classes /week**

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. Design a Full adder and a full subtractor circuit.
3. Design a 4x1 Multiplexer/ 3 to 8 decoder circuit using logic gates.
4. Implement a function (4 variable) with logic gates , MUX , Decoder ICs
5. Design a 4 bit parallel adder/subtractor circuit using 4 bit adder circuit IC
6. Design a seven-segment Display driver.
7. Using elementary gates build circuits for RS, Clocked RS, D, and JK Flip-Flop).
8. Design a Modulo N Asynchronous and Synchronous Counter using D/T/ JK Flip-Flop ICs.
9. Design a shift register using D/T/ JK Flip-Flops to study Serial and parallel shifting of data.
10. To design a digital to analog converter of given specifications.

Some of the experiments mentioned above may also be implemented using MULTISIM Software

Biochemistry Practical **4 classes /week**

Solutions:

(a) Preparation of molar, % solution and buffers
(b) Determination of Pka of acid
(c) Determination of PI for Casein

Chromatography:

(a) Separation of amino acids by descending paper chromatography
(b) Separation of leaf pigment and sugar by Thin Layer chromatography.

Electrophoresis:

(a) SDS-gel electrophoresis, Determination of Mol wt. Of proteins

(b) Agarose gel electrophoresis for DNA

Carbohydrates:

Qualitative test for sugars and preparation of osazone

Chromatography:

a) Preparation of gel permeation column
b) Separation of $COCl_2$ (Cobalt Chloride) and Blue dextran using sephantex G-25

Spectrophotometer

a) Determination of Beer's Law and λ_{max} of Cobalt chloride and Methyl orange.
b) The UV absorption of protein and nucleic acid
c) Estimation of protein by Bradford's method and Lowry's method
d) Estimation of sugars by Anthrone method

Enzymes:

Isolation and partial purification of enzyme acid phosphatase from moong dal using ammonium sulphate precipitation and find out the activity of enzymes.

INHP 306: Instrumentation Practical - VI **Marks: 100**

Practical based on Analog Electronics-I **8 classes/week**

1. To study the Half wave rectifier and study the effect of C filter.
2. To study the Full wave rectifier and study the effect of C filter.
3. To study Fixed Bias, Voltage divide and Collector-to-Base bias Feedback configuration for transistor.
4. To design a Single Stage CE amplifier for a specific gain and bandwidth.
5. To study Class A, B and C Power Amplifier.
6. To study the Colpitt's and Phase Shift Oscillator.
7. To study the frequency response of Common Source/ Common Gate FET amplifier.

Software Based Simulations (to run concurrently)

1. To study the Half wave rectifier and study the effect of C filter
2. To study the Full wave rectifier and study the effect of C filter
3. To study Fixed Bias, Voltage divide and Collector-to-Base bias Feedback configuration for transistor
4. To design a Single Stage CE amplifier for a specific gain and bandwidth
5. To study the Class A, B and C Power Amplifier
6. To study the Colpitt's and Phase Shift Oscillator
7. To study the frequency response of Common Source/ Common Gate-FET amplifier

SEMESTER IV

INHT-401: Industrial Instrumentations **Marks:100**

40 Lectures

Unit 1

Flow Measurement: Introduction, definitions and units, classification of flow meters,Mechanical type flowmeters -Theory of fixed restriction variable head type flow meters – orifice plate – venturi tube – flow nozzle – dall tube – installation of head flow meters Quantity meters, area flow meters and mass flow meters-Positive displacement flow meters – constructional details and theory of operation of mutating disc, reciprocation piston, oval gear and helix type flow meters – inferential meter – turbine flow meter – rota meter –thermal mass flow meter – volume flow meter plus density measurement –Electrical type flow meter-Principle and constructional details of electromagnetic flow meter – different types of excitation – schemes used – different types of ultrasonic flow meters – laser doppler anemometer systems – rortex shedding flow meter – target flow meter – solid flow rate measurement – guidelines for selection of flow meter.

16 Lectures

Unit 2

Measurement of Speed and Acceleration: Tachometers - Mechanical, Electric, Contact less, Frequency, Ignition, Stroboscopic tachometers. Comparative methods, Elementary accelerometers, Seismic, Practical accelerometers. **Measurement of humidity and moisture** –basic principles, hygrometers, psychrometers , humidity charts –dew point, measurement systems for humidity.- Infrared moisture measuring systems , radio

active moisture measuring systems.

10Lectures

Unit 3

Pressure measurement-Units of pressure – manometers – different types – elastic type pressure gauges – Bourde type bellows – diaphragms –measurement of vacuum – McLeod gauge, Pirani and Ionisation Gauge– thermal conductivity gauges – Ionization gauge cold cathode and hot cathode types – testing and calibration of pressure gauges – dead weight tester. Vacuum pumps- -Rotary and Diffusion

10 Lectures

Unit 4

Recorders: types, strip chart, circular, X-Y, oscillographic, magnetic tape, printers- dot matrix, ink jet, laser

04 Lectures

Text Books:

Liptak B. G. - Process Measurement and Analysis, Third Edition, Chilton Book Company, Pennsylvania, 1995.

D.Patranabis, Principles of Industrial Instrumentation Tata McGraw Hill Publishing Co.,NewDelhi,1999

Suggested Books:

A.K . Sawhney, - A course in mechanical measurements and instrumentation, Dhanpat Rai & Co.

Andrew W. G. - Applied Instrumentation in Process Industries - A Survey, Vol.1 & Vol.2, Gulf Publishing Company, Houston, 1992.

R.K. Jain - Mechanical and Industrial Measurements, Tenth Edition, Tata McGraw Hill, New Delhi, 1996.

Doeblin E. O - Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, Singapore, 1992.

INHT-402: Analog Electronics-II

THEORY **Marks: 100**

Unit 1

Basic Operational Amplifier: Concept of differential amplifiers, block diagram of an operational amplifier (IC 741)**Op-Amp parameters:** input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

Op-Amp in open and closed loop configuration: Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, summing and difference amplifier, Integrator, Differentiator, voltage to current converter, current to voltage converter.

10 Lectures

Unit 2

Comparators: Basic comparator, Level detector, Voltage limiters, Regenerative comparator.
Signal generators: Phase shift oscillator, Wien bridge oscillator, Schmitt Trigger, Square wave generator, triangle wave generator, sawtooth wave generator, Voltage controlled oscillator (IC 566), Phase locked loops (PLL). **10 Lectures**

Unit 3

Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Voltage to frequency (V/F) and frequency and voltage (F/V) converter. **05 Lectures**

Unit 4

Signal Conditioning circuits: Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Logarithmic and exponential amplifiers. **15 Lectures**

Suggested Books:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. S. Franco, Design with operational amplifiers and analog integrated circuits, Tata McGraw Hill (2002)
3. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)

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INHT403: Statistical Methods and Reliability

THEORY **Marks: 100**

Unit 1

Descriptive Statistics: Graphical and Tabular representation of data. Measures of Central Tendency, Measures of Dispersion, Measures of Skewness and Kurtosis. **Correlation and Regression:**Linear Regression and Correlation. Multiple Linear Regression. **10 Lectures**

Unit 2

Probability

Introduction of probability, Baye's Theorem, Random Variables, Probability Distributions, Mathematical Expectation. **Sampling and Sampling Distributions:** Sampling distributions and Standard errors. One and two sample estimation of means and proportions. One and two sample tests of hypothesis- means, proportions and variances. Chi-square test. **10 Lectures**

Unit 3

Nonparametric Statistics: Nonparametric tests: Sign test, Signed-Rank test, Rank-Sum test, Kruskal-Wallis test, Runs test. **5 Lectures**

Unit 4

Reliability: Different types and modes of failure, causes of failure in electronic components, reliability theory, hazard rate, failure density function, availability, maintainability, mean time to failure and repair system structures: series, parallel, K-type, reliability evaluation, optional reliability and redundancy allocation, Fault tree analysis **15 Lectures**

Suggested Books:

1. Probability and Statistics for Engineers and Scientists by Walpole, Myers, Myers and Ye, 7th Edition, Pearson Education.
2. Mathematical Statistics by Freund, Prentice Hall, India
3. Introduction to Statistical Quality Control by Montgomerry, John Wiley and Sons.
4. Principles of Biostatistics by M. Pagano and K. Gauvrean: Thompson learning (2nd edition); 2004.
5. Biostatistics: A Foundation for Analysis in the Health Sciences by W. W. Daniel: John Wiley and Sons Inc (7th edition); Indian Reprint 2006.

6. Reliability Engineering by S.Shreenath

INHT-404: Electronic Instrumentation **Marks:100**

Theory **40 Lectures**

Unit 1

Basic Measurement Instruments:

DC measurement: dc voltmeter, ohmmeter and ammeter. Digital type voltmeter, ammeter and ohmmeter ,digital multimeter, AC measurement , voltmeter, ammeter .Digital frequency meter: elements of frequency meter, universal counter and its different modes, measurement errors and extending the frequency range. Digital LCR-Q meter, digital wattmeter. **10 Lectures**

Unit 2

Signal Generators: Types of generators and their operation: Audio oscillator, Function generators, Pulse generators, RF generators, Random noise generators. **Probes and Connectors:** Test leads, shielded cables, connectors, low capacitance probes, high voltage probes, RF demodulator probes, special probes for IC's, current probes. **Electronic Displays**: The Cathode Ray Oscilloscope (CRO): Block diagram of a General Purpose Oscilloscope and its basic operation, electrostatic focusing and deflection, screen for CRT and graticules, CRT connections,CRO probes. Types of CRO's: dual trace ocilloscope, digital storage oscilloscope.

15 Lectures

Unit 3

Frequency Spectrum, Distortion and wave measurement:

Spectrum analyzer, Harmonic distortion analyzer, intermodulation distortion analyzer, wave analyzer and distortion factor meter, Tuned circuit wave meter for frequency measurement, Different type of wave meters and factors affecting their accuracy, Lumped and cavity wavemeters, Q-meter and its applications.

10 Lectures

Unit 4

Network Analyzers :FFT spectrum analyzers, Bank-of –filters, Wave meters, Resolution B.W,**Logic Analyzers:**Logic probes, timing analyzer, glitch detect, state analyzer **5 Lectures**

Suggested Books:

Joseph J Carr, Elements of electronic instrumentation and measurement, Pearson Education

Rangan, Sarma and Mani, Instrumentation, devices and systems, Tata Mc-Graw Hill

H. S. Kalsi , Electronic Instrumentation, Tata Mc-Graw Hill.

Modern electronic Instrumentation and measurement techniques, Helfrick Cooper, Pearson Education

R. A. Witte, Electronic test instruments: analog and digital measurements, Tata Mc-Graw Hill

S. Wolf and R.F.M. Smith, Student Reference Manual, Pearson Education.

Electronic Test Instruments by Robert A. Witte, Pearson Education
Electronic Instrumentation and Measurement Techniques By William D. Cooper, Prentice Hall India

Electronic Instrumentation by Kalsi, Tata-McGraw Hill

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NHP – 405: Instrumentation Practical – VII **Marks: 100**

Practical based on Electronic Instrumentation **4classes/week**

1. Study and operation of Multimeters (Analog and Digital), Function Generator, Regulated Power Supplies
2. Study and Operation of CRO.
3. Two Stage RC Coupled Amplifier
4. Current shunt and Feedback Amplifier
5. Cascade Amplifier
6. Wien Bridge Oscillator using Transistors
7. RC Phase Shift Oscillator using Transistors
8. **Simulation tools:** Design and Simulation in Simulation Laboratory using P spice or MATLAB or Equivalent Simulation Software

Practical based on Industrial instrumentation **4classes/week**

1. Discharge coefficient of orifice plate.

2. Calibration of pressure gauge.

3. Calibration of thermocouple

4. Calibration of RTD.

5. Level transmitters.

6 Conductivity meter calibration and measurements of conductivity of test solutions.

7. EM flowmeter and ultrasonic flowmeter.

8. Ratio control in combustion laboratory unit.

9. AC/DC meter calibrator.

10. To study of Circular chart recorder

INHP 406 Instrumentation Practical – VIII

Practical based on Analog Electronics-II **Marks: 100**

8 classes/week

1. To design an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
2. To design an integrator using op-amp for a given specification and stud its frequency response.
3. To design a differentiator using op-amp for a given specification and stud its frequency response.
4. To design a First Order Low-pass filter using op-amp.
5. To design a First Order High-pass filter using op-amp.
6. To design a Second Order Low-Pass filter using op-amp.
7. To design a Second Order High-Pass filter using op-amp.
8. To design a Band Pass/ Band Reject filter using op-amp.
9. To design a RC Phase Shift Oscillator using op-amp for a given specification

Software Based Simulations (to run concurrently)

1. To design an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
2. To design an integrator using op-amp for a given specification and stud its frequency response.
3. To design a differentiator using op-amp for a given specification and stud its frequency response.
4. To design a First Order Low-pass filter using op-amp.
5. To design a First Order High-pass filter using op-amp.
6. To design a Second Order Low-Pass filter using op-amp.
7. To design a Second Order High-Pass filter using op-amp.
8. To design a Band Pass/ Band Reject filter using op-amp.
9. To design a RC Phase Shift Oscillator using op-amp for a given specification

SEMESTER V

INHT-501: Microprocessor **Marks: 100**

40 Lectures

Unit 1

8085 pin diagram and architecture, CISC architecture, system bus architecture, internal registers, fetch-decode-execute cycle, Addressing modes and instruction set

Unit 2

Subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts, programming based on above concepts

Unit 3

8086 pin diagram and internal architecture, Minimum and maximum operating modes, Functional Units of 8086, Bus Interface Unit and internal registers, Addressing modes of 8086. 8086 instruction set and assembly language programming

Unit 4

Strings, procedures & macros: 8086 string instructions, writing and using procedures, writing and using assembler macros, 8086 Assembler Directives, 8086 system connections and timing**:** Read and Write cycles and their timing diagrams, Wait state, Basic Interrupt processing, interrupt flag bits and interrupt instructions

Suggested Books:

1. Ramesh Gaonkar, "Microprocessors architecture, programming and Applications", Wiley Eastern Ltd. (2002)
2. K. Udaya Kumar & B.S. Umashankar, "The 8085 Microprocessor: Architechture, Programming and Interfacing", Pearson Education
3. Liu Gibson, "Microprocessor Systems: The 8086/8088 family Architecture, Programming& Design", PHI, 1999.
4. Barry B. Brey and C R Sarma, "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro-Processor Architecture, Programming and Interfacing", Pearson Education, (2005)

5. Walter Triebel & Avtar A, Singh, "8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Pearson Education
6. D. V. Hall, "Microprocessors and Interfacing", Tata Mc Graw Hill (2005)
7. Peter Able, "IBM PC Assembly language programming", PHI, 1994.

INHT-502: Analytical Instrumentation-I **Marks: 100**

40 Lectures

Unit 1

Introduction. : Methods of Analysis – Qualitative, quantitative and instrumental methods.
Principal ,types of instrumentation, advantages and disadvantages of instrumental methods. Steps involved in chemical analysis, types of analytical methods, qualitative ndquantitativeanalysis. **Atomic absorption and flame photometry.** Principle, instrumentation, interferenceand applications.

06 Lectures

Unit 2

Separation techniques: Basic Chromatographic techniques, Planar (Paper, TLC/HPTLC) Column(gel permeation, ion exchange), Solvent extraction and centrifugation

10 Lectures

Unit 3

Column Chromatography- Theory, Principle, Instrumentation and application of column chromatography (Gas Liquid Chromatography and High Performance Liquid Chromatography)

10 Lectures

Unit 4

Spectroscopy-I: Spectro analytical methods – Energy, properties of electromagnetic radiation (EMR) General features of spectroscopy, interaction of EMR with matter. Spectrometers, molecular energy levels. Types of molecular transitions, applications.

Ultraviolet-Visible Spectroscopy: Theory, types of transitions. Instrumentation – Radiation source, monochromators, detectors. Double beam spectrophotometer, derivation of Beer's Law, numerical problems. Deviations from Beer's Law – Chemical, instrumental and real deviations.**Infrared Spectroscopy:** Principles, diatomic molecules as a simple harmonic oscillator, numerical problems. Instrumentation – Components of dispersive IR spectrometer. Source, Optical system, sampling, detectors. Double beam IR spectrometer, FTIR spectrometer. Applications – Limitations, advantages, comparison of dispersive and FTIR instruments.
Raman Spectroscopy: Principles, Mechanism of Raman Effect – Quantum theory and classical theory. Techniques and Instrumentation, Applications

14 Lectures

Text Books:

H.H.Willard, *Instumental Methods of Analysis,* CBS Publishers

Suggested Books:

Skoog & Lerry*, Instrumental Methods of Analysis,* Saunders College Publications, New York

R.M.Silverstein*, Spectrometric Identification of Organic Compounds*, John Wiley

D.C. Harris, Quntitave Chemical Analysis, W.H.Freeman

Vogel's Textbook of Qualitative Chemical Analysis, ELBS

W.Kemp, *Organic Spectroscopy*,ELBS

J.A. Dean, *Analytical Chemistry Notebook*, Mc Graw Hill
Jagmohan, *Organic Analytical Chemistry*, Narosa Publishing House
R.A.Day and A.L. Underwood, *Quantitative Analysis*, Prentice Hall of India
John H. Kennedy*, Analytical Chemistry: Principles*, Saunders College Publications**INHT-503:**

INHT 503: Electrical Machines & Control Systems **Marks:100**

40 Lectures

Unit 1

Basic Power Devices and Circuits

Brief review of SCR, Diacs and Triacs, their construction. and IV characteristics. Two transistor model of SCR. Resistive and RC triggering circuits. **Applications of SCRs:**Basic series inverter circuit and the improved circuits, Parallel Inverters, Chopper circuit – Basic concept, step up and step down choppers. Jones and Morgan's chopper. **10 Lectures**

Unit 2

Electro-mechanical Machines: Principle of electromechanical conversion, DC motors, operational comparison between generator and motor action (without constructional comparison). Significance of back EMF, Maximum power, Torque and speed relation, Characteristics of series, shunt and Compound excited, necessity of motor starters, Three point starter, Speed control methods, SCR speed control using chopper and controlled rectifiers circuits. **10 Lectures**

Unit 3

AC Machines: Types of transformers, Transformer Construction, E.m.f. equation, Transformer Losses, condition for maximum efficiency, all day efficiency, Auto transformers, Induction Motor, constructional features, Rotating magnetic field, generation of rotating magnetic field in single phase motors.

10 Lectures

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Unit 4

Open loop and closed loop control system illustration, block representation, signal terminology, general explanation with illustration of servomechanism, regulation system, Linear and non linear controls, continuous and sampled data controls digital control.

Mathematical modeling and system representation: Differential equation of physical systems such as mechanical, electrical electromechanical ,thermal, pneumatic ,liquid level etc .Analogues System , Transfer function, block diagram representation and reduction technique, signal flow graph construction ,terminology, algebra and Mason's gain formula state equation, effects of feedback on variation of system parameters , system dynamics and effect of disturbances

10 Lectures

Suggested Books:

1. G. Mc. Pherson, An introduction to Electrical Machines & Transformers, John Wiley & Sons (1990)

2. H. Cotton, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi (1984)

3. B. L. Thareja and A. K. Thareja, Electrical Technology, S. Chand & Sons., 23rd Edition

4. I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw Hill (1997)

5. S. Ghose, Electrical Machines, Pearson Education (2005)

6. N. K. De and P. K. De, Electric Drives, Prentice Hall of India (1999)

7.Control systems, Nagrath and Gopal, New Age International

8.Automatic Control Systems, Kuo, Wiley international

INHT-504: Biomedical Instrumentation-I Marks:100

Theory **40 Lectures**

Unit 1

Introduction to bioelectric potential, bioamplifier, components of man Instrument system, types of bio-medical systems, design factors and limitations of biomedical instruments, terms and transducers to various physiological events, types of bio-potential electrodes.

06 Lectures

Unit 2

Cardiac vascular system : - origin of ECG, Instruments of ECG, bipolar system lead system I, II, III, Einthovan's triangle, Augmented lead system, uni polar chest lead system, types of display.

Defibrillators – AC, DC, Cardiovertor, Pacemakers- Internal, External. Blood pressure

measurements:- direct, indirect.

Respiratory system: types of volume, types of measurements, Instrumentation of respiratory system, principle & types of pneumograph, Spirometer, pneumo tachometers, nitrogen wash out technique, apnoea detectors

15 Lectures

Unit 3

Nervous system:- Action potential of brain, brain wave, Instrumentation – Electro encephalography (EEG), analysis. **04 Lectures**

Unit 4

Medical Imaging system:Thermal imaging system, working, IR detectors, application. Ultra sound, properties, its generation & detection, types of transducers, diagnostic application – A Scan, B Scan, M Scan(echo cardio graph), real time ultrasonic imaging, linear array scanners.Radiography- conventional X ray, properties, generation of X-ray, Fluoroscopy,

X Ray computed tomography (CT Scanner) and computer-aided tomography (CAT)- principle, contrast scale, scanning system, processing unit, viewing, storage.

