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 2014 −17 Batch

http://www.kristujayanti.edu.in

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 25th October, 2013 in the MCA panel room, Kristu Jayanti College, Bangalore.

MEMBERS PRESENT **SIGNATURE**

1. Rev. Fr. Augustine George
   Chairman and Dean – Faculty of Sciences, KJC

2. Dr. Jaya Prakash
   Professor & Director, Centre for Applied Genetics, BUB

3. Dr. Gomathi Devi,
   Professor, Department of Chemistry, BUB

4. Dr. Nitesh Dave
   Senior Scientist, Biocon India Pvt., Ltd, Bangalore

5. Dr. Elcey C.D
   Professor & Head, Department of Life Sciences, KJC

6. Dr. Calistus Jude
   Assistant Professor, Department of Life Sciences, KJC

7. Dr. Deepa MA
   Assistant Professor, Department of Life Sciences, KJC

8. Dr. Bheemasena Rao D.R.
   Assistant Professor, Department of Life Sciences, KJC

9. Dr. Kavyashree R.
   Assistant Professor, Department of Life Sciences, KJC

10. Mr. Vijayanand S
    Assistant Professor, Department of Life Sciences, KJC

11. Mrs Tresa Tony
    Assistant Professor, Department of Life Sciences, KJC

12. Mr. Thomas Abraham
    Assistant professor, Department of Life Sciences, KJC

13. Ms Sruthi Cyriac
    Assistant professor, Department of Life Sciences, KJC

The Dean - Faculty of Sciences Rev. Fr. Augustine George 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 UG 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 I and II Semester syllabus.

3. Panel of Examiners:

Panel of Examiners (both external and internal) for B.Sc., programme was finalized and approved for the academic year 2013-2014.

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. (UG) in Biotechnology, Genetics, Biochemistry & Microbiology was convened on 20th March, 2014 in the MBA panel room, P.G. Block, Kristu Jayanti College, Bangalore.

MEMBERS PRESENT **SIGNATURE**

1. Rev. Fr. Augustine George
   Dean – Faculty of Sciences, KJC

2. Dr. S.K.Sarangi
   Professor & Chairman, Department of Biotechnology, BUB

3. Dr. Jaya Prakash
   Professor & Director, Centre for Applied Genetics, BUB

4. Dr. Gomathi Devi,
   Professor, Department of Chemistry, BUB

5. Dr. M.S. Shaila
   Department of Microbiology and Cell Biology, IISC

6. Dr. Elcey C.D
   Professor & Head, Department of Life Sciences, KJC

7. Dr. Calistus Jude
   Assistant Professor, Department of Life Sciences, KJC

8. Dr. Deepa MA
   Assistant Professor, Department of Life Sciences, KJC

9. Dr. Bheemasena Rao D.R.
   Assistant Professor, Department of Life Sciences, KJC

10. Dr. Kavyashree R.
    Assistant Professor, Department of Life Sciences, KJC

11. Mr. Vijayanand S
    Assistant Professor, Department of Life Sciences, KJC

12. Mrs. Tresa Tony
    Assistant Professor, Department of Life Sciences, KJC

13. Mr. Thomas Abraham
    Assistant professor, Department of Life Sciences, KJC

14. Ms. Sruthi Cyriac
    Assistant professor, Department of Life Sciences, KJC

The Dean - Faculty of Sciences Rev. Fr. Augustine George welcomed the members of the board, briefed about previous meeting and initiated discussions on the following:

1. Syllabus

The draft Autonomous syllabi for UG programme in Biotechnology, Genetics, Biochemistry and Microbiology was presented, which was perused course wise by the subject experts and necessary changes was intended for approval of the same.

2. Panel of Examiners

Panel of Examiners (both external and internal) for B.Sc., programme was screened and approved for the academic year 2014-2015.

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	HOURS PER WEEK	CREDITS x SEMESTER	TOTAL CREDITS	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 85 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 I	Bio analytical skills
Semester II	Plant and Animal Histology
Semester III	Animal Tissue Culture
Semester IV	Mushroom Technology
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, 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, **MS** − Major Special, **MS Lab** − Major Special Laboratory, **NC** − Non Core, **Lang** – Language.

I Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
	II Language	Lang	4	3	40	60	100
13ENG1201	English	Eng	4	3	40	60	100
13MBG1201	Basic Microbiology & Microbiological Techniques	MC	4	3	40	60	100
13MBG12L1	Basic Microbiology and Control of Microorganisms practical	MC Lab	2	1	20	30	50
13BCH1201	Biophysical Chemistry	MC	4	3	40	60	100
13BCH12L1	Biochemistry practical I	MC Lab	2	1	20	30	50
13GEN1201	Fundamentals of Cell Biology	MC	4	3	40	60	100
13GEN12L1	Genetics practical I	MC Lab	2	1	20	30	50
13NHU0102	Indian Constitution	NC	2	1	10	40	50
	Total		**28**	**19**	**270**	**430**	**700**

II Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
	II Language	Lang	4	3	40	60	100
13ENG2201	English	Eng	4	3	40	60	100
13MBG2201	Microbial Taxonomy & Culture Techniques	MC	4	3	40	60	100
13MBG22L1	Microbial Taxonomy & Culture Techniques practical	MC Lab	2	1	20	30	50
13BCH2201	Biomolecules	MC	4	3	40	60	100
13BCH22L1	Biochemistry practical II	MC Lab	2	1	20	30	50
13GEN2201	Principles of Genetics	MC	4	3	40	60	100
13GEN22L1	Genetics practical II	MC Lab	2	1	20	30	50
12NCS0101	Computer Fundamentals	NC	2	1	10	40	50
	Total		**28**	**19**	**270**	**430**	**700**

III Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
13ENG3201	English	Eng	4	3	40	60	100
	II Language	Lang	4	3	40	60	100
13MBG3201	Microbial Physiology & Microbial Genetics	MC	4	3	40	60	100
13MBG32L1	Microbial Physiology practical	MC Lab	2	1	20	30	50
13BCH3201	Bioanalytical Techniques	MC	4	3	40	60	100
13BCH32L1	Biochemistry practical III	MC Lab	2	1	20	30	50
13GEN3201	Cytogenetics	MC	4	3	40	60	100
13GEN32L1	Genetics practical III	MC Lab	2	1	20	30	50
	Total		**26**	**18**	**260**	**390**	**700**

IV Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
13ENG4201	English	Eng	4	3	40	60	100
	II Language	Lang	4	3	40	60	100
13MBG4201	Molecular Biology & Genetic Engineering	MC	4	3	40	60	100
13MBG42L1	Molecular Biology & Genetic Engineering Practical	MC Lab	2	1	20	30	50
13BCH4201	Human Physiology	MC	4	3	40	60	100
13BCH42L1	Biochemistry practical IV	MC Lab	2	1	20	30	50
13GEN4201	Molecular Genetics	MC	4	3	40	60	100
13GEN42L1	Genetics practical IV	MC Lab	2	1	20	30	50
	Environment Studies & Civic Sense	NC	2	1	10	40	50
	Total		**28**	**19**	**270**	**430**	**700**

V Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
13MBG5201	Agricultural & Environmental Microbiology	MC	4	3	40	60	100
13MBG52L1	Agricultural & Environmental Microbiology Practical	MC Lab	2	1	20	30	50
13MBG5202	Immunology & Medical Microbiology	MC	4	3	40	60	100
13MBG52L2	Immunology & Medical Microbiology practical	MC Lab	2	1	20	30	50
13BCH5201	Advanced Bimolecular Chemistry	MC	4	3	40	60	100
13BCH52L1	Biochemistry practical V	MC Lab	2	1	20	30	50
13BCH5202	Enzyme and Enzyme Technology	MC	4	3	40	60	100
13BCH52L2	Biochemistry practical VI	MC Lab	2	1	20	30	50
13GEN5201	Recombinant DNA Technology	MC	4	3	40	60	100
13GEN52L1	Genetics practical V	MC Lab	2	1	20	30	50
13GEN5202	Basic Human Genetics	MC	4	3	40	60	100
13GEN52L2	Genetics practical VI	MC Lab	2	1	20	30	50
	Total		**36**	**24**	**360**	**540**	**900**

VI Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
13MBG6201	Food & Dairy Microbiology	MC	4	3	40	60	100
13MBG62L1	Food & Dairy Microbiology practical	MC Lab	2	1	20	30	50
13MBG6202	Industrial Microbiology & Microbial Technology	MC	4	3	40	60	100
13MBG62L2	Industrial Microbiology & Microbial Technology Practical	MC Lab	2	1	20	30	50
13BCH6201	Intermediary Metabolism	MC	4	3	40	60	100
13BCH62L1	Biochemistry practical VII	MC Lab	2	1	20	30	50
13BCH6202	Clinical Biochemistry	MC	4	3	40	60	100
13BCH62L2	Biochemistry practical VIII	MC Lab	2	1	20	30	50
13GEN6201	Developmental and Population Genetics	MC	4	3	40	60	100
13GEN62L1	Genetics Practical VII	MC Lab	4	1	20	30	50
13GEN6202	Applied Genetics	MC	4	3	40	60	100
13GEN62L2	Genetics Practical VIII	MC Lab	4	1	20	30	50
	Project			3			
	Total		**40**	**27**	**360**	**540**	**900**

I SEMESTER

13MBG1201 BASIC MICROBIOLOGY & MICROBIOLOGICAL TECHNIQUES

3 Credits **Total: 60 Hours**

Objectives:

- Understand the history, scope and importance of microbiology
- Understand the basic techniques of staining, sterilization and methods to control microbes
- Knowledge on principles and techniques of microscopy

UNIT 1: Introduction, History and Scope of Microbiology 12 hrs

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

UNIT 2: Instruments used in Microbiology 14 hrs

Microscopy − Principles of Microscopy; resolving power, numerical aperture, working distance and magnification, Principles of photomicrography; Working principle and applications of Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Stereomicroscope, Electron Microscopy − TEM and SEM**,** Principle, construction and applications of Autoclave, Inoculation chamber − LAF, Incubator, pH meter, Spectrophotometer, Nephelometer, Hot Air Oven.

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, fungal staining.

UNIT 4: Control of Microorganisms 14 hrs

Sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agents and antimicrobial agents, Physical methods of control; principle, methodology and application of moist heat sterilization − boiling, pasteurization, Fractional sterilization − tyndallization and moist heat under pressure − autoclave, Dry heat sterilization − incineration and hot air oven, Filtration − diatomaceous earth filter, seitz filter, membrane filter and laminar air flow, 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 as antimicrobial agents, selection of a chemical agent for practical applications, evaluation of antimicrobial agents; Tube dilution and Agar plate techniques − Well method and Disk plate method.

UNIT 5: Antibiotics and other chemotherapeutic agents 12 hrs

Definition and classification of antibiotics, characteristics of antibiotics that qualify them as chemotherapeutic agents, Antimicrobial spectrum of antibiotics and mode of action of the following antibiotics; Antibacterial − Penicillins, Cephalosporins, Bacitracin, Polymyxins, Streptomycin, Chloramphenicols, Tetracyclines and Vancomycin, Antifungal − Nystatin and Cyclohexamide**,** Antiviral − Acycloguanosine

(nucleoside)**,** Synthetic chemotherapeutic agents − Nalidixic acid, Development of resistance to antibiotics a brief account.

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.

13MBG12L1 BASIC MICROBIOLOGY & CONTROL OF MICRO ORGANISMS 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 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 chamber, inoculation loop and needle, Incubator, centrifuge, pH meter, seitz filter, membrane filter, colorimeter/spectrophotometer, sonicator 04 Units
4. Cleaning and sterilization of glasswares 01 Unit
5. Study of aseptic techniques − preparation of cotton plugs for test tubes and pipettes, wrapping of petriplates and pipettes, transfer of media and inoculum 02 Units
6. Staining of bacteria:
    a. Simple staining using methylene blue
    b. Gram's staining
    c. Structural staining − cell wall staining, endospore staining and capsule staining 05 Units

13BCH1201 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 example; methane, ammonia, water, ethane and ethylene, Sigma and pi bond, Concept of Resonance, Molecular orbital theory, Properties of covalent molecules bond length, bond and angle, Polarity of molecules, Coordinate bond, Vander wall'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 electrolyte; Activity and activity coefficient, Relationship between activity coefficient and ionic strength, Common ion effect, electrochemical series and applications; 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, Freudlich and language adsorption isotherm with derivations, Applications of adsorption; Determination of viscosity of liquids using Oswald's viscometer, Relation of viscosity and shape of molecules; Definition, 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.),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.

13BCH12L1 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 balance and calibration of weights 01 Unit
2. Cleaning and calibration of glassware 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

13GEN1201 FUNDAMENTALS OF CELL BIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Describe the life cycles 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 the importance of programmed cell death (apoptosis)

UNIT 1: Model Organisms 14 hrs

Life cycles of Virus − TMV, Bacteriophage − Lambda phage, Bacteria – *E. coli*, *Caenorhabditis elegans, Neurospora, Paramecium*, Yeast, *Drosophila*, *Culex* Mosquito, *Bombyx mori, Arabidopsis thaliana*, Maize, 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; Cell wall − Chemical composition and Function; Extracellular matrix; Cytoskeletal structure – microtubules, microfilaments, intermediate filaments; Plasma Membrane − Chemical composition, Fluid mosaic model, Functions – Osmosis, Phagocytosis, Pinocytosis, Active transport, Microvilli, Demosomes.

UNIT 3: Intracellular Compartments 14 hrs

Structure, Chemical composition and functions of Endoplasmic reticulum, Ribosomes, Centrosomes, Lysosomes, Golgi complex, Mitochondria, Peroxisomes, Plastids, 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, Synaptonemal complex, Crossing over, Chiasma formation, Spermatogenesis, Oogenesis, Significance of meiosis; Cell senescence & Cell death (Apoptosis) − Death of specified cells, Programmed cell death, Mechanism of cell death, 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.

13GEN12L1 GENETICS PRACTICAL I

1 Credit **Total: 30 Hours**

Objectives:

- Mount and stain a specimen on a slide and prepare it for microscope viewing.
- Identify parts of a compound, stereo and dissection microscope and operate it effectively.
- Identify the different stages in the life cycles of model organisms.
- Identify stages of mitosis from prepared slides.

1. Handling of dissection, Stereo and Compound microscopes. 02 Units
2. Life cycle of model organisms: 05 Units
   Virus (TMV infected leaves), Bacteria (*E.coli* slides),
   Neurospora slides, *Caenorhabditis elegans*,, *Drosophila melanogaster*,
   Culex mosquito, *Bombyx mori*, *Arabiodopsis thaliana*.
3. Staining of RNA & DNA using Methyl green and Pyronin 01 Unit
4. Staining of Mitochondria − Janus green 01 Unit
5. Gram Staining of Lactobacillus and *E.coli* 02 Units
6. Observation of mitotic stages in permanent slide 01 Unit
7. Temporary squash preparation of onion root up for mitosis 03 Units

II SEMESTER

13MBG2201 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 **02 hrs**

Comparison of the three domains of organisms**.**

UNIT 2: Study of Virus & 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 Viriods − 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**;** 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 and significance; Classification, morphology, cultivation, reproduction and significance of *Rickettsiae, Chlamydiae, Mycoplasma, Actinomycetes*.

UNIT 4: Isolation & Culturing of Microorganisms **10 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 & Measurements **13 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; Multiplication in bacteria − binary fission, budding and fragmentation.

References:

Alexopoulas 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 Yok.

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 Ingraha J.L. (1987*), General Microbiology* (5th Ed.), Prentice Hall Private Limited, New Delhi.

13MBG22L1 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. Motility of bacteria by hanging drop technique. 01 Unit
4. Measurement of size of cells 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

13BCH2201 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 carbonyl 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.

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- Mineral requirement- essential macro minerals and essential 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.

13BCH22L1 BIO CHEMISTRY PRACTICAL II

1 Credit **Total: 30 Hours**

Objectives:

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

Qualitative Analysis

1. Analysis of Sugars

a) Monosaccharide's- 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 Units

4. Demonstration Experiments

a) Preparation of buffer and its pH measurements using pH meter	02 Units
b) Separation of Biomolecules by Paper Chromatography	02 Units

13GEN2201 PRINCIPLES OF GENETICS

3 Credits **Total: 60 Hours**

Objectives:

- An historical perspective of how genetics has evolved
- Learn the concepts, theories and principles of Mendelian genetics
- Learn biometrical methods for sample analysis
- Understand gene interaction and sex determination

UNIT 1: Introduction to Genetics 10 hrs

Transmission Genetics; Cytogenetics; Molecular Genetics; Population Genetics; Genetics and Society; Scope of Genetics; History of Genetics − Premendelian genetic concepts − Preformation, Epigenesis, Inheritance of acquired characters, Germplasm theory; Hereditary 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, Pea experiments, 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 doing Calculations − Punnett Square, Factor method; Terminology − Trait, Gene, Locus/loci, Allele, Diploid, Haploid, Phenotype, Genotype, Homozygous, Heterozygous, Dominant, Recessive; Incomplete or partial dominance, codominance, mutiple alleles − ABO blood groups, Rh factor in Human; Suggested problems.

UNIT 3: Elements of Biometry 14 hrs

Mean, Mode, Median, Standard Deviation, Standard Error, t test and F Test; General probability − single events & two events (product rule & sum rule), Conditional probability, Application to genetics − single trait crosses and two trait crosses, Chi − square test; Suggested problems.

UNIT 4: Gene interactions 12 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; Genic balance theory of Bridges; Y chromosome in sex determination in Melandrium; Environment and Sex determination; Hormonal control of sex determination (free martin); Gynandromorphs, Intersexes, Supersexes in Drosophila; Sex differentiation, 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.

13GEN22L1 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 Arabidopsis.	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 Antirrhinum and Mirabilis.	02 Units
4.	Blood typing**.**	01 Unit
5.	Computation− Mean, Mode, Median, Standard deviation and Standard error.	02 Units
6.	Genetic Problems − Multiple alleles; Gene Interaction.	02 Units
7.	Application of Chi−square test, t test and F test.	02 Units

III SEMESTER

13MBG3201 MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

3 Credits **Total: 60 Hours**

Objectives:

- Understand the various biochemical activities and energy yielding processes in phototrophic and heterotrophic microorganisms.
- Strengthen the student's basic knowledge which they can use to analyze and imply in applied Microbiological studies.

UNIT 1: Biomolecules and Enzymes **14 hrs**

A brief account on the properties, classification and importance of Carbohydrates, Lipids and Proteins; Techniques of separation of biomolecules − amino acids and sugars; Enzymes − Introduction, 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 − glycolytic pathway, TCA, fermentation pathways − alcoholic, lactic acid fermentation; homolactic and heterolactic fermentation, 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.

UNIT 4: Nucleic acids and Replication **14 hrs**

Genomic organization in Prokaryotes, 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 5: Genetic Recombination and Mutation **12 hrs**

Genetic recombination in Bacteria − Conjugation, F+ v/s F−, Hfr+ v/s F−, F' v/s F−; Transformation − Griffith's experiment and mechanism; Transduction− generalized and specialized; 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.

Gerald Karp (2003), *Cell Biology* (3rd Ed.), McGraw Hill Book Company, New York.

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.
Singh B.D. (2004), *Biotechnology*, Kalyani publisher, Mumbai
Smith John .E (1996), *Biotechnology*, Cambridge University Press.
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.

13MBG32L1 MICROBIAL PHYSIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Learn the methodologies to identify microorganisms based on biochemical characteristics
- Understand the techniques in estimating the amount of biomolecules present in the samples
- Enables the students to study the effect of physical parameters and nurtients on the growth of microbes

1. Determination of growth curve for 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. Charts on genetic recombination in bacteria; 01 Unit
    a) Conjugation− F+ v/s F−, Hfr+ v/s F−, F' v/s F−
    b) Transformation− Griffith's experiment and mechanism
    c) Transducation− generalized and specialized

13BCH3201: BIO ANALYTICAL TECHNIQUES

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Chromatography **14 hrs**

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

UNIT 2: Centrifuge **12 hrs**

Centrifuge- Basic principles of sedimentation, relative centrifugal force (RCF), types of centrifuge- small bench, clinical, high speed, refrigerated, ultra centrifuge- preparative and Analytical, safety aspects in use of centrifuge.

UNIT 3: Electrophoresis **09 hrs**

Electrophoresis- principle, paper electrophoresis, gel electrophoresis-column, agarose gel, pulse field, Polyacrylamide gel electrophoresis; capillary electrophoresis, 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; 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.

13BCH32L1: BIOCHEMISTRY PRACTICAL III

1 Credit **Total: 30 Hours**

Objectives:

- Understand concept of buffer preparation
- Demonstrate the principle of separation techniques

1.	Preparation of buffers: citrate, phosphate buffer and determination of pH	04 Units
2.	Conductometric titration of an amino acid	01 Unit
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

13GEN3201 CYTOGENETICS

3 Credits **Total: 60 Hours**

Objectives:

- Study the structure of chromosomes.
- Understand the concept of sex linkage, linkage and crossing over.
- Understand chromosomal aberrations and extra chromosomal inheritance.

UNIT 1: Chromosomes 14 hrs

Chromosome theory of inheritance; Eukaryotic chromosome − molecular organization; Structure of the chromosome − Primary constriction, secondary constrictions, Sat bodies, Telomeres, Heterochromatin, Euchromatin; Ultra structure of Chromosome − Nucleosome model; Karyotype; Idiogram;Special types of chromosomes − Polytene Chromosomes; Lampbrush Chromosomes; B Chromosomes.

UNIT 2: Linkage 14 hrs

Coupling and repulsion hypothesis; Chromosome theory of linkage; Kinds of linkage− Complete linkage, 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−Sterns experiment in *Drosophila*, Creighton and McClintock experiment in maize; Mechanism of crossing over; Cytological theories of crossing over; Molecular mechanism of crossing over − Holiday model, 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*, Maize.

UNIT 4: Chromosomal aberrations 10 hrs

Numerical aberrations− Euploidy (Monoploidy, Haploidy and Polyloidy), Polyploidy (Autopolyploidy and allopolyploidy), Aneuploidy (monosomes, nullisomes, & trisomes); Structural aberrations− Deletions, Duplications, Translocations, Inversions; 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., Girton, 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.

13GEN32L1 GENETICS PRACTICAL III

1 Credit **Total: 30 Hours**

Objectives:

- Culture *Drosophila* and study different types of mutant *Drosophila*.
- Dissect salivary glands and mount them to observe polytene chromosomes.
- Study chromosomal aberrations with examples and solve genetic problems on linkage and crossing over.

1. Culturing of *Drosophila* − Media preparation; Cleaning and sterilization of bottles; 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 *Rhoeo 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

13MBG4201 MOLECULAR BIOLOGY AND GENETIC ENGINEERING

3 Credits **Total: 60 Hours**

Objectives:

- Understand the central dogma of molecular biology along with their mechanisms
- Strengthen the student's basic knowledge in genetic engineering and recombinant DNA technology

UNIT 1: Introduction to Molecular Biology **10 hrs**

Types of RNA and their functions; Protein synthesis in prokaryotes − Ribosomes; types of RNA involved transcription and translation, mechanism of protein synthesis and protein inhibitors, post translational modifications of proteins.

UNIT 2: Transcription and Translation **12 hrs**

Genetic code; properties and Wobble hypothesis; Transcription − Mechanism, Initiation, elongation and termination in prokaryotes and eukaryotes; enhancers, promoters; RNA polymerase, transcription factors, transcriptional inhibitors; Modifications of eukaryotic mRNA − 5' capping and 3' poly A tailing; mRNA splicing; Ribosomes.

UNIT 3: Regulation of Gene Expression **11 hrs**

Regulation of gene expression in Prokaryotes − Operon concept, Lac and Tryp; 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 moclecules − 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 **13 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 Pastermak J.J (1998), *Moleclar 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.

13MBG42L1 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 *in vitro* 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

13BCH4201 HUMAN PHYSIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Understand the concept in human physiology
- Understand the mechanism of its action and regulation

UNIT 1: Physiology of Vision **08 hrs**

Vision- Structure of 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 CO_2 from tissues to lungs through blood, factors influencing the transport of CO_2.

UNIT 3: Digestion & Excretion **12 hrs**

Digestive system-secretion of digestive juices, digestion and absorption of carbohydrates, proteins and fats; Gastro intestinal hormones; Excretory System- Mechanism of formation of urine, composition of urine, Renal regulation of acid balance, hormone 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 of muscle contraction; Nervous system- structure of neuron, resting potential and action potential, Propagation of nerve impulses, 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 **r**eproductive 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, NewYork.

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.

13BCH42L1 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	01Unit
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 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

13GEN4201 MOLECULAR GENETICS

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT1: Chemical Basis of Heredity and Genome Organisation 14 hrs

Introduction, Experimental proof of DNA and RNA as genetic material; Structure and functions of DNA and RNA; Watson and Crick model of DNA and other forms for 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; Prokaryotic genome− Chromosomal and plasmid; Eukaryotic genome− chromosomal and organellar; Fine structure of the gene− Cistron, Muton and recon.

UNIT 2: Transcription and Translation 14 hrs

Genetic code, Features and Wobble hypothesis; Mechanism of transcription− Initiation, elongation and termination in prokaryotes and eukaryotes; enhancers, promoters; RNA polymerase, transcription factors, Post transcriptional; Transcriptional inhibitors; Modifications of eukaryotic mRNA− 5' capping and 3' poly A tailing; mRNA Splicing; Ribosomes; Mechanism of translation in Prokaryotes and Eukaryotes, Post translational modifications of proteins.

UNIT3: Regulation of Gene Expression 06 hrs

Regulation of Gene expression in Prokaryotes− Operon concept, Lactose, Galactose and Tryptophan operon.

UNIT 4: Bacterial Genetics 12 hrs

Recombination in Prokaryotes − Conjugation; F+ v/s F − , Hfr+ v/ F+, Transformation;Griffith's experiment and mechanism, Transduction; Generalized and Specialized; Bacterial Transposons.

UNIT 5: Mutation 14 hrs

Types of mutations − Base substitution, Frame shift mutation; Mutagens− Physical & Chemical Mutagens; Reverse mutation in bacteria; DNA repair mechanism − Mismatch repair, photo−reactivation, excision and SOS repair; Beneficial and harmful effects of mutations.

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.

13GEN42L1 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 − Ultracentrifuge, pH meter, Electrophoretic Unit, Micropipette, Glass Homogenizer, Glass bead sterilizer, Incubator Shaker, Laminar Air Flow and Autoclave 02 Units
2. Extraction of DNA from Cauliflower 01 Unit
3. Extraction of DNA from Coconut endosperm 01 Unit
4. Extraction of DNA from Liver tissue 01 Unit
5. Extraction of DNA from Bacteria 01 Unit
6. Paper Chromatography for separation of Leaf pigment, *Drosophila* eye pigment and Amino acids. 03 Units
7. Electrophoresis (Demonstration) − Agarose gel electrophoresis and PAGE 02 Units
8. Study of examples of mutations: Sickle cell Anaemia − Mis−sense mutation; Thalassemia−Frame shift mutation; Identification of point mutations based on the given representations. 02 Units
9. Induction of mutation in *Drosophila* and detection of sex−linked lethal Muller 5 stock. 02 Units

V SEMESTER

13MBG5201 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 **13 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 cycle, Carbon cycle, Sulphur cycle.

UNIT 2: Microorganisms in Agriculture **13 hrs**

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

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 (*Plasmodiophora 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, 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.

Unit 5: Microbiology of water **14 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 filteration, 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.

Alexopoulas, 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* (4 th 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.

13MBG52L1 AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Learning the methodology to isolate and characterize the microbes from soil, water and air
- Understanding the etiology, symptomology, pathogenesis and control measures of various plant diseases
- Determining the quality of potable water by MPN Technique

1. Isolation and enumeration of bacteria and fungi from rhizosphere and rhizoplane 02 units
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. Study of air samplers: Anderson's sampler, Hirst spore trap, rotorod sampler, Vertical cylinder 01 Unit
8. Determination of biological oxygen demand 02 Units
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

13MBG5202 IMMUNOLOGY AND MEDICAL MICROBIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Learning the structure and functions of cells and organs of immune system
- Understanding the etiology, characteristics, pathogenesis, treatment, prophylaxis and epidemiology of various animal diseases
- Understanding the phenomenon of antigen−antibody reaction

UNIT 1: Cells and organs of immune System **14 hrs**

History and scope Immunology; Types of immunity − passive, active and acquired immunity; Humoral and cell mediated immunity, Cells and organs of immune responses and their functions; Cells of immune system − macrophages, granulocytes, NK cells, T cells, B cells, B cell activation and differentiation; memory B cell and plasma cell,

UNIT 2: Antigens − Antibodies interactions **15 hrs**

Antigen and antibodies −Types, haptens, epitopes and factors influencing antigenicity, Antigen processing and presentation; Types of antigen presenting cells, antigen processing pathway, functions of APCs; Major Histocompatibility Complex − Structure of MHC I and II, presence of different MHC I and II on different cells and their significance, Antibody − structure, types, properties and functions, Production of polyclonal and monoclonal antibodies and their applications. Antigen− antibody reactions; *In vitro* tests − Agglutination, Precipitation, Compliment fixation test, Neutralization, Opsonization, Gel diffusion techniques, Immunoelectrophoresis, Labelled antibody − RIA, ELISA and Immunofluroscent techniques.

UNIT 3: Reactions of the Immune System and Vaccines **14 hrs**

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

UNIT 4: Introduction to Medical Microbiology **03 hrs**

Major developments in medical microbiology; Koch's postulates, Microbial flora of the human body, Factors responsible for microbial pathogenicity and its prevention.

UNIT 5: Study of Pathogenic Microorganisms **14 hrs**

Classification, cultural characteristics, biochemical characters, antigenic structure, pathogenesis, laboratory diagnosis, epidemiology, prophylaxis and chemotherapy of the following; Bacterial diseases − Gonorrhoea, Diphtheria, Tetanus, Shigellosis**,** Cholera, Haemophilic Influenza, Leprosy, Tuberculosis, Enterobacteriaceae − *E .coli*, *Salmonella.* Gram positive cocci**,**Viral Diseases − Polio, