



Kristu Jayanti College

AUTONOMOUS

Bangalore

Accredited 'A' Grade by NAAC | An Institution Managed by CMI Fathers

DEPARTMENT OF LIFE SCIENCES

**Bachelor of Science
(Microbiology, Biochemistry, Genetics)
Curriculum 2015 –18**

<http://www.kristujayanti.edu>.

PROCEEDINGS OF THE MEETING OF THE BOARD OF STUDIES (BoS) FOR THE FACULTY OF SCIENCE - LIFE SCIENCES (UG)

The meeting of the B.O.S. (U.G) in Biotechnology, Genetics, Biochemistry & Microbiology was convened on 24th January, 2015 in the panel room P.G block, Kristu Jayanti College, Bangalore.

MEMBERS PRESENT

SIGNATURE

1. Dr. Calistus Jude A.L.
Dean – Faculty of Sciences, KJC
2. Dr. S. K. Sarangi
Professor, Department of Biotechnology, BUB
3. Dr. Jaya Prakash
Professor & Director, Centre for Applied Genetics, BUB
4. Dr. M.S. Shaila
Department of Microbiology and Cell Biology, IISC
5. Dr. Nitesh Dave
Senior Scientist, Biocon India Pvt., Ltd, Bangalore
6. Dr. Elcey C.D.
Professor & Head, Department of Life Sciences, KJC
7. Dr. Deepa M.A.
Associate Professor, Department of Life Sciences, KJC
8. Dr. Vijayanand S.
Assistant Professor, Department of Life Sciences, KJC
9. Mr. Thomas Abraham
Assistant professor, Department of Life Sciences, KJC
10. Dr. Shalini Prabhu
Assistant professor, Department of Life Sciences, KJC
11. Mr. John Caleb T.D.
Assistant professor, Department of Life Sciences, KJC
12. Ms. Apoorva Udhayashankar
Assistant professor, Department of Life Sciences, KJC

The Dean - Faculty of Sciences Dr. Calistus Jude A.L welcomed the members of the board and initiated discussions on the following:

1. Curriculum overview

The head of the department presented an overview of the academic programme of the department which included programme matrix, assessment methodology, credit system for major core, practical, project and additional impetus. The BOS approved the same with some necessary corrections.

2. Syllabus

The draft Autonomous syllabi for U.G programmes in Biotechnology, Genetics, Biochemistry, Microbiology was presented, which was scrutinized thoroughly course wise by the subject experts. The BOS suggested necessary corrections and approved the syllabus.

3. Panel of Examiners:

Panel of Examiners (both external and internal) for B.Sc., programme was finalized and approved for the academic year 2015-2016.

CURRICULUM OVERVIEW

1. Aim of the Programme

To prepare the students to be true professionals in Microbiology and to make them fit to be employable in industries as pharma, food, fermentation, diagnostics, clinical research as well as to be competitively eligible for post graduate courses offered in various universities across the country and abroad.

2. Eligibility

Pass in PUC / 10+2 / Pre – University / equivalent course should have studied Biology / Chemistry as one of the subjects.

3. Credits

PART	CATEGORY	HOUR S PER WEEK	CREDITS x SEMESTER	TOTAL CREDI TS	SEMESTER
I	Language	4	3x4	12	I, II, III & IV
	English	4	3x4	12	I, II, III & IV
II	Major I (Theory + Practical)	4+2	3 +1= 4 (x4)	16	I, II, III, IV
	Major I (Theory + Practical)	3+2	3+1 =4 (x4)	16	V & VI
	Major II(Theory + Practical)	4+2	3 +1= 4 (x4)	16	I, II, III & IV
	Major II(Theory + Practical)	3+2	3+1=4 (x4)	16	V & VI
	Major III (Theory + Practical)	4+2	3 +1=4 (x4)	16	I, II, III & IV
	Major III(Theory + Practical)	3+2	3+1=4 (x4)	16	V & VI
III	Non – Core (Compulsory)	2	1	3	I, II & IV
IV	Project			3	
	Industrial Visit			1	
	Club Activities /Current affairs	3		2	
	Workshops / Seminars			1	
	Value Added Course			–	
IV	Life Skill Education (LSE)		2	2	I
V	NSS/NCC/Extra – Curricular/Co-curricular and Social Outreach		1x3	3	I, II, III

Student has to earn a total of 135 credits for successful completion of the programme

4. Attendance

- ✦ A student should have 75 percentage of attendance in each course
- ✦ Any student who is not complying to this requirement will not be allowed to appear for End Semester Examination
- ✦ In case a student does not appear for the examination due to shortage of

attendance, the student has to repeat that semester to make up for the attendance and the student will have to pay the fees for that semester as applicable.

5. Passing Criteria for UG

- No minimum pass mark for CIA
- ESE (End Semester Examination) alone 35% – (35 marks out of 100 / 21 marks out of 60)
- (ESE + CIA) aggregate 40 % or 40 marks out of 100
- Student has to get pass mark in non-core course of the respective semester to get overall “Pass” status.
ESE alone 35% – (32 marks out of 90 / 16 marks out of 45) and (ESE + CIA) aggregate 40% or 20 marks out of 50
- Student should achieve the total number of credits = 135 Credits for the UG programme

6. Orientation and Bridge Programme

The orientation programme of the department familiarizes students joining the programme on the culture and functioning of the department. Students are inducted into the main programme through bridge programmes on Biotechnology, Genetics and Biochemistry.

7. Value Added Courses

Semester II	Bio analytical skills
Semester III	Animal Tissue Culture
Semester V	Methods in Cytogenetic Analysis
Semester VI	Medical Biotechnology / Clinical Research

8. Internship / Project

The students have to undertake a project on any of the subjects related to life science. The students will perform the project individually or in groups of 3 members (max), in which case the work done and contribution by members of the group will be assessed on an individual basis. Periodic assessment of the project work done will be carried out by an expert panel that will include the project guide. The project will be awarded with a credit towards the end of the course.

9. Skill Development Activities

Students active participation in various activities scheduled periodically every week will be evaluated and credits awarded. This programme will comprise of activities that help the students to mould their soft skills and prepare them to face entry level competitions in their career and prepare for competitive exams.

10. Co-curricular Activities

The student joining the course will have to participate in current affairs, conferences, club activities, Invited talks, industrial visits, and technical skill development programmes, participate in intercollegiate bio-fests / organize bio-fests and earn credit

11. Social Outreach Programme

A Social Outreach Programme conducted as part of the curriculum. Students should participate and contribute in a way to express their concern towards the society.

12. Programme Matrix

ESE – End Semester Examination, **CIA** – Continuous Internal Assessment

MC – Major Core, **MC Lab** – Major Core Laboratory, **NC** – Non Core, **Lang** – Language.

I Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
AEN151201	Additional English	Lang	4	3	30	70	100
KAN151201	Kannada						
HIN151201	Hindi						
ENG151201	English						
MBG151201	Basic Microbiology & Microbiological Techniques	MC	4	3	30	70	100
MBG1512L1	Basic Microbiology and Microbiological Techniques practical	MC Lab	2	1	15	35	50
BCH151201	Biophysical Chemistry	MC	4	3	30	70	100
BCH1512L1	Biochemistry practical I	MC Lab	2	1	15	35	50
GEN151201	Fundamentals of Cell Biology	MC	4	3	30	70	100
GEN1512L1	Genetics practical I	MC Lab	2	1	15	35	50
NCS150101	Computer Fundamentals **	NC	2	1	5*	45*	50*
	Total		28	19	260	390	650

II Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
AEN152201	Additional English	Lang	4	3	30	70	100
KAN152201	Kannada						
HIN152201	Hindi						
ENG152201	English	Eng	4	3	30	70	100
MBG152201	Microbial Taxonomy & Culture Techniques	MC	4	3	30	70	100
MBG1522L1	Microbial Taxonomy & Culture Techniques practical	MC Lab	2	1	15	35	50
BCH152201	Biomolecules	MC	4	3	30	70	100
BCH1522L1	Biochemistry practical II	MC Lab	2	1	15	35	50
GEN152201	Principles of Genetics	MC	4	3	30	70	100
GEN1522L1	Genetics practical II	MC Lab	2	1	15	35	50
NHU150101	Indian Constitution **	NC	2	1	5*	45*	50*
	Total		28	19	260	390	650

III Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max
							Marks
ENG153201	English	Eng	4	3	30	70	100
AEN153201	Additional English	Lang	4	3	30	70	100
KAN153201	Kannada						
HIN153201	Hindi						
MBG153201	Microbial Physiology & Microbial Genetics	MC	4	3	30	70	100
MBG1532L1	Microbial Physiology practical	MC Lab	2	1	15	35	50
BCH153201	Bioanalytical Techniques	MC	4	3	30	70	100
BCH1532L1	Biochemistry practical III	MC Lab	2	1	15	35	50
GEN153201	Cytogenetics	MC	4	3	30	70	100
GEN1532L1	Genetics practical III	MC Lab	2	1	15	35	50
NHU150101	Environment Studies & Civic Sense	NC	2	1	5*	45*	50*
	Total		28	19	200	500	700

IV Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max
							Marks
		Lang	4	3	30	70	100
AEN154201	Additional English						
KAN154201	Kannada						
HIN154201	Hindi						
ENG154201	English	Eng	4	3	30	70	100
MBG154201	Molecular Biology & Genetic Engineering	MC	4	3	30	70	100
MBG1542L1	Molecular Biology & Genetic Engineering Practical	MC Lab	2	1	15	35	50
BCH154201	Human Physiology	MC	4	3	30	70	100
BCH1542L1	Biochemistry practical IV	MC Lab	2	1	15	35	50
GEN154201	Molecular Genetics	MC	4	3	30	70	100
GEN1542L1	Genetics practical IV	MC Lab	2	1	15	35	50
	Total		26	18	195	455	650

V Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
MBG155201	Agricultural & Environmental Microbiology	MC	4	3	30	70	100
MBG1552L1	Agricultural & Environmental Microbiology Practical	MC Lab	2	1	15	35	50
MBG155202	Immunology & Medical Microbiology	MC	4	3	30	70	100
MBG1552L2	Immunology & Medical Microbiology practical	MC Lab	2	1	15	35	50
BCH155201	Advanced Bimolecular Chemistry	MC	4	3	30	70	100
BCH1552L1	Biochemistry practical V	MC Lab	2	1	15	35	50
BCH155202	Enzyme and Enzyme Technology	MC	4	3	30	70	100
BCH1552L2	Biochemistry practical VI	MC Lab	2	1	15	35	50
GEN155201	Recombinant DNA Technology	MC	4	3	30	70	100
GEN1552L1	Genetics practical V	MC Lab	2	1	15	35	50
GEN155202	Basic Human Genetics	MC	4	3	30	70	100
GEN1552L2	Genetics practical VI	MC Lab	2	1	15	35	50
	Total		36	24	360	540	900

VI Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
MBG156201	Food & Dairy Microbiology	MC	4	3	30	70	100
MBG1562L1	Food & Dairy Microbiology practical	MC Lab	2	1	15	35	50
MBG156202	Industrial Microbiology & Microbial Technology	MC	4	3	30	70	100
MBG1562L2	Industrial Microbiology & Microbial Technology Practical	MC Lab	2	1	15	35	50
BCH156201	Intermediary Metabolism	MC	4	3	30	70	100
BCH1562L1	Biochemistry practical VII	MC Lab	2	1	15	35	50
BCH156202	Clinical Biochemistry	MC	4	3	30	70	100
BCH1562L2	Biochemistry practical VIII	MC Lab	2	1	15	35	50
GEN156201	Developmental and Population Genetics	MC	4	3	30	70	100
GEN1562L1	Genetics Practical VII	MC Lab	4	1	15	35	50
GEN156202	Applied Genetics	MC	4	3	30	70	100
GEN1562L2	Genetics Practical VIII	MC Lab	4	1	15	35	50
	Project			3			

	Total		40	27	360	540	900
--	--------------	--	-----------	-----------	------------	------------	------------

Semester	I	II	III	IV	V	VI	Total
Credits	19	19	18	19	24	27	126
Life Skill Education Part IV							2
NCC/NSS/Extra and Co-curricular Part-V(1 Credit / Year)							3
Industrial Visit							1
Club Activities/ Current affairs							2
Workshops / Seminars							1
Total Credits							135

* A pass mark in the non-core course is mandatory but marks secured for the same is not considered for grand total/grade/class

I SEMESTER

MBG151201 BASIC MICROBIOLOGY & MICROBIOLOGICAL TECHNIQUES

3 Credits

Total: 60 Hours

Objectives:

- Understand the history, scope and importance of microbiology
- Comprehend the techniques of microscopy, staining, and control of microbes
- Familiarize the various antibiotics and other chemotherapeutic agents

UNIT 1: History and Scope of Microbiology

12 hrs

Microbes and origin of life; Scope and relevance of microbiology as a modern science; Branches of Microbiology; Contribution of scientists to the field of microbiology – Anton Von Leuwenhoek, Robert Hooke, Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Flemming, Iwanovsky and Fransisco Redi.

UNIT 2: Microscopy

14 hrs

Microscopy – Principles of Microscopy : resolving power, numerical aperture, working distance and magnification; Working principle and applications of Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Stereomicroscope, Electron Microscopy – Transmission Emission Microscope (TEM) and Scanning Emission Microscope (SEM)

UNIT 3: Stains and Staining Techniques

08 hrs

Nature of dyes, physical and chemical theories of staining, staining techniques – principle, procedure and applications of simple staining, negative staining, differential staining – Gram's and acid fast staining; Structural staining – cell wall, endospore, flagella and capsular staining; Lacto phenol cotton blue for fungal staining

UNIT 4: Control of Microorganisms

14 hrs

Sterilization, disinfectants, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agents and antimicrobial agents; Physical methods of control – principle, methodology and application of moist heat sterilization: boiling, pasteurization, autoclave; Fractional sterilization – Tyndallization; Dry heat sterilization – incineration and hot air oven; Filtration – diatomaceous earth filter, seitz filter, membrane filter and laminar air flow chamber; Radiation: Ionizing radiation – Gamma rays and non-ionizing radiation – UV rays; Chemical methods – alcohol, aldehydes, phenols, halogens, metallic salts, quaternary ammonium compounds and sterilizing gases, selection of a chemical agent for practical applications.

UNIT 5: Antibiotics and other chemotherapeutic agents

12 hrs

Definition and classification of antibiotics, characteristics of antibiotics as chemotherapeutic agents, Antimicrobial spectrum of antibiotics and mode of action; Antibacterial – Penicillins, Cephalosporins, Bacitracin, Polymyxins, Streptomycin, Chloramphenicols, Tetracyclines and Vancomycin; Antifungal – Nystatin and Cyclohexamide; Antiviral – Acycloguanosine (nucleoside), Synthetic chemotherapeutic agents – Nalidixic acid; Evaluation of drug resistance against antibiotics – Tube dilution and Agar plate techniques: well diffusion method and disc plate method.

References :

- Aneja K. R. (2003), *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation* (4th Ed.), New Age International, New Delhi.
- Atlas R.M. (1995), *Microbiology– Fundamentals and applications*, Macmillan Publishing Company, New York.
- Benson Harold J., *Microbiological Application*, WCB McGraw–Hill, New York.
- Narayanan P. (2007), *Essentials of Biophysics* (2nd Ed), New Age International, New Delhi.
- Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003), *Microbiology* (5th Ed.), McGraw –Hill Book Company, New York.
- Prescott, Lansing M. Harley, John P. and Klein Donald A. (2000), *Microbiology* (4th Ed.), WCB McGraw–Hill Book Company, New York.
- Salle A.J. (1971), *Fundamental Principles of Bacteriology* (7th Ed.), Tata McGraw –Hill Book Company, New Delhi.
- Stainer R.Y. and Ingraham J.L. (1987), *General Microbiology* (5th Ed.), Prentice Hall Private Limited, New Delhi.