15 Lectures

Text Books:

Khandpur R. S. - Handbook of Biomedical Instrumentation, TMH

Suggested Books:

Bertil Jacobson & John G. Webster - Medicine and Clinical Engineering, PHI
Prof. S.k.VenkataRam-Bio-Medical Electronics and Instrumentation, Galgotia Publications
John G.Webster- Medical Instrumentation-Application and Design Wiley Student Edition)
L.Cromwell et al- Biomedical Instrumentation and Measurements PHI

INHP 505: Instrumentation Practical – IX **Marks: 100**

Practical based on Analytical Instrumentation-I **4 classes/week**

1. To determine the concentration of Na &K in the unknown sample using flame photometer
2. To find out the concentration of Potassium ions in the given sample using standard addition method
3. To find the concentration of various dyes in the given unknown solution
4. To select the appropriate filter and find the concentration of unknown solution

5. To carry out the spectrophotometric determination of any solutions
6. To find the moisture content in a given sample using Karl Fisher titrator
7. To determine the contents of unknown solution by using GC.

8. To analyze quantitatively in the given sample using interval standard in GC

Practical based on paper Biomedical Instrumentation I 4classes/week

1 .Characterization of bio potential amplifier for ECG signals.

2. Study on ECG simulator

3. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator

4 .Study of pulse rate monitor with alarm system

5. Determination pulmonary function using spirometer (using mechanical system).

6. Measurement of respiration rate using thermister /other electrodes.

7. Study of Respiration Rate monitor/ apnea monitor

8. Study on ultrasound transducers based on medical system

9. Study of a Pacemaker.
10. Measurement of pulse rate using photoelectric transducer & pulse counting for known period.

INHP 506: Instrumentation Practical – X Marks: 100

Practical based on Paper Microprocessor and Electrical Machines and Control Systems

8classes/week

(To be implemented on both 8085 and 8086 microprocessors)

1. To write an assembly language program to perform basic mathematical operations (addition, subtraction, multiplication, division)
2. To write an assembly language program to generate first N terms of an A.P. / G.P. series

3. To write an assembly language program to generate first N terms of Fibonacci series
4. To write an assembly language program to arrange the given list of number in ascending / descending order
5. To write an assembly language program to calculate N!
6. To write an assembly language program to separate prime numbers in a given list of number
7. To write an assembly language program to convert a number from one number system to another
8. To write an assembly language program to design a clock
9. To write an assembly language program to calculate a mathematical expression (for e.g. $2^N/N!$)
10. To write an assembly language program to calculate value of sin(x)
11. To implement basic 8086 interrupts using assembler
12. Power measurement in single & three phase circuit.
13. Load characterstics of D.C motor
14. Speed control of D.C. motor
15. Brake test of D.C. motor
16. Brake test of induction motor
17. Study of the Stepper motor
18. Study of Servo motor.

SEMESTER VI

INHT- 601: Analytical Instrumentation-II Marks: 100

40 Lectures

Unit 1

Gas & Air pollution analyzers: Introduction to types of gas analyzers- flue gas analyzers, paramagnetic oxygen analyzers. Hydrogen gas analyzers-IR gas analyzers, analyzers based on gas density systems based on ionization of gases. Air pollution monitoring, instrument systems for-carbon monoxide-sulpher dioxide-nitrogen oxides-hydro carbons-ozone

6 Lectures

Unit 2

Spectroscopy-II: Nuclear, Magnetic Resonance Spectroscopy: Basic principles of NMR, Chemical shift, spin – spin coupling. Instrumentation – Magnet, sweep generator, RF generator, RF receiver, signal recorder. Applications – Structural diagnosis, quantitative analysis. Atomic Absorption and Flame Photometry- Principle, Instrumentation, Interference and applications ,Mass Spectroscopy -Theory, instrument and application

16 Lectures

Unit 3

Potentiometry

Introduction, reference and indicator electrodes, ion selective electrodes and their applications. Potentiometric titrations. **08 Lectures**

Unit 4

Thermal Instrumentation: Thermal detectors. TG (thermogravimetry). – DTA(Differential Thermal analysis). – DSC(differential scanning calorimetry) – X-ray spectroscopy. Production of X-rays and X-rays spectra. Monochromators and detector used in that. X-ray diffraction and diffractometer, X-ray fluorescence.

10 Lectures

Text Book

R.S Khandpur- Analytical Instrumentation

Skoog and West: Analytical Instrumentation

Suggested Books:

Williard Meritt & Dean: Instrumental methods of analysis, (Dvan Nostr and Co)

Ewings E.W.: Instrumental methods of chemical analysis

B.E.Noltigk , Jones – Instrument Technology – Volume 2 & 3 (ELBS)

Ewings Analytical instrumentation handbook By Jack Cazes, Galen Wood Ewing

INHT-602 Biomedical Instrumentation-II **Marks: 100**

Theory **40 Lectures**

Unit 1

Ventilators: Parameters, system concepts, their classification, valve, humidifiers, nebulizers.**Oximeter**-in vivo, invitro, pulse and ear type. **Blood flow meter**- electromagnetic types. Blood gas analyzers- acid base balance, blood ph, pCO_2, pO_2 measurement

10 Lectures

Unit 2

Biotelemetery- design, single channel, bio telemetery transmitter and receiver system, based on AM, FM modulation, pulse modulation. **5 Lectures**

Unit 3

Nuclear medicine system- radioactive emissions, rectilinear scanner, gamma camera, imaging system, ECT (emission coupled tomography),positron emission tomography, safety measures.

10 Lectures

Unit 4

Clinical Instruments: General principle, working and application of Auto analyzers, elisa reader, Thermal Cycler, Blood cell counter, equipments used in surgery, safety.Fibre Optic Endoscopy: Principles and applications, neonatal instrumentation, Incubators, anaesthesia equipment.

15 Lectures

Text Books

Joseph J. Carr & John. M. Brown - Introduction to Biomedical Equipment technology
R.S. Khandpur - Handbook of Biomedical Instrumentation, McGraw Hill.

Suggested Books:

J.G. Webster - Medical instrumentation application and design, Houghton Miffin Co., Boston USA.
Mohan Murali H. - Monograph on Biomedical engineering, O.U. Press 1985.
Geddes L. A. & L. E. Baker - Principles of Applied Biomedical Instrumentation, Wiley, 1989.

Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer - Biomedical Instrumentations and Measurements (2e), PHI, 1991.

INHT-603: Statistical Quality Control **Marks: 100**

40 Lectures

Unit 1

Quality Concepts: Meaning of Quality, Approaches- Deming's Approach, Juran's Approach, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, Difference between Inspection, Quality Control and Quality Assurance, Evaluation of Quality control, concept change, Quality Improvement Techniques Pareto Diagrams, Cause-Effect Diagrams Quality Circles, Kaizen, six sigma

10 Lectures

Unit 2

Control Charts: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, ARL, sensitizing rules for control charts ,Control Charts for X-bar& R (statistical basis, development and use, estimating process capability; interpretation, the effect of non normality on the chart, the OC function, average run length and control chart for attribute (p,np,c) **10 Lectures**

Unit 3

Design of experiment & Acceptance Sampling: Meaning, objective, and types of research, approaches, two factorial experiments, Taguchi Method. National quality Award and other quality awards, Principle of acceptance sampling. Producer's and consumer's risk. AOQLand LTPD , Sampling plans –single, double O C curve. **10 Lectures**

Unit 3

ISO 9001-2000 &14000Series of Standards- History and Evolution of ISO 9000 Series, importance and overview of ISO 9000- 1998 Series standards, structure of ISO 9000-2000 Series standards, clauses of ISO 9000 series standards and their interpretation and implementation, quality system documentation and audit. Environmental management concepts, and requirement of ISO 14001, benefits of environmental management Systems

10 Lectures

Text Books:

D. C. Montgomery -Introduction to Statistical Quality Control, 4th edition 2001,

Wiley publisher.

S.Dalela - ISO 9000 Quality System

Suggested Books:

E.L.Grant & R.S. Kearenworth-Statistical Quality Control.

Kaoru Ishikawa-Guide to Quality Control, Asian Productivity Organization, Series

Jerry Banks –"Principles of Quality Control", Wiley publisher.

Juran's Quality Control Handbook.

INHT-604: Microcontrollers and its applications

Theory **40 Lectures**

Unit 1

Introduction to 8051 family microcontrollers. 8051 architechture, Register banks and Special Function Registers. Memory organization. Addressing modes. Instruction set: Data transfer, Arithmetic, Logical, Boolean and Branch instructions. **10 Lectures**

Unit 2

Oscillator and Clock Circuit, Input / Output Ports, Timers, Serial Interface, Interrupts, External Interrupts. 8051 Programing **10 Lectures**

Unit 3

8051 interfacing with Keyboard, display Units (LED, 7-segment display, LCD), ADC, DAC, Stepper motor. RS232 and RS485 driver interfacing. **10 Lectures**

Unit 4

Introduction to RISC microcontrollers. Von-Neumann and Harvard architectures. Advance microcontroller features: Reset (Power ON, Watchdog, Brown-out, External), Power Saving and Sleep Modes, Timer modes (Input capture, output compare, PWM), SPI, USART, I^2C and CAN bus

10 Lectures

Suggested Books:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education Asia, New Delhi (1999)
2. Daniel W. Lewis, “Fundamentals of Embedded Software – where C and Assembly Meet”, Pearson Education (2002)
3. John B. Peatman, Design with PIC Microcontrollers, Pearson Education (1998)
4. Kenneth J Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Penram Publications.

5. Zdravko Karakehayov, Knud Smed Christensen and Ole Winther, Introduction by: Embedded Systems Design with 8051 Microcontrollers, Marcel Dekker Inc, (1999)
6. Dave Calcutt, Fred Cowan and Hassan Parchizadeh, 8051 Microcontroller :An applications based, Elsevier.
7. Myke Predco, Programming & Customizing the 8051 Microcontroller, Mc Graw Hill, (2000)

INHP- 606: Instrumentation Practical – XI **Marks: 100**

8 classes/week

Practical based on paper Statistical Quality Control using latest statistical software package

Analytical Instrumentation -II

1. Analysis of various compounds using atomic absorption system.
   a) Qualitative analysis
   b) Quantitative analysis

2. Study of NMR machine (optional)

3. Qualitative & quantitative analysis of drugs using mass spectroscopy (optional)

4. Experiment based on ion selective electrodes.

5. T**o** analyze the given sample using external standard method using HPLC

6. To analyze quantitatively in the given sample using interval standard in GC

7. To analyze quantitatively given mixture of compound by comparing their retention time using HPLC

INHP- 606: Instrumentation Practical - XII **Marks: 100**

Practical based on paper Microcontrollers and its applications

8 classes/week

1. Write a program to add N 8 bit unsigned integer numbers.
2. Write a program to multiply two 16 bit unsigned numbers.
3. Write a program to arrange the unsigned integer numbers in ascending/descending order.
4. Interface a display to the micro controller and display number sequentially in a regular interval.
5. Interface switches and LED's. Write program to verify the switch condition and light the LED's accordingly.
6. Generate a PWM waveform whose width can be increased/decreased using switches.
7. Convert the analog voltage to digital using ADC and store the data in memory.
8. Generate the given waveform using DAC.

9. Using display and keys write program to work as a stop clock.
10. Using display and keys write program to work as a counter.
11. Interface a matrix keyboard and display the key pressed.
12. On-OFF temperature controller.
13. RPM meter.
14. Stepper motor control.

UNIVERSITY OF DELHI

One Year P.G. Diploma Course
in
Molecular & Biochemical Technology

SCHEME OF EXAMINATION
&
COURSE OF STUDEY FOR SEMESTER SYSTEM

Effective from the Academic Year 2011-2012

1. Affiliation: The Programme shall be governed by the Department of Biochemistry, University of Delhi, South Campus under the Faculty of Interdisciplinary & Applied Sciences.

2. Programme Structure and Codification of Papers:

EXAMINATION SCHEME:

Semester - I

Theory		**Marks**	
PGD MB 101	Biophysical Techniques-I	100	
PGD MB 102	Recombinant DNA Technology-I	100	
PGD MB 103	Immunology-I	100	
Practical Examination			
PGDMB L104	Labwork-I	50	
PGDMB L105	Labwork-II	50	
PGDMB L106	Labwork-III	50	
	Viva	50	
	Total	**500**	

Semester – II

Theory		**Marks**	
PGD MB 201	Biophysical Techniques-II	100	
PGD MB 202	Recombinant DNA Technology-II	100	
PGD MB 203	Immunology-II	100	
Practical Examination			
PGDMB L204	Labwork-IV	50	
PGDMB L205	Labwork-V	50	
PGDMB L206	Labwork-VI	50	
	Viva	50	
	Total	**500**	

Grand Total: Ist Semester + IInd Semester = 1000

In each paper, 70% marks are for end Semester Examination while 30% marks are for internal assessment

Scheme for Examination

1. Duration is one year with two semesters.
2. Each semester will have three theory papers and three practical papers.
3. Minimum pass percentage for each semester, theory & practical examination will be 40 percent each.

Teaching Programme

Faculty from the Department of Biochemistry of the college.

Eligibility

- Eligibility Criteria for Entrance Examination : Graduates (only those with three years undergraduate programs) with minimum 50% aggregate in the disciplines of B.Sc. Life Science, B.Sc. Botany/ Biochemistry/ Chemistry/ Microbiology/ Zoology/ Applied Zoology/ Applied Sciences, Biomedical Sciences, Biological Sciences, Biotechnology B.Tech (Biotech) and B. Pharma.

Schedule of the Course

According to the University calendar

Selection process

- Admission is based on an All India Entrance Examination on the second Sunday of July, followed by an interview.

- The test paper consists of multiple choice questions covering basic science disciplines up to graduation level.

- Candidates who have appeared for the final year examinations and awaiting results can also apply.

Total Course Fee : Rs. 15,575.00

Evaluation

Students will be evaluated at the end of each semester by written test, practical test and Viva Voce in each paper.

Number of seats : 27

Brochure

Rs.200 including the admission fee.

Reservation

As per the University/U.G.C. norms.

Promotion criteria

- Pass marks in each semester shall be 40% in each theory paper, internal assessment as well as practical, separately.

- A student who is unable to pass the theory examination for semester I will be allowed to pursue studies for semester II. (However, he/she can reappear in the remaining papers of semester I or II when the examinations are conducted in the next academic session). In the case of ex students, marks for Practical Examinations already awarded will be taken into account as no second attempt is permitted for practical exams.

- No candidate shall be allowed to appear in the examination more than twice and a candidate must take the Diploma examination within 3 years of their first admission to the course.

Division criteria

Successful candidates will be classified on the basis of combined results of both the semesters as follows.

75% and above	Distinction
60% and above	1st Division
Greater than or equal to 50% but less than 60%	2nd Division
Greater than or equal to 40% but less than 50%	3rd Division

Attendance requirements

75% in each semester

Semester I

PAPER - PGD MB 101: BIOPHYSICAL TECHNIQUES-I

Quantification of Proteins:

Principles of Spectrophotometry: ultraviolet- visible absorption spectrophotometry, visible recording of spectra for proteins and nucleic acids and calculation of concentration of protein and nucleic acids from spectrum. Fluorescence spectroscopy, mass spectrometry (6 periods)

Separation of Proteins

Gel Filtration chromatography: Separation based on size, principle, types of gel filtration beads, preparation of slurry, packing of column, determination of void volume, separation of proteins by filtration, determination of molecular weight, storage of columns. (6 periods)

Ion Exchange chromatography: Separation based on charge, types of ion exchangers and general properties, selection of ion exchanger, selection of buffer, operating methods, batch operation and column operation packing and development of column, various gradients for elution, effect of flow rate, volume of gradient and fraction size on separation, high pressure liquid chromatography, fast protein liquid chromatography (8 periods)

Affinity Chromatography: Separation based on affinity, principle, activation of matrix, ligands, methods used for elution, metal chelate chromatography, hydrophobic and covalent chromatography (6 periods)

Thin Layer chromatography: Principles of thin layer chromatography, systems for separation of various molecules, activation of Silica plates, elution of material from silica gel. (2 periods)

Gas liquid chromatography: Principle, instrumentation, detectors. (2 periods)

Purification of proteins: using salts, organic solvents, organic polymers. Dialysis and membrane filtration. (2 periods)

Enzymes: Basic features of enzymes, catalysis, estimation of Vmax and Km using Lineweaver –Burke plot, enzyme inhibition, specific activity. (6 periods)

Tissue Culture: concept of totipotency, callus, plant tissue culture laboratory set up, tissue culture media, phytohormones, cybrids, cell, tissue and organ culture, somatic embryogenesis, organogenesis, applications (somatic hybridization, embryo rescue, virus-free plants, somaclonal variations etc).
(6 periods)

Animal tissue culture: primary culture, cell lines, continuous cell lines (transformation, anchorage independence, contact inhibition etc) applications. (6 periods)

Suggested Reading:

1. Biochemistry and Molecular Biology, Keith Wilson & John Walker (6th Edition, 2008) Cambridge University Press
2. Biochemistry Laboratory: Modern Theory and Techniques Rodney Boyer (International Edition, 2009) Benjamin Cummings
3. Physical Biochemistry Freifelder (2^{nd} edition, 1982) W.H.Freeman and Co
4. Principles of Biochemistry (Lehninger) Nelson and Cox, (5^{th} edition, 2008) W.H.Freeman and Co.
5. Modern Industrial Microbiology and Biotechnology, Nduka Okafor (Science Publishers, 2007)
6. Plant Tissue Culture Theory and Practice, Bhojwani and Razdan ,2008,Elsevier
7. Culture of Animal Cells, Freshney (4^{th} edition, 2000) Wiley-Liss Inc.

PAPER - PGD MB 102 : **RECOMBINANT DNA TECHNOLOGY- I**

Concept of gene manipulation :

Restriction enzymes: various types, their properties, nomenclature, creating new restriction sites by DNA manipulation.

DNA methylation systems in *E.coli* (dam, dcm, M *EcoKI*). (8 periods)

Various DNA modifying enzymes used in cloning (DNA polymerases :DNA Polymerase I, Klenow fragment, T4DNA Polymerase, T7 DNA Polymerase), RNA

Polymerases(T3, T7, SP6), Reverse Transcriptase (AMV, MoMLV), Ligases (T4 DNA ligase, E.coli DNA ligase), Taq polymerase etc (5 periods)

Cloning vectors : Biology of plasmids (conjugative, nonconjugative, relaxed and stringent control of copy number , incompatibility) Plasmid based vectors(one step and two-step selection); Biology of Lambda phage (lytic versus lysogenic cycle), λ bacteriophage based vectors (insertional and replacement),in vitro packaging; Biology of M13 bacteriophage, M13 phage based vectors, phagemids

High capacity vectors: cosmids, P1 phage based vectors, PACs, yeast artificial chromosomes, bacterial artificial chromosomes. Advantages of each vector. (12 periods)

Covalent linkage of DNA fragments to vector molecules: linkers, adapters, conversion adaptors, homopolymer tailing (recovery of DNA insert after homopolymer tailing). (2 periods)

Generation of genomic and cDNA libraries: (mRNA source, integrity, enrichment techniques, different methods of first strand and second strand of cDNA synthesis)

Limitations of cDNA synthesis (5'end RACE, 3' end RACE) (6 periods)

Solid phase synthesis of DNA: (phosphoramidite based). (2 periods)

Selection and screening of recombinant clones: Radiolabelled probe preparation via nick translation, random priming, 3' end labeling, 5'end labeling, Guessmers and degenerate probes, Non radioactive probes preparation using Biotin, Digoxigenin. (6 periods)

Sequence dependent and independent screening: PCR based, colony and plaque hybridization, functional screening, immunological screening, gain of function screening. HRT, HART (4 periods)

Suggested Reading:

1. Principles of Gene Manipulation and Genomics
   S.B. Primrose & R.M. Twyman (7th Edition,2006) Blackwell Publishing

2. Molecular Cloning (A Laboratory Manual)
   Sambrook and Russell (3rd Edition,2001) CSHL Press

PAPER - PGD MB 103 : IMMUNOLOGY - I

Overview of the immune system: historical background, innate immunity, toll like receptors (8 periods)

Organization of the immune system : primary & secondary lymphoid organs, myeloid cells, lymphoid cells, dendritic cells and natural killer cells (4 periods)

Antigens : immunogenicity and antigenicity, factors that influence immunogenicity, haptens, carrier, epitopes, cross reactivity (4 periods)

Antibodies : structure of immunoglobulins, immunoglobulin subtype, B cell receptor, isotype, allotype, diotype, Monoclonal antibodies : preparation of lymphocytes, myeloma cells, fusion protocol, selection, cloning and culturing of monoclonal antibody secreting hybridoma cell line, engineering of antibodies (6 periods)

Antigen antibody interactions : affinity, avidity, cross reactivity, precipitation reactions, agglutination reactions, immunofluorescence, fluorescence activated cell sorter, complement tests, ELISA, RIA (8 periods)

The major histocompatibility complex : structure and cellular distribution of MHC molecules, peptide binding by MHC, MHC and immune responsiveness (4 periods)

Antigen processing and presentation : Cytosolic and Endocytic pathway (2 periods)

The response of B cells to antigen : B cell maturation, activation and proliferation, signaling pathways leading to B cell activation, germinal centers and formation of

plasma cells, memory cells, class switching (6 periods)

Generation of antibody diversity : multi gene organization of immunoglobulin genes, mechanism of gene rearrangement (6 periods)

Suggested Reading

1. Immunology by Janis Kuby (Freeman and Company),6th edition,2007
2. Immunobiology by Janeway , Travers, Walport, Sclomchik 9 Garland publishing) 6th edition, 2005

PRACTICAL PAPER - PGD MBL 104 : BIOPHYSICAL TECHNIQUES-I

1. Spectrophotometric analysis of nucleic acids.

   Protein estimation at $\lambda_{280.}$

   Effect of solvent perturbation on absorption by a chromophore

2. Determination of void volume and partition coefficient by Gel filtration

3. Purification of proteins on ion exchange chromatography

4. Purification of proteins on affinity chromatography

5. Thin layer chromatography

6. Ammonium sulphate fractionation and dialysis

7. Assay of enzyme activity (standardization of assay conditions)

   Determination of optimum pH, K_M and V_{max}.

8. Agarose gel electrophoresis:

   Determination of molecular weight of unknown DNA sample

Suggested Reading:

1. The Tools of Biochemistry Terrance G. Cooper(Wiley Interscience, 2011 reprint)

2. Purifying Proteins for Proteomics Richard J. Simpson , 2004(CSHL Press)

3. Molecular Cloning (A Laboratory Manual)

Sambrook and Russell (3rd Edition,2001) CSHL Press

PRACTICAL PAPER - PGD MBL 105: RECOMBINANT DNA TECHNOLOGY- I

1. Preparation and sterilization of LB medium.

2. Obtaining isolated colonies of *E.coli* by streak plate and spread plate method.

3. To study the growth curve of *E.coli* DH5α

4. Isolation of chromosomal DNA of *E.coli*

5. Isolation of plasmid DNA by the alkaline lysis method (maxi-preparation and mini-preparation) and the boiling lysis method.

6. Digestion of plasmid DNA with restriction enzymes

7. Recovery of DNA from low-melting temperature agarose gel: organic extraction etc.

Suggested Reading:

1. Molecular Cloning (A Laboratory Manual)
   Sambrook and Russell (3rd Edition, 2001) CSHL Press
2. Gene Cloning and DNA Analysis T.A.Brown, (6th Edition, 2010) Blackwell Publishing
3. Prescott, Harley and Klein's Microbiology Wiley, Sherwood, Woolverton (7th edition, 2008) McGraw Hill

PRACTICAL PAPER - PGD MBL 106 : IMMUNOLOGY - I

1. Quantitative precipitation test

2. Immuno diffusion : Single radial immunodiffusion, double immunodiffusion

3. Immuno electrophoresis

4. **Electroimmunoprecipitation:Counter immunoelectrophoresis, Rocket immunoelectrophoresis, Crossed immunoelectrophoresis**

5. Staining of precipitin bands in gel

6. Identification of human blood groups and Rh factor

7. Passive agglutination using inert particles like SRBC, latex particles

8. Inhibition of agglutination using latex particles

9. Preparation of lymphocytes from spleen and blood

10. Immunization of rabbit to raise polyclonal antiserum

Suggested Reading

1. Practical Immunology by Hudson & Hay (Blackwell Publishing) 4th edition 2002

2. Handbook of Immunoprecipitation by Nils H. Axelsen (Blackwell Publishing) 1984

IInd Semester

PAPER - PGD MB 201 : BIOPHYSICAL TECHNIQUES - II

Separation of macromolecules by electrophoresis:

Theory of polyacrylamide gel electrophoresis: native and SDS PAGE, reducing and non reducing gels, detection of protein bands in gels- Coomassie blue staining, silver staining, fluorescence staining, molecular weight determination by SDS PAGE recovery of proteins from the gel, affinity staining, isoelectric focusing of proteins, Two dimensional gel electrophoresis, gradient gel electrophoresis, Differential gel electrophoresis(DIGE).

Theory of agarose gel electrophoresis, Pulsed Field Gel Electrophoresis. (8 periods)

Blotting Techniques: Southern blot and factors affecting DNA transfer, Northern blot, Western blot; colony and plaque lift, dot blot.
(5 periods)

Centrifugation : Principle, instrumentation and applications (5 periods)

Radio active materials: Types, precautions for handling, methods of measurements and applications. Autoradiography. (6 periods)

Fundamentals of fermentation technology: *Batch, fed batch and continuous cultures, stirred tank reactors and airlift fermentors, downstream processing. (6 periods)*

Additional methods to identify associated proteins: Analysis of protein–protein interactions: Yeast two-hybrid systems, analyzing protein interaction s by fluorescence resonance energy transfer (FRET), protein fragment complementation(PCA), Mass Spectroscopy (MS), library based methods (surface display) Protein microarrays.
(5 periods)

Bioinformatics and computational biology: An overview

Biological databases and Archives: sequence databases, structure databases, microbial databases, and eukaryotic databases. (4 periods)

Genomics: Genome and genes, gene organization, prokaryotic and eukaryotic protein structure,

control switches,ORF, promoters, ESTs, genome analyses, gene prediction, statistical models, mathematical models, sequence alignment, comparative genomics, genomics in preservation of endangered species, SNPs.

(4 periods)

Proteomics: atomic view of proteins, the hierarchical nature of protein architecture, protein folding, protein structure prediction, homology models, threading/fold recognition, Ab-initio models, protein-protein interactions, proteins as drug targets, phylogenetic analyses (4 periods)

Suggested Reading:

1. Biochemistry and Molecular Biology, Keith Wilson & John Walker (6th Edition, 2008) Cambridge University Press
2. Biochemistry Laboratory: Modern Theory and Techniques Rodney Boyer (International Edition, 2009) Benjamin Cummings
3. Physical Biochemistry Freifelder (2^{nd} edition, 1982) W.H.Freeman and Co
4. Principles of Biochemistry (Lehninger) Nelson and Cox, (5^{th} edition, 2008) W.H.Freeman and Co.
5. Modern Industrial Microbiology and Biotechnology, Nduka Okafor (Science Publishers, 2007)
6. Introduction to Bioinformatics, Attwood, Parry- Smith, Phukan, 2007, Pearson

Education

7. Bioinformatics, CSHL Press 2001, David Mount
8. Plant Tissue Culture Theory and Practice, Bhojwani and Razdan ,2008,Elsevier
9. Culture of Animal Cells, Freshney (4th edition, 2000) Wiley-Liss Inc.

PAPER - PGD MB 202 : RECOMBINANT DNA TECHNOLOGY - II

Heterologous protein expression of cloned DNA in E.coli: Expression vectors (lac promoter, tryptophan promoter, Lambda cI promoter, arabinose promoter based) optimization of protein expression(using upstream and downstream signals) Fusion proteins, cell-free translation systems. RNAi vectors. (4 periods)

DNA transformation in yeast: methods of gene transfer to yeast ,YIp, YEp, YCp, YRp, shuttle vectors), optimization of protein expression. (4 periods)

Gene transfer to plants: Biolistics, protoplast mediated, electroporation, Agrobacterium mediated transfer (Ti plasmid, disarmed vectors, cointegrate vectors, binary vectors),virus-mediated transfer (CaMV), in planta transformation, signals for optimization of protein synthesis. (4 periods)

Gene transfer to animal cells: chemical transfection, lipofection, electroporation, gene-gun, microinjection, transient and stable transformation, optimization of protein synthesis, use of reporter genes. (4 periods)

Characterization of cloned DNA : Restriction mapping, DNA sequencing (dideoxy chain termination, chemical degradation, pyrosequencing, shotgun sequencing and contig assembly).

(5 periods)

Polymerase Chain Reaction and its applications: components of the PCR, importance of primer designing, various thermostable enzymes vs Taq polymerase. RAPD etc (5 periods)

DNA markers: VNTRs and DNA fingerprinting, SNPs, RFLPs. (4 periods)

Modification of cloned DNA : Site directed mutagenesis(cassette mutagenesis, primer extension method, overlap extension method, megaprimer method), selection against parental phenotype.

Protein engineering (4 periods)

Applications of recombinant DNA technology : Transgenic animals, Transgenic plants, Gene therapy, Pharmaceutical products. (4 periods)

Genomics : organization of genomes, organization of nuclear DNA, mapping and sequencing genomes. (5 periods)

Analysis of the transcriptome: RNA expression level profiling with microarrays, MPSS, SAGE, ESTs, loss of function - Knock out ,knock down, antisense RNA and RNAi,

(5 periods)

Safety of recombinant DNA technology and ethical issues (Patenting): Restriction and regulation for the release of Bt crops etc. (4 periods)

Suggested Reading:

1. Principles of Gene Manipulation and Genomics

   S.B. Primrose & R.M. Twyman (7th Edition,2006) Blackwell Publishing

2. Molecular Cloning (A Laboratory Manual)

   Sambrook and Russell (3rd Edition, 2001) CSHL Press

PAPER - PGD MB 203 : IMMUNOLOGY-II

The response of T cells to antigens : T cell receptor, T cell accessory membrane molecules, thymic selection of T cell repertoire, organization and rearrangement of TCR genes, cell mediated immune response : generation of cytotoxic cells, CTL mediated cytotoxicity, response of NK cells (6 periods)

Cytokines : properties, function of IL -1 to IL-5, IL-10, Il-12, IFNs, TNFs, cytokine receptors and signal transduction mediated by them, cytokine related diseases (4 periods)

The complement system : classical & alternate pathway, Lectin pathway, regulation of the pathway, biological consequences of complement activation (6 periods)

Hypersenstivity reactions : type I, II,III and IV (6 periods)

Vaccines : active and passive immunization, attenuated & inactivated vaccines, new approaches to vaccine development (4 periods)

Autoimmunity : organ specific and systemic autoimmune diseases (4 periods)

Transplantation immunology : types of grafts, tissue typing, immunological basis of graft rejection, immunosuppressive therapy (4 periods)

Immune response to infectious diseases: immune response to bacterial, viral, protozoan and helminth infections, genomics and the challenge of infectious diseases (10 periods)

Cancer and the immune system : oncogenes, tumor antigens and induction of immune response, immunotherapy for tumors (3 periods)

Regulation of the immune response : antigen & antibody mediated regulation, Jerne's theory (4 periods)

Suggested Reading

1. Immunology by Janis Kuby (Freeman and Company) 7th edition,2006
2. Immunobiology by Janeway , Travers, Walport, Sclomchik (Garland publishing) 6th edition, 2005

PRACTICAL PAPER – PGD MBL 204 : BIOPHYSICAL TECHNIQUES-II

1. Polyacrylamide gel electrophoresis

2. SDS gel electrophoresis of proteins (reducing and nonreducing) and determination of molecular weight of protein samples.

3. Isoelectric focussing of proteins and two dimensional gel electrophoresis

4. Southern blotting

5. Western blotting

6. Immunoblotting

7. Bioinformatics Exercises:

   Databases: Protein data bank, Nucleic acid database, Genbank,

   Sequence alignment using BLASTn, BLASTp, CLUSTALW.

   Gene finding tools- GenScan, GLIMMER

   Introduction to proteomics Protparam, GOR, nnPredict, SWISSMODEL

   Visualization Softwares - Rasmol, JMOL

Suggested Reading:

1. The tools of Biochemistry by Terrance G. Cooper(Wiley Interscience)
2. Purifying Proteins for Proteomics by Richard J. Simpson (CSHL Press)
3. Introduction to Bioinformatics, Attwood, Parry- Smith, Phukan, 2007, Pearson Education
4. Bioinformatics, CSHL Press 2001, David Mount

PRACTICAL PAPER – PGD MBL 205: RECOMBINANT DNA TECHNOLOGY-II

1. Preparation of competent cells of *E.coli*

2. Transformation of competent *E.coli* cells with plasmid DNA.

3. To study the effect of alkaline phosphatase on plasmid recircularization

4. To amplify a gene using PCR.

5. Calculation of the phage titre with a phage titration kit.

Suggested Reading:

1. Molecular Cloning (A Laboratory Manual)
   Sambrook and Russell (3rd Edition,2001) CSHL Press
2. Gene Cloning and DNA Analysis T.A.Brown, (6th Edition,2010) Blackwell Publishing

PRACTICAL PAPER - PGD MBL 206: IMMUNOLOGY - II

1. Quantitative estimation of haemolytic complement activity in serum
2. Complement fixation test
3. Purification of antibodies from serum using salt fractionation and gel filtration
4. Purification of IgG by ion exchange chromatography
5. Preparation of IgG fraction using Protein A Sepharose column
6. Digestion of antibodies with pepsin and preparation of F(ab)2 fragment using Sephadex G-100 chromatography
7. Linking of enzyme to antibodies using one step glutaraldehyde method
8. Dot ELISA
9. Determination of antibody titre by indirect ELISA
10. Measurement of antigens by Direct and Competitive ELISA

Suggested Reading:

1. Practical Immunology by Hudson & Hay (Blackwell Publishing) 4th edition 2002
2. Handbook of Immunoprecipitation by Nils H. Axelsen (Blackwell Publishing) 1984