

Detailed course matrix and scheme of evaluation for Integrated B.Sc. – M.Sc. in Biological Sciences (Revised)

SEMESTER – I

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS101T	Systematics and diversity of Non-vascular Plants (core)	4	4	3	70	30	100
IBS102T	Systematics and diversity of Invertebrates (core)	4	4	3	70	30	100
IBS103T	Biophysical chemistry(core)	4	4	3	70	30	100
IBS104T	Computer applications & IT (SEC)	2	2	2	35	15	50
IBS105T	Language I-1 (Kannada / Hindi)	2	2	3	70	30	100
IBS106T	Language I-1 (English)	2	2	3	70	30	100
Practical							
IBS107P	Systematics and diversity of Non-vascular Plant (core)	4	2	4	35	15	50
IBS108P	Systematics and diversity of Invertebrates (core)	4	2	4	35	15	50
IBS109P	Biophysical chemistry (core)	4	2	4	35	15	50
	Co-curricular & Extra-curricular activities	-	Pass/Fail	-	-	50	50

SEMESTER – II

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS201T	Systematics and diversity of Vascular Plants (core)	4	4	3	70	30	100
IBS202T	Systematics and diversity of Vertebrates (core)	4	4	3	70	30	100
IBS203T	Bio-organic chemistry (core)	4	4	3	70	30	100
IBS204T	Communication skills (AEC)	2	2	2	35	15	50
IBS205T	Language I-2 (Kannada / Hindi)	2	2	3	70	30	100
IBS206T	Language I-2 (English)	2	2	3	70	30	100
Practical							
IBS207P	Systematics and diversity of Vascular Plant(core)	4	2	4	35	15	50
IBS208P	Systematics and diversity of Vertebrates(core)	4	2	4	35	15	50
IBS209P	Bio-organic chemistry(core)	4	2	4	35	15	50
	Co-curricular & Extra-curricular activities	-	Pass/Fail	-	-	50	50

SEMESTER – III

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS301T	Plant anatomy & physiology (core)	4	4	3	70	30	100
IBS302T	Animal anatomy & physiology (core)	4	4	3	70	30	100
IBS303T	Biological chemistry (core)	4	4	3	70	30	100
IBS304T	Environment & Public health (AEC)	2	2	2	35	15	50
IBS305T	Language I-3 (Kannada / Hindi)	2	2	3	70	30	100
IBS306T	Language I-3 (English)	2	2	3	70	30	100
Practical							
IBS307P	Plant anatomy & physiology (core)	4	2	3	35	15	50
IBS308P	Animal anatomy & physiology (core)	4	2	3	35	15	50
IBS309P	Biological chemistry (core)	4	2	3	35	15	50
	Co-curricular & Extra-curricular activities	-	Pass/Fail	-	-	50	50

SEMESTER – IV

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS401T	Cell biology (core)	4	4	3	70	30	100
IBS402T	Instrumentation & techniques (core)	4	4	3	70	30	100
IBS403T	Biophysics (core)	4	4	3	70	30	100
IBS404T	Constitution of India & Human rights (AEC)	2	2	2	35	15	50
IBS405T	Language I-4 (Kannada / Hindi)	2	2	3	70	30	100
IBS406T	Language I-4 (English)	2	2	3	70	30	100
Practical							
IBS407P	Cell biology (core)	4	2	3	35	15	50
IBS408P	Instrumentation & techniques (core)	4	2	3	35	15	50
IBS409P	Biophysics (core)	4	2	3	35	15	50
	Co-curricular & Extra-curricular activities	-	Pass/Fail	-	-	50	50

SEMESTER – V

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS501T	Molecular biology (DSE)	4	4	3	70	30	100
IBS502T	Evolutionary biology (DSE)	4	4	3	70	30	100
IBS503T	Developmental biology (DSE)	4	4	3	70	30	100
IBS504T	Biostatistics (SEC)	2	2	2	35	15	50
Practical							
IBS505P	Molecular biology (DSE)	4	2	3	35	15	50
IBS506P	Evolutionary biology (DSE)	4	2	3	35	15	50
IBS507P	Developmental biology (DSE)	4	2	3	35	15	50

SEMESTER – VI

Course code	Course Title	Total No. of hours	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS601T	Plant reproduction & breeding(DSE)	4	4	3	70	30	100
IBS602T	Animal reproduction & breeding (DSE)	4	4	3	70	30	100
IBS603T	Genetics (DSE)	4	4	3	70	30	100
IBS604T	Mathematical biology (SEC)	2	2	2	35	15	50
Practical							
IBS605P	Plant reproduction & breeding(DSE)	4	2	3	35	15	50
IBS606P	Animal reproduction & breeding(DSE)	4	2	3	35	15	50
IBS607P	Genetics(DSE)	4	2	3	35	15	50

SEMESTER – VII

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS701T	Pathology	4	4	3	70	30	100
IBS702T	Parasitology	4	4	3	70	30	100
IBS703T	Immunology	4	4	3	70	30	100
IBS704T	Microbiology	4	4	3	70	30	100
IBS705T	Teaching Methodology	2	2	2	35	15	50
Practical							
IBS7065P	Parasitology & Pathology	4×2	4	4	70	30	100
IBS707P	Microbiology & Immunology	4×2	4	4	70	30	100

SEMESTER – VIII

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS801T	Genomics & Proteomics	4	4	3	70	30	100
IBS802T	Animal Molecular Physiology	4	4	3	70	30	100
IBS803T	Plant Molecular Physiology	4	4	3	70	30	100
IBS804T	Bioinformatics & Computational biology	4	4	3	70	30	100
IBS805T	Research Methodology	2	2	2	35	15	50
Practical							
IBS806P	Genomics, Proteomics & Bioinformatics	4×2	4	4	70	30	100
IBS807P	Molecular Physiology of Plants & Animals	4×2	4	4	70	30	100

SEMESTER – IX

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS901T	Systems biology	4	4	3	70	30	100
IBS902T	Genetic Engineering	4	4	3	70	30	100
IBS903T	Biomedical Sciences	4	4	3	70	30	100
IBS904T	Plant & Animal biotechnology	4	4	3	70	30	100
IBS905T	Open Elective	4	4	3	70	30	100
Practical							
IBS7065P	Genetic Engineering & Biotechnology	4	2	4	35	15	50
IBS707P	Biomedical Sciences & Systems biology	4	2	4	35	15	50

SEMESTER – X

Course code	Course Title	Hrs / week	Total credits	Duration of examination (hrs)	Maximum marks	*Internal Assessment	Total marks
Theory							
IBS 1001T	Dissertation Project	-	24	-	450	150	600

***Internal Assessment :**

Theory (30 marks): Class test – 15 marks; Seminar Report – 05 marks; Seminar Presentation – 05 marks; Attendance – 05 marks

Practical (15 marks): Class test – 05 marks; Class Record – 05 marks; Attendance – 05 marks

Core: core course; SEC, skill enhancement course; AEC, ability enhancement course; DSE, Discipline specific elective

CC & EC (50 marks): Performance in CC: 25 marks; Performance in EC: 25 marks: this is a non-credit course judged by Pass / Fail.

SEMESTER I

Scheme of Instruction and Examination

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS101T	Systematics and diversity of non-vascular plants	4	-	52	3	70	30	100	4
IBS102T	Systematics and diversity of invertebrates	4	-	52	3	70	30	100	4
IBS103T	Biophysical chemistry	4	-	52	3	70	30	100	4
IBS104T	Computer Applications & IT	2	-	26	2	35	15	50	2
IBS105T	Language I-1 (Kannada/Hindi)	2	-	26	3	70	30	100	2
IBS106T	Language II -1 (English)	2	-	26	3	70	30	100	2
IBS107P	Systematics and diversity of non-vascular plants	-	4	52	4	35	15	50	2
IBS108P	Systematics and diversity of invertebrates	-	4	52	4	35	15	50	2
IB 109P	Biophysical chemistry	-	4	52	4	35	15	50	2

Total marks: 700, Total credits: 24

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

IBS101T SYSTEMATICS AND DIVERSITY OF NON-VASCULAR PLANTS

52 hours | 4 credits

Aims & Objectives

- To provide the students with an opportunity to develop basic knowledge in non-vascular plants.
- To understand the basic concepts of Nomenclature and Systematics of non-vascular plants

Unit 1

Viruses : General characters, replication in viruses, TMV (RNA Virus) and T4 Phage (DNA Virus) Lytic and Lysogenic cycle. Economic importance of Viruses – a brief account Virioids and Prions – General structure.

Unit 2

Bacteria: General characters, Morphology and Cell structure, Reproduction and Genetic recombination (Conjugation, transformation and transduction) in Bacteria. Economic importance of Bacteria - a brief account.

Cyanobacteria: General characters, Morphological and Structural diversity and Reproduction. Cyanophages – a brief account. Economic importance of Cyanobacteria.

Mycoplasma: General characters, Morphological and Structural diversity and Reproduction. Economic importance Mycoplasma – a brief account.

Unit 3

Fungi: General characters and Classification (Ainsworth, 1971) of Fungi. Morphological and Structural diversity and Reproduction in Myxomycotina (Stemonites), Mastigomycotina (Saprolegnia), Zygomycotina (Rhizopus), Ascomycotina (Penicillium and Aspergillus), Basidiomycotina (Agaricus and Puccinia) and Deuteromycotina (Cercospora)

Economic importance of Fungi – a brief account. Mycorrhiza – ectomycorrhiza and Endomycorrhizae and their significance.

Unit 4

Algae: General characters and Classification (Fritsch, 1950). Morphological and Structural diversity and Reproduction in Chlorophyceae (Volvox, Hydrodictyon, Spirogyra, Caulerpa and Coleochaete), Charophyceae (Chara), Bacillariophyceae (Diatoms), Xanthophyceae (Botrydium), Phaeophyceae (Ectocarpus and Sargassum), Rhodophyceae (Batrachospermum and Polysiphonia). Cultivation and Economic importance of Algae.

Bryophytes: General characters and Classification (Proskauer, 1957). Morphological and Structural diversity, Reproduction in Marchantiaceae (Marchantia), Porellaceae (Porella), Anthocerotaceae (Anthoceros), Sphagnaceae (Sphagnum) and Mosses (Funaria). Economic importance of Bryophytes.

Recommended readings:

1. Alexopoulos C.J. & Mims C.W. 1990. Introductory mycology, 5th edn Wiley Eastern Limited, New Delhi.
2. Fritsch, F.E. 1961. Structure and reproduction in algae, Vol. I, II. Cambridge University Press, London.
3. Bhatia, K.N. 1984. A treatise on Algae. S. Chand and Company, New Delhi.
4. Bold, H.C. and Wynne, M.J. 1978. Introduction to Algae: Structure and reproduction. Prentice Hall, Engle Wood Cliffs, New Jersey.
5. Chopra, R.N & Kumar, P.K. 1988. Biology of Bryophytes. New Age International Publisher, New Delhi.
6. Contract, F. H., Kimball, P.C. and Jay, L. 1998. Virology. Prentice Hall, Englewood Cliff, New Jersey.
7. Fritsch, F.E. 1961. Structure and Reproduction in Algae. Vol. I and II. Cambridge University Press. Cambridge, U.K.
8. Kumar, H.D. 1990. Introductory Phycology. Affiliated East West Pvt. Ltd. Bangalore.
9. Pandey, B.P. 1994. Fungi. S. Chand and Company Ltd, New Delhi.
10. Parihar N.S. 1970. An Introduction to Embryophyta, Vol. I Bryophyta. Central Book. Dept. Allahabad, India.

IBS102T SYSTEMATICS AND DIVERSITY OF INVERTEBRATES

52 hours | 4 credits

Aims & Objectives

- To understand the basis for classification and relationship among invertebrates.
- To know about biodiversity and conservation.
- To realize the evolutionary trends in invertebrates.

Unit 1

10 hours

Systematics of Animals : Meaning, Nomenclature, Principles of Classification, Classification of Animal Kingdom. Major branches of invertebrates and their relationships. Diversity and distribution of invertebrates in space and time.

Unit 2

13 hours

Classification, general characters and diversity of Phylum Protozoa, Porifera, Coelenterata, Ctenophora, Platyhelminthes and Aschelminthes. Life cycle of Plasmodium, Trypanosoma, Obelia, Fasciola hepatica, Taenia solium, Ascaris lumbricoides.

Unit 3

03 hours

General characteristics and classification of minor phyla

Unit 4

09 hours

General characteristics, classification and diversity of Phylum Annelida, Arthropoda, Mollusca and Echinodermata. Life cycle of leech, Cockroach, fresh water mussel and star fish.

Unit 5

08 hours

Social organization in Insects: Honeybee and termites. Coral and coral reefs. Larval forms in Invertebrates

Unit 6

09 hours

Economic importance of invertebrates and their products and byproducts. Culture and management practice of important invertebrates - Vermiculture, Apiculture, Sericulture, Lac cultivation, prawn culture and mariculture (pearl culture).

Recommended readings:

- 1) Bames, R.D. 1968. Invertebrate Zoology, 2nd Edn. Saunders, Philadelphia.
- 2) Barrington, E.J.W. 1967. Invertebrate structure and function, Nelson, London.
- 3) Hyman, L.H. 1940-67. The invertebrates, Vol. I-VI. McGraw-Hill, New York.
- 4) Marshall, A.J. and Williams W.D. (Eds). 1995. Text book of Zoology–Invertebrates Ed., Vol. I, A.I.T.B.S. Publications.
- 5) Richard Brusca & Gary J. Brusca 2003. Invertebrates, Sinaver Associates. Inc., Publishers.
- 6) A manual of Zoology part 1 non- chordates - Ekambaranatha Ayyar.

IBS103T BIO-PHYSICAL CHEMISTRY

52 hours | 4 credits

Aims and Objectives:

- To acquaint with chemical and physical forces involved in the formation of biomolecules and to have a basic knowledge of the physical properties of these biomolecules.

Unit 1

01 hour

Introduction to Measurement: SI units-standard units for measurement, Basic units, Prefixes, measurement-Length, mass, time and temperature. Derived units-volume. Significant figures-zero as significant figure.

Unit 2

05 hours

Atomic structure: Wave particle duality-the de Broglie equation. The Schrodinger wave equation. Quantum numbers. Atomic orbitals and their shapes. Hund's rule

Unit 3

07 hours

Periodic Classification and Chemical Bonding: Periodic Classification. Trends in the periodic table- atomic and ionic radii, ionization energy, electronegativity and electron affinity. Concept of oxidation number and its computation.

Chemical Bonding: Ionic bond-energetics - Valence bond theory. Hybridization - examples: methane, ammonia, water, ethane and ethylene. Sigma and pi bonds. Concept of resonance. Molecular orbital theory. Properties of covalent molecules- bond length, bond energy and bond angle. Hydrogen bond, inter-and intra-molecular types, importance in biomolecules. Hydrophobic forces.

Unit 4

05 hours

Radioactivity: Detection of radioactivity. Characteristics of radio elements. Disintegration constant. Half-life. Tracer techniques-production of labeled ^{14}C , ^{32}P and compounds and their applications in biological studies. Biological effects of radiation emitted by isotopes, safety measures.

Unit 5

08 hours

Solutions and Colligative Properties: Concentration units - molarity, molality, normality and mole fraction. Types of solutions - homogenous and heterogeneous. Factors influencing solubility, solubility curves, Henry Law - applications. Osmotic pressure and its measurement by the Berkley-Hartley method. Laws of osmotic pressure. Hypo, hyper and isotonic solutions. Effect of osmotic pressure on living cells. Donnan membrane equilibrium. Relative lowering of vapour pressure. Rault's law. Elevation of boiling point, depression in freezing point and their applications in the determination of molecular weight. Abnormal molecular weights. Vant Hoff factor. Degree of association and dissociation.

08 hours

Unit 6

Electrolytic Dissociation and Mass Law : Strong and weak electrolytes. Activity and activity coefficient. Relationship between activity coefficient and ionic strength. Common ion effect, solubility product and their applications. Conductance and its

measurement. Electrochemical cells-Oxidation-reduction reactions, Reversible electrodes and cells. Single electrode potential. Nernst equation. Standard electrodes and their applications.

Unit

7

10 hours

Acids, Bases and Buffers: Modern concepts of acids and bases. Ionisation of acids. Dissociation of water. Ionic product of water. Hydrogen ion concentration.-pH. Determination of pH. Dissociation of weak acids (pKa). Effects of salts on dissociation of acids. Interaction of acids with bases. Dipolar ions - isoelectric pH of amino acids and proteins. Buffers, buffer equation, buffer capacity. Problems on preparation of buffer solutions. Buffers of blood plasma, red blood cells and tissue fluids. Use of buffers. Determination of pH- colorimetric method, based on use of indicators, limitations. Use of buffer solutions and indicators.

Unit 8

08 hours

Biopolymers, Viscosity of liquids and Surface tension: Biopolymers-Classification. polymerization process. Number-average and weight-average molecular weights. Molecular weight determination by osmometry.

Viscosity of liquids: Determination of viscosity of liquids using Oswald's viscometer. Relation of viscosity and shape of molecules with examples.

Surface tension: Definition, determination of surface tension of liquids using Stalagmometer. Effect of surfactants.

Recommended readings:

- Casey, E.J. 1969. Biophysics, concept and mechanism, Affiliated East West press.
- Bose, S. 1982. Elementary Biophysics. Jyothi Books, New Delhi.
- Ackerman, E. 1967. Biophysical Science. Prentice Hall, N.Y.
- Narayanan, P. 2000. Essentials of Biophysics. New Age International Publication. New Delhi.
- Van Holde, 1998. Principals of physical biochemistry. Prentice Hall, N.Y.
- J.D. Lee, 2009. Concise Inorganic chemistry. 4th edition. Wiley India publication.

IBS104T COMPUTER APPLICATIONS AND INFORMATION TECHNOLOGY

26 hours | 2 credits

Aim and Scope:

- To acquaint the students about the basics of Computers, its evolution and applications in various sectors.

Unit 1: History and Generations of Computers 04 hours

Evolution, Generations of computers (I, II, III,IV, V) Classification of computers (mainframes, mini computers, microcomputers, special purpose) Comparison with respect to memory, power, cost and size, Real-Time, Online, Offline ,Overview and functions of a computer systems, Input and output devices, Storage devices: Hard disk, Diskette, Magnetic tape, RAID, ZIP, devices, Digital tape, CD-ROM, DVD (capacity and access time), Main Circuit Board of a PC: Chips, Ports, Expansion.

Unit 2: Categories of Computers and Operating Systems. 05 hours

The workstation, The Minicomputer, Mainframe Computers, Parallel processing Computer & The Super Computer, Operating System concepts, Windows 98/XP and later versions, Windows server NT/2000, Unix/Linux & servers. Introduction to networking: various terminologies, Associated hardware devices, gadgets (Router, Switch) tools, services, and resources, Network Topologies and Protocols, LAN, WAN and MAN World Wide Web (WWW) Network security: fire walls.

Unit 3: Data processing & presentation 04 hours

Introduction, Office Automation Software (Open Source Software)

Unit 4: Computer viruses and Internet Searches. 05 hours

An overview of Computer viruses, What is a virus ? Virus symptoms, How do they get transmitted ? What are the dangers ? General Precautions, Search engines: Google, Yahoo, Concepts in text-based searching , searching Medline, PubMed, bibliographic databases

Unit 5: Algorithms, Flowcharts & Programming concepts: 05 hours

Algorithms: Concepts & Definitions, Converting algorithms to flowchart; coding: flowcharts to programs, Comparing algorithms, flowcharts & programs; Introduction & Overview of Biological databases.

Unit 6: Bio-informatics 03 hours

Introduction to Bio-informatics: Definition, Introduction to data mining, Computational gene finding – multiple alignment and sequence search (BLAST, FASTA, CLUSTALW). Applications of Bioinformatics.

Recommended readings:

- Computer Fundamentals , 4th edition (2004) P.K. Sinha, BPB publication, India
- Computer Networks. 4th edition (2008). Tanenbaum. Pearson Education, India
- Biostatistics:P.N.Arora ,P.K.Malha.
- Introduction To Database Management Systems, 1st edition, (2004), Atul Kahate, Pearson education, India.

IBS105T LANGUAGE | -1 (KANNADA)

26 hours | 2 credits

ಕಾವ್ಯ

೧. ಕುಲಂ ಕುಲಮಲ್ಪು ಚಲಂ ಕುಲಂ
೨. ಅಮುಗೆಯ ಕಾಯಮ್ಮನ ವಚನಗಳು
೩. ಸಾಕು ಈ ಬಲಾತ್ಕಾರ

ಪ್ರಬಂಧ

೧. ಮೊಡ್ಡದ ವಿರುದ್ಧ ಸಿಡಿದಿದ್ದೆ ಡಾ. ಕೋವೂರ್
೨. ಏನೆಂದು ಸಂಭ್ರಮಿಸೋಣ_.....
೩. ಮಾನವೀಯತೆ ಅಂತಾರಲ್ಲ ಅದರ ಬಗ್ಗೆ ವಿವೇಚನೆ

ಕಥನ

೧. ಮಾಮರವೂ ಮಾಪಿಳ್ಳೆಯೂ
೨. ಗಾಂಧಿ
೩. ಡೇರ್ ಡೆವಿಲ್ ಮುಸ್ತಾಫಾ

ನಾಟಕ

ಅಪ್ಪ

IBS105T LANGUAGE I -1 (HINDI)

26 hours | 2 credits

1. Collection of prose: "Gadya Deepika: Edited by Dr.M.Vimala

Prof.D.H Fathimabi

2. Vyakaran: Vikari Shabd- Sanjna , Sarvanam, Visheshan, Kriya, and Sandhi

3. Translation of Scientific Terminology.

IBS106T LANGUAGE II -1 (ENGLISH)

26 hours | 2 credits

General English Course Book

1. Fabre : Homer of Insects – By Donald Culross Peattie
2. Deep Ecology : A new Paradigm- by Fritjof Capra
3. Daffodils No More: by Gordon JL Ramel
4. Loser of Everthing – by David Diop
5. The Thakur's Well- by Premchand
6. The Rat- by Mumtaz Mufti
7. Honouring the Sahab- by Harishankar Parasai
8. Mistaken Modernity- by Dipankar Gupta

General English Work Book

1. Remedial Grammar
 - a. Articles
 - b. Prepositions
 - c. Concord
 - d. Tenses
 - f. Punctuation
2. Reading Comprehension
 - a. Introduction
 - b. Description
 - c. Narration
 - d. Example
3. Listening and Speaking Skills
 - a. Introducing oneself/ others
 - b. Asking for / Giving Instructions
 - c. Asking for/ Giving Directions
4. Writing Skills
 - a. Paragraph Writing

i. Descriptive Paragraph

ii. Narrative Paragraph

b. Note Taking / Making

IBS 107P SYSTEMATICS AND DIVERSITY OF NON - VASCULAR PLANTS

52 hours| 2 credits

1. Measurement of microscopic structures.
2. Bacterial staining.
3. Study of morphology and Micro-preparation of the following; Phytophthora, Albugo, Rhizopus, Aspergillus, Penicillium, Puccinia, Tikka.
4. Study of morphology and Micro-preparation of the following;
Cyanophyceae: Oscillatoria, Nostoc, Scytonema.
Chlorophyceae: Hydrodictyon, Spirogyra, Caulerpa, Coleochaete.
Charophyceae : Chara.
Xanthophyceae: Botrydium.
Phaeophyceae: Ectocarpus and Sargassum.
Rhodophyceae : Batrachospermum and Polysiphonia.
5. Study of Morphology, Anatomy of Vegetative and Reproductive structures of Marchantia, Porella, Anthoceros, Sphagnum, Funaria.
6. Field visits to study and to collect non-vascular plants.

IBS108P SYSTEMATICS AND DIVERSITY OF INVERTEBRATES

52 hours| 2 credits

1. Identification and Classification of Representatives of Phylum Protozoa – Paramecium, Vorticella, Plasmodium, Euglena, Trypanosoma, Noctiluca, Entamoeba (Amoeba). Porifera - Leucosolenia, Gemmule, Euspongia (Bath sponge), Euplectella (Venus flower basket), Hyalonema (glass rope sponge). Coelenterata – Obelia, Aurelia, Sea anemone Physalia, Velella, Porpita, Corals – Fungia, Astrea, Gorgonia, Meandrina (Brain coral), Tubifera (Slag horn coral), Penantula (Sea pen). Platyhelminthes - Liver fluke, tape worm, planaria. Aschelminthes - Ascaris, Ancylostoma (Hook worm), Schistosoma (Blood worm) Filarial worm.

Identification and Classification of major representatives of Annelida - Earth worm, Nereis, Aphrodite, leech, sabella, Tubifex, Arenicola. Arthropoda - Lepas, Balanus, Centipede, Millipede, Scorpion, Peripatus, Limulus, Prawn, Crab, Lobster, Grass hopper, mouth parts of insects : butterfly, mosquito, honeybee, housefly and cockroach. Mollusca - Sepia, Octopus, chiton, Patella, Dentalium, fresh water mussel, pila globosa (snail), Nautilus, Murex, Xanchus, Cypraea. Echinodermata - Sea urchin, Starfish, Sea cucumber, Brittle star, sea lilly.

2. Demonstration of Dissections –
 - a. Reproductive, Digestive and Nervous system of male and female Cockroach, Silkmoth.
 - b. Earth worm – Nervous system (nerve ring) and setae mounting.
3. Field visits to Museums, Butterfly park and natural habitats of invertebrates

IBS109P BIOPHYSICAL CHEMISTRY

52 hours| 2 credits

1. Preparation of Acetate and Phosphate Buffer and checking pH using pH meter-Calculation of pKa.
2. Preparation of standard potassium biphthalate and estimation of alkali (Eg NaOH).
3. Preparation of standard sodium oxalate and estimation of potassium permanganate.
4. Estimation of sulphate as Barium sulphate by Gravimetric method.
5. Estimation of Hardness of water using EDTA
6. Determination of Density of a liquid.
7. Determination of Viscosity of a liquid.
8. Determination of Surface tension of a liquid.
9. Determination of molecular weight by Walker-Lumsden method.

SEMESTER II

Scheme of Instruction and Examination

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS201T	Systematics and diversity of Vascular plants	4	-	52	3	70	30	100	4
IBS202T	Systematics and diversity of Vertebrates	4	-	52	3	70	30	100	4
IBS203T	Bio-organic chemistry	4	-	52	3	70	30	100	4
IBS204T	Communication skills	2	-	26	2	35	15	50	2
IBS205T	Language I-2 (Kannada/Hindi)	2	-	26	3	70	30	100	2
IBS206T	Language II -2 (English)	2	-	26	3	70	30	100	2
IBS207P	Systematics and diversity of Vascular plants	-	4	52	4	35	15	50	2
IBS208P	Systematics and diversity of Vertebrates	-	4	52	4	35	15	50	2
IBS209P	Bio-organic chemistry	-	4	52	4	35	15	50	2

Total marks: 700, Total credits: 24

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

SEMESTER – II

IBS201T SYSTEMATICS AND DIVERSITY OF VASCULAR PLANTS

52 hours | 4 credits

Aims and objectives:

- To provide the students with an opportunity to develop basic knowledge in vascular plants.
- To understand the basic concept of nomenclature and Systematics of vascular plants

Unit 1

10 hours

Pteridophytes: General characters and classification (Reimers 1954). Morphology, anatomy and reproduction in Psilotaceae (*Psilotum*), Lycopodiaceae (*Lycopodium*), Selaginellaceae (*Selaginella*), Equisetaceae (*Equisetum*), Ophioglossaceae (*Ophioglossum*), Marattiaceae (*Angiopteris*), Osmundaceae (*Osmunda*), Polypodiaceae (*Pteris*), Marseliaceae (*Marselia*).

A brief account on stelar evolution, heterospory and seed habit.

Fossil Pteridophytes -Fossilization, Types of fossils Psilophytales (Rhynia), Lepidodendrales (Lepidodendron and Lepidocarpon), Calamitales (Calamites).

Unit 2

10 hours

Gymnosperms: General characters and classification (Pilger and Melchior (1954) Morphology, Anatomy and Reproduction in Cycadaceae (*Zamia and Encephalartos*), Pinaceae (*Pinus*), Podocarpaceae (*Podocarpus*), Ginkgoaceae (*Ginkgo*), Taxaceae (*Taxus*) and Gnetaceae (*Gnetum, and Ephedra*). A brief account of economic importance, origin and evolution of Gymnosperms

Unit 3

06 hours

Fossil Gymnosperms: A general account on morphology, anatomy and reproductive structures of Pteridospermales (Lyginopteridaceae), Bennetitales (Cycadeiodaceae), Caytoniales (Caytoniaceae), Pentoxylales (Pentoxylaceae), Glassopteridales (Glossopteridaceae) and Cordaitales (Cordaitaceae).

Unit 4

06 hours

4.1 Systematics of Angiosperms: Introduction and a brief account of the history of taxonomy.

4.2 Importance and relevance of character evidence: Phytochemistry, Palynology, Cytology, Molecular taxonomy, Numerical taxonomy. Origin of Angiosperms.

Unit 5**04 hours****Botanical Nomenclature** : Principles of Nomenclature, a brief account of ICBN and ICNCP.**Unit 6****04 hours****6.1 Botanical literature** : Floras, Revisions, Monographs, and Role of computer in taxonomy.**6.2 Herbarium** – Preparation, maintenance and Importance of herbaria; Important herbaria of the world.**6.3 Botanical garden** – a brief account and importance of botanical garden; Important botanical gardens of the world**Unit 7****04 hours****Classification:** Classifications of Bentham and Hooker, Engler and Prantl, Cronquist and APG III system.**Unit 8****08 hours****Salient features and economic importance of the following families:****Dicots:** Magnoliaceae, Nymphaeaceae, Caryophyllaceae, Malvaceae, Euphorbiaceae, Rubiaceae, Scrophulariaceae, Asclepiadaceae, Asteraceae.**Monocots:** Alismataceae, Arecaceae, Poaceae, Cyperaceae, Zingiberaceae, Liliaceae and Orchidaceae.

Recommended readings:**Pteridophytes and Gymnosperm :-**

1. Bower F.O. 1884. On the comparative morphology of the vascular cryptogams and gymnosperm. Phil. Trans. Roy. Society. London.
2. Eames A.J. 1936. Morphology of vascular plants (lower groups). Mc. Graw Hill Publications, New York
3. Parihar. N.S. 1977. The morphology of Pteridophytes, Central book Dept, Allahabad, India.
4. Andrew. H.N. 1961. Studies in Paleobotany. John Wiley, New York.
5. Bhatnagar and Moitra. A. 1996. Gymnosperms. Poplei. New Age International Ltd. New Delhi. fossilization, fossilization,
6. Chamberlain. C.J. 1986. Gymnosperms, structure and evolution. CBS Publications, New Delhi.
7. Chopra. G.L and Verma. V. 1988. Gymnosperm. Pradeep Publications, Jalandar, India

Angiosperms :-

1. Cronquist. A. 1981. An integrated system of classification of flowering plants. Columbia University Press, New York.

2. Davis. P.H. and Heywood. V.H. 1973. Principles of Angiosperm taxonomy, Robert and E. Kriegen Publications, New York.
3. Heywood. V.H and Moore. D.M. 1984. Current concept in plant taxonomy, Academic Press, London.
4. Sambamurthy. A.V.S.S. 2005. Taxonomy of Angiosperm. IK International Publishers, New Delhi.
5. Lawrence. G.H.M. 1951. Taxonomy of vascular plants, Mac Milan, New York.

IBS202T SYSTEMATICS AND DIVERSITY OF VERTEBRATES

52 hours | 4 credits

Aims and objectives:

- To understand the basis for classification and relationship among vertebrates.
- To know about various adaptations and behavior patterns.
- To realize the evolutionary trends in vertebrates.

Unit 1: Origin, systematic position and characteristics of Vertebrates. **04 hours**

Unit 2: Diversity, Salient features and Classification of classes Pisces, Amphibia, Reptilia, Aves and Mammals (up to orders). **09 hours**

External characters of fish (shark), frog and rabbit-Digestive, Respiratory, Circulatory, Excretory, Nervous and Reproductive systems. **09 hours**

Unit 3: Economic importance of vertebrates and their products & by-products. **04 hours**

Unit 4: Adaptations – Aquatic, Terrestrial, Aerial (Volant) **06 hours**

Unit 5: Migration in fishes & birds. Parental care in fishes & amphibians. Nesting in birds. Adaptive radiations in Reptiles & mammals. **11 hours**

Unit 6: Animal Behaviour - Ethogram, Learning, Instincts, Motivation, Cooperation and conflicts, Social organization in Primates. **09 hours**

Recommended readings:

- 1) Parker, J & W. Haswell, 1995. Textbook of Zoology – Vertebrates. The Macmillan Press Ltd., U.K.
- 2) Stephen A. Miller & John P. Harley 2001, Zoology. The Animal Kingdom. Wm. C Publishers.
- 3) Berme, R.N. and Levy MN Principles of Physiology, Mosby Year Book. Inc.1996.
- 4) Eckert and Randall. Animal Physiology – Mechanisms and adaptations. CBS Publishers, 2000.
- 5) Schmidt-Nielsen. Animal Physiology. Cambridge Univ. Press, 2000.
- 6) D. Jenson. The Principles of Physiology. Appleton-Century-Crofts, 1996.
- 7) Prosser CL. Comparative Animal Physiology. WB Saunders and Company, 1973.
- 8) Ekabaranatha Ayyar - A manual of Zoology. Part -2 Books on animal behavior.
- 9) Marles P & Hamilton W.J. Mechanisms of Animal Behavior, John Wiley & Sons, M.C. N.Y, Land, Tokyo.

IBS203T BIO-ORGANIC CHEMISTRY

52 hours | 4 credits

Aims and objectives:

- To understand the basics of organic chemistry in the context of Biology.
- To understand the rules and regulation in basic chemistry.
- Familiarize the students with organic preparations and the diversity of organic molecules which are relevant to biology.

Unit 1: Introduction and nomenclature of organic compounds: IUPAC nomenclature of organic compounds including bifunctional ones. Detection and principles of estimation of C, H, N, halogens, S and P in organic compounds. Inductive effect, resonance and hyperconjugation concepts. Reactive intermediates - carbocations, carbanions, carbenes and free radicals.

03 hours

Unit 2: Hydrocarbons: Mechanism of addition of HCl to propene. Markovnikov's rule. Peroxide effect. Alkenes - ozonolysis and oxidation. Alkynes-formation of acetylides and their importance. Dienes: Types with examples. Conjugate dienes. 1, 3-Butadiene - Stability, Mechanism of addition of HBr. Conformational analysis of ethane and n-butane.

03 hours

Unit 3: Carbohydrates: Biological importance and classification. Monosaccharides; D and L designation. Glucose- structural elucidation and conformation. Ring structure of fructose, galactose, mannose and ribose. Straight chain structure of sedoheptulose. Epimers and anomers; ascending and descending of monosaccharide series. Derived monosaccharides; structure and biological importance of amino sugars, sugar phosphates, sugar-acids and deoxy sugars. Disaccharides; glycosidic linkage. Structure and biological importance of sucrose, maltose, lactose, isomaltose, cellobiose and trehalose, Storage Polysaccharides-starch and glycogen. Structural-cellulose and chitin, Pectins, glycosaminoglycans, cell wall components- peptidoglycan and teichoic acid.

07 hours

Unit 4: Cycloalkanes and Arenes: *Cycloalkanes* : Reactivities and relative stabilities. Baeyer strain theory. Sachse-Mohr theory. Boat and chair forms of cycloalkane. Axial and equatorial bonds.

Arenes: Modern concept of the structure of benzene. Aromaticity. $4n+2$ rule. Mechanism of electrophilic substitution in benzene. Nitration and Friedel-crafts's alkylation. Electronic interpretation of the orienting influence of substituents in the electrophilic substitution of toluene, chlorobenzene and nitrobenzene. Structures of Naphthalene, anthracene, phenanthrene and diphenyl. Oxidation reactions of naphthalene.

06 hours

Unit 5: Alkyl halides and Organometallic compounds: SN¹ and SN² mechanisms taking primary, secondary and tertiary alkyl halides as examples. Mechanistic concepts of elimination reactions t-butyl chloride and n-butyl chloride. Organometallic compounds - examples. Preparation and synthetic applications of Grignard reagents.

03 hours

Unit 6: Stereochemistry: Stereoisomerism: Types. Stereochemical terminology. Optical isomerism: Molecular dissymmetry. Chirality: glyceraldehyde, lactic acid and tartaric acid. Nomenclature of enantiomers - The RS system and DL. Rotation, racemisation and resolution. Fischer projection formulae. Geometrical isomerism: Cis trans isomerism in alkenes and ring compounds. Structure and properties of maleic and fumaric acids. (E) - (Z) system of specifying geometrical isomers. Significance of chirality in the biological world.

04 hours

Unit 7: Carboxylic Acids and amines: Carboxylic Acids-Meaning and usefulness of pK_a values. Acidity of monocarboxylic acids. Effect of substituents on acid strength. Hydroxy acids: Preparation and properties of lactic acid. Structures of tartaric, malic, citric and isocitric acids. Dicarboxylic acids: Saturated dicarboxylic acids - effect of heat on the first five members. Keto acids : Structures of pyruvic, α-ketoglutaric acid and oxaloacetic acids. Properties of pyruvic acid. *Amines*: Classification. Isomerism. Distinguishing reactions of 1^o, 2^o & 3^o amines. pK_b values of amines. Effect of substituents on the basic strength of amines. Some biologically important amines.

05 hours

Unit 8: Heterocyclic Compounds: Structural formula and occurrence of furan, pyran, thiophene, thiazole, pyrrole, imidazole, pyridine, pyrimidine, purine, isoalloxazine and indole. Reactions of imidazole and pyridine. Aromaticity of furan, thiophene, pyrrole and pyridine.

Terpenes - Isoprene rule. Classification with examples, biological importance and occurrence of the following: limonene, menthol, santonin, juvenile hormone I, abscisic acid, phytyl, gibberic acid, lanosterol, lycopene. Polyphenols - dolichols. Steroids; basic ring system. Structures of cholesterol, steroid hormones (testosterone and estradiol) Structures and importance of β-carotene, chlorophyll a, ubiquinone and plastoquinone.

Alkaloids - Introduction and general characteristics. General method of extraction. Structure and medicinal uses of nicotine, atropine and LSD. Phytochemicals-Introduction and uses.

09 hours

Unit 9: Bioinorganic Chemistry : Metal ions in biological systems. Roles of Iron in myoglobin, hemoglobin and cytochrome C, Copper in haemocyanin, Magnesium in chlorophyll, Cobalt in vitamin B12 and Molybdenum in nitrogenase. Metallo-enzymes.

04 hours

Unit 10: Antibiotics : Definition: Types. Sources, structures and antimicrobial spectrum of action of penicillin, chloramphenicol, streptomycin and tetracyclines.

Pesticides : Structures and uses of the following insecticides: DDT, gammexane lindane allethrin and malathion.
Herbicides ; 2, 4-D and 2, 4, 5-T.

Green chemistry: Atom economy, concept with examples. Wash – production and prevention. Water as a solvent, microwave irradiation and organic synthesis- concept and advantages. Ecofriendly pesticides – pyrethroids. Biocatalysis –advantages.

08 hours

Recommended readings:

- 1) Lancaster, M. 2002. Green Chemistry: an Introduction. Royal Society of Chemistry, London.
- 2) Sangi, S and Srivastav, M.M. 2003. Environment friendly alteration. Narosa Publishing House.
- 3) L. Indira and G.R Chatwal. 2004. College chemistry -1. Himalaya publishing house.
- 4) K. Peter. C. Vollhardt, Neil. E. Schore. 2002. Organic chemistry structure and function. 4th edition.
- 5) Clayden, Geeves, Warren and Wothers. Organic chemistry. Oxford publication.
- 6) Francis. A Carey. Richard. J Sundberg, Advanced organic chemistry. 4th edition.

IBS204T COMMUNICATION SKILLS

26 hours | 2 credits

Aims & objectives

- To enhance the learners communication skills by giving adequate exposure in reading, writing, listening and speaking skills and the related sub-skills
- To build up the learners confidence in oral and interpersonal communication by reinforcing the basics of pronunciation

Unit 1: Basic Language Skills: Grammar and Usage: Writing creative paragraphs, filling in the blanks, correct errors, choose correct forms out of alternative choices, join clauses, rewrite sentences, and usage of single words / opposites / synonyms. **03 hours**

Unit 2: Comprehension of passage and Phonology: Understanding passage in question; general language skills and issues with reference to words and usage within the passage; use of short independent composition based on themes and issues raised in the passage. Writing passages (Literary/ Scientific/ Technical writing/ Journalism/ Management/ Commerce), training in sounds and correct pronunciation. **04 hours**

Unit 3: Official and Social Correspondence: Official Correspondence - a. Enquiries, Complaints and Replies; Representations; b. Letters of application for jobs; c. Letters to the editor and Social appeals in the form of Social Correspondence – letters, pamphlets, brochures, news reports; Seven C's of communication. **5 hours**

Unit 4: i) Types of Logical Structures based on Analysis, Argumentation, Classification.

Comparison and Contrast and Cause and Effect relationship

Exemplification, Definition,

Statement- elaboration: Expanding points into paragraphs.

Listing, Chronological patterning, Process

Repetition, General- Specific, Specific-general

ii) Principles of Editing

Punctuation, Substitution of words, Restructuring of sentences, Re-organizing sentence, sequence in a paragraph, Use of link words and Principles of Coherence and Cohesion. **6 hours**

Unit 5: Summary Writing and Interpretation of Technical Data: Organization of material — points and sub-points, the logical connection between these points; notions of the “main idea”, “thesis statement” and the “supporting ideas”; shortening the material; Reading and interpretation of maps, charts, graphs

06 hours

Unit 6: Report Writing: Writing and composition of Committee reports, newspaper reports and activity reports.

02 hours

Recommended readings:

1. Anderson, Kenneth. Joan Maclean and Tony Lynch. Study Speaking: A Course in Spoken English for Academic Purposes. Cambridge: CUP, 2004.
2. Bellare, Nirmala. Reading Strategies. Vols. 1 and 2. New Delhi. Oxford University Press, 1998.
3. Bhasker, W. W. S & Prabhu, N. S.: English through Reading, Vols. 1 and 2. Macmillan, 1975.
4. Blass, Laurie, Kathy Block and Hannah Friesan. Creating Meaning. Oxford: OUP, 2007.
5. Brown, Ralph: Making Business Writing Happen: A Simple and Effective Guide to Writing Well. Sydney: Allen and Unwin, 2004.
6. Buscemi, Santi and Charlotte Smith, 75 Readings Plus. Second Edition New York: McGraw-Hill, 1994.

IBS205T LANGUAGE | -2 (KANNADA)

26 hours | 2 credits

ಕಾವ್ಯ

೧. ಚಂದ್ರಮತಿಯ ವಿಲಾಪ
೨. ಆ ಮುಖ ಈ ಮುಖ
೩. ನಾವೆಲ್ಲರೂ ಒಂದೆ ಜಾತಿ

ಪ್ರಬಂಧ

೧. ಸ್ತ್ರೀಯರೂ ಪುರುಷರೂ
೨. ಹೊಲಸು ತಿಂಬುವವನೇ ಹೊಲೆಯ
೩. ಮೋಕ್ಷ ಹುಡುಕುತ್ತಾ ಪ್ರೀತಿಯ ಬಂಧನದಲ್ಲೆ

ಕಥನ

೧. ಅವಶೇಷ
೨. ಹಸಿವು
೩. ಸರಳ ಮದುವೆಗಾಗಿ

ನಾಟಕ

೧. ದೂರೆ ಈಡಿಪಸ್

IBS205T LANGUAGE I -2 (HINDI)

26 hours | 2 credits

1. Collection of Poems: Kavya Pankaj

Edited by Dr.B.GAnesh, Prof.Siddaramesh.T.C

(Printed and published by prasaranga, Bangalore University, Bangalore)

2. Vyakaran: Avikari shabd- Kriya Visheshan, Sambandh Suchak, Samuchaya Bodhak, Vismayadi
Bodhak and Samas

3. Translation : Terminology

IBS206T LANGUAGE II -2 (ENGLISH)

26 hours | 2 credits

General English Course Book

1. The Terrorist, He Watches- by Wislawa Szymborska
2. Sea Breeze, Bombay – by Adil Jussawalla
3. Our Town – by Sa Kandasamy
4. On ahima- by M.K. Gandhi
5. Starting from Mile Zero- by Preety Sengupta
6. Beast tales from Burma- by Theophilus
7. Young Pele- by Clare and Frank Gault
8. Audition- by Mahim Bora
9. The Pleasures of Drawing – by Orham Pamuk

General English Workbook

Remedial Grammar

- a. Direct and Indirect (Reported) Speech
- b. Passive and Active Voice
- c. Linking Devices
- d. Question forms

Listening and Speaking Skills

- a. Making Enquiries
- b. Taking and Leaving Messages

Reading comprehension

- a. Classification
- b. Process Analysis
- c. Comparison and Contrast

Writing Skills

- a. Paragraph Writing
 - i. Reflective Paragraph
 - ii. Persuasive Paragraph
- b. Writing a Summary

IBS 207P SYSTEMATICS AND DIVERSITY OF VASCULAR PLANTS

52 hours | 2 credits

1. **Pteridophytes:** Study of morphology, anatomy of vegetative and reproductive structures of Psilotum, Selaginella, Lycopodium, Equisetum, Ophioglossum, Osmunda, Pteris, Marsilia.
Fossil pteridophytes subjected to the availability of materials / slides.
2. **Gymnosperms:** Study of morphology, anatomy of vegetative and reproductive structures of Zamia, Pinus, Podocarpus, Ephedra, Gnetum.
Fossil Gymnosperms subjected to the availability of materials/slides.
3. **Angiosperms:** Herbarium preparation, Description of a taxon using technical terms.
4. Derivation of a taxon to respective family using Floras.
5. Study of local flora and field visits to various Botanical gardens to study the vegetation.

IBS208P SYSTEMATICS AND DIVERSITY OF VERTEBRATES

52 hours | 2 credits

1. Identification and classification of vertebrates – Shark, Eel, Tetradon, Macropodus, Ophiocephalus, Narcine, Protopterus, Stegostoma, Salamander, Ichthyophis, Calotes, Mabuya, Phrynosoma, Draco, Varanus, Chamaeleon, Naja naja, Viper, Sphoenodon, Ostrich, Archaeopteryx, Owl, Vamphyrus, Loris, Pangolin, Porcupine.
2. Demonstration of Dissection: Rat nervous, Arterial and venous system, Reproductive system of male and female.
3. Life cycle of Frog.
4. Identification of skulls of chordates.
5. Dentition of chordates
6. Visit to Biological National Parks, Zoo, Sanctuaries

IBS209P BIOORGANIC CHEMISTRY

52 hours | 2 credits

1. Systematic qualitative analysis of - alcohol, phenol, carboxylic acid, aldehyde, ketone, ester, amine, amide, nitrocompound and halogen compounds
2. Systematic qualitative analysis of monosaccharides-glucose, fructose, pentose, disaccharides and starch.
3. Preparation of acetyl salicylic acid from salicylic acid.

SEMESTER III**Scheme of Instruction and Examination**

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS301T	Plant anatomy & physiology	4	-	52	3	70	30	100	4
IBS302T	Animal anatomy & physiology	4	-	52	3	70	30	100	4
IBS303T	Biological chemistry	4	-	52	3	70	30	100	4
IBS304T	Environment & Public health	2	-	26	2	35	15	50	2
IBS305T	Language I-3 (Kannada/Hindi)	2	-	26	4	70	30	100	2
IBS306T	Language II -3 (English)	2	-	26	4	70	30	100	2
IBS307P	Plant anatomy & physiology	-	4	52	4	35	15	50	2
IBS308P	Animal anatomy & physiology	-	4	52	4	35	15	50	2
IBS309P	Biological chemistry	-	4	52	4	35	15	50	2

Total marks: 700, Total credits: 24

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

SEMESTER – III
IBS301T PLANT ANATOMY AND PHYSIOLOGY
52 hours | 4 credits

Aims & objectives:

- To understand the general account of plant anatomy.
- To understand the physiological process in plants
- To understand the process of mineral metabolism

Unit 1

13 hours

1.1 Plant anatomy:

Organization of primary plant body, apical meristems and primary growth, Primary xylem - composition, Primary phloem - composition, the role of auxins in the development of the primary vascular system.

1.2 Cell wall

Structure and development of the cell wall (light microscopic and ultramicroscopic structure), composition of the cell wall, Cell wall development, role of cytoskeleton in wall development and genetic control of wall development.

1.3 Meristems

Definition, classification of meristem, Apical meristems of Shoot and Root apex, relevant theories pertaining to structure and organization of root apex and shoot apex: Shoot Apex: Apical Cell Theory, Tunica Corpus Theory, Zonation Theory.

Root Apex: Histogenic boundaries; Quiescent center

Formation of leaf primordia, Transitional tissue regions, The primary peripheral thickening meristem of Monocotyledons,

Unit 2

08 hours

2.1 Development of the secondary vascular system of the stem and root. Role of the vascular cambium, the effect of secondary growth on the primary body on leaf and branch traces.

Secondary Xylem: Structure and development of secondary xylem, Secondary xylem of gymnosperms and dicotyledons. Patterns of distribution of xylary elements and rays, Tyloses, Genetic control of differentiation of secondary xylem. Evolution in secondary xylem of dicotyledons.

2.2 Secondary phloem: Gross and Ultra structure, development of the phloem. Nature and development of the cell wall of sieve elements. Nature of protoplast of sieve elements, Nature and function of P-protein, Distinctive features of phloem of gymnosperms, The nature and function of companion cells and Strasburger cells

Unit 3

05 hours

3.1 Nodal anatomy: A general account

3.2 Anamalous secondary growth: *Aristolochia*, *Boerhaavia*, *Dracaena*

3.4.Periderm: Structure and development, formation of rhytidome, Lenticels

3.5 Secretary tissues in plants : Internal secretory structures and External secretory structures.

3.6 Ecological adaptations: Xerophytes, Mesophytes, Hydrophytes, Epiphytes, Parasites and Mangroves.

Unit 4

06 hours

Water relation of a plant cell: Water potential, osmotic potential, pressure potential, membrane and their permeability mechanism of water absorption, SPAC concept.

Ascent of sap: Vital and physical forces.

Mineral nutrition: Importance of nutrients, major and minor elements, their deficiency disorders and treatments. Passive and active transport of solutes across the membranes, ion transport in roots, mechanism of translocation, sources and sink concept.

Unit 5

05 hours

Photosynthesis: General concepts and historical backgrounds, photosynthetic apparatus, mechanism of absorption of light, Absorption spectrum, Emersson's enhancement effect, two pigment system-PS-I and PS-II. Non cyclic and cyclic electron transport system. Photophosphorylation, carbon assimilation-the Calvin cycle, C₄ cycle and the CAM pathway. Photorespiration and its significance.

Unit 6

04 hours

Respiration:Types of respiration, mechanism of respiration, Glycolysis, Kreb's Cycle, Electron transport system. Oxidative phosphorylation, Energetics of biological oxidation, respiratory inhibitors.

Unit 7

06hours

Growth and metabolism of growth hormones: Definition, Kinetics, growth hormones, biosynthesis, transport and physiological effects of Auxins, Cytokinins, Gibberellins, Abscissic acid and ethylene, mechanism of hormone action.

Unit 8

05 hours

Nitrogen metabolism: Introduction, nitrogen fixation, biochemistry of nitrogen fixation role of *nif* genes and Leghaemoglobin.

Recommended readings:

Plant Anatomy:

1. Katherine Easn, 1996. Anatomy of seed plants, First Wiley prints, New Delhi.
2. Cutter, D.G. 1971. Plant anatomy- Part-1. Cell and Tissues. Edward Arnold, London.
3. Cutter, D.G. 1971. Plant Anatomy, Part II, Cell and tissues, Edward Arnold, London.
4. Chand, S. 2005. Plant Anatomy, S, Chand and Company Ltd., New Delhi.
5. Metcalf C.R and L. Chalk, 1950, Anatomy of Dicotyledons. Leaves, Stems and wood in relation to taxonomy with Notes on Economic users II Vols. Clerodendron press, Oxford.
6. Pandey, Plant Anatomy, Chand and Company Ltd, New Delhi.
7. Cutler Botha and Stevenson (2007) Plant anatomy an applied approach. Black well publishing, UK.
8. Fahn A.1990, Plant anatomy, 4th edition, Pergamon press, Oxford.

Physiology:

9. Conn, E.E., Stumpf, Bruenning, G. and Doi, R.H. 1987. Outlines of Biochemistry, John Wiley and Sons, New York.
10. Wilkins, M.B. (eds). 1989. Advanced physiology, Pitman publishing Ltd, London.
11. Salisbury and Ross, 2005. Plant physiology, CBS publication, New Delhi.
12. Zeigler, 2006. Plant physiology, Sinaere publisher.
13. Trivedi and Verma, 2007. A text book of physiology, biochemistry and biotechnology, S. Chand and Co., New Delhi.
14. Tiaz & Zeiger, 2010. Plant Physiology, 5th edition, Dincoln Taiz & Eduardo Zugier, Parima Publishing, New Delhi.
15. W.G Hopkins and W.P.A Huner Introduction to plant physiology 4th edition, 2011.

IBS302T ANIMAL ANATOMY AND PHYSIOLOGY
52 hours | 4 credits

Aims & objectives:

- To understand the general account of animal anatomy.
- To understand the physiological process in animals

Unit 1

05 hours

Integument and derivatives: Structure and functions of skin (Mammals), scales, claws, nails, hairs, feathers and horns.

Unit 2

14 hours

Comparative account of heart (Fish, Frog, Reptile, Bird and Mammals), eyes –compound and camera eye, gills (fish) and lungs (Mammals), skull (rabbit), limbs - fore limbs & hind limbs (mammals).

Unit 3

07 hours

Histophysiology: Liver, Kidney, Spleen, Testis, Ovary, Pituitary, Pancreas.

Unit 4

05 hours

Respiration and Circulation: Types of respiration, Respiratory pigments, transport of O₂ and CO₂, Open and closed circulation, Blood composition and function.

Unit 5

04 hours

Excitability - Nature of the Nerve Impulse. Origin and propagation of action potential. Propagation of action potential across cell membrane and synaptic junction

Unit 6

03 hours

Excretory patterns in vertebrates: ammonotelism, ureotelism and uricotelism.

Unit 7

07 hours

Contractility: Cytoplasmic Streaming, Ameboid Movement, Ciliary, Flagellar and Muscular movements. Contraction of smooth, cardiac, skeletal muscle fibers. The sliding Filament Mechanism of Muscular Contraction. Mechanism of Contraction – Excitation and Relaxation of Muscle Cell.

Unit 8

07 hours

Feeding and digestion: Feeding patterns in vertebrates. Chemical and mechanical digestion, Stimulation of gastro-intestinal secretions, Digestion of carbohydrates, lipids and proteins. Nutritive types, vitamins, minerals, energy requirements, nutrition requirements of different ages. Nutritional disorders.

Recommended readings :

- 1) Parker, J&W. Haswell, 1995. Textbook of Zoology – Vertebrates. The Macmillan Press Ltd., U.K.
- 2) Stephen A. Miller & John P. Harley 2001, Zoology. The Animal Kingdom. Wm. C Publishers.
- 3) Berme, R.N. and Levy MN Principles of Physiology, Mosby Year Book. Inc.1996.
- 4) Eckert and Randall. Animal Physiology – Mechanisms and adaptations. CBS Publishers, 2000.
- 5) Schmidt-Nielsen. Animal Physiology. Cambridge Univ. Press, 2000.
- 6) D. Jenson. The Principles of Physiology. Appleton-Century-Crofts, 1996.
- 7) Prosser CL. Comparative Animal Physiology. WB Saunders and Company, 1973.

IBS303T BIOLOGICAL CHEMISTRY

52 hours | 4 credits

Aims and objectives

- Biochemistry being a fundamental basis of life, a basic concept of biomolecules and metabolism is essential in understanding the life activities.

Unit 1

01 hour

Introduction: Development and scope of Biochemistry, Biochemical composition of living organisms.

Unit 2

07 hours

Carbohydrates metabolism: Glycolysis-entry of other carbohydrates into glycolysis, the fates of pyruvate, the citric acid cycle, the energetics of glucose metabolism. Enzymatic control of glycolysis and TCA cycle. Outline of pentose phosphate pathway and its significance. The Cori's cycle, Outline of gluconeogenesis and glycogen metabolism. The amphipathic and integrating role of the citric acid cycle. Substrate level phosphorylation. Regulation of blood sugar level and Diabetes mellitus. Glycogen storage disorder.

Unit 3

09 hours

Amino acids, Proteins and their metabolism: Protein and non-protein amino acids, structure and classification of amino acids and their properties. Peptides-The peptide bond, biologically important peptides. Proteins-Classification based on composition, shape and function, color reaction. Structural organization – primary, secondary, tertiary and quaternary structures, denaturation.

Amino acid metabolism- General reactions of amino acid metabolism- transamination, deamination and decarboxylation. The urea cycle and its regulation. Biosynthesis of glycine, alanine cysteine and aspartic acid. Biosynthesis of biologically active amines-epinephrine, nor-epinephrine, histamine and poly amines. Disorders of aminoacid metabolism- PKU and AKU.

Unit 4

09 hours

Lipids, Bio-Membranes and their metabolism: Classification of lipids and biological function. Fatty acids; classification based on structure, properties of fatty acids. Acyl glycerols; Hydrolysis, Rancidity, acid, saponification and iodine values. Phosphoglycerides; structures and biological roles, Sphingolipids; phosphosphingolipids - sphingomyelins; Glycosphingolipids - gangliosides and cerebroside. Prostaglandins; An overview of biological roles, structure of PGE₂ and PGF_{2a}. Waxes of biological importance, Lipoproteins; types and functions, Membranes; Behaviour of amphipathic lipids in water, formation of micelles, bilayers and vesicles. Lipoproteins- types and functions. Functions and chemical composition of biological membranes, Fluid mosaic model. Steroids- Function of cholic acid, cholesterol, androgen and estrogens. The beta- oxidation pathway- even and odd numbered saturated and unsaturated fatty acids, Structure and functions of fatty acyl synthase. Energetics of total oxidation. General scheme of biosynthesis of fatty acids, Outline of cholesterol biosynthesis. Ketone bodies, atherosclerosis

Unit 5**06 hours**

Nucleic acid and their metabolism: Structure and Properties - Nitrogen Bases, Nucleosides, Nucleotides, Polynucleotides. Nucleic acid metabolism- Biosynthesis of Purine and Pyrimidines, Denovo and Salvage pathways, Biodegradation of Purines and Pyrimidines.

Unit 6**09 hours**

Bioenergetics and biological oxidation: Bioenergetics- Energy transformations in living systems, free energy concept. Exergonic and endergonic reactions, ATP and other high energy compounds, energy coupling. Biological oxidation; Step-wise process of biological oxidation, standard reduction potentials of some biochemically important half-reactions, calculation of energy yields from biological oxidation reduction reactions. Mitochondrial electron transport chain-components, schematic representation indicating sites of ATP synthesis. Oxidative phosphorylation- Chemiosmotic theory (an outline)

Unit 7**11 hours**

Enzymes : Introduction, Classification Characteristic and their specificity. Theories of interaction between active sites and substrate, Energy of activation, cofactors, coenzymes. Enzyme assays and International Units Enzyme kinetics; Factors affecting the rate of enzyme-catalyzed reactions- enzyme concentration, substrate concentration, pH, and temperature. Michaelis-Menten equation, Significance of K_m and V_{max} and their determination using LineWeaver- Burke plots. Enzyme inhibition; reversible and irreversible, Reversible-competitive, noncompetitive, uncompetitive inhibition with graphical representations using L-B plots. Brief mention of allosteric enzymes and isoenzymes. Biotechnological and clinical application of enzymes.

Recommended text books:

1. Gilbert, H.F. 2002. Basic concept of biochemistry. McGraw Hill professional, New York.
2. Down. M.B. 1999. Biochemistry. Lipincott Willam and Wilkins, London.
3. Cambell, M. and Farrell, D. 2005. Biochemistry. Thomson Books/Cole.
4. Stryer, L 1999. Biochemistry. W.H. Freeman and Company, New York.
5. Power and Chatwal. 2000. Biochemistry. Himalayan publishing house, New Delhi.
6. Nelson, D.L., Cox, M.M. Lehninger Principles of Biochemistry 3rd or 4th edition Pub WH Freeman Co.
7. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3rd Indian edition, Pub. Oxford.
8. Mathews, Van Holde and Ahern, Biochemistry by 3rd edition, Pub Pearson education
9. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co. NY.
10. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2nd edition Pub: Tata.
11. Voet, D., Voet J.G. (2004). Biochemistry 2nd Edn.
12. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc. NY
13. Zubey G.L. Parson, W.W., Vance D.E (1994). Principles of Biochemistry WmC Brown publishers. Oxford
14. Edwards and Hassall. Biochemistry and Physiology of the cell 2nd Edn. McGraw Hill Co. UK. Ltd.

IBS304T ENVIRONMENT AND PUBLIC HEALTH
26 hours | 2 credits

Unit 1

03 hours

Linkages between Environment and Health: Understanding linkages between Environment and Public Health: Effect of quality of air, water and soil on health. Perspective on Individual health: Nutritional, socio-cultural and developmental aspects, Dietary diversity for good health; Human developmental indices for public health

Unit 2

04 hours

Climate Change and Implications on Public Health: Global warming - Agricultural practices (chemical agriculture) and Industrial technologies (use of non-biodegradable materials like plastics, aerosols, refrigerants, pesticides); Manifestations of Climate change on Public Health- Burning of Fossil fuels , automobile emissions and Acid rain.

Unit 3

05 hours

Diseases in Contemporary Society Definition- need for good health- factors affecting health. Types of diseases - deficiency, infection, pollution diseases- allergies , respiratory, cardiovascular, and cancer Personal hygiene- food - balanced diet. Food habits and cleanliness, food adulterants, avoiding smoking, drugs and alcohol. Communicable diseases: Mode of transmission -epidemic and endemic diseases. Management of hygiene in public places - Railway stations, Bus stands and other public places. Infectious diseases: Role of sanitation and poverty case studies on TB, diarrhea, malaria, viral diseases .Non-communicable diseases: Role of Lifestyle and built environment. Diabetes and Hypertension.

Unit 4

04 hours

Perspectives and Interventions in Public Health Epidemiological perspectives — Disease burden and surveillance; Alternative systems of medicine - Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH); Universal Immunization Programme (UIP); Reproductive health-Youth Unite for Victory on AIDS (YUVA) programme of Government of India. Occupational health hazards-physical-chemical and biological. Occupational diseases- prevention and control.

Unit 5

04 hours

Environmental Management Policies and Practices Municipal solid waste management: Definition, sources, characterization collection and transportation and disposal methods. Solid waste management system in urban and rural areas. Municipal Solid waste rules. Policies and practices with respect to Environmental Protection Act, Forest Conservation Act, Wild life protection Act, Water and Air Act, Industrial, Biomedical and E waste disposal rules.

Unit 6

06 hours

Assignment /Field Work (from the list)

- Examining local cuisines for dietary diversity.
- Examining National Health Survey data e.g. National Family Health Survey, Annual Health surveys.
- Survey of Immunization coverage in a particular area.
- To establish if there is a relation between GDP and life expectancies/Health parameters.
- Survey of Respiratory allergies.
- Examining household/institutional/market/neighborhood wastes and their disposal mechanism.
- Survey of households along the Arkavathi and Cauvery River for life expectancy and common ailments and diseases.

- Determine the extent of use of paper and suggest means of reducing the use of paper and paper products.
- Documentation of festival/fasting and mapping of agro-ecological cycles.
- Definitions of poverty - Governmental policies on poverty mitigation - facts and fiction.
- Health indicators vis- a-vis income groups.
- Deforestation and flooding - myth or fact?
- Smoking and Lung Cancer
- Estimation of water-demands of a city/town.
- Adapting water-harvesting technology - survey, sustainability.
- Quantitative relation between bio-resource and consumer products - bathing soap, paper, furniture & construction as related to trees.
- Differential access to water - demand and actual access.
- Transport losses in water supply.
- Storage losses in food grain.
- Study of sewage treatment plants.
- Social perspective - child-health and small scale industries.
- Document infant immunization.
- Studying effective programme implementation - Reproductive health.
- Opportunities of physical activities in neighborhood - Study of built environment - Land-use pattern in Urban Settlements.
- Air quality in Delhi.
- Changing transport means in Delhi - CNG.
- Rituals and environmental pollution e.g. water, noise, air.
- Dialogue with doctors and paramedics.
- Methods of consultation of doctors.
- Population pressure/growth and resource degradation.
- Nutritional disorders/deficiencies in different populations groups-surveys.
- Compose and enact street plays. Create posters/ audio-video materials/ greeting cards highlighting environmental issues.
- Collecting information on medicinal plants.
- Collecting information from elders and other prominent persons.
- Occupational hazards and health issues.
- Water-borne diseases - exacerbation by irrigation projects.
- Alternate medicines - use of therapies for different diseases categories.
- Lifestyle diseases.
- Pollutants in air/water/soil and their effect on health.
- FDI in specific manufacturing Industries and local health problems.
- Differential pricing policy of petroleum products and environmental pollution - case studies.
- Wildlife Protection Act - case studies.
- Bhopal Gas Tragedy- Science, Laws and Public Health
- Changing Human Development Indices over time – in India/other countries.
- Supply, demand and gap filling –role of ground water

Recommended readings:

1. Indian Academy of Paediatrics. (2011). *Guidebook on Immunization*. mfc bulletin, 45-50.
2. Nandini N, Sunitha N. and Sucharita Tandon, (2007), *Environmental Studies*, Sapna Book House, Bangalore

3. Michel, Mckinney, Robert and Logan (2007). *Environmental Science – Systems & Solutions*. Jones & Barlett Publishers, Canada.
4. Minkoff, E., & Baker, P. (2003). *Biology Today: An Issues Approach* (3 ed.).
5. Park, K. (2011). *Preventive and Social Medicine*. Benarsi Das Publications, (pp. 16- 19,24-27).
6. Public Health Nutrition in Developing Countries Part-2). Wood head Publishing India.
7. Sadgopal, M., & Sagar, A. (2007, July-September). Can Public Health open up to the AYUSH Systems and give space for People's views of health and disease?.
8. Sekhsaria, P. (2007). Conservation in India and the Need to Think Beyond 'Tiger vs. Tribal'. *Biotropica*, 39(5), 575-577.
9. Tyler Miller and Scott E. Spoolman 'Environmental Science' (2012) 13th edition First Indian Reprint Chapters 14-17
10. UNDP. (2013). *The Human Development Report, The Rise of the South: HumanProgress in Diverse World*. New York: UNDP, (also available in Hindi),
11. Wani, M., & Kothari, A. (2007, July 15). Protected areas and human rights India: the impact of the official conservation model on local communities. *Policy Matters*, 100-114.

IBS305T LANGUAGE | -3 (KANNADA)
26 hours | 2 credits

ಕಾವ್ಯ

೧. ಕನ್ನಡಮೆನಿಪ್ಪಾ ನಾಡು ಚೆಲ್ವಾಯ್ತು- ಅಂಡಯ್ಯ
೨. ಶಿಲಾ ಎಲ್ಲೆ ಉಳಿತೇಳಣ್ಣಿ- ಕಡಕೋಳ ಮಡಿವಾಳಪ್ಪ
೩. ರಾಜಕೀಯ ಗಾಥೆ- ಎಸ್. ಈ. ಸಿದ್ದರಾಮಯ್ಯ

ಪ್ರಬಂಧ

೧. ಕನ್ನಡ ಬರಹ ಎಲ್ಲರ ಸೊತ್ತಾಗುವ ಬಗೆ- ಡಿ. ಎನ್. ಶಂಕರಬಟ್
೨. ಬಹುರಾಷ್ಟ್ರೀಯರ ಯಜಮಾನಿಕೆ: ಸಂಸ್ಕೃತಿಯ ಪರಾಧೀನತೆ
೩. ಇನ್ನೊಂದು ದಿವಸ ಕಾದರೆ ನಷ್ಟವೇ- ಕೆ. ರಂ. ನಾಗರಾಜ

ನಾಟಕ

೧. ಗೆಲ್ಲಲಾರು ಕ್ಕೆ ಮೈತ್ಯುರಾಜನಂ- ಎಚ್. ಎಲ್. ಪುಷ್ಪ

ಕತೆಗಳು

೧. ಕತೆಗಾರ ಮಂಜಣ್ಣ
೨. ಗಿರಿಜ ಕಂಡ ಸಿನಿಮಾ
೩. ದೇವರು ಮತ್ತು ಅಪಘಾತ

IBS305T LANGUAGE I -3 (HINDI)
26 hours | 2 credits

1. Drama: " Bakari" by Sarveshwar Dayal Saksena

(Published by Vaani Prakashan, New Delhi)

2. Hindi Ke Pramukh Sahiyakar:

- Tulsidas,
- Meerabai,
- Maithili Sharan Gupt,
- Vidyanivas Mishra,
- Harishankar Parsai

IBS306T LANGUAGE II -3 (ENGLISH)
26 hours | 2 credits

1. In the Kingdom of Fools – A K Ramanujan
2. In Search of Myself – Chhaya Datar
3. Bhishma – The Final Effort- Iravati Karve
4. An Education in Language – Richard Rodriguez
5. Shame- Dick Gregory
6. Can we Know the Universe? : Reflections on a Grain of Salt- Carl Sagan
7. Why I am a Feminist- Shashi Deshpande
8. Sonnet 25- William Shakespeare
9. The Louse and the Mosquito – Vikram Seth

General English Work Book

1. Remedial Grammar
 - a. Combining Sentences
2. RTI Act
3. Reading Comprehension
 - a. Analogy
 - b. Definition
 - c. Cause- and – Effect Analysis
4. Writing Skills
 - a. Report Writing
 - b. Letter Writing
5. Media Transfer

IBS 307P PLANT ANATOMY & PHYSIOLOGY

52 hours | 2 credits

1. Free hand section of Stem: Helianthus (Normal), Maize(Normal), Triticum, Cucurbita and Peperomia (Special features).
2. Study of anomalous secondary growth of stem: Boerrhavia, Aristolochia , Nyctanthus and Draceana.
3. Study of leaf anatomy of Isobilateral (Nerium) and Dorsiventral leaf (Ficus)
4. Study of stomata: Paracytic, anisocytic, anamocytic, Tetracytic, Diacytic types.
5. Study of root anatomy : Aerial root (Ficus), Orchid root.
6. Study of Ecological adaptation – Xerophyte (Opuntia, Euphorbia), Hydrophyte (Nymphaea,Hydrilla)
7. Wood anatomy-TLS & RLS of Gymnospermous wood (Pinus/Araucaria) & Angiospermous wood(Michelia)
8. Nodal anatomy – Cocculus, Polyscias, Helianthus
8. Plant Microtechnique - Microtomy, Maceration.
9. Determination of water potentials by following drops methods.
10. Hydroponics study of deficiency symptoms (chlorosis, necrosis)
11. Separation of chlorophylls and carotenoids by Ascending paper chromatography
12. Bioassay of Phyto hormones – Auxins, Cytokinins, Gibberllins, Abssisic acid, Ethylene
13. Determination of lipid activity
14. Estimation of Leghaemoglobin in the nodules.

IBS308P ANIMAL ANATOMY & PHYSIOLOGY
52 hours | 2 credits

ANATOMY

1. Identification and functions of scales (fishes), claws, nails, hairs, horns, feathers, Hoofs and nests.
2. Field visits to Research institutes, national parks and natural vegetations.
3. Vertebrae – Procoelous (Frog), Amphicoelous (Bird), Amphiplateous (Rabbit).
4. Skulls in vertebrates : Frog, Bird, Mammal, rabbit, dog, man, turtle.
5. Histology sections of Testis, Ovary, Liver, Pancreas, Kidney, Spleen, intestine.
6. Microtomy – Organ fixing, Block making, Sectioning and staining of any one organ (rat)

PHYSIOLOGY

1. Determination of oxygen consumption and metabolic rate in fish.
2. Rate of protein digestion by trypsin.
3. Acetylcholine activity in tissues
4. Determination of ATPase activity in tissues

IBS309P BIOCHEMISTRY

52 hours | 2 credits

1. Extraction and assay of acid phosphates from peas.
2. Extraction and assay of Invertase from yeast.
3. Extraction and assay of Urease from horse-gram.
4. Analysis of kinetic parameters of salivary amylase (Specific activity, K_m and V_{max} , p^H Optimum)
5. Estimation of reducing glucose by Hegedorn and Jensen method.
6. Estimation of protein by F.C method.
7. Estimation of inorganic phosphate by Fiske-Subbarao method.
8. Determination of Iodine number and Saponification number in lipid samples

SEMESTER IV**Scheme of Instruction and Examination**

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS401T	Cell biology	4	-	52	3	70	30	100	4
IBS402T	Instrumentation & techniques	4	-	52	3	70	30	100	4
IBS403T	Biophysics	4	-	52	3	70	30	100	4
IBS404T	Indian constitution & human rights	2	-	26	4	35	15	50	2
IBS405T	Language 1-4 (Kannada / Hindi)	2	-	26	4	35	15	100	2
IBS406T	Language II -4 (English)	2	-	26	4	35	15	100	2
IBS 407P	Cell biology	-	4	52	4	35	15	50	2
IBS408P	Instrumentation & techniques	-	4	52	4	35	15	50	2
IBS409P	Biophysics	-	4	52	4	35	15	50	2

Total marks: 700, Total credits: 24

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

IBS401T CELL BIOLOGY

52 hours: 4 credits

Aims and Objectives

- To understand the structure and functional unit of every life form
- To understand the biology of cell and its organelles

Unit 1

02 hours

Methods to study cells, sub-cellular structures and cell membranes: Light microscopy, tissue fixation and sectioning, selective staining of cellular components, Fluorescence microscopy, Phase-contrast microscopy, Confocal scanning microscopy, SEM & TEM, Cryoelectron microscopy

Unit 2

08 hours

Organization of Prokaryotic and Eukaryotic cells: Plasma membrane organization, structure and function. Lipid bilayer, Membrane Protein – Fluid mosaic model. Principles of membrane transport –carrier proteins, active transport and ion channels

Unit 3

05 hours

Cytoskeleton and Extracellular matrix : microtubules, cilia, flagella. Tubulin, Actin and Myosin filaments. Microtubule structure and dynamics. Intermediate filaments.

Unit 4

06 hours

Structure and function of endoplasmic reticulum, Golgi complex, mitochondria, chloroplast, lysosomes and peroxisomes. Vesicular traffic -exo and endocytosis

Unit 5

05 hours

Nucleus: nuclear envelope, organization and functions of nucleolus. Structure and function of chromatin, organization of nucleosomes, euchromatin, heterochromatin. Mechanism of chromosome condensation. Specialized chromosomes (B-chromosomes, polytene chromosomes, lamp brush chromosome). Cytoplasts and karyoplasts.

Unit 6

07 hours

Cell cycle and cell division: Mitosis and Meiosis, present concept of chromosomal movement, importance of M phase, cytoskeleton, mechanism of cell division. Amitosis, Endomitosis, cMitosis and their significance; Regulation of cell division through cyclins.

Unit 7

07 hours

Cell Signaling and Apoptosis: General principles of cell signaling (autocrine, paracrine, synaptic, endocrine), classes of cell-surface receptor proteins(ion-channel linked, G protein-linked, enzyme-linked), signaling via GPCRs & enzyme-linked cell-surface receptors, Programmed cell death by intracellular proteolytic cascade, regulation of apoptosis by Bcl-2 family of proteins

Unit 8**08 hours**

Stem cells and Cancer cells: Tissue maintenance and renewal, properties of stem cells, classification of stem cells (embryonic vs adult), stem cell niche and its role in stem cell renewal and differentiation, Cancer as a microevolutionary process- different types of cancer, origin of cancerous cell, development of cancer , Metastasis, molecular genetics of cancer (role of p53, oncogenic retrovirus-mediated tumorigenesis, proto-oncogenes and tumor-suppressor genes)

Unit 9**03 hours**

Cell culture: Isolation of cells from tissues and their separation, in-vitro cell culture, primary cells vs cell lines, adherent vs suspension cultures, cell culture medium composition, eukaryotic cell lines, hybridoma culture.

Recommended readings :

1. Cell and Molecular Biology. De Roberts and De Roberts., Saunders College, USA 6th edition.
2. Molecular Cell Biology. Lodish, Berk, Zipursky, Matsudaira, Baltimore & Darnell. Freeman Press, 6th edition.
3. Cell Biology. Karp G., McGraw Hill book comp. New York. 2010 6th edition.
4. The Cell : A molecular approach. Cooper, G.M. ASM Press, USA 2009, 5th edition.
5. Chromatin structure and function. Wolfe, A., Academic press, New York 1995.
6. Cell Biology. Pollard. J.P. and Earnshaw, W.C. Saunders, 2002.
7. The Cell –A molecular approach. Cooper, G.M. Princeton Publishers, NY, 2000.
8. Molecular Cell Biology. Lodin, H., Berk, A., Zipursky, S.L., Matsudain, P., Baltimore, D. and Darneil, T. Will Freeman company, NY, 6th edition.
9. Molecular biology of the cell. Albert, B., Johnson, A., Raff, M., Robert, K., Walter, P. Garland Sciences, NY, 5th edition.

IBS402T INSTRUMENTATION AND TECHNIQUES

52 hours | 4 credits

Aims and Objectives

- To know the principles and mechanism of various bio-instruments and their applications

Unit: 1

13 hours

Microscopy and Microscopic techniques: Mechanism, application of light, inverted phase contrast, electron microscope (SEM & TEM), confocal microscope, scanning tunneling microscope, fluorescent microscope. Micrometry and flow cytometry. Rotary and ultra microtomes.

Unit: 2

13 hours

pH meter and its applications, Cell disruption techniques – Physical and chemical methods, PCR, RT-PCR, nano-drop, DNA analyzer, Centrifugation – basic principles of sedimentation, types of centrifuges and rotors, ultracentrifugation, differential centrifugation, density gradient and analytical ultracentrifugation and its application.

Unit: 3

13 hours

Chromatography – General principles and definition, Partition, absorption, gas-liquid chromatography, paper chromatography and TLC. Principles of Gel filtration, affinity chromatography, HPLC and ion-exchange chromatography.

Electrophoresis - PAGE, SDS-PAGE, isoelectric focussing, 2D electrophoresis, agarose gel electrophoresis, recovery of DNA from agarose gels, Pulse-field gel electrophoresis.

Unit: 4

09 hours

Immunochemical techniques - antibodies and their specificity, antigen - antibody interactions, immunoassay, western blotting, ELISA, immunoelectrophoresis. Radioisotopes and dosimetry, radiation counters, Radio isotopes and safety. Labelling of Antibodies.

Unit 5

04 hours

Principle and application of UV- visible spectrophotometer, fluorescence spectroscopy.

Recommended readings:

- The Principles and practices of electron microscopy. Watt IM, Cambridge Univ. press, London, 1989.
- Gordon M.H and Macrae, M. Instrumental analysis in biological sciences, Blackie and sons Ltd. Loondon, 1998.
- Principles of physical biochemistry. Vanholdem W.C. and Johnson, P.S. Printice Hall, 1998.
- Principles & techniques in practical biochemistry. Wilson, K and Walker, J.M. Foundation books, New Delhi, 1994

IBS403T BIOPHYSICS

52 hours | 4 credits

Aims and Objectives:

- Students to learn many relevant applications of fundamental physics to biological science and medicine.

Unit 1

02 hours

Foundations of Biophysics-Matter and energy – Photo electric effect, quantum theory of light, de Broglie wave equation, wave function, atomic models, Bohr's atomic energy levels.

Unit 2

05 hours

Biomolecular interactions-Water-properties and interactions of water, association of macromolecules, supramolecular interactions, protein-protein interactions, protein nucleic acid interactions, lipid/membrane-protein interactions

Unit 3

06 hours

Thermodynamics: Laws of Thermodynamics, Gibbs free energy, Entropy and enthalpy and its relationship, Relation between standard free energy change and equilibrium constant, Redox reactions and a brief account on photo and chemo-bioenergetics.

Unit 4

04 hours

Protein Structure analysis : Alpha helix and Beta sheet structure of proteins (fibroin structure), conformation of protein – Ramachandran plot, Tertiary conformation

Unit 5

09 hours

Protein thermodynamics: Free energy and entropic forces, solvent interactions and solvent entropy, polypeptide chains in water, the folding process, folding pathways, simulations and predictions, experimental studies on folding, Excitement and relaxation of protein structure, equilibrium fluctuations, kinetics of proteins, proteins as complex systems.

Unit 6

08 hours

Spectroscopy : Instrumentation and application of UV - visible spectrophotometer, fluorescence spectroscopy, NMR, Mass spectroscopy, IR, Raman. X-ray diffraction in determining molecular structure of proteins.

Unit 7

09 hours

Radiation biophysics: Special characteristics of atmosphere long wave and short wave radiation, radiation fluxes in natural environment, the ultraviolet region absorption and scattering, alpha, beta, gamma and x-radiation, cosmic radiation, absorption of electromagnetic radiation and interaction with matter, comparison of different ionizing radiations, radiation as environmental pollutant, radioisotopes, detection and measurement of radiation, effect of radiation at cellular levels-structural and functional changes, interaction with biological macromolecules, interaction of carcinogens/anti-cancer agents with DNA, RNA and nucleoproteins.

09 hours

Unit 8

Biological effects of light: Importance of Light, Radiant energy, Light interaction with biological materials, Effect on growth patterns in plants-Phytochrome system, Photochemical mechanism, Phototropism, Photoperiodism, Solarization, Photodynamic action, UV light on living system, Photoreactivation, Lethal effects on animals and plants.

Recommended readings:

1. Casey, E.J. 1969. Biophysics, Concept and Mechanics. Affiliated East West Press.
2. Dr. R. N. Roy, 2007. A Text book of Biophysics. New Central Book Agency (P) Ltd.
3. Ackerman, E. 1967. Biophysical Sciences. Prentice Hall, NY.
4. Narayan, P. 2000. Essentials of biophysics. New Age Int. Pub. New Delhi.
5. Cantor R. and Schimmel P.R, W.H. Freeman. Biophysical chemistry
6. David Freifelder, W H Freeman and company. Physical Biochemistry
7. A.L. Stanford, Academic Press. Foundations of Biophysics

IBS404T CONSTITUTION OF INDIA AND HUMAN RIGHTS
26 hours | 2 credits

Aim and Objectives:

- To ensure students are well aware of basic principles and concepts in Indian Constitution and Human rights.