MBG1512L1 BASIC MICROBIOLOGY & MICROBIOLOGICAL TECHNIQUES PRACTICAL

1 Credit

Total: 30 Hours

Objectives:

- ♦ Understand the aseptic techniques in handling microbes
- ♦ Learn the basic techniques of staining and sterilization
- ♦ Learn the technique of using a microscope

1. Safety measures in Microbiology Laboratory 01 Unit
2. Study of compound microscope – construction, working, principle, care to be taken while using the microscope, use of oil immersion objective 02 Units
3. Study of Instruments: Autoclave, Hot air oven, Laminar air flow chamber, inoculation loop and needle, Incubator, centrifuge, pH meter, seitz filter, membrane filter, spectrophotometer. 04 Units
4. Cleaning and sterilization of glassware 01 Unit
5. Study of aseptic techniques – preparation of cotton plugs, wrapping of Petri plates and pipettes 01 Unit
6. Preparation of bacterial media (Nutrient Agar/ broth) and transfer of media and inoculum 01 Unit
7. Staining of bacteria:
 - a. Simple staining using methylene blue/ Crystal violet/ Carbol Fuschin
 - b. Gram's staining
 - c. Structural staining – cell wall staining, endospore staining and capsule staining 05 Units

BCH151201 BIOPHYSICAL CHEMISTRY

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the system of units, atomic structure and chemical bonding
- ♦ Study the concepts of acids bases and electrolytic dissociation
- ♦ Learn the principles of adsorption, viscosity and surface tension
- ♦ Understand the radioactive measurements and its applications

UNIT 1: Measurement and Atomic Structure

12 hrs

Derived units, subsidiary units, significant figures, dimensional analysis, exponential notation (graphical representation of data; errors in quantitative analysis); Electromagnetic radiation; wave particle duality; De-Broglie equation; Heisenberg uncertainty principle; Schrödinger wave equation; Quantum numbers; Atomic orbitals and their shapes; Pauli's exclusion principle; Hund's rule; Electronic configuration of the element; Trends in the periodic table, atomic radii, ionization energy, electro negativity and electron affinity; Concept of oxidation number and its computation.

UNIT 2: Chemical Bonding

12 hrs

Ionic bond, energetics, Born Haber cycle, covalent bond, valence bond theory; Hybridization, examples methane, ammonia, water, ethane and ethylene, Sigma and pi bond; Concept of Resonance, Molecular orbital theory; Properties of covalent molecules, bond length and bond angle, polarity of molecules, coordinate bond, Vander Waal's forces, Hydrogen bonds; inter and intra molecular types, importance in biomolecules, hydrophobic forces.

UNIT 3: Acids, Bases and Electrolytic Dissociation

12 hrs

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, effects of salt on dissociation of acids; Interaction of acids with bases-strong and weak electrolytes; Activity and activity coefficient, relationship between activity coefficient and ionic strength; Common ion effect; Nernst equation, standard electrode potentials, electrochemical series and applications; Reference electrodes.

UNIT 4: Principles of Adsorption, Viscosity and Surface Tension

12 hrs

Adsorption of gases by solids, Heat of adsorption, Freundlich and Langmuir adsorption isotherm with derivations, applications of adsorption; Determination of viscosity of liquids using Oswald's viscometer, relation of viscosity and shape of molecules; Definition and determination of surface tension of liquids using Stalagmometer, effects of surfactants.

UNIT 5: Radioactivity

12 hrs

Radioactive decay, units of radioactivity, detection and measurement of radioactivity, Geiger-Muller counter, scintillation counter, auto-radiography, applications of radio- isotopes in biological and medical sciences.

References:

- Arun Bahl and Tuli, G.D. (2006), *Essentials of Physical Chemistry* (5th Ed.), S Chand Co Ltd, New Delhi.
- Cantor Charles Schimmel and Paul, R (1980), *Biophysical chemistry* (1st Ed.), S Chand and Co Publishers, New Delhi.
- Emil, S. Smith., (1983), *Principles of Biochemistry* (7th Ed.), McGraw-Hill publishers, New York.
- Frederick George Mann., (1978), *Organic chemistry* (4th Ed.), Longman publishers, New York.
- Whittaker A. G and Mount, A.R., (2001), *Physical Chemistry* (4th Ed.), Viva Publishers, New Delhi.
- Pandey (2009), *A Text book of Practical organic chemistry* (5th Ed.), S Chand and Co publishers, New Delhi.
- Puri, B. R and Sharma, S. L. R., (1986), *Principles of Physical Chemistry* (19th Ed.), S Chand Co Ltd, New Delhi.
- Upadhyay., (2002), *Biophysical chemistry-Principles & Techniques* (3rd Ed.), Himalaya Publishers, Mumbai.

BCH1512L1 BIOCHEMISTRY PRACTICAL I

1 Credit

Total: 30 Hours

Objectives:

- ◆ Understand the use of analytical instruments and its calibration
- ◆ Understand the preparation of inorganic molecules and its estimation

- | | |
|--|----------|
| 1. Use of analytical balance and calibration of weights | 01 Unit |
| 2. Cleaning and calibration of glass wares | 02 Units |
| 3. Preparation of standard potassium pthalate and estimation of alkali | 02 Units |
| 4. Preparation of standard sodium oxalate and estimation of potassium permanganate | 02 Units |
| 5. Preparation of standard potassium dichromate solution and estimation of sodium thiosulphate | 02Units |
| 6. Estimation of hardness of water using EDTA | 02 Units |
| 7. Gravimetric estimation of sulphate | 02 Units |
| 8. Gravimetric estimation of magnesium | 02 Units |

GEN151201 FUNDAMENTALS OF CELL BIOLOGY

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the life cycle and genetic significance of model organisms.
- ♦ Become familiar with the various sub-cellular structures and organelles inside eukaryotic cells.
- ♦ Understand the basic events of the cell cycle and events

UNIT 1: Model Organisms

14 hrs

Life cycles: TMV, Lambda phage, *E. coli*, *Caenorhabditis elegans*, *Neurospora*, *Paramecium*, Yeast, *Drosophila*, *Culex* sp., *Bombyx mori*, *Arabidopsis thaliana*, Maize and Pea.

UNIT 2: Cell Structure and Function

14 hrs

Discovery of cells; Basic properties of cells; Cell theory; Cell complexity, Cell size & shape; Different classes of cells – Prokaryotic cell and Eukaryotic cell; Plasma Membrane – chemical composition, fluid mosaic model, functions – osmosis, phagocytosis, pinocytosis, active transport, Microvilli, Desmosomes. Cell wall – Chemical composition and Function; Cytoskeletal structures – microtubules, microfilaments, intermediate filaments;

UNIT 3: Intracellular Compartments

14 hrs

Structure, chemical composition and functions of Endoplasmic reticulum, Ribosomes, Centrosomes, Lysosomes, Golgi complex, Mitochondria, Peroxisomes, Plastids and Nucleus.

UNIT 4: Cell Motility

04 hrs

Amoeboid, ciliary and flagellar movements; Types of flagella, structure of Bacterial flagella.

UNIT 5: Cell Cycle and Cell Division

14 hrs

Cell cycle – Interphase, G1, S, G2 and M phase; Check points; Mitosis – Mitotic apparatus - structure and chemistry, Mitotic phases – Prophase, Metaphase, Anaphase, Telophase, Cytokinesis; Mitotic blockage, stimulation of cell division; Significance of mitosis; Meiosis – stages (mention stages), synaptonemal complex, crossing over, chiasma formation; Spermatogenesis, Oogenesis; Significance of meiosis; Cell senescence & cell death (Apoptosis), significance of apoptosis.

References:

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., (2002), *Molecular Biology of the Cell* (4th Ed.), Garland Science, New York.
- Becker, W. M. and Klein smith, L. J., (2005), *World of the Cell* (6th Ed.), Benjamin Cummings.
- Cooper, G. M., (2000), *The Cell* (2nd Ed.), Sinauer Associates, Sunderland
- Gupta, P. K. (2003), *Cell and Molecular Biology* (2nd Ed.), Rastogi Publication, Meerut

Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., and James, D. (2000), *Molecular Cell Biology* (4th Ed.), W. H. Freeman, New York
 Stern, K.R. (2002), *Introduction to plant Biology* (8th Ed.), Mc-Graw Hill, Boston
 Verma, P. S., and Agarwal, V. S., (2005), *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology* (14th Ed.), S. Chand & Company Ltd, New Delhi.

GEN1512L1 GENETICS PRACTICAL I

1 Credit

Total: 30 Hours

Objectives:

- ✦ Learn to operate compound, stereo and dissection microscope.
- ✦ Mount and stain a specimen on a slide for microscopic observation.
- ✦ Identify the different stages in the life cycles of model organisms.
- ✦ Identify stages of mitosis and Meiosis

- | | |
|---|----------|
| 1. Handling of dissection, stereo and compound microscopes. | 01 Unit |
| 2. Life cycle of model organisms:
Virus (TMV), Bacterium (<i>E.coli</i>),
<i>Neurospora</i> , <i>Caenorhabditis elegans</i> ., <i>Drosophila melanogaster</i> ,
<i>Culex</i> mosquito, <i>Bombyx mori</i> , <i>Arabidopsis thaliana</i> . | 03 Units |
| 3. Staining of RNA & DNA using Methyl green and Pyronin | 01 Unit |
| 4. Staining of Mitochondria using Janus green | 01 Unit |
| 5. Observation of mitotic stages in permanent slide | 01 Unit |
| 6. Temporary squash preparation of onion root tip for mitosis | 02 Units |
| 7. Observation of stages in Meiosis | 02 Units |
| 8. Study of Meiosis using Grasshopper testes. | 04 Units |

II SEMESTER

MBG152201 MICROBIAL TAXONOMY AND CULTURE TECHNIQUES

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the taxonomy, nomenclature and phylogeny of microbes
- ♦ Study the ultra – structure, life cycle and significance of various microbes
- ♦ Study the different methods of isolation and growth measurement of microbes

UNIT 1: Introduction to the Microbial World

04 hrs

Comparison of the three domains of microorganisms

UNIT 2: Study of Virus and Bacteria

14 hrs

Virus– Early developments in virology, general structure and properties of viruses, virus purification and assay, principles of viral taxonomy (Baltimore & ICTV); Structure, reproduction, cultivation and significance of Bacteriophage (T4 and lambda), Plant viruses (TMV), Animal viruses (HIV and Herpes Virus); Prions and Viroids – Nature and significance; Bacteria – size, shape and arrangement of bacterial cells; Fine structure, composition and function of cell wall, cell membrane, cytoplasm, nucleoid, flagella, pili/ fimbriae, slime layer, capsule, spores and cysts; Multiplication in bacteria – binary fission, budding and fragmentation. Classification of Bacteria (Bergey's Manual), numerical taxonomy, chemotaxonomy, serological taxonomy and genetic analysis.

UNIT 3: Study of Algae, Fungi and other Unique Organisms

14 hrs

Algae – Characteristics, classification, cell structure and reproduction of cyanobacteria (type study of *Anabaena* and *Spirulina*); Parallelism between bacteria and cyanobacteria; Fungi – Ultrastructure of fungal cell, salient features, classification (Alexopolus), reproduction and significance of major groups of fungi (Phycomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes); Type study of *Rhizopus*, *Aspergillus*, *Penicillium*, Yeast, *Agaricus* and *Fusarium*. Unique organisms – general features, classification, morphology, reproduction and significance of *Rickettsiae*, *Chlamydiae*, *Mycoplasma*, *Actinomycetes*.

UNIT 4: Isolation and Culturing of Microorganisms

14 hrs

Culture media – Synthetic and non-synthetic; solid, liquid and semi – solid media; Special media – enriched, selective, transport, differential, maintenance and enrichment media; Microbial isolation methods – Methods of isolation of bacteria and fungi; Serial dilution, pour plate, spread plate and streak plate; Maintenance of pure cultures; Cultivation of anaerobic bacteria – anaerobic jar method.

UNIT 5: Microbial growth and Measurements

14 hrs

Nutritional requirements of microorganisms – macronutrients, micronutrients and growth factors; Nutritional types of microorganisms – Autotrophs and heterotrophs, phototrophs and chemotrophs; Physical factors affecting growth of microorganisms – temperature, pH and oxygen; Bacterial growth curve, synchronous growth, batch culture, continuous culture; Measurement of bacterial growth- Direct methods – Haemocytometry, SPC, total count, DMC; Indirect method – Turbidometric estimation and Coulter counter.

References:

- Alexopoulos C.J. and Mims C.W. (1996), *Introductory Mycology* (4th Ed.), New Age International, New Delhi.
- Aneja K.R. (2003), *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation* (4th Ed.), New Age International, New Delhi.
- Atlas R.M. (1995), *Microbiology– Fundamentals and applications*, Macmillan Publishing Company, New York.
- Benson Harold J. (2001), *Microbiological Applications*, WCB McGraw–Hill, New York.
- Bold H.C. and Wynne M.J. (1978), *Introduction to algae*, Prentice Hall Private Limited, New York.
- Brock T.D. and Madigan M.T. (2006), *Biology of Microorganisms* (11th Ed.), Prentice Hall Private Limited, New York.
- Mehrotra R.S. and Aneja K.R. (1990), *An Introduction to Mycology*, New Age International, New Delhi.
- Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003), *Microbiology* (5th Ed.), McGraw –Hill Book Company, New York.
- Prescott, Lansing M. Harley, John P. and Klein Donald A. (2000), *Microbiology* (4th Ed.), WCB McGraw–Hill Book Company, New York.
- Stainer R.Y and Ingraham J.L. (1987), *General Microbiology* (5th Ed.), Prentice Hall Private Limited, New Delhi.

MBG1522L1 MICROBIAL TAXONOMY AND CULTURE TECHNIQUES PRACTICALS

1 Credit**Total: 30 hours****Objectives:**

- ♦ Learn the aseptic method of media preparation
 - ♦ Isolate and study the characteristics of microbes
-
1. Preparation of Media – nutrient broth, nutrient agar, Martin’s Rose Bengal medium, Sabouraud’s agar, preparation of agar slants. 02 Units
 2. Isolation of bacteria and fungi from soil 03 Units
 - a) Preparation of serial dilutions
 - b) Spread plate and pour plate techniques, streaking techniques for isolation and purification of bacteria
 - c) Study of colony characteristics of bacteria
 - d) Identification of bacteria and fungi
 3. Study of Bacterial motility by hanging drop technique. 01 Unit
 4. Measurement of cell size by micrometry. 02 Units
 5. Counting of yeast cells and fungal spores using Haemocytometer. 02 Units
 6. Study of Fungi – identification of fungi by Tease mount method using Lactophenol cotton blue; Type study of *Aspergillus*, *Penicillium*, Yeast, *Rhizopus* and *Fusarium* (Specimens) . 02 Units
 7. Isolation of bacteriophage from sewage. 02 Units
 8. Study of blue green algae – *Anabaena* and *Spirulina* (Specimens). 01 Unit

BCH152201 BIOMOLECULES

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the structure and classification of various biomolecules
- ♦ Learn the significance and requirements of vitamins and mineral elements

UNIT 1: Carbohydrates

12 hrs

Definition, classification, stereochemistry, cyclic structures and anomeric forms, Haworth projections; Monosaccharides: reactions, characteristics of aldehyde and ketone groups, action of acids and alkalis on sugars, reactions of sugars due to hydroxyl groups; Disaccharides: structure, chemistry and function; sucrose, lactose, maltose and cellobiose; Trisaccharides: structure of raffinose; Polysaccharides: Homopolysaccharides – starch, glycogen, cellulose, chitin, dextrin and inulin; Heteropolysaccharides – hyaluronic acid, chondroitin sulfate and heparin; Artificial sweeteners: Saccharin, Aspartame.

UNIT 2: Amino Acids and Peptides

12 hrs

Definition, amino acids as ampholytes; Structure and classification of amino acids based on chemical nature, chemical reaction of amino acids due to carboxyl and amino groups; Essential amino acids, peptides, structure and properties; Determination of peptide structure; Biologically important peptides.

UNIT 3: Lipids

12 hrs

Definition, classification of lipids, simple, compound and derived; Simple lipids; Physical and chemical properties of fats, Characterisation of fat - saponification number - acid number - iodine number and Reichert-Miessl number; Compound lipids- structure and function of phospholipids, glycolipids and lipoproteins; Derived lipids - fatty acids- saturated and unsaturated, essential fatty acids; Steroids-structure of cholesterol, ergosterol.

UNIT 4: Nucleic Acids

12 hrs

Structure of Purine and Pyrimidine, Nucleotides and Nucleosides; DNA double helix, A, B and Z forms of DNA; Denaturation and renaturation; RNA types, unusual bases; DNA as genetic material; structure of chromatids, nucleosome and histones(Modify related to biochemical aspects)

UNIT 5: Vitamins and Minerals

12 hrs

Definition and classification - Fat soluble vitamins, sources, structure and physiological functions; Water soluble vitamins: sources, structure and physiological functions; Minerals - requirement - essential macro and micro minerals, sources and functions.

References:

David, T. Plummer (2008), *An introduction to practical biochemistry* (2nd Ed.), Tata McGraw-Hill Publishers, New Delhi.

Deb, A. C. (1989), *Fundamentals of Biochemistry* (3rd Ed.), New Central Agency Publishers, Calcutta.

Jain, J. L. (2005), *Fundamentals of Biochemistry* (6th Ed.). S Chand Publication, New Delhi.

Jayaraman J., (2002), *Laboratory manual in Biochemistry* (1st Ed). New Age International Publishers, New Delhi.

Lehninger, A. L. (1982), *Principles of Biochemistry* (4th Ed.), CBS Publishers, NewDelhi.

Lubert Stryer (2000), *Biochemistry* (4th Ed.), W H Freeman & Co, NewYork.

Murray Granner and Mayes Rodwell, V. W., (2006), *Harper's illustrated Biochemistry*, McGraw- Hill Publishers, NewYork.

Pattabiraman (2008), *Laboratory manual in biochemistry* (4th Ed.), All India Publishers, NewDelhi.

Ranganatha Rao, (2002), *Text Book of Biochemistry* (3rd Ed.). Prentice Hall publishers, NewDelhi.

BCH1522L1 BIOCHEMISTRY PRACTICAL II

1 Credit

Total: 30 Hours

Objectives:

- ✦ Understand the qualitative analysis of sugars, amino acids and lipids
- ✦ Understand the principle and method of separation techniques

Qualitative Analysis

1. Analysis of Sugars

- | | |
|---|----------|
| a) Monosaccharides - Glucose, Fructose, Galactose, Mannose, Pentose | 02 Units |
| b) Disaccharides - Sucrose, Maltose and Lactose | 01 Unit |
| c) Polysaccharides - Starch and Dextrin | 01 Unit |

2. Analysis of Amino Acids

- | | |
|---|---------|
| a) Histidine, b) Tyrosine, c) Tryptophan, | 01 Unit |
| d) Methionine, e) Cysteine, f) Arginine. | 01 Unit |

3. Lipid Analysis [Group Experiments]

- | | |
|---|----------|
| a) Determination of Saponification number | 01 Unit |
| b) Determination of Acid number | 02 Units |
| c) Determination of Iodine number | 02 Unit |

4. Demonstration Experiments

- | | |
|--|----------|
| a) Preparation of buffer and its measurements using pH meter | 02 Units |
| b) Separation of biomolecules by paper chromatography | 02 Units |

GEN152201 PRINCIPLES OF GENETICS

3 Credits

Total: 60 Hours

Objectives:

- ◆ A historical perspective of genetics
- ◆ Learn the concepts, theories and principles of Mendelian genetics
- ◆ Basis of biometrical methods in genetics
- ◆ Understand the concept of gene interaction and sex determination

UNIT 1: Introduction to Genetics

10 hrs

Scope of Genetics; History of Genetics – Premendelian genetic concepts – preformation, epigenesis, inheritance of acquired characters, Germplasm theory Cytogenetics; Developmental genetics; Transmission Genetics; Molecular Genetics; Population Genetics; Genetics and Society;; Heredity and environment, genotype and phenotype; Heredity and variation; Clones, purelines, inbred lines; Norms of reaction; Phenocopies.

UNIT 2: Mendelian Genetics and Extension of Mendelian Genetics

14 hrs

Mendel's Experiments – Biographical information, experiments in Pea plants, postulates, dominance, recessiveness; Law of segregation – monohybrid cross, back and test cross; Law of independent assortment– dihybrid crosses in pea, *Drosophila*, back and test cross; Methods for calculations – Punnett's square, factor method; Terminology – trait, gene, locus/loci, allele, diploid, haploid, phenotype, genotype, homozygous, heterozygous, dominant, recessive; Incomplete or partial dominance, co-dominance, multiple alleles – ABO blood groups, Rh factor in humans; Problems on Mendelian genetics

UNIT 3: Elements of Biometry

14 hrs

Mean, median, mode, standard deviation, standard error, t test and F test; General probability– single events & two events (product rule & sum rule), conditional probability, application in genetics–single trait and two trait crosses, Chi-square test; Suggested problems.

UNIT 4: Gene Interactions

11 hrs

Dominant epistasis (12:3:1), Recessive epistasis (9:3:4), Cumulative effect (9:6:1), Duplicate dominant genes (15:1), Complementary gene interaction (9:7), Supplementary gene interaction (9:3:3:1).

UNIT 5: Sex Determination

11 hrs

Chromosomal theory of sex determination – XX–XY, XX–XO, ZZ–ZW; Bridges' Genic Balance theory; Y chromosome in sex determination in *Melandrium*; Environment and sex determination; Hormonal control of sex determination (free martin); Gynandromorphs, intersexes and supersexes in *Drosophila*; Sex differentiation and dosage compensation.

References:

- Atherly, A. G., Girton, J. R & Donald, M.C., (1999). *The Science of Genetics*. Saunders College Publications, Harcourt Brace.
- Daniel, H. & Jones, E.W. (1998) *Genetics, Principles and Analysis* (4th Ed.). Jones & Barlett Publication.
- Robert, H. T. (2002). *Principles of Genetics* (7th Ed.), Tata–McGraw Hill. New Delhi
- Strickberger, M. W. (1985) *Genetics* (3rd Ed.), Macmillan Publications, New York
- Sturtevant, A. H. (1965), *History of Genetics*, Harper & Row, New York
- Verma, P. S., and Agarwal, V. S., (2005). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology* (14th Ed.). S.Chand & Company Ltd, New Delhi.

GEN1522L1 GENETICS PRACTICAL II

1 Credit

Total: 30 Hours

Objectives:

- ◆ Understand the different parts of a flower
- ◆ Identify stages of meiosis from prepared slides
- ◆ Perform blood typing using blood typing kits
- ◆ Apply biometrical methods in different genetic problems.

- | | |
|---|----------|
| 1. Study of floral structure of Pea plant, Maize and <i>Arabidopsis</i> . | 02 Units |
| 2. Temporary squash preparations of Onion flower buds and Grasshopper testis. | 04 Units |
| 3. Study of variations in Pea plant, flower colour in <i>Antirrhinum</i> and <i>Mirabilis</i> . | 02 Units |
| 4. Blood typing. | 01 Unit |
| 5. Computation– Mean, Median, Mode Standard Deviation and Standard Error. | 02 Units |
| 6. Genetic Problems on Multiple alleles and Gene Interaction. | 02 Units |
| 7. Application of Chi–square test, t test and F test. | 02 Units |

III SEMESTER

MBG153201 MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the various biochemical activities and energy yielding processes
- ♦ Learn bacterial physiology and Genetic recombination in bacteria.

UNIT 1: Biomolecules and Enzymes

14 hrs

Properties, classification and importance of Carbohydrates, Lipids and Proteins; Techniques of separation of biomolecules – amino acids and sugars; Enzymes – properties, nomenclature and classification, mechanism of enzyme action, effect of various factors influencing enzyme activity, enzyme inhibition and regulation; Ribozymes and abzymes.

UNIT 2: Energy yielding processes and Bioenergetics

14 hrs

Energy yielding processes: breakdown of carbohydrates – glycolysis, ED pathway, TCA; Fermentation pathways – alcohol and lactic acid fermentations; Bioenergetics – free energy, ATP and other high energy compounds, oxidative phosphorylation, ETC.

UNIT 3: Bacterial Photosynthesis

06 hrs

Photosynthetic pigments and apparatus in prokaryotes; Photosynthesis in purple and green bacteria.

UNIT4:GenomeOrganization

14 hrs

Prokaryotic genome – *E. coli* chromosome, coiled, super coiled, (plectonemic, solenoid), folded fiber model; Gene transfer mechanisms: Transformation–Griffith's experiment; Conjugation– F⁺ v/s F⁻, Hfr⁺ v/s F⁻, F' v/s F⁻; Transduction– generalized and specialized.

UNIT 5: Genetic Recombination and Mutation

12 hrs

Models in genetic recombination – Holliday model, Messelsen's model; Model organisms – *Mycoplasma genitalium* and *E.coli*; Molecular basis of mutations – Spontaneous and induced mutations; Transposable elements and transposon mutagenesis; Detection and isolation of mutants – replica plating method.

References:

- Freifelder David. (1987), *Microbial Genetics* (2nd Ed.), Narosa Publishing House, New Delhi.
- Moat A.G. and Foster S.W. (2004), *Microbial Physiology* (4th Ed.), John Wiley and Sons, New York.
- Nelson David .L, Cox Michael and M. Lehninger (2003), *Principles of Biochemistry*, (3rd Ed.), Mac Millian Press/Worth Publishers, New York.
- Purohit S .S. (2001), *Biotechnology - Fundamentals and Applications*, Agro Bios, Jodhpur.
- Sadasivam.S. & Manickam.A. (2004) *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.
- Stick Berger M.W. (2010), *Genetics* (3rd Ed.), Prentice Hall Private Limited, New Delhi.

Sullia S.B & Reshma Ashok (2004), *A Text Book of Biotechnology*, United publications, New Delhi.
 Voet D and Voet J.G. (2011), *Biochemistry* (4th Ed.), John Wiley and Sons, New York.
 Walker J. M. and Gingold E.B. (1983), *Molecular Biology & Biotechnology* (Indian Edition), Royal Society of Chemistry, U.K.

MBG1532L1 MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS PRACTICAL

1 Credit

Total: 30 Hours

Objectives:

- ◆ Categorize microorganisms based on biochemical characteristics
- ◆ Learn to analyse biomolecules present in the samples
- ◆ Study the effect of physical parameters on the growth of microbes

- | | |
|---|----------|
| 1. Determination of growth curve of fungi by colony diameter method | 02 Units |
| 2. Biochemical tests used for the identification of bacteria | 06 Units |
| a) IMVIC
b) Fermentation of glucose, sucrose and lactose – acid and gas production
c) Mannitol motility test
d) Starch hydrolysis
e) Gelatin liquefaction test
f) Catalase test
g) Oxidase test | |
| 3. Estimation of reducing sugar –glucose by DNS method | 01 Unit |
| 4. Estimation of protein by Lowry's method | 01 Unit |
| 5. Effect of pH and temperature on bacterial growth | 02 Units |
| 6. Study of genetic recombination in bacteria(charts) 01 Unit | |
| a) Conjugation– F+ v/s F–, Hfr+ v/s F–, F' v/s F–
b) Transformation– Griffith's experiment and mechanism
c) Transduction– generalized and specialized | |

BCH153201: BIO ANALYTICAL TECHNIQUES

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the principle and applications of analytical techniques
- ♦ Comprehend the principle and applications of biosensors

UNIT 1: Chromatography

14 hrs

Chromatography– principle and application of paper, thin layer, column – adsorption, ion exchange, affinity, gel permeation, Gas liquid chromatography (GLC), High Performance Liquid chromatography (HPLC).

UNIT 2: Centrifugation

12 hrs

Centrifuge – Basic principles of sedimentation, relative centrifugal force (RCF), types of centrifuges – bench top, clinical, high speed refrigerated, ultra centrifuge- preparative and analytical; Differential centrifugation; safety aspects in the use of centrifuge.

UNIT 3: Electrophoresis

09 hrs

Electrophoresis – principle, paper electrophoresis, gel electrophoresis – column, agarose gel, pulse field, polyacrylamide gel; capillary electrophoresis and immuno electrophoresis.

UNIT 4: Spectroscopy

14 hrs

Electromagnetic radiation, spectroscopy: X ray Spectroscopy, Ultraviolet and visible spectroscopy (UV-VIS), Infra– red spectrophotometry, Electron spin resonance spectrophotometry, Nuclear Magnetic Resonance (NMR), Atomic spectroscopy- emission and absorption.

UNIT 5: Biosensors

11 hrs

Principle and construction of biosensors, types of biosensors - Electrochemical, Amperometric, enzyme electrodes, thermistor containing biosensor, bio affinity sensor, whole cell biosensor; Nano check, Applications of biosensors.

References:

- Asokan A., (2001), *Basics of Analytical Biochemistry* (3rd Ed.), China International Publishers, china.
- Chang, R, (2005), *Physical Chemistry for Biosciences*, (9th Ed.), University Science Books Publishers, California.
- Keith Wilson and Kenneth H. Goulding., (1992), *Biomedical Instrumentation and Measurement* (3rd Ed.), Orient Longman publishers, New York.
- Okotore R.O., (1998), *Basic Separation Techniques in Biochemistry*, New Age International Publishers, New Delhi.
- Sadasivam A Manickam., (2004), *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.
- Sharma B. K., (2002), *Instrumental method of chemical analysis* (11th Ed.), APH Publishers, New Delhi.

Keith Wilson and John M. Walker (2010), *Principles and Techniques of practical Biochemistry* (3rd Ed.), Cambridge University Press, Cambridge.
Upadhyay and Nath., (2002), *Biophysical chemistry- Principles & Techniques* (3rd Ed.), Himalaya Publishers, Mumbai.

BCH1532L1: BIOCHEMISTRY PRACTICAL III

1 Credit

Total: 30 Hours

Objectives:

- ◆ Knowledge on the preparation of buffers
- ◆ Understand the principle of separation techniques

1. Preparation of buffers and determination of pH: citrate and phosphate 04 Units
2. pH metric titration of an amino acid 01Unit
3. Separation of amino acids by paper chromatography 02 Units
4. Separation of biomolecules by TLC 02 Units
5. Separation of proteins by SDS- PAGE electrophoresis 03 Units
6. Isolation and separation of DNA by agarose gel electrophoresis 03 Units

GEN153201 CYTOGENETICS

3 Credits

Total: 60 Hours

Objectives:

- ♦ Study the structure of chromosomes.
- ♦ Understand the concepts of linkage and crossing over.
- ♦ Understand chromosomal aberrations and extra chromosomal inheritance.

UNIT 1: Chromosomes

14 hrs

Chromosome theory of inheritance; Eukaryotic chromosome – Structure, primary constriction, secondary constrictions, sat bodies, telomeres; Heterochromatin, euchromatin; Ultra structure of chromosome – Nucleosome model; Karyotype; Idiogram; Special types of chromosomes – Polytene, Lampbrush, B chromosomes.

UNIT 2: Linkage

14 hrs

Coupling and repulsion hypothesis; Chromosome theory of linkage; Kinds of linkage– complete and incomplete linkage; Linkage groups; Linkage in Maize and *Drosophila*; Factors affecting linkage – distance, age, temperature, X– rays; Significance of linkage; Linkage maps in Maize and *Drosophila*; Meiotic behavior of chromosomes and non–disjunction; Bridges' theories of non–disjunction; Sex linkage in *Drosophila*; Sex linked genes in Poultry and Moths; Sex related genes in Maize; Attached X–chromosome.

UNIT 3: Crossing Over

12 hrs

Types of crossing over – somatic, germinal; Cytological basis of crossing over– Stern's experiment in *Drosophila*, Creighton and McClintock experiment in Maize; Mechanism of crossing over; Cytological theories of crossing over; Molecular mechanism of crossing over– Holliday model and Single strand break model; Crossing over in *Drosophila*, absence of crossing over in male *Drosophila*; Tetrad analysis in *Neurospora*; Interference and coincidence; Construction of genetic maps – *Drosophila* and Maize.

UNIT 4: Chromosomal Aberrations

10 hrs

Numerical aberrations– Euploidy (monoploidy, haploidy and polyploidy- autopolyploidy and allopolyploidy), Aneuploidy (nullisomy, monosomy & trisomy); Structural aberrations– deletion, duplication, translocation, inversion; Evolutionary significance of chromosomal aberrations.

UNIT 5: Extra Chromosomal Inheritance

10 hrs

Mitochondrial DNA; Chloroplast DNA; Kappa particles in *Paramecium*; Sigma factor in *Drosophila*; Cytoplasmic Male Sterility (CMS) in crop plants and its commercial exploitation.

References:

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2002), *Molecular Biology of the Cell* (4th Ed.), Garland Science, New York.
- Atherly, A. G., Garton, J. R & Donald, M. C., (1999), *The Science of Genetics*.: Saunders College Publications. Harcourt Brace.
- Becker, W. M. & Klein smith, L. J. (2005), *World of the Cell* (6th Ed.), Benjamin Cummings.
- Gupta, P. K. (2003). *Cell and Molecular Biology* (2nd Ed.). Rastogi Publication. Meerut.
- Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., & James, D. (2000). *Molecular Cell Biology* (4th Ed.). W. H. Freeman. New York.
- Robert, H. T. (2002). *Principles of Genetics* (7th Ed.). Tata–McGraw Hill. New Delhi:
- Strickberger, M. W. (1985) *Genetics* (3rd Ed.). Macmillan Publications. New York.
- Verma, P. S. & Agarwal, V. S. (2005). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology* (14th Ed.), S. Chand & Company Ltd, New Delhi.

GEN1532L1 GENETICS PRACTICAL III

1 Credit

Total: 30 Hours

Objectives:

- ◆ To culture *Drosophila* and study different mutants
 - ◆ Observe and study special chromosomes.
 - ◆ Study chromosomal aberrations and solve genetic problems on linkage and crossing over.
-
1. Culturing *Drosophila* – Cleaning and sterilization of culture bottles; Media preparation; Culture and handling of *Drosophila*; Isolation of virgin flies. 02 Units
 2. Study of *Drosophila* mutants – Body colour mutants; Wing mutants; Eye colour mutants. 02 Units
 3. Mounting of sex comb of *Drosophila*. 01 Unit
 4. Dissection of Salivary glands 02 Units
 5. Staining and observation of Polytene chromosomes. 02 Units
 6. Observation of permanent slides of inversion in salivary gland chromosomes of *Drosophila nasuta*. 01 Unit
 7. Temporary squash preparations of *Rheo discolor* to observe translocation. 01 Unit
 8. Induction of polyploidy in Onion root tips. 01 Unit
 9. Genetic problems on Linkage and Crossing over 03 Units

IV SEMESTER

MBG154201 MOLECULAR BIOLOGY AND GENETIC ENGINEERING

3 Credits

Total: 60 Hours

Objectives:

- ♦ Conceptualize molecular biology
- ♦ Understand basics and applications of genetic engineering

UNIT 1: Nucleic Acids and Replication

12 hrs

Nucleic acids – chemical composition of DNA and RNA, Watson and Crick model of DNA and other forms of DNA (A, B, Z and H); Supercoiling of DNA, functions of DNA and RNA including Ribozymes; DNA Replication in Prokaryotes – Enzymes and proteins involved in replication, semi conservative method, rolling circle model, origin of replication, primers and template, replication fork, unidirectional and bi-directional (θ model).

UNIT 2: Transcription and Translation

12 hrs

Genetic code; properties and Wobble hypothesis; Transcription in prokaryotes – Mechanism, Initiation, elongation and termination in prokaryotes and eukaryotes; enhancers, promoters; RNA polymerase, transcription factors, transcriptional inhibitors; Protein synthesis in prokaryotes – Ribosomes; types of RNA involved transcription and translation, mechanism of protein synthesis and protein inhibitors, post translational modifications of proteins-Modifications of eukaryotic mRNA – 5' capping and 3' poly A tailing; mRNA splicing;

UNIT 3: Regulation of Gene Expression

10 hrs

Regulation of gene expression in Prokaryotes – Operon concept, Lac and Trp; Regulation of gene expression in Eukaryotes – Transcriptional activation, galactose metabolism in Yeast.

UNIT 4: Tools for Genetic Engineering

14 hrs

Introduction to genetic engineering; DNA manipulative enzymes – restriction enzymes, ligases and other DNA modifying enzymes; Gene cloning vectors – salient features, plasmids; pBR322 and pUC18, Bacteriophages; M13, Cosmids, Vectors for plants; Ti, Vectors for animals; SV40, *In vitro* construction of rDNA molecules – Isolation of passenger and plasmid DNA from bacteria, Cutting of DNA molecules – Physical methods, enzymatic methods and joining of DNA molecules – Homopolymer tails, linkers and adapters, Transformation of rDNA into target host organisms – Calcium chloride mediated and agro bacterium mediated DNA transfer, electroporation, microinjection, liposome fusion and microparticle bombardment, Screening and selection of recombinant host cells – insertional inactivation, *in situ* colony hybridization and immunological techniques.

UNIT 5: Genetic Engineering Techniques and Applications

12 hrs

Molecular techniques – Electrophoresis, Blotting techniques; Southern, Northern, Western and Dot Blot, amplification through PCR, RFLP. Applications – medicine (gene therapy), Agriculture (nif gene cloning); Potential hazards and safe guards of genetic engineering.

References:

Glick B.T and Pasternak J.J (1998), *Molecular Biotechnology, Principles and applications of Recombinant DNA*, ASM press, Washington D.C.

Purohit S .S (2001), *Biotechnology Fundamentals and Applications*, Agro Bios.

Sadasivam .S & Manickam .A (2004), *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.

Singh, B.D. (2004), *Biotechnology*, Kalyani publisher.

Smith John E (1996), *Biotechnology*, Cambridge University Press.

Sullia S.B & Reshma Ashok, (2004), *A Text Book of Biotechnology*, United publications, New Delhi.

Walker J. M. and Gingold E.B. (1983, *Molecular Biology & Biotechnology* (Indian Edition) Royal Society of Chemistry, U.K.

MBG1542L1 MOLECULAR BIOLOGY AND GENETIC ENGINEERING PRACTICAL

1 Credit

Total: 30 Hours

Objectives:

- ◆ Learn the method to quantitatively estimate nucleic acids and protein concentrations in unknown samples from different sources
- ◆ Understand the methods of isolating the genetic material from different sources
- ◆ Demonstrate and learn the various techniques applied in the field of genetic engineering

- | | |
|---|----------|
| 1. Estimation of DNA by DPA method. | 01 Unit |
| 2. Estimation of RNA by Orcinol method. | 01 Unit |
| 3. Extraction and estimation of protein from microbial source. | 01 Unit |
| 4. Protein separation by Polyacrylamide Gel electrophoresis. | 01 Unit |
| 5. Isolation of genomic DNA from bacteria and separation of DNA by electrophoresis. | 03 Units |
| 6. Isolation of plasmid DNA from bacteria and separation by gel electrophoresis. | 03 Units |
| 7. Isolation of auxotrophic mutants by replica plating method. | 01 Unit |
| 8. Separation of proteins by SDS – PAGE (demonstration). | 01 Unit |
| 9. Demonstration of Restriction digestion of DNA and <i>in vitro</i> DNA ligation. | 02 Units |
| 10. Charts on genetic engineering; | 02 Units |
| a) pBR 322 | |
| b) pUC 18 and 19 | |
| c) SV 40 | |
| d) Bacteriophage λ | |
| e) Gene cloning | |
| f) Selection of recombinants by replica plating technique | |

BCH154201 HUMAN PHYSIOLOGY

3 Credits

Total: 60 Hours

Objectives:

- ◆ Understand concepts in human physiology
- ◆ Understand mechanism of physiological system and its regulation

UNIT 1: Physiology of Vision

08 hrs

Vision- structure of the eye, image formation and defects of the eye, receptor mechanism of the eye, photo pigments; visual cycle and colour adaptation.

UNIT 2: Components of Blood and Respiration

14 hrs

Composition and function of red blood cells, hemoglobin, white blood cells and platelets, Blood coagulation, blood groups and blood transfusion; Respiration- diffusion of gases in lungs, transport of oxygen from lungs to tissues through blood, factors influencing the transport of oxygen, transport of CO₂ from tissues to lungs through blood, factors influencing the transport of CO₂.

UNIT 3: Digestion and Excretion

12 hrs

Digestive system– secretion of digestive juices, digestion and absorption of carbohydrates, proteins and fats; Gastro intestinal hormones; Excretory System–formation of urine, composition of urine, renal regulation of acid balance, hormones of the kidney

UNIT 4: Muscular and Nervous System

14 hrs

Skeletal Muscle-structure of skeletal muscle, contraction of muscle fibre, chemical changes during muscle contraction and sources of energy for muscle contraction; Nervous system– structure of neuron, resting potential and action potential, propagation of nerve impulse; Structure of synapse, synaptic transmission (electrical and chemical theory); Structure of neuro muscular junction and mechanism of neuro muscular transmission; Neuro transmitters.

UNIT 5: Physiology of Reproduction

12 hrs

Male reproductive system-structure of testis, spermatogenesis, functions of testis, Female reproductive system-ovarian cycle, structure and functions of male and female sex hormones- testosterone, estrogen and progesterone.

References:

- Agarwal G.R and Agarwal R.A., (1999), *Text book of Biochemistry* (1st Ed.), Jaypee Brothers Medical Publishers, New Delhi.
- Chatterjee C.C (2006), *Human Physiology* (11th Ed.), Medical Allied Agency Publishers, Kolkata.
- Chatterjee M.N (2003), *Text book Medical Biochemistry* (11th Ed.), Jaypee Brothers Medical Publishers, New Delhi.
- David T. Plummer (2008), *An introduction to practical biochemistry* (2nd Ed.), McGraw- Hill Publishers, New York.

Gerard J. Tortora (2008), *Principles of Anatomy and Physiology* (12th Ed.), John Wiley Sons, New York.

Guyton and Hall (2010), *Text book of Medical physiology* (12th Ed.), Saunders publishers, London.

Jayaraman J (2002), *Laboratory manual in Biochemistry* (1st Ed.), New Age International Publishers, New Delhi.

Pattabiraman (2008), *Laboratory manual in biochemistry* (4th Ed.), All India Publishers, New Delhi.

Sadasivam. A. Manickam (2004), *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.

BCH1542L1 BIO CHEMISTRY PRACTICAL IV

1 Credit

Total: 30 Hours

Objectives:

- ◆ Understand the colorimetric principle and estimation of biomolecules
- ◆ Understand the titrimetric principle and estimation of vitamins and reducing sugars
- ◆ Demonstrate the separation of molecules using electrophoresis and column chromatography

I. Colorimetry

- | | |
|--|---------|
| 1. Estimation of Glucose by ortho toluidine | 01 Unit |
| 2. Estimation of Phosphorus by Fiske Subbarow method | 01 Unit |
| 3. Estimation of Urea by DAM method | 01 Unit |
| 4. Estimation of Uric acid by Caraway method | 01 Unit |
| 6. Estimation of Protein by Lowry's method | 01 Unit |
| 7. Estimation of Creatinine by picric acid method | 01 Unit |
| 8. Estimation of RNA by orcinol method | 01 Unit |

II. Titrimetry

- | | |
|---|----------|
| 1. Estimation of Ascorbic acid by 2, 6 Dichloro phenol indo phenol method | 02 Units |
| 2. Estimation of Chloride by Vanslyke's method | 02 Units |

III. Separation Techniques (Demonstration)

- | | |
|---|----------|
| 1. Separation of protein by electrophoresis | 02 Units |
| 2. Separation of biomolecules using TLC | 02 Units |

GEN154201 MOLECULAR GENETICS

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand concepts of gene organization
- ♦ Understand the concepts of bacterial genetics
- ♦ Comprehend mutation and DNA repair mechanism

UNIT 1: Chemical Basis of Heredity

12 hrs

Introduction, experimental proof of DNA and RNA as genetic material; Structure and functions of DNA and RNA; Watson and Crick model of DNA, other forms of DNA – A and Z; Functions of DNA and RNA including ribozymes; DNA replication – Prokaryotic and Eukaryotic, enzymes and proteins involved in replication, Theta model and rolling circle model;

UNIT 2: Genome Organization

12 hrs

Genome - Viral genome; DNA containing viral chromosomes, RNA containing viral chromosomes; supercoiling of viral chromosomes; Prokaryotic genome – chromosomal and plasmid; Eukaryotic genome– chromosomal and organellar; Fine structure of the gene– cistron, muton and recon. Genetic code, features and Wobble hypothesis;

UNIT 3: Recombination

12 hrs

Recombination in Prokaryotes–Conjugation; F^+ and F^- , Hfr^+ and F' ; Transformation: Griffith's experiment and mechanism, Transduction; Generalized and Specialized; Bacterial Transposons. IS elements, t elements in Drosophila, AC-DS in Maize

UNIT 4: Mutation

12 hrs

Types of mutations – base substitution, frame shift mutation; Mutagens– physical & chemical; Reverse mutation in bacteria; DNA repair mechanism – Mismatch repair, photo–reactivation, excision and SOS repair; Beneficial and harmful effects of mutations; Site directed mutagenesis; Detection of mutation by Ames test.

UNIT 5: Applications of Molecular Genetics

12 hrs

Use of r-DNA – Huntington's disease, Fragile X chromosome, Cystic fibrosis, Molecular diagnosis of human diseases; Human gene therapy; DNA profiling – paternity tests, forensic applications; Transgenic animals and plants – Ti plasmids. Transgenic mice; Reverse genetics – knockout mice, T- DNA and transposons insertions, RNA interference.

References:

- Becker, W.M. & Klein smith, L. J.(2005), *World of the cell* (6th Ed.), Benjamin Cummings, Washington DC.
- Cooper, G.M.(2000), *The Cell* (2nd Ed.).Sinauer Associates,Sunderland.
- Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. &Gelbart, W. M.(2000) *An Introduction to Genetic Analysis* (7th Ed.), Freeman, New York.
- Hames, B. D. & Hooper, N. M.(2002). *Instant Notes in Biochemistry* (2nd Ed.). Viva Books.
- Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., Silver, L. M. &Veres, R. C. (2000) *Genetics: From Genes to Genomes*, Tata–McGraw Hill, New Delhi.

Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., & James, D. (2000). *Molecular Cell Biology* (4th Ed.). Freeman. New York.

Lodish, J. H & Baltimore, D. (1990). *Molecular Cell Biology* (2nd Ed.), Scientific American Books, New York.

Watson, J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. & Weiner, A. M. (1987). *Molecular Biology of the Gene* (4th Ed.), Benjamin Cummins, Menlo Park.

GEN1542L1 GENETICS PRACTICAL IV

1 Credit

Time: 30 Hours

Objectives:

- ◆ Understand the principle and working of different laboratory instruments.
- ◆ Extract genomic DNA and run the DNA in a gel through gel electrophoresis.
- ◆ Perform paper chromatography with different pigments.
- ◆ Study different mutations with examples.

1. Instrumentation – PCR machine, Micropipette, Glass Homogenizer, Glass bead sterilizer
02 Units
2. Extraction of genomic DNA from coconut endosperm 01 Unit
3. Extraction of genomic DNA from liver tissue 01 Unit
4. Extraction of genomic DNA from bacteria 01 Unit
5. Paper Chromatography for separation of *Drosophila* eye pigment 03 Units
6. Electrophoresis (Demonstration) – Agarose gel electrophoresis and PAGE 02 Units
7. Study of examples of mutations: Sickle cell anaemia – Missense mutation; Thalassemia–frame shift mutation; Identification of point mutations based on the given representations. 02 Units
8. Induction of mutation in *Drosophila* and detection of sex–linked lethal Muller 5 stock. 02 Units

V SEMESTER

MBG155201 AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

3 Credits

Total: 60 Hours

Objectives:

- ◆ Getting to know about pedology and edaphology
- ◆ Learn the etiology, symptoms, life cycle and control measures of plant diseases.
- ◆ Learn the significance and role of microbes in air and water

UNIT 1: Soil Microbiology

12 hrs

Soil – definition, types, physical and chemical characters, soil profile; Soil microorganisms (Bacteria, Fungi, Actinomycetes, Algae, Protozoa and Viruses); Interactions between plants and microorganisms - types of interactions (positive and negative); Microorganisms of rhizosphere, rhizoplane and phylloplane; Mycorrhiza – types and its applications; Biogeochemical cycles – Nitrogen, Carbon, Sulphur, Phosphorous cycle.

UNIT 2: Microorganisms in Agriculture

12 hrs

Biochemistry, genetics and physiology of Nitrogen fixation, biological fixation by symbiotic bacteria, mechanism of nodule formation, non-symbiotic Nitrogen fixation; Biofertilizers and their types – bacterial, fungal, phosphate solubilizers, BGA, Plants – *Azolla*, kinds of association, mode of application and merits; Biopesticides– bacterial (*Bacillus thuringiensis*), viral (NPV) and fungal (*Trichoderma*).

UNIT 3: Plant Pathology

12 hrs

Study of plant diseases – Blast disease of rice (*Pyricularia sp.*), Black/stem rust of wheat (*Puccinia sp.*), Late blight of potato (*Phytophthora sp.*), Tikka disease of ground nut (*Cercospora sp.*), Downy mildew of grapes (*Plasmidiophora sp.*), Viral diseases – TMV, tomato leaf curl; General methods to control plant pathogens.

UNIT 4: Aeromicrobiology

12 hrs

Introduction, definition, atmospheric layers, sources of microorganisms, air microflora - indoor and outdoor, airborne diseases, significance of air borne microbes and endotoxins; control and management of air borne microbes: Air sampling devices – slit sampler, gravity slide, vertical cylinder, Hirst spore trap, rotorod sampler, Anderson sampler, Burkard spore trap, Impingers. Bio - occupational hazards.

Unit 5: Microbiology of Water

12 hrs

Introduction, natural water, distribution of microorganisms in aquatic environment, sources and types of water pollution, biological indicators of water pollution, determination of sanitary quality of water - MPN index, membrane filtration, biological oxygen demand; Municipal waste water treatment system – preliminary, primary, secondary and tertiary methods.

References:

- Alexander M. (1977), *Introduction to Soil Microbiology* (2nd Ed.), New Age International , New Delhi.
- Alexopoulos, C.J. and Mims C.W. (1996), *Introductory Mycology* (4th Ed.), New Age International ,New Delhi.
- Aneja K.R. (2003), *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation* (4th Ed.), New Age International, New Delhi.
- Malhotra R.S. and Aneja K.R. (1990), *An Introduction to Mycology*, New Age International, New Delhi.
- Stacey R.H. and Evans H.J. (1992), *Biological Nitrogen Fixation*, Chapman and Hall Limited, New York.
- Stainer R.Y and Ingraham J.L. (1987), *General Microbiology* (5th Ed.), Prentice Hall Private Limited, New Delhi.
- Subbara N.S. (2005), *Soil Microorganisms and Plant Growth* (4th Ed.), Oxford and IBH Publishing Company, Wiley Eastern Limited, New Delhi.

MBG1552L1 AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY PRACTICAL

1 Credit

Total: 30 Hours

Objectives:

- ♦ Understanding methodologies to isolate and characterize microbes from soil, water and air
- ♦ Understanding the etiology, symptoms, pathogenesis and control measures of various plant diseases
- ♦ Learn to analyze the quality of potable water

1. Isolation and enumeration of bacteria and fungi from rhizosphere and rhizoplane 02units
2. Isolation of airborne microorganisms by exposure plate technique 01 Unit
3. Isolation and staining of *Rhizobium* from leguminous root nodules 02 Units
4. Isolation of *Azotobacter* from soil 02 Units
5. Isolation of *Actinomycetes* from soil 01 Unit
6. Study of plant pathogens: Tikka disease, Downy mildew, Tomato leaf curl, Citrus canker and Sandal spike disease 01 Unit
7. Determination of biological oxygen demand 02 Units
8. Determination of Chemical Oxygen Demand 01 Unit
9. Microbial examination of water for coliforms – MPN test. 02 Units
10. Study of fungi – *Cladosporium sp*, *Curvularia sp*, *Alternaria sp*, *Trichoderma sp*, *Fusarium sp*, *Helminthosporium sp*. 01 Unit

MBG155202 IMMUNOLOGY AND MEDICAL MICROBIOLOGY

3 Credits

Total: 60 Hours

Objectives:

- ✦ Understanding the immune system and functions
- ✦
- ✦ Understanding the etiology, characteristics, pathogenesis, treatment, prophylaxis and epidemiology of various diseases

UNIT 1: Cells and Organs of the Immune System

14 hrs

History and scope of Immunology; Types of immunity – passive, active, acquired and innate immunity; Humoral and cell mediated immunity; B cell activation and differentiation; memory B cell and plasma cell and their functions; Organs of the immune system – Primary (thymus, bone marrow) and Secondary (lymph node, spleen); Cells of the immune system – T cells, B cells, macrophages, granulocytes, NK cells, .

UNIT 2: Antigen – Antibody Interactions

14 hrs

Antigen –Types, haptens, adjuvants, epitopes and factors influencing antigenicity; Antigen processing and presentation, types of antigen presenting cells, antigen processing pathway;; Major Histocompatibility Complex – structure and functions of MHC I and II; Antibody – structure, types, properties and functions; Production of polyclonal and monoclonal antibodies and their applications; Antigen– antibody reactions: *In vitro* tests – Agglutination, Precipitation, Complement fixation test, Neutralization, Opsonization, Gel diffusion techniques - Immunoelectrophoresis, ODD and Radial Immuno Diffusion; Labelled antibody techniques – RIA, ELISA and Immunofluorescence.

UNIT 3: Reactions of the Immune System

14 hrs

Complement system – structure, components and functions, Hypersensitivity and allergic reactions; Components of Blood, ABO blood grouping and Rh typing; Vaccines and immunization – Passive and Active immunization, Types of vaccines - Inactivated, Attenuated and Recombinant vaccines; Peptide and DNA vaccines.

UNIT 4: Introduction to Medical Microbiology

04 hrs

; Koch's postulates; Normal flora of the human body; Mode of infection- portals of entry of the pathogen into the human host, virulence factors and their role in breaching the host defense.

UNIT 5: Study of Pathogenic Microorganisms

14 hrs

Classification, culture characteristics, biochemical characters, antigenic structure, pathogenesis, laboratory diagnosis, epidemiology and treatment of Bacterial diseases – Enteric Fever, Cholera, Diphtheria, Tuberculosis, Tetanus, Shigellosis, , Leprosy, Gonorrhoea,.; Viral diseases – Polio, Rabies, Hepatitis B, HIV and Protozoan diseases – Amoebiasis, Malaria; Fungal disease- Candidiasis.

References:

- Abbas Abul .K, Lightman Andrew .K & Pober Jordan .S (2003), *Cellular and Molecular Immunology* (5th Ed.), W.B Saunders Company, Philadelphia.
- Anathanarayana Paniker (2000), *Text Book of Microbiology* (6th Ed.), Orient and Longman, New Delhi.
- Jawetz Mehick, Adel berg Brooks, Butel & Orston (2007), *Medical Microbiology*, Prentice Hall, London.
- Roitt I.M. (2001), *Essentials of Immunology* (6th Ed.), ELBS Blackwell scientific Publishers, London
- Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne & Janis Kuby (2007), *Kuby Immunology* (6th Ed.), W.H. Freeman and Company, New York.

MBG1552L2 IMMUNOLOGY AND MEDICAL MICROBIOLOGY PRACTICAL

1 Credit

Total: 30 Hours

Objectives:

- ♦ Awareness on the growth characteristics of pathogenic microbes
 - ♦ Understanding the significance of Biochemical tests in disease diagnosis
1. Isolation and identification of microorganisms from Ear, Nose, Throat, Sputum and Urine (Growth on Blood Agar, Chocolate agar, MacConkey Agar, Nutrient Agar) 02 Units
 2. Biochemical analysis of samples – (Qualitative) Urine albumin, Reducing Sugar and Cholesterol. 02 Units
 3. Coagulase test
 4. Blood grouping 01 Unit
 5. Differential count of WBC 01 Unit
 6. WIDAL test 01 Unit
 7. VDRL test 01 Unit
 8. Spot ELISA 01 Unit
 9. Ouchterlony Double Diffusion (ODD) 01 Unit
 10. Radial Immunodiffusion (RID) 01 Unit
 11. Study of pathogenic microorganisms - Study of Acid fast bacilli, *Shigella*, *Clostridium*, *Staphylococcus*, *Streptococcus*, *Entamoeba*, *Plasmodium* and *Candida* (slides) 01 Unit
 12. Antimicrobial sensitivity test – Disc Diffusion method 01 Unit

BCH155201: ADVANCED BIOMOLECULAR CHEMISTRY

3 Credits

Total: 60 Hours

Objectives:

- ◆ Understand the structure and classification of biomolecules
- ◆ Study of energetics and biological oxidation

UNIT 1: Introduction

08 hrs

Development and scope of biochemistry, overview of functions of biomolecules in cell organelles, Water as a solvent of life, properties of water.

UNIT 2: Carbohydrates

14 hrs

Biological importance, classification, monosaccharides, D and L designation, epimers and anomers, ascending and descending of monosaccharide series, derived monosaccharide; Biological importance of amino sugars, sugar phosphates, sugar acids and deoxy sugars; Disaccharides, glycoside linkage, structure and biological importance of sucrose-maltose-lactose, isomaltose, cellobiose and trehalose; polysaccharides- starch and glycogen, Structure of cellulose and chitin, pectin, glycosaminoglycan, peptidoglycan and teichoic acid.

UNIT 3: Amino Acids and Proteins

12 hrs

Protein and non-protein amino acids, structure and classification of α -amino acids, acids-base, chemical and optical properties; Peptides, peptide bond; biologically important peptides; Proteins: classification based on composition, shape and function, colour reaction, Structural organization-primary, secondary, tertiary and quaternary structures; Denaturation.

UNIT 4: Lipids and Membranes

14 hrs

Classification and biological function of lipids; Fatty acids- classification based on structure, properties of fatty acids, Acyl glycerol; Hydrolysis- rancidity- acid- saponification and iodine values, Phosphoglycerides-structures and biological roles; Sphingolipids phosphosphingolipids, sphingomyelins, glycosphingolipids, gangliosides and cerebrosides; Prostaglandins-structure and an overview of their biological roles; Functions and chemical composition of biological membranes, Fluid mosaic model; Steroids- Function of cholic acid, cholesterol, androgen and estrogens.

UNIT 5: Bioenergetics and Biological Oxidation

12 hrs

Bioenergetics, energy transformation in living systems, free energy concept, exergonic and endergonic reaction, ATP and other high energy compounds, energy coupling; Biological oxidation- stepwise process, Mitochondrial electron transport chain- components, schematic representation indicating sites of ATP synthesis, Oxidative phosphorylation, Chemiosmotic theory – an outline.

References:

- Deb A.C (1989), *Fundamentals of Biochemistry* (3rdEd.), New Central Agency Publishers, Kolkata.
- Jain J. L (2005), *Fundamentals of Biochemistry* (6th Ed.), S Chand Publication, New Delhi.
- Jayaraman J., (2002), *Laboratory manual in Biochemistry* (1st Ed.), New Age International publishers, New Delhi.
- Lehninger A. L. (1982), *Principles of Biochemistry* (4th Ed), CBS Publishers, New Delhi.
- Lubert Stryer (2000), *Biochemistry* (4th Ed.), W H Freeman & Co, New York.
- Pattabiraman (2008), *Laboratory manual in biochemistry* (4th Ed.), All India Publishers, New Delhi.
- Plummer T (2008), *An introduction to practical biochemistry* (2nd Ed.), McGraw-Hill Publishers, New York.
- Sadasivam A Manickam (2004), *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.
- Voet and Voet (1995), *Biochemistry* (2nd Ed.), John Wiley & Sons, New York.

BCH1552L1: BIOCHEMISTRY PRACTICAL V

1 Credit

Total: 30 Hours

Objectives:

- ◆ Quantitative estimation of amino acid, ascorbic acid, calcium and qualitative analysis of biomolecules
- ◆ Demonstrate biological preparations

- | | |
|--|----------|
| 1. Qualitative analysis of carbohydrates, amino acids, proteins and lipids-
preparation of solid derivatives of monosaccharides | 05 Units |
| 2. Estimation of amino acids by Sorenson's formal titration method | 02 Units |
| 3. Estimation of ascorbic acid from biological samples by titrimetric method | 02 Units |
| 4. Determination of iodine value of a lipid | 02 Units |
| 5. Estimation of calcium in milk | 02 Units |
| 6. Preparation of starch from potato | 01 Unit |
| 7. Preparation of casein from milk | 01 Unit |

BCH155202 ENZYME AND ENZYME TECHNOLOGY

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the classification, structure and applications of enzymes
- ♦ Understand the source, extraction and purification process of enzymes
- ♦ Study the kinetic parameters and action of enzymes

UNIT 1: Basic Concepts in Enzymology

14 hrs

Introduction, definition, IUPAC classification of enzymes, properties of enzymes; Enzyme specificity; Enzyme units; Definition of active sites; Theories of enzyme action- lock and key and induced fit model; Extraction, purification and characterization of enzymes.

UNIT 2: Enzyme Kinetics and Enzyme Inhibitors

14 hrs

Enzyme kinetics-derivation of Michaelis Menton equation, significance of k_m and V_{max} , Line Weaver Burk Plot; Factors affecting enzyme activity; Enzyme inhibition-competitive, noncompetitive inhibition; Enzyme regulation; Allosteric enzymes, Isoenzymes,

UNIT 3: Coenzymes, Cofactors and Mechanism of Enzyme Action

12 hrs

Definition, structure and functions of Thiamine Pyro Phosphate, Nicotinamide Adenine Dinucleotide, Nicotinamide Adenine Dinucleotide Phosphate, Flavin Adenine Dinucleotide, Flavin Mono Nucleotide, Coenzyme-A and metal cofactors; Multienzyme complex-Pyruvate Dehydrogenase; Mechanism of enzyme action-general acid base catalysis, covalent catalysis.

UNIT 4: Enzyme Production and Immobilization

10 hrs

Industrial production and applications of enzymes- Amylase, Proteases, Lipases and Pectinases; Immobilized enzymes, methods of immobilization, effect of immobilization on enzyme activity, applications of immobilized enzymes.

UNIT 5: Applications of Enzymes

10 hrs

Enzymes as Biosensors-Principle, techniques and mechanism; Enzyme engineering-Artificial enzymes; Enzymes used in diagnosis of various diseases, normal and abnormal values.

References:

- Alan Welshman (1993), *Hand book of enzyme biotechnology* (2nd Ed.), Brown Publishers, New Delhi.
- Jayaraman J (2002), *Laboratory manual in Biochemistry* (1st Ed.), New Age International, New Delhi.
- Malcolm and Edwin C. Webb Dixon., (1964), *Enzymes* (2nd Ed.), Academic Publishers, New York.
- Martin Chaplin and Christopher Bucke., (2004), *Enzyme Technology* (2nd Ed.), Wiley Press, New York.
- Pattabiraman (2008), *Laboratory manual in biochemistry* (4th Ed.), All India Publishers, New Delhi.
- Plummer T (2008), *An introduction to practical biochemistry* (2nd Ed.), McGraw-Hill Publishers, New York.

Sadasivam A. Manickam (2004), *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.
Trevor Palmer (1991), *Understanding enzymes* (3rd Ed.), Ellis Harwood Publishers, New York.

BCH1552L2 BIOCHEMISTRY PRACTICAL VI

1 Credit

Total: 30 Hours

Objectives:

- ◆ Determine the activity and assay of enzymes
- ◆ Study the factors affecting the activity of enzymes

1. Preparation of crude enzyme extracts	01 Unit
2. Effect of pH on the activity of acid phosphatase and catalase	02 Units
3. Effect of temperature on the activity of acid phosphatase and catalase	02 Units
4. Effect of enzyme concentration on the activity of acid phosphatase and catalase	02 Units
5. Effect of substrate concentration on the activity of acid phosphatase and catalase	02 Units
6. Assay of α -amylase activity	02 Units
7. Assay of urease activity	02 Units
8. Effect of pH & temperature on the activity of alkaline phosphatase	02 Units

GEN155201 RECOMBINANT DNA TECHNOLOGY

Objectives:

- ♦ Familiarize concepts in Genetic Engineering
- ♦ Understand the techniques in Genetic Engineering
- ♦ Comprehend the applications of recombinant DNA technology

UNIT 1: Tools for Genetic Engineering**14 hrs**

Introduction to genetic engineering, DNA manipulative enzymes– Restriction enzymes, Ligases and other DNA modifying enzymes; Brief account of alkaline phosphatase, polynucleotide kinase, exonuclease III, DNAase I, Mung bean and S1 nuclease, DNA polymerase and Klenow fragment, terminal nucleotidyl transferase, RNA dependent DNA polymerase, RNases, RNase H; Vectors– Properties of an ideal vector, Cloning vectors – Prokaryotic vectors (pBR 322, pUC 18, Lambda phage, M13, Cosmids), Eukaryotic vectors (YAC vectors, Shuttle vectors– Yeast and *E. coli*), integrative DNA transfer using *Agrobacterium* vectors, Ti plasmid, Binary and co-integrated vectors, animal viral vectors - SV 40, Retroviral and Vaccinia viral vectors; Expression vectors in Prokaryotes and Eukaryotes.

UNIT 2: Technique for Recombinant DNA Technology**12 hrs**

Gel electrophoresis– AGE and SDS–PAGE; Hybridization– Southern, Northern, Western, Dot blots, Autoradiography, DNA sequencing– Sanger's di-deoxy method, molecular probes, cDNA library, genomic library, amplification through PCR.

UNIT 3: Direct Gene Transfer Methods**06 hrs**

Chemical methods, lipofection, electroporation, microinjection, ballistic method– particle shot gun method.

UNIT 4: Selection and Screening of Recombinants**14hrs**

Identification and selection of transformed cells; Direct methods– insertional inactivation, visual screening method, plaque formation, complementation of mutation /nutrition; Indirect methods – colony hybridization, immunochemical detection; Use of selectable genes – plants – npt, animals–TK; Scorable genes – Plants–Gus, animals–lux; Expressions of cloned genes - products generated due to the recombinant gene expression in host and their application.

UNIT 5: Applications**14 hrs**

Transgenic animals – mouse (knock–out, methodology, applications), A brief account of transgenic sheep, goat, poultry, fish, cow, pig, rabbit with value added attributes; Transgenic Plants–resistance to diseases (pathogen resistant – viral, fungal and bacterial), insects (Bt gene transfer), herbicides, fertilizer management– Nif gene transfer.

References:

Brown, T. A. (2002). *Genetics: A Molecular Approach* (2nd Ed.), Garland Science, New York.

Desmond, S. T. N. (2002). *An introduction to Genetic Engineering* (2nd Ed.), University Press, Cambridge.

Glick, B. R. & Pasternak, J. J. (1998). *Molecular Biotechnology* (2nd Ed), ASM Press, Washington, D.C.

Gupta, P. K. (2003). *Elements of Biotechnology* (2nd Ed.), Rastogi Publication, Meerut.

Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., Silver, L. M. & Veres, R. C. (2000) *Genetics: From Genes to Genomes*, Tata–McGraw Hill, New Delhi.

Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., & James, D. (2000). *Molecular Cell Biology* (4th Ed.). New York: Freeman.

Ravishanker, G. A. & Venkataraman, L. V. (1997). *Biotechnological Application of Plant Tissue and cell culture*, Oxford IBH, New Delhi.

Robert, H. T. (2002). *Principles of Genetics* (7th Ed.), Tata–McGraw Hill, New Delhi.

GEN1552L1 GENETICS PRACTICAL V

1 Credit

Total: 30 Hours

Objectives:

- ♦ Understand the principle and working of different instruments used for Recombinant DNA Technology
- ♦ Quantification of DNA and RNA
- ♦ Comprehend the techniques in Recombinant DNA Technology

1. Instrumentation – Microneedle, Magnetic stirrer, UV Transilluminator, PCR
03 Units
2. Vectors – pBR 322 and Cosmid, YAC, Ti plasmid – binary vector, SV 40 and
Vaccinia viral vector 02 Units
3. Transgenic organisms – Plants – Bt cotton and Animals – Knock out Mouse
01 Unit
4. Quantification of DNA by DPA method 02 Units
5. Quantification of RNA by orcinol method 02 Units
6. Agarose Gel Electrophoresis of DNA 01 Units
7. Demonstrations – Isolation of Plasmid DNA, restriction enzyme digestion, ligation of
DNA fragment, transformation – T complementation 04 Units

GEN155202 BASIC HUMAN GENETICS

3 Credits

Total: 60 Hours

Objectives:

- ✦ Characterize the human chromosomes
- ✦ Understand the inheritance pattern of certain genetic diseases
- ✦ Understand the genetics of immunology
- ✦ Understand the genetics of cancer
- ✦ Comprehend the importance of genetics in society

UNIT 1: Human Chromosomes

06 hrs

Normal human karyotype; Paris nomenclature; Flow karyotyping – Quantification on DNA of individual chromosomes; FACS – Fluorescence Activated Cell Sorter.

UNIT 2: Genetic Diseases and Inheritance Pattern

14 hrs

Autosomal dominant inheritance– Adult polycystic kidney, Achondroplasia & Neurofibromatosis; Autosomal recessive inheritance – Albinism, Sickle cell anemia, Phenyl ketonuria; X-linked recessive – Duchenne Muscular Dystrophy; X-linked dominant – Xg blood group; Y-linked inheritance – Testes determining factor; Multifactorial inheritance – cleft lip and palate, rheumatoid arthritis and diabetes; Mitochondrial diseases – Leber's hereditary optic neuropathy.

UNIT 3: Immunogenetics

12 hrs

Genetics of normal immune system; Inherited immunodeficiency– X-linked agammaglobulinaemia; Major Histocompatibility Complex – Study of Twins (MHC); HLA disease associations; Transplantation, graft versus host disease.

UNIT 4: Cancer Genetics

14 hrs

Properties of cancer cells; Types– Proto oncogenes, oncogenes, cellular oncogenes, tumor suppressor genes, viral oncogenes; Chromosomal abnormalities associated with the specific malignancies – Chronic myelogenous leukemia, Acute promyelocytic leukemia, Acute lymphocytic leukemia, Acute nonlymphocytic leukemia, chronic lymphocytic leukemia & Retinoblastoma.

UNIT 5: Genetics and Society

14 hrs

Genetic Counseling – History and pedigree construction, examination, diagnosis, counseling, follow up; Prenatal diagnosis, various procedures – amniocentesis, chorionic villus sampling, ultrasonography and fetoscopy; Dermatoglyphics – introduction, classification, dermatoglyphics in clinical disorders, clinical application; Eugenics– Positive and negative, eugenics, euphenics; Human genome project; Gene therapy; Stem cell therapy.

References:

Davies, Gardner. A. (2010). *Human Genetics* (2nd Ed.). Viva Books.

Emery, A. E. H. & Rimoin, D. L. (1990). *Principles and Practice of Medical Genetics* (2nd Ed.), Churchill Livingstone, New York.

Gerald, J. S. (1989). *The New Human Genetics*, Wm. C. Brown, Iowa.

Lewis, R. (2001). *Human Genetics: Concepts and Applications* (5th Ed.), McGraw Hill, Boston.

Mandal, S. (1996). *Fundamentals of Human Genetics*. New Central Book.

McKusick, V. A. (1998). *Mendelian Inheritance in Man, A Catalog of Human Genes and Genetic Disorders* (12th Ed.), Johns Hopkins University Press, Baltimore.

GEN1552L2 GENETICS PRACTICAL VI

1 Credit

Total: 30 Hours

Objectives:

- ◆ Determine the frequencies of a dominant or recessive traits occurring in a given population.
 - ◆ Identify the sex chromatin
 - ◆ Learn to draw and analyze pedigree charts
 - ◆ Learn to record and study dermatoglyphic prints.
1. Study of Mendelian traits – Hair pattern, Widow’s peak, Dimpled cheeks, Mid-digital hair, Hitchhiker’s thumb, Clasping of hands, Hypertrichosis. 02 Units
 2. Study of normal karyotyping in humans – Male (46. XY), Female (46. XX); G banded metaphase plate. 02 Units
 3. Study of Abnormal Karyotypes – Down syndrome, Turner syndrome, Klinefelter Syndrome. 02 Units
 4. Barr body analysis in cheek epithelium. 01 Units
 5. Blood smear study of drum sticks in Neutrophils. 02 Units
 6. Blood cell counting using Haemocytometer (RBC and WBC) 02 Units
 7. Study of pedigree symbols used in autosomal recessive disorder, autosomal dominant disorder and sex linked disorders. 02 Units
 8. Study of Dermatoglyphics – Recording of print of fingertips and palm; Finger prints – Arch, Loop and whorl; Palm print – Hypothenar, Thenar and Inter digital areas; Record presence or absence of Simian crease; Ridge counting, atd angle calculation. 02 Units

VI SEMESTER

MBG156201 FOOD AND DAIRY MICROBIOLOGY

3 Credits

Total: 60 Hours

Objectives:

- ♦ Study the significance of microbes in food industry
- ♦ Learn the various preservation techniques and to detect food spoilage

UNIT 1: Contamination and Spoilage of Food

10 hrs

Food as a substrate for microorganisms, sources of contamination of food, spoilage of canned food, cereals, fruits, vegetables, meat and fish. Microbial examination of food – DMC, viable colony count, examination of faecal *Streptococci*.

UNIT 2: Food Preservation

10 hrs

Principles of food preservation, methods of food preservation – high temperature, canning, freezing, dehydration, chemical preservatives and radiation.

UNIT 3: Food Poisoning & Detection

14 hrs

Endotoxin – Staphylococcal poisoning, exotoxins – Botulism and Salmonellosis, Mycotoxins produced by fungi, Aflatoxin in stored food and grains; Food sanitation and control; HACCP

UNIT 4: Dairy Microbiology

14 hrs

Sources of microbial contamination of milk – milch animal, utensils and equipment, water, milking environment, personnel and packaging material; Physical and chemical properties of milk; Fermentation in milk – Souring, lactic acid fermentation, colour and flavour, gassy fermentation and proteolysis; Methods of preservation of milk and milk products - Pasteurization, sterilization and dehydration; Condensed and dried milk; Adulterants in milk; Test to detect spoilage in milk - Rapid platform tests (organoleptic, Clot on Boiling (COB); Titrable acidity, alcohol test, SPC, reductase test – MBRT, Resazurin test.

UNIT 5: Fermented Milk Products

12 hrs

Types and production of cheese - Cheddar & Cottage; Cultured butter milk; Fermented milk products – Yogurt, Kefir and Kumiss, Substitute with specific topic

References:

- Betty C. Hobbs (1962), *Food Microbiology*, Arnold–Heinemann Publishing Private Limited, New Delhi.
- Frazier and Wasthoff (2008), *Food Microbiology* (4th Ed.), Tata McGraw–Hill Publishing Company Limited, New Delhi.
- Hammer B.W. and Babal (1957), *Dairy Bacteriology* (4th Ed.), Prentice Hall Incorporated, London.
- Jay J.M. (1989), *Modern Food Microbiology*, CBS Publishers and Distributors, New York.
- Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003), *Microbiology* (5th Ed.), New York, McGraw –Hill Book Company.
- Prescott, Lansing M. Harley, John P. and Klein Donald A. (2000), *Microbiology* (4th Ed.), New York, WCB McGraw–Hill Book Company.
- Salle A.J. (1971), *Fundamental Principles of Bacteriology* (7th Ed.), New Delhi, Tata McGraw –Hill Book Company.

Stainer R.Y. & Ingraham J.L. (1987), *General Microbiology* (5th Ed.), New Delhi, Prentice Hall Private Limited.

Varnam A.H. & Evans M.G. (1996), *Food borne Pathogens*, London, Wolfe Publishing House.

MBG1562L1 FOOD AND DAIRY MICROBIOLOGY PRACTICAL

1 Credit

Total: 30 Hours

Objectives:

- ✦ Study and analyse the composition and characteristics of milk Learning to check the quality of Dairy products
 - ✦
 - ✦ Learn to identify and study the various food pathogens
-
1. Adulteration in milk – Starch and Formaldehyde tests
02 Units
 2. Isolation and identification of microbes from curd, idli batter and stored foods - Jams, Jellies, Sauce and Pickles 03 Units
 3. Bacterial examination of milk by SPC 02 Units
 4. Bacterial examination of milk by DMC 01 Unit
 5. MBRT 01 Unit
 6. Estimation of fat content in milk by Gerber's method 01 Unit
 7. Estimation of Lactose in milk 01 Unit
 8. Production of Aflatoxins from fungi and detection by paper chromatography 03 Units
 9. Study of food borne pathogens – *Clostridium*, *Staphylococcus* and *Salmonella* 01 Unit

MBG156202 INDUSTRIAL MICROBIOLOGY

3 Credits

Total: 60 Hours

Objectives:

- ♦ Learn the basics of fermentation technology
- ♦ Comprehend upstream and downstream processing Understand the techniques of production of Industrially important microbial products

UNIT 1: Introduction

10 hrs

History, scope and development of industrial microbiology and fermentation technology; Isolation and screening of industrially important microorganisms – primary and secondary screening, maintenance of strains; Strain improvement - mutant selection and recombinant DNA methods.

UNIT 2: Fermentation Media and Process Parameters

12 hrs

Fermentation media – natural and synthetic media, components of an essential media; Carbon, Nitrogen, vitamins, minerals, role of buffer, anti-foam agents; Sterilization of media; Process of aeration, agitation, temperature and pH regulation,

UNIT 3: Fermentors

12 hrs

Types of Fermentors – Typical, Airlift, Tower and Bubble cap fermentor, Types of fermentations – batch, fed batch and continuous fermentation; solid state, submerged, shake flask fermentation, Immobilized enzyme and cell bioreactors.

UNIT 4: Downstream Processing

12 hrs

Solid – liquid separation (filtration, flocculation, centrifugation and sedimentation), Release of intracellular products: physical, enzymatic, chemical; Concentration and Purification – chromatographic techniques (affinity, column, HPLC, ion exchange and GLC); Product formulation.

UNIT 5: Production of Microbial Products

14 hrs

Production of ethanol, alcoholic beverage – Beer; Organic acid – Citric acid; Antibiotic – Penicillin; Amino acid – Glutamic acid; Vitamin – B₁₂; Enzyme – Amylase; Fermented foods – Yoghurt, Tempeh, Cheese; Microbial foods – single cell protein (SCP) and Single cell oil (SCO).

References:

- Bisen P.S (1994), *Frontiers in Microbial Technology* (1st Ed.), CBS Publishers, New Delhi.
- Glazer A.N. & Nikaído. H (1995), *Microbial Biotechnology*, W.H. Freeman & Co, New York.
- Prescott & Dum (1987), *Industrial Microbiology* (4th Ed.), CBS Publishers, New Delhi.
- Sullia S. B & Shantharam S. (1998), *General Microbiology*, Oxford, & IBH Publishing Co Pvt, New Delhi.
- Creueger W. & Crueger A. (2000), *A Text of Industrial Microbiology* (2nd Ed.), Panima Publishers corp, Delhi.
- Prescott & Dum (2002), *Industrial Microbiology*, Agrobios (India) Publishers, Jodhpur.
- Stanbury P.F, Whitaker H. & Hall S.J. (1978), *Principles of Fermentation Technology*, Pergamone Press, Oxford.

1 Credit

Total: 30 Hours

Objectives:

- ♦ Culturing Industrially important microorganisms
 - ♦ Perform the various titrimetric method to estimate fermented products
-
1. Algal and fungal culture: *Spirullina*, Yeast and *Aspergillus* 01 Unit
 2. Production of citric acid from *Aspergillus* sp. culture 02 Units
 3. Estimation of citric acid 02 Units
 4. Estimation of lactic acid 02 Units
 5. Estimation of lactose 02 Units
 6. Immobilization of Yeast cells. 02 Units
 7. Preparation of wine. 02 Units
 8. Estimation of percentage of alcohol by specific gravity method 02 Units
 9. Visit to Industries/ Institutes

BCH156201 INTERMEDIARY METABOLISM

3 Credits

Total: 60 Hours

Objectives:

- ◆ Understand the basic concepts of metabolism
- ◆ Understand the metabolic pathway and significance of carbohydrate, protein, lipid and nucleic acid

UNIT 1: Biochemical Investigations and Introduction to Metabolism 10 hrs

Perfusion of isolated organs, slice techniques, tracer techniques and mutant studies for elucidation of metabolic pathways; Anabolism, catabolism, stages in catabolism, compartmentalization of metabolic pathways in cells and energy conservation.

UNIT 2: Carbohydrate Metabolism- I 14 hrs

Fate of carbohydrates, Glycolysis, pathways and energetic, Oxidation of pyruvate to acetyl CoA; TCA Cycle pathway and energetics; anaplerotic reaction, Gluconeogenesis; Pasteur effect, Glycogenesis and glycogenolysis, Pentose Phosphate Pathway (HMP shunt).

UNIT 3: Carbohydrate Metabolism- II 12 hrs

Glucuronic acid cycle and glyoxylate cycle (ED pathway) Metabolism of other hexoses- Fructose and galactose; Biological oxidation-reduction, reduction equilibria; redox potential, enzymes and coenzymes involved in oxidation and reduction, Electron transport chain-Role of respiratory chain in mitochondria, energy capture; respiratory control.

UNIT 4: Lipid Metabolism 14 hrs

Blood lipids and dietary lipids, Oxidation of fatty acids-Carnitine cycle; beta oxidation, Alpha oxidation and omega oxidation, Biosynthesis of propionyl CoA. Biosynthesis of fatty acids, Biosynthesis of unsaturated fatty acids-Monounsaturated and polyunsaturated fatty acids, Biosynthesis-Lecithin, cephalin, inositol, phosphatidyl serine, cholesterol and plasma lipoproteins, Biosynthesis of glycolipids.

UNIT 5: Protein & Nucleic Acid Metabolism 10 hrs

Fate of dietary proteins, metabolic nitrogen pool, Catabolism of amino acid-Oxidative deamination, non-oxidative deamination, transamination, amino acid decarboxylation, catabolism of carbon skeleton of amino acids, Catabolism of glycine, phenylalanine and tyrosine; Interrelation between carbohydrates, fat and protein metabolism, Metabolism of purines-De novo synthesis, salvage pathways; catabolism, Metabolism of pyrimidine-De novo synthesis, salvage pathways; catabolism.

References:

- Garrett R.H and Grisham C.M., (1995), *Biochemistry* (3rd Ed.), Saunders College Publishers, Florida.
- Jain, J. L. (2005), *Fundamentals of Biochemistry* (6th Ed.), S Chand Publication, New Delhi.
- Jayaraman, J. (2002), *Laboratory manual in Biochemistry* (1st Ed.), New Age International Publishers, New Delhi.
- Lubert Stryer ., (2000), *Biochemistry* (4th Ed.), WH Freeman & Co Publishers, New York .

Mathews, Freeland and Miesfeld.,(1996), *Biochemistry* (4th Ed.),Wiley & sons Publication, NewYork.

Pattabiraman (2008), Laboratory manual in biochemistry (4th Ed.),All India Publishers, NewYork.

Plummer T (2008), An introduction to practical biochemistry (2nd Ed), McGraw-Hill Publishers,New York.

Sadasivam.A.Manickam., (2004), Biochemical methods (2nd Ed.), New Age International Publishers,New Delhi.

Voet and Voet (1995), *Biochemistry* (2nd Ed.), John Wiley & Sons publishers, New York.

BCH1562L1 BIOCHEMISTRY PRACTICAL VII

1 Credit

Total: 30 Hours

Objectives:

- ♦ Estimate glycogen, glucose, chlorophyll, ketose and protein
- ♦ Determine albumin globulin ratio and estimate nucleic acids

1. Estimation of glycogen from liver sample	01 Unit
2. Estimation of chlorophyll from green leaves	02 Units
3. Estimation of glucose by Benedict's method	02 Units
4. Estimation of ketoses by resorcinol	02 Units
5. Estimation of DNA	02 Units
6. Estimation of RNA	02 Units
7. Determination of albumin globulin ratio	02 Units
8. Estimation of protein by Bradford method	02 Units

BCH156202 CLINICAL BIOCHEMISTRY

3 Credits

Total: 60 Hours

Objectives:

- ♦ Study the signs and symptoms of clinical disorders
- ♦ Understand the diagnosis and treatment of metabolic disorders

UNIT 1: Disorders of Carbohydrate Metabolism

14 hrs

Normal sugar level in blood, renal threshold and regulation of blood glucose concentration, Hypoglycemia; definition and causes, Hyperglycemia; definition and causes, Diabetes Mellitus- Introduction, aetiology, types of diabetes mellitus, clinical pathology and diagnosis, Urine testing, random blood sugar and GTT, acute and chronic complications of Diabetes mellitus- Glycosuria-Differential diagnosis of glycosuria, fructosuria, pentosouria, galactosemia and glycogen storage diseases.

UNIT 2: Disorders of Lipid Metabolism

14 hrs

Plasma lipids and lipoproteins, Introduction to Hyperlipoproteinemia- Types I, II, III, IV and V, Alpha lipoproteinemia, Hypolipoproteinemia-beta lipoproteinemia-Hypobeta lipoproteinemia, Tangier's disease and LCAT deficiency; Atherosclerosis, Fatty liver and hyper lipidemia, Hypercholesterolemia, Lipidosis and Xanthomatosis, Tay sach's disease, Niemann Pick disease.

UNIT 3: Disorders of Amino Acid & Nucleic Acid Metabolism

12 hrs

Plasma protein abnormalities, Total plasma (Serum) protein- Fibrinogen, Albumin and Globulins, Non protein nitrogen-Urea, Uric acid, Creatinine and Ammonia, Porphyria, Amino acid metabolism-Cystinuria, phenylketonuria, maple syrup disease, alkaptonuria, Albinism and Hartnup disease; Disorders of Purine Gout; Hypouricemia, Xanthinuria and Liathiasis, Disorders of pyrimidine metabolism-Orotic aciduria.

UNIT 4: Gastric, Pancreatic and Intestinal Functions

10 hrs

Gastric function-Introduction, tests of gastric function, insulin stimulation test, determination of Gastrin in serum and tubeless gastric analysis, Pancreatic function-introduction, pancreatic function tests- serum amylase and lipase, Intestinal function-introduction, test of monosaccharide absorption (xylose excretion test) and determination of total protein (Lowry's method).

UNIT 5: Liver and Kidney Functions

10 hrs

Introduction, bilirubin metabolism and jaundice, liver function tests, Estimation of conjugated and total bilirubin in serum (Diazo method), Detection of bilirubin and bile salts in urine (Fouchet's test and Hay's sulphur test), Thymol turbidity test, prothrombin time; Serum enzymes in liver disease; Serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH); Kidney function test- introduction, physical examination of urine, elimination tests, clearance tests; inulin clearance, creatinine clearance test and urea clearance test, renal blood flow and filtration fraction.

References:

- Jayaraman J (2002), *Laboratory manual in Biochemistry* (1st Ed.), New Age International Publishers, New Delhi.
- Pattabiraman (2008), *Laboratory manual in biochemistry* (4th Ed.), All India Publishers, New Delhi.
- Philip D Mayne (1994), *Clinical Chemistry in diagnosis and treatment* (6th Ed.), ELBS Publication,
- Plummer T (2008), *An introduction to practical biochemistry* (2nd Ed.), McGraw-Hill Publishers, New York.
- Sadasivam.A.Manickam(2004), *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.
- Smith A. F, Whitby L.G and Beckett G.J., (2004). *Lecture notes on Clinical Biochemistry* (5th Ed.), Blackwell Publishers, England.
- Thomas M Devlin (2001), *Textbook of Biochemistry with Clinical Correlations* (5th Ed.), Wiley Liss publishers, New York.

BCH1562L2 BIOCHEMISTRY PRACTICAL VIII

1 Credit

Total: 30 Hours

Objectives:

- ◆ Estimate urea, uric acid ,cholesterol in blood
- ◆ Analyse the normal and abnormal constituents of urine
- ◆ Study the activity of Alkaline, Acid phosphatase, SGOT and SGPT

I. Blood Analysis:

- | | |
|---|----------|
| 1. Estimation of Urea by DAM method | 01 Unit |
| 2. Estimation of Uric acid by Caraways method | 02 Units |
| 3. Estimation of Alkaline Phosphatase in serum | 01 Unit |
| 4. Estimation of Acid Phosphatase in serum | 02 Units |
| 5. Estimation of Cholesterol in serum by Zak's method | 02 Units |
| 6. Estimation of SGOT | 02 Units |
| 7. Estimation of SGPT | 02 Units |
| 8. Estimation of Blood sugar by Folins Wu method | 01 Unit |

II. Qualitative analysis

1. Analysis of urine sample-Normal and Abnormal constituents

GEN156201 DEVELOPMENTAL AND POPULATION GENETICS

3 Credits

Total: 60 Hours

Objectives:

- ♦ Outline the principles of genetic inheritance
- ♦ Learn the concepts of evolutionary genetics and population genetics
- ♦ Comprehend the concepts in quantitative genetics and biometrical genetics.

UNIT 1: Animal and Plant Development

14 hrs

Role of nuclear transplantation and development in Amphibians and Acetabularia; Switching genes on and off during development– Tissue specific methylation, Differential expression of haemoglobin genes; Fate mapping; The genetics of development in Arabidopsis – Embryonic, Meristem, Flower development; The genetics of development in *Drosophila* – Early development, Origin of anterior–posterior polarity, Role of maternal genes, Segmentation genes, Homeotic selector genes, Establishment of dorso–ventral polarity.

UNIT 2: Evolutionary Genetics

10 hrs

Darwin's theory, Mutation theory, Neo Darwinism, Synthetic Theory; Evolution at molecular level – Nucleotide sequence; Speciation, Methods of speciation – Allopatric and sympatric, Premating and post mating isolating mechanisms.

UNIT 3: Population Genetics

10 hrs

Gene pool, Gene frequencies, Genotype frequencies; Hardy–Weinberg principle, Evolutionary agents – Selection– Fitness, Gametic selection, Zygotic selection, Migration, Mutation, Non–random mating and Genetic drift.

UNIT 4: Quantitative Inheritance

12 hrs

Introduction, Features of polygenic traits in relation to oligogenic traits, Inheritance of kernel color in wheat and skin colour in human, Transgressive inheritance, Environmental effects; Quantitative trait loci (QTL); Significance of polygenic inheritance in animal breeds.

UNIT 5: Biometrical Genetics

14 hrs

Co–relation, Regression, ANOVA; Genetic analysis of quantitative trait – Ear length in corn; Variance in polygenic variability – Phenotypic, Genotypic, Environmental variability, Additive Variance, Dominance variance and Epistatic variance; Heritability in broad sense, Narrow sense heritability, Response to selection; Problems related to variance and heritability.

References:

- Balinsky, B. I. (1975). *Introduction to Embryology* (4th Ed). Saunders, Philadelphia.
- Charles, W., Wolf. J. B. (2006). *Evolutionary Genetics*, Oxford University press, New York.
- Cooper, G. M. (2000). *The Cell* (2nd Ed.). Sunderland: Sinauer Associates.
- Falconer, D. (1995). *Introduction to Quantitative Genetics*. (4th Ed.). Longman, London.
- Gilbert S. F. (2003). *Developmental biology* (7th Ed.). Sunderland: Sinauer Associates.

- Gurbachan, S. M (2006) *Developmental Genetics*, I.K. International Publishing House, New Delhi.
- Lynch, M., Walsh, B. (1997). *Genetics and Analysis of Quantitative traits*. Senauer Associates, Sunderland.
- Phundhan, S. (2001). *Elements of Plant Breeding*. (2nd Ed.), Kalyani Publishers, New Delhi.
- Primrose, S. B. (1995). *Principles of Genome Analysis*, Blackwell, Oxford.
- Stickberger, M. W (1990). *Evolution*, Jones and Bartlett, Boston.

GEN1562L1 GENETICS PRACTICAL VII

1 Credit

Total: 30 Hours

Objectives:

- ✦ Project work and submission of thesis on any of the given topics.
- ✦ Solving biometrical problems.

1. Project Work in any one of the following topics: **07 Units**
 - a) Population genetics – Field study on gene and genotype frequency of autosomal and sex linked Mendelian traits in Human.
 - b) Human genetics – Study of genetic disease with pedigree analysis, sample size minimum 25.
 - c) Human genetics – Study of genetic disease with dermatoglyphic analysis, sample size minimum 25.
 - d) Cytogenetics – Cytogenetic analysis of different species of any plant and pollen fertility studies.
 - e) *Drosophila* genetics – Study of mendelian inheritance of any two mutant traits in *Drosophila*.
2. Biometrical problems in Quantitative Inheritance **08 Units**

Problems on Kernel color in Wheat, Ear length in Maize, Body size in Poultry & Rabbits; Genetic problems on portioning polygenic variability; Genetic problems on Heritability; Problems in population genetics.

GEN156202 APPLIED GENETICS

3 Credits

Total: 60 Hours

Objectives:

- ♦ Understand the concept of genetic resources and biodiversity.
- ♦ Understand the concept of heterosis in plants and animals.
- ♦ Comprehend the applications of genetics in the field of medicine, agriculture and forensics.
- ♦ Understand the importance of bioinformatics in genetics.

UNIT 1: Genetic Resources and Biodiversity

10hrs

Germplasm, Classification, Germplasm activities, Organizations associated with germplasm – NBPGR, IBPGR; Genetic Erosion, Biodiversity, Centers of Diversity, Vavilovian centers of Diversity, Law of Parallelism; Gene Sanctuaries, Gene Bank, Cyro-preservation.

UNIT 2: Heterosis in Animals and Plants

14 hrs

Introduction to heterosis and characteristics in animals; Animal breeding techniques – Inbreeding, Grading, Cross breeding; Fish breeding – Selection, Induced polyploidy, Gynogenesis, Androgenesis, Inbreeding; Production of breeds – Crossing of inbred lines for commercial production; Breeding strategies for improvement of livestock for milk, meat, wool production; Breeding strategies for improvement of poultry; Introduction to heterosis and characteristics in plants; Genetic concepts – Dominance, Over dominance, Estimation of heterosis; Hybridization techniques – Intergeneric and Interspecific hybridization; Inbreeding depression; Hybrid vigor exploitation in Rice, Cotton, Chilly, Tomato.

UNIT 3: Introduction to plant tissue culture

12 hrs

Embryo, Anther and Ovary Cultures; Shoot and Root Meristem Cultures; Callus Culture from Undifferentiated cells; Protoplast Culture; Economic benefits of Tissue Culture – Resistance to pests and pathogens and improvement in nutritive value.

UNIT 4: Genetics in Medicine, Industry and Forensic Science

14 hrs

Production of – Recombinant insulin, Interferon, Human growth hormone, Antibiotics – Penicillin, Steroid drugs – Corticosteroids, Vaccines – Hepatitis B vaccine; Preparation of DNA probes, Monoclonal antibodies and Diagnostic kits; DNA fingerprinting, Methodology of DNA fingerprinting; Molecular markers – RFLP, RAPD, Microsatellites, SNPs, STR; Application – Forensic Science, Medico-legal, Wildlife.

UNIT 5: Bioinformatics

10 hrs

Introduction, Scope and objective of bioinformatics, levels of bioinformatics in structural biology, components of bioinformatics, Biological database, database types, protein data base, structural data base, nucleotide and genome database, basic tools of bioinformatics, applications of bioinformatics.

References:

- Atherly, A. G., Girton, J. R. & Donald, M. C., (1999) *The Science of Genetics*, Saunders College Publications, Harcourt Brace.
- Brown, T. A. (2002). *Genetics: A Molecular Approach* (2nd Ed.), Garland Science, New York.
- Desmond, S. T. N. (2002). *An introduction to Genetic Engineering* (2nd Ed.), University Press, Cambridge.
- Glick, B. R. & Pasternak, J. J. (1998). *Molecular Biotechnology* (2nd Ed), ASM Press, Washington, D.C.
- Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. & Gelbart, W. M. (2000) *An Introduction to Genetic Analysis* (7th Ed.), Freeman, New York.
- Gupta, P. K. (2003). *Elements of Biotechnology* (2nd Ed.), Rastogi Publication, Meerut.
- Pennington, S. R. & Dunn, M. J. (2002). *Proteomics*, Viva Books, New Delhi
- Phundhan, S. (2001). *Elements of Plant Breeding*. (2nd Ed.), Kalyani Publishers, New Delhi.
- Primrose, S. B. (1995). *Principles of Genome Analysis*, Blackwell, Oxford.
- Ravishanker, G. A. & Venkataraman, L. V. (1997). *Biotechnological Application of Plant Tissue and cell culture*, Oxford IBH, New Delhi.
- Robert, H. T. (2002). *Principles of Genetics* (7th Ed.), Tata–McGraw Hill, New Delhi.

GEN1562L2 GENETICS PRACTICAL VIII

1 Credit

Total: 30 Hours

Objectives:

- ◆ Learn to use medical diagnostic kits.
- ◆ Understand the application of BLAST and FASTA.
- ◆ Study hybrid plants and animals.

- | | |
|---|----------|
| 1. Study of different techniques in plant hybridization | 02 Units |
| 2. Study of pollen fertility | 02 Units |
| 3. Study of diagnostic kits–WIDAL & VDRL | 03 Units |
| 4. Bioinformatics: Homology sequence alignment by using BLAST and FASTA | 04 Units |
| 5. Study of hybrid plants – Rice, Cotton, Chilly and Tomato | 02 Units |
| 6. Study of hybrid animals – Poultry, Dairy and Fishery | 02 Units |

NON CORE PAPERS

NHU150102 INDIAN CONSTITUTION

1 Credit

TOTAL: 30 Hours

Objectives:

- ◆ Enables the citizens to know their rights and duties
- ◆ Makes them an ideal citizen of India
- ◆ Helps them for their valuable contribution of nation building

UNIT 1 : Introduction

06 hrs

Constituent assembly, preamble, features of Indian constitution, fundamental duties, fundamental rights, methods of constitutional amendment, directive principles of state policy

UNIT 2: Union Parliament

07 hrs

Rajya Sabha- powers and functions, Loka Sabha- powers and functions, committees of the parliament, speaker. State legislature- Legislative council and legislative assembly – powers and functions

UNIT 3: Union Executive

07 hrs

President, Prime Minister Powers and functions. Governor, Chief Minister- powers and functions. Union and state council of ministers. Coalition government

UNIT 4: Judiciary

05 hrs

Features of Indian judiciary. Supreme court- powers and functions. High court- powers and functions. Public interest litigation

UNIT 5: Issues

05 hrs

Indian federation- Centre and state powers, Indian secularism. Reservations in India, Social justice, Environmental protection, Human rights

References:

- Austin, Granville (1999), *Indian constitution: cornerstone of a nation* New Delhi
- Bakshi, P.M (2002), *The Constitution of India* – Universal Law publishers.
- Basu, Durga Das (1995), *Introduction to the constitution of India* New Delhi: Prentice –hall of India Pvt.
- Basu, Durga Das (2002), *Introduction to the Constitution of India* New Delhi: Wadhwa and Company Law Publishers.
- Kabburi, S.K (2006), *Indian constitution-institutions and process*.
- Kagzi, M.C. (2001), *The Constitutional of India Vol.1 & 2*.New Delhi: India law house.
- Pylee, M.V (2002), *Constitution Government and Politics* New Delhi: Universal Law publishing Co.Pvt.Ltd.
- Raj, Hans (1998), *The Constitution of India*: New Delhi: Surjeet Publications.

NCS150101 COMPUTER FUNDAMENTALS

1 Credit

Total: 30 Hours

Objectives:

- ♦ To provide basic knowledge of Computer and its Usage.

UNIT 1: Introduction to Computers

05 hrs

General features of a Computer – Generation of Computers - Personal Computer – Workstation – Mainframe Computer and Super Computers. Computer Applications – Data Processing – Information Processing – Commercial – Office Automation – Industry and Engineering – Healthcare – Education – Graphics and Multimedia.

UNIT 2: Computer Organization

05 hrs

Central Processing Unit – Computer Memory – Primary Memory – Secondary Memory – Secondary Storage Devices – Magnetic and Optical Media – Input and Output Units – OMR – OCR – MICR – Scanner – Mouse - Modem.

Unit 3: Computer Hardware and Software

10 hrs

Machine language and high level language. Application software. Computer program. Operating system. Computer virus, antivirus and Computer security. Elements of MS DOS and Windows OS. Computer arithmetic. Binary, octal and hexadecimal number systems. Algorithm and flowcharts. Illustrations. Elements of database and its applications

UNIT 4: Microsoft Office

05 hrs

Word processing and electronic spread sheet. An overview of MS WORD, MS EXCEL and MS POWERPOINT. Elements of BASIC programming. Simple illustrations

UNIT 5: Computer Networks

05 hrs

Types of networks. LAN, Intranet and Internet. Internet applications. World wide web. E-mail, browsing and searching. Search engines. Multimedia applications

LIST OF PRACTICAL ASSIGNMENTS: (12 Sessions of 2 hours each)

System use, keyboard, mouse operations. Word pad and paint brush.

Creating a folder and saving a document 2 sessions.

Simple MS. DOS commands 1 Session

Windows operating system – icons, menus and submenus, my computer 2 sessions

Desktop publishing – preparation of a document using MS.WORD 2 sessions

Installation of a software, virus scanning – illustrations 1 session.

Spreadsheet calculations using MS.EXCEL 1 session.

BASIC programming – illustrations 1 session.

Internet use. Surfing, browsing, search engines, E-mail. 2 sessions.

References:

- Alexis Leon and Mathews Leon (1999): *Fundamentals of information technology*, Leon Techworld Pub.
- Archanakumar – *Computer Basics with office automation*, I.K. International Publishers.
- Jain, S.K. (1999): *Information Technology* “O” level made simple, BPB Pub.
- Jain, V.K. (2000): “O” Level Personal Computer Software, BPB Pub.
- Rajaraman, V. (1999): *Fundamentals of Computers*, Prentice Hall India.
- Sinha, *Computer Fundamentals*, BPB Pub.

NHU150101 ENVIRONMENTAL STUDIES AND CIVIC SENSE

1 Credit

Total: 30 Hours

Objectives:

- ♦ Understand the various aspects of Environment
- ♦ To harness the concern for the environment and its resources
- ♦ Comprehend the correlation between human population, social issues with that of environment

UNIT 1: Nature of Environmental Studies:

03 hrs

Definition, scope and importance, Multi - disciplinary nature of environmental studies, need for public awareness. Natural resources and associated problems: (a) Forest resources: Use and over-exploitation, deforestation timber extraction, mining, dams and their effects on forests and tribal people, (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. (d) Food resources: World food problems, changes caused by agriculture effects of modern agriculture, fertilizer-pesticide problems. (e) Energy resources: Growing energy needs, renewable and non - renewable energy sources, use of alternate energy sources. (f) Land resources: land as resources, and land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources equitable use of resources for sustainable lifestyles

UNIT 2: Ecosystems

03 hrs

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, Characteristic features, structure and function of the following ecosystem: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT 3: Biodiversity and its conservation

03 hrs

Introduction-Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and

option value, Biodiversity at global, national and local levels, India as a mega-diversity nation, Western ghat as a bio-diversity, Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife Conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ, Conservation of biodiversity.

UNIT 4: Environmental Pollution

03 hrs

Definition, causes, effects and control measures of: a) Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards., Solid waste management: causes, effects and control measures urban and industrial wastes, Role of an individual in prevention of pollution, Disaster management: floods, earthquake, cyclone and landslides, Tsunami.

UNIT 5: Social Issues, Human Population and Environment

06 hrs

From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns, Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation, consumerism and waste products, Environment protection Act, Air (Prevention and control of pollution) Act., Water (Prevention and control of pollution) Act., Wildlife protection act, Forest conservation Act, Issues involved in enforcement of environmental legislation public awareness. Population growth, variation among nations, Population explosion, Family welfare programme, Environment and human health, Value Education, Women and Child Welfare, Role of information technology in Environmental and human health.

CIVIC SENSE

Objectives

- ◆ To sensitize students to the concept and practice of civic sense
- ◆ Understanding the pivotal role in the transformation of urban attitudes along with the local government for sustainable change
- ◆ Fortifying experiential understanding of initiating and sustaining good civic sense in the community

UNIT I: Introduction to Civic Sense / Social Ethics

03 hrs

Concept nature and scope of civic sense, need and importance of civic sense, inter-relation between civic sense, citizenship and community.

UNIT II: Issues of Promoting Civic Sense

03 hrs

Spitting, urinating and defecating in public, lettering, shop lifting, consuming alcohol in public, smoking in public, consuming drugs, mugging, vandalizing public property, vulgar graffiti on public spaces, loud and rude behavior, argumentativeness, lack of humility and conduct, general disregard to the law of the land, disrespect to elders, ragging, eve teasing, women subjugation, stalking, lack of traffic discipline, jay walking, honking without reason, willful noise pollution,

road rage, use of cell phones while driving. Reporting Instances of Poor Civic Sense: Highlighting the manifestations and ramifications including the moral and the legal consequences of the victims and the accused. Preventive / precautionary measures for the innocent victims who are soft targets.

UNIT III: Promotion of Civic Sense

02 hrs

Role of educational institutions and media; the role of family / teachers, local self-Government and non-Government organization –

UNIT IV: Success stories signifying good Civic Sense within India and Foreign Countries

01 hr

UNIT V: Group Project – sensitizing students to the practice and inculcation of civic sense.

01 hr

References:

- Agarwal, K.C., (2001) *Environmental Biology*, Nidi Publ. Ltd. Bikaner
- Bharucha Erach, *The Biodiversity of India*, Mapin publishing Pvt. Ltd. Ahmedabad-
- Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. (2001) *Environmental Chemistry*, Wiley Eastern Ltd.,
- Heywood, Vh & Watson R.T. 1995 *Global biodiversity Assement* Cambridge Univ.
- Jadhav H & Bhosle V.M. 1995 *Environmental Protection and laws*. Himalayas Pub. House Delhi, 284p
- Mckinney M.L. & Schocl R.M. 1996 *Environmental Science systems & Solutions* Web.Enhanced edition 639p.