Unit : 1

7 hours

Indian Constitutional Philosophy

- a) Features of the Constitution and Preamble
- b) Fundamental Rights and Fundamental Duties
- c) Directive Principles of State Policy

Unit : 2

6 hours

Union and State Executive, Legislature and Judiciary

- a) Union Parliament and State Legislature: Powers and Functions
- b) President, Prime Minister and Council of Ministers
- c) State Governor, Chief Minister and Council of Ministers
- d) The Supreme Court and High Court: Powers and Functions

Unit : 3

7 hours

Concept and Development of Human Rights

- a) Meaning Scope and Development of Human Rights
- b) United Nations and Human Rights – UNHCR
- c) UDHR 1948, ICCPR 1996 and ICESCR 1966

Unit : 4

6 hours

Human Rights in India

- a) Protection of Human Rights Act, 1993 (NHRC and SHRC)
- b) First, Second and Third Generation Human Rights
- c) Judicial Activism and Human Rights

Recommended texts:

- Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
- SubashKashyap, Indian Constitution, National Book Trust J.A. Siwach, Dynamics of Indian Government & Politics
- D.C. Gupta, Indian Government and Politics
- H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
- V.N.Shukla, Constitution of India (Eastern Book Co)
- J.C. Johari, Indian Government and Politics
- Hans J. Raj Indian Government and Politics
- M.V. Pylee, Indian Constitution
- Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi 48
- Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012
- S.K. Kapoor, Human Rights

IBS405T LANGUAGE | -4 (KANNADA)
26 hours | 2 credits

ಕಾವ್ಯ

೧. ನಾರದ ಮುನಿಗಾದುದು ನೋಲ್ವ ಕೌತುಕಂ ಜಾನಕಿಯಂ
೨. ಎರದ ಮುಳ್ಳಿನಂತೆ ಪರಗಂಡಕೆನಗೆ
೩. ಗೋವು ತಂದು ಗೋವಿನಂತಾದವರು

ಪ್ರಬಂಧ

೧. ಹೆಣ್ಣಿನೊಳಗೆ ಭಾಷಾಂತರ
೨. ಪರಿಸರ ಸಂರಕ್ಷಣೆ ಮತ್ತು ರಾಜಕೀಯ ಚರಿತ್ರೆ
೩. ಭಗದ್ಗೀತೆ ಹಾಗೂ ಅಪರಾಧ ಮತ್ತು ಶಿಕ್ಷೆ

ನಾಟಕ

೧. ಕುತ್ತವ ಬಡಿದರೆ

ಕತೆಗಳು

೧. ಮಂಜುಗಣ್ಣಿನ ಮಾಯಣ್ಣ
೨. ಬಿಜ್ಜಿದ ಜೋಳಿಗೆ (ಆತ್ಮಕತನ)
೩. ಸಂಬಂಧ

IBS405T LANGUAGE I -4 (HINDI)
26 hours | 2 credits

1. Khand kavya : “ Droupadi” by Narendra Sharma

(Published by Rajkamal Prakashan , New Delhi)

2. Essays :

- Paryavaran,
- Jeevan Aur Vigyan Ka Antarsambandh,
- Bharatiya Samvidhan,
- Vigyanik Anusandhan,
- Prakritik Vikop

IBS406T LANGUAGE II -4 (ENGLISH)
26 hours | 2 credits

General English Course Book

1. The Model Millionaire- Oscar Wilde
2. Mirror- Sylvia Plath
3. The Town by the Sea- Amitav Ghosh
4. Two Gentlemen of Verona- A.J. Cronin
5. Siddhartha- Edwin Arnold
6. How to Escape from Intellectual Rubbish- Bertrand Russell
7. The Affliction of Margaret -William Wordsworth

General English Work Book

1. Dialogue writing / narrating past events
2. a. Project report
b. Referencing Skills
3. a. Job Skills
b. Non Verbal Communication
c. Interviews
4. Presentation Skills

IBS 407P CELL BIOLOGY

52 hours | 2 credits

1. Isolation and separation of sub cellular organelles.
2. Vital staining of mitochondria
3. Squash and smear preparation of mitotic and meiotic chromosomes –
Allium cepa, *Poeciloceris picta*.
4. Determination of chromosome number from mitotic and meiotic preparations.
5. Preparation of Polytene chromosome- *D.melanogaster* /Chironomous
5. Cytological technique, preparation of semi-permanent and permanent slides.
6. Identification of B-chromosomes, sex chromosomes and chromosomal abnormalities.
7. Counting of cells using haemocytometer
8. Tissue culture techniques – Passage, maintenance, cryo-preservation– Adherent & Suspension cell types

IBS408P INSTRUMENTATION & TECHNIQUES

52 hours | 2 credits

1. Separation and identification of amino acids by paper chromatography.
2. Separation and identification of sugars and lipids by TLC.
3. Separation of proteins by ion exchange chromatography
4. Separation of proteins by gel filtration.
5. Dialysis.
6. Isolation of mitochondria by differential centrifugation.
7. Separation of proteins by SDS-PAGE
8. Amplification of gene by PCR.

IBS409P BIOPHYSICS

52 hours | 2 credits

1. Absorption spectra of amino acids, proteins and nucleic acids by Spectrophotometer.
2. Verification of Beer-Lambert law.
3. Analysis of IR spectra of a diatomic molecule / simple biomolecules.
4. Denaturation and Renaturation of Protein by spectroscopic method.
5. Experiment with GM counter.
6. Experiment to demonstrate photo-electric effect

SEMESTER V**Scheme of Instruction and Examination**

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS501T	Molecular biology	4	-	52	3	70	30	100	4
IBS502T	Evolutionary biology	4	-	52	3	70	30	100	4
IBS503T	Developmental biology	4	-	52	3	70	30	100	4
IBS504T	Biostatistics	2	-	26	2	35	15	50	2
IBS505P	Molecular biology	-	4	52	4	35	15	50	2
IBS506P	Evolutionary biology	-	4	52	4	35	15	50	2
IBS507P	Developmental biology	-	4	52	4	35	15	50	2

Total marks: 500, Total credits: 20

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

IBS501T MOLECULAR BIOLOGY

52 hours: 4 credits

Aims and objectives:

- Familiarize the student with the structure, organization and function of the genetic material at the molecular level in prokaryotes and eukaryotes.
- Introduce the student to the mechanisms of DNA replication, transcription and translation both in prokaryotes as well as eukaryotes.

Unit 1: Introduction to molecular biology: History of molecular biology, prokaryotic and eukaryotic cell composition, organization of chromosomes in prokaryotic and eukaryotic cells, model organisms in the study of molecular biology (*E. coli*, *Sachharomyces*, *Arabidopsis*, *C. elegans*, *Drosophila*, *Mus musculus*, *Homo sapiens*)
3 hours

Unit 2: Nucleic acids: Structure and function of DNA (DNA as a storehouse of information; genes are mutable units; DNA is the genetic material; topology of nucleic acids; isolating the gene), the structure of eukaryotic chromosomes (chromatin and nucleosomal organization, DNA packing in several layers, interphase chromosomal architecture, nucleosomal remodeling allows access to DNA). Structure, function and biogenesis of different types of RNA.
10 hours

Unit 3: DNA replication, repair and recombination: The replicon- unit of replication (mapping of origin of replication, replicon in bacterial vs eukaryotic genomes, rolling circle model of DNA replication, bacterial replication and cell cycle, plasmid propagation and plasmid incompatibility), Primosomes and Replisomes (apparatus for DNA replication, DNA polymerases, Okazaki fragments, Leading and Lagging strand synthesis, common events in priming replication at origin, methylation regulating initiation at origin), DNA repair mechanisms, recombination (breakage and reunion involves heteroduplex DNA, Holliday junction)
13 hours

Unit 4: Transcription and post-transcriptional modifications: Transcription complex (promoters, factors, RNA polymerases), initiation-elongation-termination of transcription, mono-cistronic and poly-cistronic RNAs, Transcription factors and their functions (zinc-fingers, helix-loop-helix, leucine zippers, homeo domains, steroid receptors), inhibitors of transcription, Post transcriptional modifications of m-RNA, t-RNA and r-RNA, apparatus for nuclear splicing (spliceosome and lariat formation, alternative splicing, self-splicing by group I introns).
13 hours

Unit 5: Translation: Genetic code- General features of Genetic code. Mechanism of protein synthesis: initiation, elongation and termination in Prokaryotes and eukaryotes. Inhibitors of protein synthesis Post-translational modifications. Protein sorting and targeting. Signal hypothesis – signal sequences, signal recognition particle.
9 hours

Unit 5: Gene regulation in prokaryotes, eukaryotes and phages: Transcriptional and post-transcriptional control of gene expression in prokaryotes and eukaryotes: control at initiation (RNA polymerase-promoter

interactions), a panoply of operons(Lactose and Tryptophan operon), control of RNA structure (termination and anti-termination), Phage strategies (lytic cascade and lysogenic repression).

4 hours

Recommended readings:

10. Cell and Molecular Biology. De Roberts and De Roberts., Saunders College, USA 6th edition.
11. Molecular Biology. Lodish, Berk, Zipursky, Matsudaira, Baltimore & Darnell. Freeman Press, 6th edition.
12. Cell Biology. Karp G., McGraw Hill book comp. New York. 2010 6th edition.
13. The Cell : A molecular approach. Cooper, G.M. ASM Press, USA 2009, 5th edition.
14. Genes V: Benjamin Lewin. Oxford University Press, 1995
15. Cell Biology. Pollard. J.P. and Earnshaw, W.C. Saunders, 2002.
16. Molecular biology of the cell. Albert, B., Johnson, A., Raff, M., Robert, K., Walter, P. Garland Sciences, NY, 5th edition.
17. The Cell –A molecular approach. Cooper, G.M. Princeton Publishers, NY, 2000.
18. Molecular Cell Biology. Lodin, H., Berk, A., Zipursky, S.L., Matsudain, P., Baltimore, D. and Darneil, T. Will Freeman company, NY, 6th edition.

IBS502T: EVOLUTIONARY BIOLOGY

52 hours: 4 credits

Aims and Objectives:

- Provides a comprehensive understanding of evolutionary principles, the role of speciation in evolution and major events in the evolution of *Homo sapiens*

Unit 1: Introduction to Evolution:

Molecules to Organisms: The first ten billion years (universe and earth arise, the atmosphere, rocks and continents), Origin of life (origin of the molecules of life-molecules, membranes, protocells, the first cells, eukaryotic organelles and organisms)

Theories of Evolution: Voyages of discovery, Theories of Evolution (Lamarckism, Darwinism, Mendel's theory of heredity, Neo-Darwinian Synthesis). Evidences for evolution. **13 hours**

Unit 2: Natural selection: Survival of the fittest, Types of Natural selection (Stabilizing, Directional, Disruptive, Sexual, Group selection, frequency dependent and density dependent selectors) , Selection in relation to constraint, changing environments and plasticity, fitness, and balanced polymorphism.

8 hours

Unit 3: Evolutionary genetics: Basic population genetics: Hardy-Weinberg genetic equilibrium; basic one-locus models of mutation, migration and selection; genetic polymorphism; average effect of an allele, breeding value for fitness; breeding value; random genetic drift and inbreeding. **5 hours**

Unit 4: Speciation and molecular evolution: Species concepts; reproductive isolation mechanisms and patterns; different models of speciation; phyletic gradualism, punctuated equilibrium; neutral theory of molecular evolution; molecular clocks, phylogeny construction. **10 hours**

Unit 5: Population biology: Population growth, biological interactions within populations, competition, niche segregation, predation, symbiosis; Coevolution: Parasitism and viral pathogens, insects and host plants, plant evolution **3 hours**

Unit 6: Human Origins & cultural evolution: Primate evolution, Chimpanzees and Humans, Earliest Hominids, Australopithecins: the southern apes of Africa, Bipedalism and brain size, origins of *Homo*, Out of Africa, Humans as hunter-gatherers; Cultural and Social evolution: Instincts and learned behavior, Learning, society and culture, cultural evolution dominating phenotypic evolution, Social Darwinism, inheritance of social behavior.

13 hours

Recommended readings:

1. Brown, Genomes, Bios, 1999.
2. Strickberger, Evolution, Jones and Barlett, 2000.
3. Jobling *et al*, Human Evolutionary Genetics, Garland, 2004.
4. Daniel Hartal and Andrew Clark. Population genetics, 3rd edition.
5. Ridley, M. (2004) Evolution. III Ed. Blackwell.

6. Futuyma, D. (1998) Evolutionary Biology. III Edn. Sinauer Assoc. Inc.
7. 5. Barton, Briggs, Eisen, Goldstein and Patel. (2007) Evolution. CSHL.

IBS503T: DEVELOPMENTAL BIOLOGY

52 hours: 4 credits

Aims & objectives:

- Familiarize the student with the developmental pathways in plants and animals

Unit 1: Introduction to developmental biology; Early development- Fertilization, Types & mechanisms of cleavage. Gastrulation: Cell movement and formation of germ layers in frog & chick and mouse, Concept of cell type determination, competence and differentiation, Creation of specific organs (organogenesis – chick)

8 hours

Unit 2: Organizer concept: Primary organizer, embryonic stem cell, development of vertebrate nervous system (chick) Formation of neural tube, regions of brain.

5 hours

Unit 3: Genetics of pattern formation: *Coenorhabditis* – Vulva formation, *Drosophila* – Maternal gene and formation of body axes, Homeotic gene function, Imaginal disc development, Axes formation in vertebrate, Hox genes.

6 hours

Unit 4: Post embryonic development:

- Metamorphosis- endocrine control of metamorphosis in insects and amphibian.
- Regeneration – Cellular processes in regeneration, Sources, determination of polarity, regulation of regeneration.

7 hours

Unit 5: Gametogenesis in plants:

Microsporogenesis & male gametophyte :- Anther wall Structure and development- Endothecium, Middle layers, Tapetum, Nuclear behaviour in tapetal cells and Sporogenous tissue; Formation of vegetative and generative cells, Formation of sperms, pollen wall – Structure and development and abnormal pollen grains.

Megasporogenesis & female gametophyte :- Structure and development of ovules, Types and parts of ovules. Structure and development of female gametophyte, Types of female gametophytes, Structure of Mature Embryo sac, Embryo sac haustoria.

13 hours

Unit 6: Fertilization and embryogeny: Structure of style and stigma, Pollen germination and pollen tube growth. Path of pollen tube, pollen tube discharge, Double fertilization: triple fusion and syngamy. Central cell as the second gamete of the flowering plant. Structure and types of endosperm, Physiology and cytology of endosperm and functions of endosperm and endosperm haustoria. Classification of Embryogeny, early embryogenesis and mature embryo of Dicotyledons – *Capsella bursa pastoris* and mature embryo of monocotyledons- *Najus lacerata* and Grass.

13 hours

Recommended readings:

1. Alberts *et al*, Molecular Biology of The Cell. Garland, 2002.

2. Scott F. Gilbert, Developmental Biology, Sinauer, 2003.
3. Kalthoff, Analysis of Biological Development, McGraw Hill, 1996.
4. Lewin, Genes VIII, Pearson, 2004.
5. Monk, Mammalian Development – A Practical Approach, IRL, 1987.
6. O’Rahilly and Muller, Human Embryology and Teratology, Wiley, 1992.
7. Rana, Human Embryology Made Easy, Harwood, 1998.
8. Wolpert, Principles of Development, Oxford, 2002.
9. Singh, P. 2001. Essentials of Plant Breeding, Kalyani Publishers, Hyderabad.
10. Allard, R. W. 1999. Principles of Plant Breeding. John Willey & Sons. New York.
11. Dana, S. 2001. Plant Breeding. Naya Udyog. Calcutta.
12. Singh. B. D. 1995. Plant Breeding – Principles and Methods. Kalyani Publishers, New Delhi.

IBS504T: BIOSTATISTICS

26 hours: 2 credits

Aims & Objectives:

- Provide basic understanding of statistical principles and tools for analyzing research data

Unit 1: Descriptive Statistics: Basic statistical concepts. Reduction of data frequency distribution. Graphical representation of frequency distribution-histogram, frequency curve, cumulative frequency curve. Measures of central tendency and dispersion. Relative dispersion and coefficient of variation. Measures of skewness and kurtosis. **5 hours**

Unit 2: Sampling techniques: Random sampling. Simple random sampling and stratified random sampling. Use of random number tables, sample size determination. **4 hours**

Unit 3: Probability and Distributions: Simple space. Events. Probability and conditional probability. Addition and multiplication theorems of probability. Probability distributions. Binomial, Poisson and normal distributions. Illustrations. **4 hours**

Unit 4: Correlation and Regression: Problem of relative variables. Scatter diagram. Product moment correlation coefficient and its properties. Rank correlation coefficient. Simple linear regression. Method of least squares. Curve fitting. Exponential and power curves. Coefficient of determination. **5 hours**

Unit 5: Test of Significance: Statistical hypothesis. Type-1 and Type-2 errors, level of significance, size and power of a test. Definition of Chi-square, t and F distributions. Central limit theorem. Tests for the mean, equality of two means, variance (for large and small samples). Large samples tests for proportions. Chi-square test for goodness of fit and for independence of attributes in contingency tables. Confidence interval. **7 hours**

Unit 6: Design of Experiments: Analysis of variance. One-way and two-way classified data. Design of experiments. Analysis of completely randomized, randomized block and nested designs. **3 hours**

Recommended readings:

1. Cambell. R.C, Statistics for Biologists, Cambridge University Press, UK, 1967.
2. Fry J.C., Biological data analysis, a practical approach, IRL Press, Oxford, U.K, 1993.
3. Snedecor P.S., Statistical Methods, Affiliated East-West press, New Delhi, 2000.
4. Primer of Biostatistics, 7th edition (2011), Stanton Glantz, McGraw-Hill Medical. ISBN- 13: 978-0071781503.
5. Biostatistics: A Foundation for Analysis in the Health Sciences, 10th edition (2013), Wayne W Daniel and Chad L. Cross, Wiley. ISBN-13: 978-1118302798.
6. Biostatistical Analysis, 5th edition (2009), Jerrold H. Zar, Pearson. ISBN-13: 978- 0131008465.

IBS505P: MOLECULAR BIOLOGY

52 hours: 2 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Isolation of nucleic acids from plant (young leaves, *Allium cepa*) and animal (butterfly or silkworm larva, adult Uzi fly, *Drosophila* larva) by CTAB and SDS-Proteinase K method
2. Isolation of plasmid DNA from bacterial culture using DNA extraction kit
3. Extraction of total RNA from bacterial culture using RNA isolation kit
4. Estimation of DNA content by Diphenylamine(DPA) method
5. Estimation of RNA by Orcinol method
6. Estimation of protein by Bradford method
7. Separation of nucleotide bases by paper chromatography
8. Agarose gel electrophoresis of DNA and RNA
9. Polyacrylamide gel electrophoresis of proteins

IBS506P: EVOLUTIONARY BIOLOGY

52 hours: 2 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

Evidences of fossils

1. Study of types of fossils (e.g. trails, casts and moulds and others) and Index fossils of Palaeozoic era
2. *Connecting links/transitional forms* - Eg. *Euglena*, *Neopilina*, *Balanoglossus*, *Chimaera*, *Tiktaalik*, *Archaeopteryx*, *Ornithorhynchus*
3. Living fossils - Eg. *Limulus*, *Peripatus*, *Latimeria*, *Sphaenodon*
4. Vestigial, Analogous and Homologous organs using photographs, models or specimen

Variations

5. Sampling of human height, weight and BMI for continuous variation
6. Sampling for discrete characteristics (dominant vs. recessive) for discontinuous variations e.g. hitch-hiker's thumb, dexterity, tongue rolling, ear lobe (data categorization into 16 groups based on the combination of 4 traits; assigning each subject to the respective group)

Selection Exemplifying Adaptive strategies

7. Coloration, Mimetic form, Co-adaptation and co-evolution; Adaptations to aquatic, fossorial and arboreal modes of life) using specimens

Neo-Darwinian Studies

8. Calculations of genotypic, phenotypic and allelic frequencies from the data provided
9. Simulation experiments using coloured beads/playing cards to understand the effects of selection and Genetic drift on gene frequencies

Phylogeny

10. Digit reduction in horse phylogeny (study from chart),
11. Study of horse skull to illustrate key features in equine evolution
12. Study of monkey and human skull - A comparison to illustrate common primate and unique Hominine features

IBS507P: DEVELOPMENTAL BIOLOGY

52 hours: 2 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Study of whole mounts of frog and chick- early developmental stages
2. Study of chick development from live eggs (window viewing) & permanent embryo mounting
3. Study of section of chick embryo through selective developmental stages
4. Dissection and mounting of imaginal discs of *Drosophila* / silk worm
4. Videos showing selective embryonic events like cleavage; gastrulation
5. Study of gene expression during development with Lac Z reporter gene
6. Measurement of animal/plant cell size using ocular and stage micrometer.
7. Study of microsporangium development, microsporogenesis, male gamete development (subject to availability)-slides only
8. Study of types of megasporangium, Structure of the megasporangium, development of megaspore, types of embryo sacs (subject to availability)
9. Mounting of endosperm – *Cucumis* sp.
10. Mounting of embryo – *Cyamopsis* / *Tridax* sp.

SEMESTER VI**Scheme of Instruction and Examination**

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS601T	Plant reproduction & breeding	4	-	52	3	70	30	100	4
IBS602T	Animal reproduction & breeding	4	-	52	3	70	30	100	4
IBS603T	Genetics	4	-	52	3	70	30	100	4
IBS604T	Mathematical biology	2	-	26	2	35	15	50	2
IBS605P	Plant Reproduction & breeding	-	4	52	3	70	30	50	2
IBS606P	Animal Reproduction & Breeding	-	4	52	4	35	15	50	2
IBS607P	Genetics	-	4	52	4	35	15	50	2

Total marks: 500, Total credits: 20

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

IBS601T: PLANT REPRODUCTION & BREEDING

52 hours: 4 credits

Aims & objectives:

- To understand plant reproduction and mechanisms involved
- To understand various aspects of plant breeding, its history, objectives, significance & problems
- To understand the future prospects of plant breeding and its role in crop improvement

Unit 1: Introduction to Plant reproduction:

Angiosperm flower: Calyx, Corolla, Androecium, Gynoecium, Transition of shoot apex to flowering apex, Specification of floral organs, ABC – Model- *Arabidopsis thaliana*, Homeotic mutants.

Pollination: Structural adaptations of pollen dispersals, pollen viability, storage and germination, pollen- pistil interaction – Genetic control of pollen – pistil interaction and pollen allelopathy.

Pollen sterility: Genetic and cytoplasmic male sterility, chemical induction of male sterility, utilization of male sterility in hybrid seed production. **13 hours**

Unit 2:

Incompatibility:- Types of Incompatibility, methods to overcome Incompatibility, Delayed pollination, bud pollination, Intra-ovarian pollination, test tube fertilization, somatic hybridization, egg transformation, ovary and embryo culture.

Apomixis and Polyembryony:- Types of Apomixis, Embryology of gametophytic-apomicts, apomixis and plant breeding, Polyembryony- A brief account **13 hours**

Unit 3: Introduction to Plant breeding: Concept and scope of plant breeding, a brief historical account of plant breeding, objectives, significance, problems of plant breeding. National and International institutes, location, aims, achievements, prospects of plant breeding. **4 hours**

Unit 4:

- Methods of Plant breeding:** Plant introduction and acclimatization, germplasm maintenance, Selection (pure line, mass, pedigree analysis, single seed descent, clonal selection).
- Hybridisation :** Definition, methods of hybridization (self pollinated crops – rice and wheat, cross pollinated crops – maize, asexually propagated crops- sugarcane, potato) Polyploidization and breeding- its significance.
- Mutation breeding:** Methods of mutation breeding (chemical and physical), merits and demerits of mutation breeding, significance.
- Heterosis:** definition, types, theories of Heterosis, heterosis in self and cross pollinating plants and its application.
- Inbreeding depression:** Hybrid vigour and inbreeding depression, genetical basis of inbreeding depression, degree of inbreeding depression, out breeding and significance of inbreeding and out breeding.
- Back cross breeding:** Methods, merit and demerits, markers assisted breeding. **9 hours**

Unit 5: Plant genetic resources: Definition, classification, genetic diversity, significance of genetic diversity, erosion of genetic diversity, dangers of erosion, concepts of asexual seeds. **8 hours**

Unit 6: Seed certification and quarantine. **5 hours**

Recommended readings:

1. Bhojwani S.S. & Bhatnagar, S.P. The embryology of Angiosperms. Kalyani Publishers, NewDelhi.2001
2. Johri B.M. Ambegaokar, K.B. and Srivastava P.S. Comparative Embryology of Angiosperms, Vol. I& II, Springer Verlag.
3. Chahal, G.S. & Gosal S.S. Principles & Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.
4. Singh, P. 2001. Essentials of Plant Breeding, Kalyani Publishers, Hyderabad.
5. Allard, R. W. 1999. Principles of Plant Breeding. John Willey & Sons, New York.
6. Dana, S. 2001. Plant Breeding. Naya Udyog. Calcutta.
7. Singh. B. D. 1995. Plant Breeding – Principles and Methods. Kalyani Publishers, New Delhi.

IBS602T: ANIMAL REPRODUCTION & BREEDING

52 hours: 4 credits

Aims & objectives:

- To understand animal reproduction and mechanisms involved
- To understand various aspects of livestock breeding, its history, objectives, significance & problems
- To understand the future prospects of plant breeding and its role in crop improvement

Unit 1:

Introduction:

Invertebrates: Reproduction in Coelenterates, Annelida and Arthropoda with special reference to insects, male and female reproductive systems, hormones, pheromones and their role in sex differentiation and gonadal activity. Mollusca and Echinodermata: Male and female reproductive systems, Gamete diversity, comparative embryonic development.

Vertebrates: Reproduction in vertebrates: Fishes, Amphibians, Reptiles and Birds: Male and female reproductive systems, Reproductive patterns - Ovipary, Ovo-vivipary and vivipary. **13 hours**

Unit 2: The Female Reproductive System in mammals: Comparative anatomy and physiology of the mammalian and sub-mammalian ovary and ductal system. Follicular growth, Ovarian hormones, two cell theory of Estrogen biosynthesis. Autocrine, Paracrine, Endocrine regulation of Ovarian functions. **7 hours**

Unit 3: The Male Reproductive System in mammals: Comparative anatomy and physiology of the Mammalian and sub-mammalian testis and sex accessory glands: Function and organisation of Testis, Spermatogenic cycle, Testicular androgens, Autocrine, Paracrine, Endocrine regulation of Testicular function, semen and its biochemical nature. **6 hours**

Unit 4: Fertilization in Mammals: Pre-fertilization events, bio-chemistry of fertilization and post-fertilization events. Implantation and its hormonal regulation, delayed implantation. Placenta as an endocrine tissue; foeto-placental unit. Gestation and its hormonal regulation. **7 hours**

Unit 5: Regulation of mammalian reproduction: The Pituitary gland: Functional cytology, adeno-hypophyseal hormones, their chemistry and physiology. The hypothalamus and its neuro secretory centres: structure of Neurosecretory cells, the hypothalamic, principles: synthesis, storage, release and chemistry. The phenomenon of neuro-endocrine integration and the hypothalamo hypophyseal gonadal axis, mammary gland, endocrinology of lactation. **6 hours**

Unit 6: Animal Breeding: Concepts, development and applications breeds and breed structure, basic breeding methods; Silkworm, sheep and poultry and cattle; genetic principles in animal breeding, heredity and environment, Heritability, repeatability, methods of their estimations; genotypic, phenotypic and environmental correlations. Traits for selection, breeding efficiency and inbreeding, out breeding, top crossing, grading, cross breeding, criss-crossing, triple crossing system. Artificial insemination, infertility and assisted reproduction. **13 hours**

Recommended readings:

1. Balinsky, B.I. 1981. An Introduction to Embryology, 5th ed. W. B. Saunders Co. West Washington Square, Philadelphia.
2. Bodemer, C.W.1968. Modern Embryology, Holt, Reinhart Winston Inc. NY. Chicago.
3. Enerjee, G.C.1987.A text Book of Animal Husbandry, 6th ed. Oxford and IBH Pub. Co. NY. Delhi, Calcutta & Mumbai.
4. Dalton, D. C. 1987. An Introduction to Practical Animal Breeding. English Language Book Society Collins.
5. Gordon I (1983) Controlled Breeding in Farm Animals. Paragon Press, Oxford, NY & Sydney
6. Hafez, E.S.E. (1987).Reproduction in Farm Animals, 5th ed. Lea & Febigar, Philadelphia.

IBS603T: GENETICS

52 hours: 4 credits

Aims & objectives:

- To introduce the principles the principles of genetic inheritance, etiology of genetic disorders

Unit 1: Introduction to Genetics: Mendelism – Mendel's Law of segregation, Law of Independent Assortment. Chi-square test & its applications, Chromosomal basis of segregation & Independent assortment.

13 hours

Unit 2: Extension of Mendelian principles: Codominance, Incomplete dominance, Gene interactions, Pleiotropy, Genomic imprinting, Penetrance and expressivity, Phenocopy. Concept of gene – Allele, Multiple alleles, Pseudoalleles, Complementation test.

13 hours

Unit 3: Non-Mendelian inheritance & linkage studies: Linkage and crossing over, Linkage maps and interference and Coincidence, Intragenic recombination, Polygenic inheritance, Sex determination in animals and plants. X Chromosome inactivation in mammals, X linked inheritance, Sex limited and sex influenced characters. Cytoplasmic inheritance – maternal effects.

8 hours

Unit 4: Bacterial and Viral genetics: Genetics of Bacteria and their viruses, Bacterial Conjugation, Bacterial Transformation, Transduction, Lytic and Lysogenic cycle, Bacteriophage genetics.

5 hours

Unit 5: Human Genetics – Pedigree analysis, Karyotype, Genetic disorders (syndromes)

6 hours

Unit 6: Mutations: Mutations – Types of Mutations, Chemical mutagens, Radiation mutagenesis, Detection of mutations. Structural rearrangements of chromosomes: Deletion, Duplication, Translocation, Inversion; Numerical variation in Chromosomes – Aneuploidy, Euploidy.

7 hours

Recommended readings:

1. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.
2. Genetics - A Conceptual Approach (2012), 4th ed., Pierce, B.A., W.H. Freeman & Co.(New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.
3. An Introduction to Genetic Analysis (2010), 10th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 1-4292-2943-8.

IBS604T: MATHEMATICAL BIOLOGY

26 hours: 2 credits

Aims & objectives:

- To provide the student with a basic understanding of mathematical principles required for appreciating the use of mathematical equations in solving biological problems

Unit 1: Ratio and Proportions, fractional notations, Permutations and Combinations. **3 hours**

Unit 2: Functions: Linear functions, polynomials, simple rational functions, exponential functions (growth and decay), natural logarithmic functions and periodic functions (Sine and Cosine only) **4 hours**

Unit 3: Derivatives and Chain Rule, implicit differentiation. **6 hours**

Unit 4: Applications: Extrema, graph sketching, optimization, related rates. **6 hours**

Unit 5: Accumulated change and definite integrals (using definite integrals for finding area) for functions. **5 hours**

Unit 6: Partial Differentiation. **2 hours**

Recommended readings:

1. Applied Calculus, Hughus-Hallet et. Al. Wiley Publishers, 2005
2. An Introduction to the Mathematics of Biology, E.K. Yeaegers, R.W. Shonkwiler & J.V. Birkhauser (1996)
3. A Biologist's Basic Mathematics, D.R. Causton, Carollina Biological Supply Company (1983)
4. Calculus and analytic geometry, George Brinton Thomas, Ross L. Finney, Addison-Wesley Pub. Co.,2007.

IBS605P: PLANT REPRODUCTION & BREEDING

52 hours: 2 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Morphology of the reproductive parts of flower
2. Tests for Pollen Viability – *In vitro* pollen germination, Tetrazolium test.
3. Study of effect of Sucrose, Boron and Calcium on pollen germination.
4. Vegetative reproduction- Artificial methods- Grafting, Cutting ,Gootee, and Layering.
5. Breeding by emasculation, bagging and artificial cross pollination.

IBS606P: ANIMAL REPRODUCTION & BREEDING

52 hours: 2 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Reproduction in animals with models of vertebrates and invertebrates
2. Identification of sperms in insects, annelids, amphibians, and mammalian (slides)
3. Sperm counting, studies on process of fertilization (slides/Rat)
4. Visit to breeding research station/ and institutes- GKVK, IISC, Animal house etc.

IBS607P: GENETICS

52 hours: 2 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Study of Linkage, recombination, gene mapping using marker based data from *Drosophila*.
2. Study of sexual dimorphism in *Drosophila*.
3. Study of mutants in *D. melanogaster*.
4. Study of inheritance pattern of mono and dihybrid crosses, sex-linked inheritance & multiple allelism (ABO and MN blood group typing)
5. PTC testing in a population and calculation of allele and genotype frequencies.
6. Study of abnormal human karyotype and pedigree analysis (dry lab).
7. Determination of chiasma frequency and terminalization coefficient in *Allium cepa* & *Poekilocerus picta*.
8. Restriction enzyme digestion plasmid DNA & estimation of size of a DNA fragment after electrophoresis using DNA markers.
9. Construction of Restriction digestion maps from data provided.
10. Demonstration of DNA fingerprinting.

SEMESTER VII

Scheme of Instruction and Examination

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS701T	Pathology	4	-	52	3	70	30	100	4
IBS702T	Parasitology	4	-	52	3	70	30	100	4
IBS703T	Immunology	4	-	52	3	70	30	100	4
IBS704T	Microbiology	4	-	52	3	70	30	100	4
IBS705T	Teaching Methodology	2	-	26	2	35	15	50	2
IBS706P	Parasitology & Pathology	-	4×2	52×2	4	70	30	100	4
IBS707P	Microbiology & Immunology	-	4×2	52×2	4	70	30	100	4

Total marks: 650, Total credits: 26

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

IBS701T: Pathology

52 hours: 4 credits

Aims & objectives:

- Introduce the students to the central concepts of disease causing organisms
- Familiarize the students with terminologies used in description of plant & animal diseases
- Make the student understand, learn, and appreciate life-cycles of selected pathogens, their effects on the host, resistance of hosts, and the various control and eradication methodologies.

Plant pathology:

Unit 1: Introduction to plant pathology: Importance of plant diseases, disease concept, disease description and diagnosis, disease cycle terminology, life-cycle strategies of plant pathogens, host-pathogen interactions and co-evolution. **4 hours**

Unit 2: Plant fungal pathogens: Study of Oomycetes, Ascomycetes, Basidiomycetes as disease causing agents; disease cycle, host resistance, gene for gene concept, disease management with special emphasis on biological control. **9 hours**

Unit 3: Bacterial, Viral and Nematode pathogens of plants: Life cycle of selected pathogens affecting agricultural crops (Beans, tomato, rice, grapes, citrus, groundnuts, Ladies finger, tobacco), integrated management by cultural, chemical, biological and host resistance method, importance of plant quarantine in disease management. **13 hours**

Animal pathology

Unit 4: Introduction to animal pathology: History of pathology, principles of animal pathology including etiology, course and termination of disease. **4 hours**

Unit 5: Study of animal pathogenesis: Various degenerations, infiltration, necrosis, endogenous and exogenous pigmentations associated with animal pathology, circulatory and growth disturbances, reversible and irreversible cell injuries, different types of inflammation with special emphasis on chemical mediators.

9 hours

Unit 6: Fungal, viral and bacterial diseases of animals including disease management: Foot & mouth diseases of cattle, bird flu, mastitis in cattle, Grasserie, Flacherie, Muscardine, Pebrine (in silkworm and economically important insects), coccidiosis, scrapie, brucellosis, Q fever, marine white spot disease.

13 hours

Recommended readings:

1. George N. Agrios, Plant pathology, 5th edition, Elsevier academic press, 2000
2. R.S.Singh, Plant pathogens, Oxford and IBH publishing co., 1994

3. G.L.Schumann & C.J. D'Arcy, Essential Plant Pathology, 2nd edition, 2009
4. K. Starr Chester, Nature and prevention of plant diseases, 2006
5. JD Smyth, An Introduction to Animal Parasitology, 3rd edition, CUP, 1994
6. S.H. Gillespie & P.M. Hawkey ed. Medical Parasitology – A Practical Approach, OUP, 1995
7. F.E.G. Cox ed., Modern Parasitology, Blackwell Publishing, 1993.

IBS702T: Parasitology

52 hours: 4 credits

Aims & objectives:

- Introduce the students to the central concepts of parasitism & molecular parasitology
- Familiarize the students with ecology & evolution of parasites
- Make the student understand, learn, and appreciate life-cycles of selected parasites representing various phyla, their effects on the host, resistance of hosts, and the various control and eradication methodologies

Unit 1: Introduction to Parasitology: Comparative aspects of symbiosis (mutualism, commensalism, parasitism), types of hosts (definitive, intermediate, paratenic, accidental, reservoir host) and parasites (ectoparasites & endoparasites, facultative & obligatory parasites, pseudoparasites, occult parasitism, aberrant parasitism), host-parasite interactions (hypobiosis, zoonosis). **5 hours**

Unit 2: Ecology & evolution of parasites: Parasite ecology, parasite populations (macro & microparasites, population structure, multiple species infections), modes of parasitic reproduction (asexual, viviparity, hermaphroditism), parasitic transmission, epidemiology and parasite evolution. **8 hours**

Unit 3: Molecular Parasitology: Molecular mechanisms of susceptibility & resistance, immunity & immune responses, and xenobiotics. **8 hours**

Unit 4: Life-cycle, biology, distribution, disease and clinical management of protozoan parasites: *Entamoeba histolytica*, *Plasmodium* sp., *Trypanosoma* sp., *Leishmania* sp. **5 hours**

Unit 5: Life-cycle, biology, distribution, disease and clinical management of helminth parasites: Flat worms, blood flukes, liver flukes, intestinal flukes and lung flukes. **5 hours**

Unit 6: Life-cycle, biology, distribution, disease and clinical management of nematode & arthropod parasites: hookworms, pinworms, lungworms, root knot nematodes, Ascarids; lice, bugs, fleas, ticks & mites. **8 hours**

Unit 7: Classification, occurrence, biology and management of plant parasites: *Cuscuta*, *Striga*, *Viscum*, *Loranthus*. **6 hours**

Unit 8: Agriculturally important insect pests and parasites: Pests and parasites of commercially important crops (vegetables, cereals, pulses, fruits etc.) **7 hours**

Recommended readings:

1. JD Smyth, An Introduction to Animal Parasitology, 3rd edition, CUP, 1994
2. S.H. Gillespie & P.M. Hawkey ed. Medical Parasitology – A Practical Approach, OUP, 1995
3. F.E.G. Cox ed., Modern Parasitology, Blackwell Publishing, 1993.

IBS703T: Immunology

52 hours: 4 credits

Aims & objectives:

- Introduce the students to the central concepts of immunity and immune system
- Familiarize the students with the mechanisms of immune action & immunological dysfunction
- Make the student understand, learn, and appreciate immunological techniques & their application

Unit 1: Introduction to Immunology: Historical account; Cells and organs of immune system; Lymphocytes, their origin and differentiation (B-Lymphocytes and T-Lymphocytes); antigens, types and classification; complement system and its biological functions; types of immune responses; mechanism of immune response.

7 hours

Unit 2: Types of Immunity: Innate and acquired, humoral and cellular;

Humoral immunity - B-lymphocytes and their activation; structure and function of immunoglobulins; immunoglobulin classes and subclasses, genetic control of antibody production, monoclonal antibodies and diagnosis, idiotypes and idiotypic antibodies

Cellular immunity - Major histocompatibility complex. Thymus derived lymphocytes (T cells) their classification, antigen presenting cells (APC) - macrophages, dendritic cells, langerhans cells, their origin and functions; mechanisms of phagocytosis; identification of cell types of immune system; immunosuppression, immune tolerance.

13 hours

Unit 3: Immune hypersensitivity: Mechanisms of T cell activation, cytokines and their role in immune response; Leukocyte migration and inflammation; hypersensitivity of macrophage activation and granuloma formation, immune regulations, immune response to infectious organisms, Vaccines.

6 hours

Unit 4: Immunotechniques and their applications: Immunodiffusion, immunoblot, immunofluorescence, immunoaffinity, ELISA, agglutination, immunoprecipitation, immunoelectrophoresis, cross-linking.

10 hours

Unit 5: Transplantation and Grafting: Graft rejection, evidence and mechanism of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, mechanisms of immunity to tumor antigens.

10 hours

Unit 6: Autoimmunity: Auto-antibodies in humans, pathogenic mechanisms, experimental models of auto immune diseases, treatment of auto immune disorders.

6 hours

Recommended readings:

1. Roitt's Essential Immunology, by Delves, Martin, Burton & Roitt, 12th edition, Wiley-Blackwell, , 2011.
2. Kuby Immunology. Owen, Punt, Stranford, 7th edition, Macmillan, 2013.
3. Cellular & Molecular Immunology, Abbas et al., 7th edition, Elsevier, 2011.

IBS704T: Microbiology

52 hours: 4 credits

Aims & objectives:

- Introduce the students to the world of microbes
- Familiarize the students with the culture, maintenance & application of microorganisms for economic benefit

Unit 1: Introduction to Microbiology: History of microbiology, composition of microbial world, development of microbiology as a science, disciplines of microbiology and evolution of microorganisms.

Characteristic features and classification of Viruses, Bacteria, Actinomycetes, Eukaryotic microbes (Algae, Fungi, Protozoa, Nematodes). Recent trends in microbial taxonomy (chemotaxonomy, numerical taxonomy, DNA taxonomy, serological methods, genetic methods, ecological methods). **6 hours**

Unit 2: Culturing, maintenance and control of Microbes: Micro and macro nutrients, growth factors. Nutritional types of bacteria. Types of media (simple, complex, special), isolation, purification, Mass culturing, maintenance, effect of environmental factors on microbial growth- temperature, moisture, light, oxygen etc., control of microbial growth (disinfection and sterilization). Growth kinetics, generation time, growth curve. Aerobic, anaerobic, batch, continuous and synchronous cultures. IMViC tests. **10 hours**

Unit 3: Food & Dairy Microbiology: Microbes in food, food spoilage, food preservation, fermented foods, toxins and food poisoning. General account of Milk and milk products, contamination of milk, source of contamination, micro flora of milk and milk products, pasteurization, preservation of milk and dairy products **10 hours**

Unit 4: Agricultural microbiology: Micro flora of rhizosphere, rhizoplane, and phylloplane, Biological Nitrogen fixation, application of mycorrhizae and biofertilizers. **6 hours**

Unit 5: Atmospheric and aquatic microbiology- Air borne microbes, air samplers, air borne diseases, Microbes of marine and fresh water, microbes in potable water, water purification, waste water and sewage disposal, bioremediation. **10 hours**

Unit 6: Industrial microbiology: Industrially useful microbes, microbial fermentation - alcohol, wine and yoghurt, microflora of humans and domestic animals. **10 hours**

Recommended readings:

1. McCormick T, Essentials of Microbiology, Research & Education, NJ, 1998.
2. Johnson *et.al.*, Microbiology and Immunology, Lippincot Williams & Willkin, NY, 2002.

3. Waites M, Morgan N, Industrial Micro Biology, Blackwell Science, London, 2001.
4. Lynne I *et.al.*, Microbiology for health careers, Thomson Delmer Learning, NY, 1999.
5. Schelegel, H.G., General Microbiology, Cambridge University Press, London, 1996.
6. Thomas D. Brock, Michael T. Madigan, Biology of Microorganisms, Science, 10th edition
7. Pelczar, Microbiology, Tata McGraw-Hill. 1998
8. Elmer H. Marth, James L. Steele Applied dairy microbiology, CRC Press, 2001
9. P. D. Sharma, Environmental microbiology, Science, 2005
10. Roger Y. Stanier, General microbiology, Science, 1987
11. Lansing M. Prescott, John P. Harley, Donald A. Klein, Microbiology, Science, 2001
12. Funke Case Tortora, Cram, Microbiology, Education – 2006

IBS705T: Teaching Methodology

26 hours: 2 credits

Aims & objectives:

- Develop effective teaching and communication skills in students
- Make the student understand the challenges of teaching in higher education
- Make the student aware of integration of personal skills and ICT skills in teaching
-

Unit 1: Micro-teaching: Meaning, definition and importance of micro-teaching, micro-teaching cycle, elements of micro-teaching, planning of micro-lesson, skills of teaching (introducing lesson, explaining, fluency in questioning, stimulus variation, probing questions, using black-board), integration of skills.

6 hours

Unit 2: Strategies of teaching: Teacher-centred approaches (exposition teaching, demonstration method, lecture method), Learner-centred approaches (discussion method, brainstorming), individualized instruction, mastery learning.

6 hours

Unit 3: Communication & Education: Meaning & definitions of communication, components of communication, skill cycle, types of communication, factors affecting communication, communication models, strategies for effective communication, teacher expectancy, communication skills & teacher.

6 hours

Unit 4: Models of Teaching: Meaning of teaching/learning models, general features(syntax, social system, principle of reaction, support system, application), families of models of teaching (information processing, social interaction, personal development, behavioural modification), models of concept attainment, inductive, thinking and role model.

6 hours

Unit 5: Teaching effectiveness: Meaning of teaching competency, interaction analysis of category system (Flanders), components of teaching effectiveness.

2 hours

Recommended readings:

1. H.M. Shailaja & Rajeev P. Gundale, Skills and strategies of teaching, Vidyanidhi Prakashana, 2006
2. Rupal Jain, How to be a good teacher, Pustak Mahal, 2014.

IBS706P PARASITOLOGY& PATHOLOGY

52×2 hours: 4 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Identification of protozoan parasites

- *Trypanosoma*
- *Plasmodium*
- *Amoeba*
- *Nosema bombysis*
- *Leishmania*
- *Trichomonas*, ,
- *Entamoeba*
- *Toxoplasma*
- *Gregarina*,
- *Giardia*: and *Eimeria*,

2. Identification of Parasitic Arthropods (lice, fleas, Ticks, mites, Uzi fly)

3. Identification of vectors: Mosquitoes, Leaf hoppers, Thrips and Jassids

3. Identification of Soil and animal nematode parasites and platyhelminthes.

4. Methods of studying plant diseases- Scoring, Collection and preservation of samples

5. Culturing of Nematodes – Isolation and pathogenesis

6. Identification of disease pathology in

Plants: Tikka of ground nuts, Blast of rice, Mosaic of bhindi, Powdery mildew of grapes, Leaf spot of bean, Citrus canker.

Animals: Grasserie, Flacherie, Muscardine, Pebrine, Foot and mouth diseases, Mastitis in cattle, coccidiosis, Scrapie, Brucellosis, Bird flu, Q Fever, Marine White Spot Disease in fishes.

7. Identification of insect pests of agricultural crops – Leaf roller, mealy bugs, stem borers, sap suckers.

8. Field Visit to study crop diseases.

IBS707P MICROBIOLOGY & IMMUNOLOGY

52×2 hours: 4 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

Microbiology

1. Study of disinfectants and different methods of sterilization
2. Preparation of media for culturing bacteria, fungi and yeast
3. Isolation and identification of microbes – from soil and plant materials
4. To perform sub-culturing – streaking techniques (T streaking)
5. Study bacterial growth curve & effect of pH, temperature, UV light on bacterial growth.
6. Staining of microorganisms – Gram staining, Negative staining AFB staining, staining of fungi.
7. To perform antibiotic resistance assay
8. Enumeration of CFU of *E. coli* by serial dilution and spread plate method
9. Conjugation experiment
10. Microbes of milk and milk products – SPC
11. Milk quality testing by Methylene blue dye reductase test
12. Measurement of fungal microbes
13. Field visits: Dairy and Brewery

Immunology:

1. Separation of serum from blood samples
2. Isolation and enumeration of lymphocytes using haemocytometer
3. Isolation and enumeration of spleen cells
4. Purification of IgG from serum by ammonium sulphate fractionation method – Dialysis
5. ABO Blood group typing
6. VDRL/ WIDAL test
7. Immunodiffusion tests: Ouchterlony double immunodiffusion method (DID) and Single Radial immunodiffusion (SRID, Mancini method)
8. Demonstration of ELISA

9. Immunoelectrophoresis: Countercurrent IEP & Rocket IEP
10. Isolation and enumeration of lymphocytes using haemocytometer
11. Survey of structural plant defences: viz. cuticle, wax, lignin, bark, thorns, prickles, trichomes, armour in different plants species including thigmonasty, camouflage, mimicry.
12. Survey: Quantitative and qualitative secondary metabolites in plants: alkaloids, glycosides, glycosinolates, terpinoids, phenolics, gammosis etc. in healthy and diseased plant/plant organs.

SEMESTER VIII

Scheme of Instruction and Examination

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS801T	Genomics & Proteomics	4	-	52	3	70	30	100	4
IBS802T	Animal Molecular Physiology	4	-	52	3	70	30	100	4
IBS803T	Plant Molecular Physiology	4	-	52	3	70	30	100	4
IBS804T	Bioinformatics & Computational biology	4	-	52	3	70	30	100	4
IBS805T	Research Methodology	2	-	26	2	35	15	50	2
IBS806P	Genomics, Proteomics & Bioinformatics	-	4×2	52×2	4	70	30	100	4
IBS807P	Animal & Plant Molecular Physiology	-	4×2	52×2	4	70	30	100	4

Total marks: 650, Total credits: 26

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks. Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

IBS801T: GENOMICS & PROTEOMICS

52 hours: 4 credits

Aims & objectives

- To expose students to the concepts of genomics, transcriptomics and proteomics
- To provide students with the basic knowledge of genome, transcriptome and proteome manipulation

Unit 1: Genomics and the Human Genome project: History, organization and goals of human genome project, Mapping strategies, current status of various maps; DNA segment nomenclature, Human genome diversity, Organization of human genome, Mitochondrial genome, Gross base composition of nuclear genome, Gene density, CpG islands, RNA-encoding genes, Functionally identical/similar genes, Diversity in size and organization of genes. General aspects of the structure of *E. coli*, *Arabidopsis*, rice, yeast, *Drosophila*, *C. elegans* and mouse genome **13 hours**

Unit 2: Gene families: Multigene families – Classical gene families, families with large conserved domains, families with small conserved domains, Gene super families, Gene families in clusters, Pseudogenes, Repetitive DNA and transposable elements, Origin of gene families (Haemoglobin, Myoglobin as examples). **6 hours**

Unit 3: Comparative Genomics: Whole genome analysis, Genome sequence, micro assay, molecular phylogeny, Overview of prokaryotic and eukaryotic genomes, C-value, number of genes and complexity of genomes, Conservation and diversity of genomes, Comparative genomics as an aid to gene mapping and study of human disease genes. Comparative genomics of mitochondria and chloroplast genomes. **7 hours**

Unit 4: Genome wide analysis: Global study of Genome activity, Transcriptome and its analysis, Proteomics, Synthetic genomics **6 hours**

Unit 5: Protein characterization: Amino acids; proteins as polypeptides- classification of proteins, Backbone flexibility- Φ and ψ - Properties of amino acids-Hydrophobicity, EIIIP, Molecular weight, α and β propensities etc. Proteome and Proteomics Proteins as workhorse molecules of life, -protein separation & analysis using 2D Gel Electrophoresis, protein arrays; Liquid chromatography, Mass spectrometry- Protein-protein interaction; Detection of functional linkages. **7 hours**

Unit 6: Protein structure analysis: Structure prediction of primary, secondary and tertiary structure of proteins- SCOP, DALIDD, CATH classification. Interatomic forces and protein structure, covalent interaction, hydrogen bonds, hydrophobic and hydrophilic interaction, charge/dipole interaction, Vander waals forces, steric interaction, Determining protein structure, Homology modeling, CASP, *Ab initio* prediction, Molecular dynamics & conformational energy calculation, Prediction of function. **13 hours**

Recommended readings:

1. T.A. Brown, Genomes, Bios, 2002.
2. Coleman and Tsongalis, Molecular Diagnosis, Humana, 1997.
3. Dale & Scharz, From Genes to Genomes, Wiley, 2003.
4. Hawley and Mori, The Human Genome, Academic, 1999.
5. Lewis, Human Genetics, WCB, 1999.
6. Liebler, Introduction to Proteomics, Humana, 2002.
7. Pasternak, An Introduction to Molecular Human Genetics, Fitzgerald, 2000.
8. Primrose & Twyman, Principles of Genome Analysis & Genomics, Blackwell, 2003.
9. Strachan and Read, Human Molecular Genetics, Wiley, 1999.
10. Sudbery, Human Molecular Genetics, Prentice Hall, 2002.

IBS802T: ANIMAL MOLECULAR PHYSIOLOGY

52 hours: 4 credits

Aims and objectives:

- To provide an overview of the basic physiology in animals
- To expose the students to the concept of homeostasis in physiological regulation
- To educate the students about the physiological response in disease conditions

Unit 1: Introduction to mammalian physiology: Basic body plan in mammals, location of organs, concept of homeostasis. **2 hours**

Unit 2: Circulatory & Respiratory system – Composition of blood, cells, homeostasis, mechanism of blood clotting, organization of neuro cardiovascular reflexes, neuro-hormonal control of arterial pressure, integrated cardiovascular responses.

Mechanical properties of respiratory system. Tissue gas exchange, control of breathing. Distribution of ventilation and perfusion. **16 hours**

Unit 3: Excretory System – Renal hemodynamics. Glomerular filtration. Formation of urine, acid – base balance. Control of body fluid volume and osmolytes. **8 hours**

Unit 4: Nervous System & sensory organs – Synapses, NMJ, Cholinergic and Adrenergic systems, inhibitory neuro transmitters, structure and function of acetyl choline receptor. Mechanism of vision, taste, olfaction and auditory responses. **8 hours**

Unit 5: Muscular system- Muscle proteins, molecular mechanism of muscle contraction. Cardiac action potential, pacemaker, contractile machinery and mitochondria and energy supply. Cardiac performance (ECG). **8 hours**

Unit 6: Gastrointestinal System – Mechanism of gastric acid, pepsin and bicarbonate secretion, features of motor activity of gut, sphincters, specific patterns of motor activity, pattern of contraction. Digestion and absorption in gut. **6 hours**

Unit 7: Biomembranes – Physicochemical properties of biological membranes – membranes as permeability barriers. Special transporters on absorptive and secretory epithelium, types and role of ATPases, Ion channels including aquaporin and TRIP. **4 hours**

Recommended readings:

1. Bullock N, Boyle S, Wang M.B, Physiology, Lippincott Williams, New York, 2001.
2. Astrand P.P, Rodahl, Stromme, Text Book of Physiology, Kinetic Inc. New York, 2005.
3. William P. Stone G, Johnston I., Environmental Physiology of Animals, Blackwell Publishers, London, 2001.
4. Gerald Karp, Cell and Molecular Biology, Cell and Molecular Biology- Concepts and Experiments, John Wiley & Sons, New York, 1996.

5. Schmidt, Animal Physiology: Adaptation and Environment, 5th edition, Cambridge University Press, London, 1997.
6. Roberts M.B.V, Nelson Thrones, Biology: A Fundamental approach, Bristol, 2003.

IBS803T: PLANT MOLECULAR PHYSIOLOGY

52 hours: 4 credits

Aims and objectives:

- To provide an overview of the basic physiology in plants
- To expose the students to the concept of homeostasis in physiological regulation
- To educate the students about the physiological response in disease conditions

Unit 1: Photobiology and Signal Transduction: Signal transduction in stomatal opening and phototropism, Red/Far Red, Green and Blue light stimulated stomatal opening. (Role of Photoreceptors- Phototropins, Phytochromes, Cryptochromes and Zeaxanthin) on the Photosynthesis & Stomatal movements). **10 hours**

Unit 2: Cellular and Molecular mechanism of Phytochrome : Phytochrome- the Red/ Far-Red photoreceptor, structure, photo reversibility, properties, phytochrome induced whole plant responses- VLFRS, LFR & HIR and phytochrome induced Gene expression. **6 hours**

Unit 3: Floral stimulus and biochemical signaling involved in flowering: Circadian rhythms, molecular mechanism of photo-periodism and vernalization. **6 hours**

Unit 4: Biochemical signaling in plants: Role of cyclic nucleotides, calcium calmodulin cascade, protein kinases, phosphatase and specific signaling mechanism (Membrane based receptors & nuclear based receptors). **6 hours**

Unit 5: Defense mechanisms in plants: Genetic basis of Plant-pathogen interactions, R genes and R-gene mediated Disease resistance. Multiple types of defense reactions activated by pathogen attack, Hypersensitive reactions, Role of Reactive oxygen species in plant resistance response, Nitric oxide signaling, Role of salicylic acid and jasmonic acid in defense reactions, role of PR proteins and other defense other defense related proteins in signal transduction cascades. **10 hours**

Unit 6: Secondary metabolites: Types, chemical nature, mode of action of phenolics, terpenes and nitrogen containing compounds like alkaloids, cyanogenic glycosides and non-protein amino acids. **7 hours**

Unit 7: Stress Physiology: Molecular, biochemical and physiological aspects of plant responses and adaptations to water stress, Role of solutes in cell osmotic adjustment, Role of Seed proteins, Freezing stress, chilling stress, Heat stress, salinity stress & oxygen deficiency and Oxidative stress in plants (free radicals, scavenging enzymes- superoxide dismutase, peroxides and catalase). **7 Hours**

Recommended readings:

1. Gerald Karp, Cell and Molecular Biology, Cell and Molecular Biology- Concepts and Experiments, John Wiley & Sons, New York, 1996, 2014.
2. Buchanan B.B, Gruissem W and Jones R.L. Biochemistry and Molecular Biology of Plants, I.K. International Pvt. Ltd., 2004, 2007.
3. Dey and Harborne J.B. Plant Biochemistry, Aca. Press, 1977.
4. Hall D.O and Rao KK, Photosynthesis, Cambridge Press, 1999.
5. Harborne TC, Phytochemical methods- A guide to modern techniques of plant analysis, Chapman and Hall, 1981.
6. Moore TC, Biochemistry and Physiology of Plant Hormones, Springer, 1989.
7. Moore TC, Research experiences in Plant Physiology, Springer, 1974.
8. Taiz L. and Zeiger, E. Plant Physiology, Panima Publishing Co-operation, 2008.

IBS804T: BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

52 hours: 4 credits

Aims and objectives:

- To familiarize the student with the concept, tools and application of genomic & proteomic data mining

Unit 1: Introduction to Bioinformatics and Computational biology: Branches of Bioinformatics, Applications of Bioinformatics. Biological databases: Introduction, Classification of Biological databases, Biological data retrieval systems **9 hours**

Unit 2: Sequence Comparison and Database Search: Introduction, Pair wise alignment, global alignment, local alignment, multiple sequence alignment, scoring a multiple alignment, multiple sequence alignment methods **7 hours**

Unit 3: Dynamic programming approach, Progressive alignment, iterative refinement methods, pattern matching in DNA and protein sequences, PAM matrices, BLAST, FAST and FASTA. **10 hours**

Unit 4: Molecular phylogenetics: Introduction, application of phylogenetic trees, basic terminology- taxa, taxonomy, root, leaf, node, tree, branch, clade, dendrogram, cladogram, rooted tree, unrooted tree, scaled tree. **7 hours**

Unit 5: Molecular Clocks: Introduction, basic steps of phylogenetic tree construction, methods of phylogeny, Distance based methods-UPGMA, NJ algorithm, Character based methods- Maximum parsimony method, maximum likelihood method, validating phylogenetic methods-bootstrapping and jackknifing, study of Phylip, NJ plot, Clustal X, and other popular softwares. **9 hours**

Unit 6: Computer programming: Basics of linux, C, C++, Java, Perl & HTML programming **10 hours**

Recommended readings:

- 1) Zhumur Ghosh and Bibekanand Mallick, Bioinformatics, Principles and Applications, Oxford University Press, New Delhi, 2008
- 2) Teresa Attwood, et.al, Introduction to Bioinformatics, Pearson Education, Singapore, 2006
- 3) Joao Carlos Setubal et. al., Introduction to Computational Molecular Biology, PWS publishing company, Boston.
- 4) David W. Mount, Bioinformatics, Sequence and Genome analysis, CBS Publishing House
- 5) Balagurusamy, Computing Fundamentals And C Programming, McGraw-Hill Education (India) Pvt Ltd, 2008.
- 6) Arthur M. Lesk, Introduction to Bioinformatics, University of Cambridge, 2002.
- 7) O'Reilly & Associates, Beginning Perl for Bioinformatics, 1st edition, Sebastopol, CA, 2001.

IBS805T: RESEARCH METHODOLOGY

26 hours: 2 credits

Aim and scope:

- Introduces to the student the methodology of identifying research problem & designing experiments
- Familiarizes student to the techniques of presentation of research in papers & conferences

Unit 1: Research methodology: Nature of Research: Concept, Meaning and Definition. Introduction to research methods, concepts of research – basic v/s applied research, Historical and Descriptive/ Analytical Research, Conceptual and Experimental/ Empirical Research. **3 hours**

Unit 2: Research processes: Research design, identification of research gaps, Research problems: Identification, selection and formulation of hypothesis, conceptualization of research problems, data tools and techniques. **5 hours**

Unit 3: Sources of data: Primary and secondary data: Survey – Sampling techniques, systematic random sampling, multiple random sampling and positive random sampling. **4 hours**

Unit 4: Designing of Experiments: Questionnaires and interview methods, data processing and data analysis: Presentation and prediction of research findings, Statistical tools **6 hours**

Unit 5: Review of literature: Identification of sources of literature, Types of literature, Collection and Review of research literature, and their evaluation. Necessity and importance of review of literature. **4 hours**

Unit 6: Presentation of Research findings

Report/ thesis writing/ research correspondence, General strategies for preparation of Research Proposal, Data representation in Technical Reports, Poster presentation in Scientific conferences and Workshops. Preparation of manuscripts for national and international journals. Yardsticks employed in evaluation of manuscripts for publication. Citation index & impact factor of journals. **4 hours**

Recommended readings:

1. Louis Cohen, Research Methods in Education (6th Edition), Lawrence Manion, and Keith Morrison, Paperback Publications, 2007.
2. Robert K. Yin, Case Study Research: Design and Methods: (Applied Social Research Methods), Paperback Publications, 2003.
3. Jane Ritchie and Jane Lewis, Qualitative Research Practice: A Guide for Social Science Students and Researchers, Paperback, 2003.
4. Stephen F. Davis, Handbook of Research Methods in Experimental Psychology, Black Well Publications, London, 2005.

IBS806P: GENOMICS, PROTEOMICS & BIOINFORMATICS

52×2 hours: 4 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

Genomics & Proteomics:

1. Restriction mapping of plasmid DNA
2. RAPD analysis
3. RFLP analysis
4. DNA fingerprinting analysis: Parentage detection
5. Demonstration of EST/ STS/ Microarray analysis
6. Homogenization, fractionation and separation of enzymes/ proteins in plants and animals
7. 2D-PAGE separation of proteins

Bioinformatics:

1. Searching bibliographic databases for relevant information;
2. Sequence retrieval from nucleic acid and protein databases;
3. Restriction mapping; Sequence (FASTA and BLAST) searches;
4. Pair wise comparison of sequences; Multiple alignment of sequences; Evolutionary studies / Phylogenetic analysis;
5. Identification of genes in genomes; RNA folding; Primer Design;
6. Protein databank retrieval and visualization;
7. Superposition of structures; Secondary structure prediction of proteins;
8. Identification of membrane proteins;
9. Pattern searching in proteins (PROSITE);
10. Pattern searching in nucleic acids; Validation of 3D structures;
11. Genome analysis – a typical example.
12. Basic programming: C, Linux, C++, Java, HTML

IBS807P: ANIMAL & PLANT MOLECULAR PHYSIOLOGY

52×2 hours: 4 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Effect of isotonic, hypotonic and hypertonic salines on erythrocytes
2. Estimation of RBC count and total WBC count using haemocytometer
3. Oxygen consumption in aquatic animals by Winkler titrimetry and dipping Oxygen electrode.
4. Measurement of heart beat rate in Invertebrates. Influence of excitatory and inhibitory neurotransmitter on the rate.
5. Effect of ACh and DOPA on Skeletal muscle contraction (Using Kymograph)
6. Estimation and separation of amino acids from various tissues including blood
7. Estimation of alkaloids in the given plant.
8. Estimation of Flavonoids in the given plant.
9. Estimation of total Phenolics in the leaf tissue.
10. Estimation of Proline in the leaf tissue.
11. Extraction and Estimation of total chlorophylls, carotenoids and total proteins in Normal (unstressed) and stressed plants.
12. Estimation of antioxidant activity in a given plant.

SEMESTER IX

Scheme of Instruction and Examination

Paper code	Paper title	Hours / week		Total no. of hours / semester	Examination				Credits
		Theory	Practical		Duration (hours)	Max. Marks	Internal Assessment	Total Marks	
IBS901T	Systems biology	4	-	52	3	70	30	100	4
IBS902T	Genetic Engineering	4	-	52	3	70	30	100	4
IBS903T	Biomedical Sciences	4	-	52	3	70	30	100	4
IBS904T	Plant & animal Biotechnology	4	-	52	3	70	30	100	4
IBS905T	Open Elective	4	-	52	3	70	30	100	4
IBS906P	Genetic Engineering & Biotechnology	-	4	52	4	35	15	50	2
IBS907P	Biomedical Sciences & Systems biology	-	4	52	4	35	15	50	2

Total marks: 600, Total credits: 24

Internal assessment:

Theory paper (30 marks): Class test – 15 marks; Seminar (report + presentation) – 5+5 = 10 marks; Attendance – 5 marks.

Practical paper (15 marks): Class test – 5 marks; Laboratory record – 5 marks; Attendance – 5 marks.

IBS901T SYSTEMS BIOLOGY

52 hours: 4 credits

Aims and objectives:

- To provide understanding regarding the interactive network of biological components that make up a cell or an organism, and how the networks generate whole cell functions (for example, the enzymatic and metabolic pathways)

Unit 1: Introduction: Systems biology as a new perspective, scope and application of systems biology. Systems structure –Biological systems, metabolic systems, signal transduction systems, neural networking systems, pathways, dynamics, response to perturbation, stress response, Heat shock response. **7 hours**

Unit 2: Control of enzyme activity & metabolic pathways: Introduction, control of activities of the single enzymes, controlling the activity by change in covalent structure of enzymes, models account for the behavior and regulation of enzymes, significance of allosteric and cooperative behavior of enzymes. Metabolic pathways - general consideration, amplification of signals, formulation of theories for control of metabolic pathways, examples Regulation of glycolysis, gluconeogenesis and glycogen metabolism. **13 hours**

Unit 3: Enzymes in organized systems:

- Models of multi-enzyme complexes
- Pyruvate dehydrogenase from *E.coli* and mammalian Tissues.
- Tryptophan synthase.

6 hours

Unit 4: Gene expression: Introduction, analysis of gene expression , different tools available for analysis of gene expression, measurement of gene expression by Micro arrays, RNAi types of micro arrays, analysis of micro array gene expression data, Relating Expression data to other biological information – Predicting binding sites of proteins to DNA, Predicting protein-protein interactions and protein functions, Predicting functionally conserved modules, Reverse-engineering of gene regulatory networks. **13 hours**

Unit 5: Introduction to proteomics and genomics: Genomics and Proteomics as a foundation for Systems Biology, Strategies relating to In-silico Modeling of biological processes, Metabolic Networks, Signal Transduction Pathways, Gene Expression Patterns. Applications of Systems Biology Markup language (SBML), E-cell and V-cell Simulations and Applications; Synthetic genomics – Methods and applications

9 hours

Unit 6: Bioinformatics in Drug and Vaccine Design: Introduction, The drug discovery process, Techniques in drug and vaccine designing. **4 hours**

Recommended readings:

1. Jonathan Pevsner, "Bioinformatics and Functional Genomics" 2003 John Wiley & Sons, Inc.
2. ICRF handbook of genome analysis, by NK Spurr, BD Young, SP Bryant. Volumes I & II. - Blackwell science publishers.
3. ICRF handbook of genome analysis, by NK Spurr, BD Young, SP Bryant. Volumes I & II. - Blackwell science publishers
4. Daniel P. Berrar, Werner Dubitzky, Martin Granzow, "A Practical Approach To Microarray Data Analysis" 2003 Kluwer Academic Publishers ISBN: 1-4020-7260-0
5. Molecular Modeling Principles and Applications, Andrew R. Leach, II ed. 2001. Prentice Hall
6. Murphy K.P. (ed.) Protein structure, stability, and folding (Humana Press, 2001)
7. Current Protocols in Protein Science, Wiley Publishers, 2005

IBS902T: GENETIC ENGINEERING

52 hours: 4 credits

Aims & objectives:

- Introduce the various techniques and tools for genetic manipulation of plant and animal genomes
- Provide an understanding of the ethics & patent rights associated with gene manipulation

Unit 1: Introduction to Recombinant DNA technology: An overview of structure and function of nucleic acids, role of enzymes used in Genetic Engineering (endo- & exonucleases, RNase, DNase, restriction endonucleases) DNA methylation, RNA modification, role of kinases, phosphatases, bacteriophage polynucleotide kinase, Ligases. Vectors employed in recombinant DNA technology, – cloning plasmids (pBR322, pUC19/18, Ti) cosmids, phagemids, shuttle vectors, ARS, mini chromosomes, BACs, PACs, YACs, Expression vectors used for expression of proteins in bacteria, yeast, plants and animal cell lines.

13 hours

Unit 2: Gene cloning and expression: Various techniques and strategies used in gene cloning in prokaryotes (*E. coli*) and eukaryotes (*S. cerevisiae*, *Pichia pastoris*), gene transfer methods: Physical, Chemical and Biological. Transformation into bacteria and yeast, transfection into plant and animal cells, selection of recombinant cells, expression of recombinant proteins.

9 hours

Unit 3: Gene Screening and Isolation: Isolation and purification of nucleic acids, Construction of genomic and cDNA libraries, Selection of probes and labeling, Blotting of DNA / RNA and hybridization, Colony, plaque screening and hybridization.

4 hours

Unit 4: DNA sequencing: Dideoxy and chemical methods, sequence assembly, automated sequencing, and applications of DNA sequencing (synthetic oligonucleotides), Next Generation Sequencing (NGS).

3 hours

Unit 5: Application of recombinant DNA technology: Overview of transgenic plants and GMO (Bt cotton, golden rice, tomato, corn, brinjal, cow, sheep, poultry, fish). Gene therapy: rationale, types of gene therapy (additive, replacement), gene therapy vectors (viral, non-viral), gene therapy drawbacks, gene therapy clinical trials and outcome, integration of gene and cell therapy.

10 hours

Unit 6: Bioethics and IPR

Introduction to ethics: deontology & consequentialism, ethics codes, relationship to law; Human subject research: history and standards; federal regulation of research, protection; Genetics & ethics: privacy and confidentiality, discrimination & commercialization; Introduction to IPR, Patents-Gene Patenting, Trademarks, Copyrights, Industrial Designs, Geographical Indications, Future Developments of Intellectual Property Rights.

6 hours

Unit 9: Bioprocess engineering

Screening and selection of industrial microorganisms, Bioreactors – types, basic functions, design and components, construction, temperature control, aeration, agitation systems, sterilization of fermenters, air supply and medium, aseptic inoculation and sampling methods.

7 hours

Recommended readings:

- Introduction to Genetic Engineering by Nicholl. Cambridge Low Price Edition.
- Principles of gene manipulation - An introduction to genetic engineering, Old R.W., Primrose S.B., Blackwell Scientific Publications, 1993.
- Genes VIII by Benjamin Lewis. Oxford University & Cell Press
- Bacterial Plasmids by P. Broda.
- Genetic Engineering Vol. 1-4 (Williamson Edition)
- Recombinant DNA by Watson et al., 1983.
- Vectors by Rodriguer and Denhardt, 1987.
- Molecular cloning Volumes I, II and III. Sambrook J et al (1989, 2000). Cold Spring Harbor laboratory Press, New York, USA.
- Furrow et al., Bioethics (6th ed. 2008).
- Intellectual property rights: innovation, governance and the institutional, Birgitte Andersen, Law – 2006

IBS903T: BIOMEDICAL SCIENCES

52 hours: 4 credits

Aims & objectives:

- Familiarize the student with frontier areas of biomedical research & application
- Provide an understanding of technology & tools associated with disease detection & cure

Unit 1: Stem Cells: Definition and characteristics, classification of stem cells (Embryonic stem cells and adult stem cells), stem cell niche, stem cell division and its control, induced pluripotent stem cell generation & application, hemopoietic stem cell disorders: classification and manifestations, principle and procedure of bone marrow transplantation. **8 hours**

Unit 2: Human Cytogenetics: Human Chromosomes and karyotypes, sex determination, X and Y chromosomes, evolution of human chromosomes, Fragile sites mutagenesis studies, causes of chromosome breakage, SCE/MN, In-situ Hybridization, chromosome and cancer, studies of prenatal chromosomes, Somatic cell hybrids in gene mapping, chromosomal disorders/ syndromes. **6 hours**

Unit 3: Cancer Biology: Different types of tumors, factors and mechanism involved in tumor formation, oncogenes, tumor suppressor genes, methods of detection of cancer, tumor markers, treatment-chemotherapy, radio therapy, immunotherapy and gene therapy for cancer. **7 hours**

Unit 4: Human Microbial diseases: Mode of infection, symptoms, epidemiology and control of AIDS, Hepatitis B, Rabies, Tetanus, Typhoid, STD, TB, Cholera, Aspergillosis, Histoplasmosis, Cryptococcosis, Leprosy, H₅N₁ and H₁N₁; Arboviral diseases: Yellow fever, Dengue, Japanese Encephalitis, Chickungunia, Kyasanur forest disease- epidemiology and management. **8 hours**

Unit 5: Haematology and transfusion science: Structure, function and production of blood cells, platelet structure and function haemostasis, fibrinolysis, thrombosis. Types of anaemias, haemoglobinopathies and thalassaemias, Haematological malignancy. Transfusion science, Genetics, inheritance, structure and role of red cell antigens, The preparation, storage and use of blood components, the selection of appropriate blood components for transfusion and possible adverse effects, immune mediated destruction of blood cells, health and safety aspects of handling blood. **11 hours**

Unit 6: Disease diagnostics: Nervous system, perspective and behaviour, Neural disorders and repair. DNA finger printing in Forensic science and Disease diagnosis. Enzymes in diagnosis of human diseases and Health care. Acetylcholinesterase, angiotensin converting enzyme (ACE), Pseudocholinesterase, 5'- nucleotidase (5NT), Glucose-6-phosphate dehydrogenase (GPD) and other red cell enzymes; CK isoforms, Immunoreactive trypsinogen (IRT) and Chymotrypsin; Amylase isoenzymes, Macroamylases, Isoenzymes (CK, LD, ALP). SGOT and SGPT. Diagnosis of Diabetes mellitus and Glucosurea. **12 hours**

Recommended readings:

- Enzyme Technologies for pharmaceutical and biotechnological applications by Herbert A Kirst, Wu-Kuang Yeh, Milton J.
- Developmental Biology, 6th Edition, by Scott F. Gilbert
- Hematology, by William J. Williams, Ernest Beutler, Allan J. Erslev, Marshall A. Lichtman
Molecular Biology of the Cell, 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson
- Caul .E (1992) Immuno-flouresent–antigen detection techniques in diagnostic microbiology, Pub ,Health Lab services
- Cruick shank et.all Medical microbiology
- Goding, M.J.W Monoclonal Antibodies: principles and practice – (1983) Academic press.
- Kuby.J (1992) Immunology 4th Edn. Richard A. Goldsby Kindt & Oshome Eds W.H. Feeman & Co .NY
- Zaiko, G.E (2004) Biotechnology and agriculture & Food industry, Nova publishers
- A. V. Hoffbrand, P. A. H. Moss, J. E. Pettit, Essential haematology- Medical – 2006
- Atul B. Mehta, A. V. Hoffbrand, Haematology at a glance- Medical – 2005

IBS904T: PLANT AND ANIMAL BIOTECHNOLOGY

52 hours: 4 credits

Aims & objectives:

- Familiarize students with the tools, techniques, bio-safety and bioethics of plant and animal biotechnology

Plant Biotechnology

Unit 1: Introduction to plant tissue culture: Scope and importance of plant tissue culture – media composition and types, hormones and growth regulators, explants for organogenesis, somaclonal variation and cell line selection, production of haploid plants and homozygous cell lines. Micropropagation, somatic embryogenesis, protoplast culture and somatic hybridization, selection and maintenance of cell lines, cryopreservation, germplasm collection and conservation, plant tissue culture certification. **9 hours**

Unit 2: Metabolic engineering of plants: Plant cell culture for production of useful chemicals and secondary metabolites (hairy root culture, biotransformation, elicitation)- pigments, flavanoids, alkaloids, mechanism and manipulation of shikimate pathway. Production of industrial enzymes, biodegradable plastics, therapeutic proteins, edible vaccines and antibiotics using transgenic technology. **9 hours**

Unit 3: Transformation techniques & GM technology: Ti and Ri plasmids as vectors, role of virulence genes, design of expression vectors (35S promoter, genetic markers, reporter genes). Direct gene transfer methods – particle bombardment, electroporation and microinjection. Transgene stability & gene silencing. Crop improvement, productivity, performance and fortification of agricultural products. Strategies for engineering stress tolerance plants. Current status of transgenic plants in India and other countries. Importance of terminator gene technology. Environmental impact of herbicide resistance crops and super-weeds. **8 hours**

Animal Biotechnology

Unit 4: Introduction to animal cell culture: Cell culture laboratory design, layout and maintenance. Methods of sterilization, types of culture media, composition, preparation and metabolic functions. Role of CO₂, serum, supplements, growth factors (EGF, PDGF,NGF, Gap-43). Serum and protein-free defined media. Culture and maintenance of primary and established cell lines. Biology of cultured cells – culture environment, cell adhesion, cell proliferation and differentiation. Characterization of cultured cells, viability, cytotoxicity, growth parameters, cell death and apoptosis. Expression of culture efficiency. **13 hours**

Unit 5: Transgenic animals: Methods involved in the production of transgenic animals. Gene knock-out and mice models of human diseases. Methods of animal cloning and their importance with reference to domestic animals. Improvement of biomass, disease resistance, recombinant vaccines for poultry. Pharmaceutical products produced by mammalian cells – plasminogen activator, erythropoietin, blood clotting factors, glycoprotein hormones, interleukins, interferons, cell culture based vaccines. **10 hours**

Unit 6: Biosafety: The Cartagena protocol on biosafety. Biosafety management: environmentally responsible use of biotechnology, ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons. National and international guidelines with regards to rDNA technology, transgenics and

GM crops. Good manufacturing practice (GMP) and Good laboratory practices (GLP).

3 hours

Recommended readings:

1. Ballin C.A. et al., Animal Biotechnology, Pergamon press, New York 1989.
2. Glick B.R. and Pasternak J.J., Molecular Biotechnology, ASM Press, Washington DC, 2003.
3. Ratledge C. and Kristiansen B., Basic biotechnology, CUP, London 2001.
4. Shantharam D. et al., Biotechnology, Biosafety & Biodiversity: Scientific & Ethical issues for sustainable development, 1999.
5. John Davis, Animal cell culture:Essential methods (1st ed), Wiley-Blackwell & Sons, 2011.
6. Kirakosyan A., and Kaufman P.B., Recent advances in Plant Biotechnology (1st edition ed.), Springer publishers, 2009.
7. Nickoloff J.A., Plant cell electroporation and electrofusion protocols- Methods in molecular biology, Humana Press, NJ, USA, 1995.
8. Heldt, Plant biochemistry and Molecular biology, Oxford and IBH Publishing Co., Delhi 1997.

IBS905T: OPEN ELECTIVE**48-56 hours: 4 credits****Open Electives under Faculty of Science**

Serial no.	Department	Elective code	Title of the Elective
01	Botany	305(B)	Environmental biology and natural resources
02	Sericulture/ Life Sciences	LS304	Human health & hygiene
03	Biochemistry	304.2 Elective	Biochemistry in daily life
04	Physics	P305	Physics and our world
05	Electronic media	T306	Skills for broadcast media
06	Geography	Paper 3.6	Geography for all
07	Library & Information Science	P306	Information literacy
08	Environmental Science	ES304	Climate change & current issues
09	Microbiology & Biotechnology	MBO-304	Biotechnology in human welfare
10	Fashion & Apparel design	FAD 3.8 OE	Fashion design
11	Psychology		Psychology & life
12	Chemistry	C-304	Chemistry for all
13	Zoology	304	Economic Zoology
14	Mathematics	M307(G)	Mathematics for everyone
15	MCA Programme		Cyberspace
16	Geology		The world of rocks and minerals
17	Statistics	ST304	Statistical methods
18	Human consciousness and yoga sciences	3.6	Yoga & life
19	Home Science		

Open Electives under Faculty of Arts

Serial no.	Department	Elective code	Title of the Elective
01	English		Write it right
02	Social work		Social movements & social action
03	Rural development		Co-operative management
04	Political Science		Indian politics today
05	Centre for Women's studies		Gender and society
06	History		Social movements of India
07	Urdu		Urdu Ghazal
08	Sociology		Themes & perspectives in Sociology
09	Hindi		Samanya Hindi
10	Economics		Economics of globalization
11	Kannada		
12	Performing Arts		Performing Arts and Society
13	Communication		Media and society
14	Telugu		Introductory Telugu course
15	Sanskrit		Sanskrit made easy 1. Arthasastra 2. Sahitya
16	Gandhian studies		Mahatma Gandhi & contemporary world
17	Ambedkar studies		
18	Foreign languages		
19	Visual arts		
20	Philosophy		

Open Electives under Faculty of Commerce

Serial no.	Department	Elective code	Title of the Elective
1	MBA		Management perspectives
2	M.Com		Finance and banking

Open Electives under Education, Physical Education & Law

To be announced.

IBS906P: GENETIC ENGINEERING & BIOTECHNOLOGY

52 hours: 4 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Callus Induction Techniques
2. Artificial seed production
3. Production of haploid plants by anther and pollen culture
4. *Agrobacterium* mediated transformation
5. Isolation and purification of plasmid DNA from *E. coli*
6. Fibroblast culture from chick embryo
7. Cell disruption techniques
8. Solid-liquid separation methods: Sedimentation.
9. Solid-liquid separation methods: Filtration.
10. Solid-liquid separation methods: Centrifugation.
11. Estimation of percentage of ethanol from fermented broth
12. Estimation of Lactic acid from fermented broth.
13. Production, isolation and purification of biopharmaceuticals/ antibiotics, *Pencillium notatum*.
14. Production of wine using yeast
15. Micro injection and transformation

IBS907P: BIOMEDICAL SCIENCES & SYSTEM BIOLOGY

52 hours: 4 credits

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Estimation of SGOT in blood samples by standard curve method
2. Estimation of SGPT in blood samples by standard curve method
3. Estimation of LDH in blood samples by standard curve method
4. Estimation of Creatinine in blood samples by standard curve method
5. Estimation of Cholesterol – hypercholesteremia samples
6. Estimation of Bilirubin
7. Estimation of blood glucose by glucose oxidase method
8. Immunoassay for detection of typhoid (kit method)
9. STD detection by agglutination method (kit method)
10. Chromosomal analysis, bright field technique, GTG and CBC banding
11. NOR staining and sex chromosome identification
12. Identification of organelles by marker enzymes: SDH, LDH, acid phosphatase
13. Fluorescence technique, Q & C banding, FISH
14. Labeling of DNA-probes by Nick –translation filter test. .
15. Karyotyping- normal karyotyping, Aneuploidy, Aberrations.
16. Gene expression measurement through DNA microarrays and SAGE.

SEMESTER X

Scheme of examination and evaluation

Paper	Component	Max. marks	Credits
IBS1001T Dissertation Project	Seminar, Poster & Colloquium (IA)	50+50+50	24
	Dissertation	350	
	Oral presentation	50	
	Viva-voce	50	
	Total	600	24

- Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life problem. The students are expected to pursue a research project, either in-house, or in an external research institute (private / public). In addition to the Principal Investigator in whose laboratory the student will be pursuing the research project, an internal guide from the Department of Biological Sciences will be assigned to the student. S/he will be responsible for keeping track of the student's progress towards submission of the final dissertation. Additionally, the student may approach him/her at any point of time seeking guidance / suggestion, if required.
- Within one month of starting to work on the research project, the student will be required to deliver a seminar outlining the background, objectives and methodology of the project undertaken by him/her. This will be evaluated by members of faculty assigned by the Chairman/Coordinator and **will count towards internal assessment (IA)**.
- In the mid-semester (date to be announced at the beginning of the semester), the students will be expected to make a poster presentation of their research project and deliver a colloquium highlighting background literature review and showcasing results obtained thus far. The poster and the presentation will be evaluated by the members of an internal committee constituted by the Coordinator /Chairman of the Department. **These will count towards internal assessment (IA)**.
- After the student has completed his/her research project within the stipulated time, s/he will be required to submit two copies of dissertation approved both by the external as well as internal guide, present the results in an open seminar (oral presentation), and defend the theses through a viva-voce conducted in accordance with existing regulations.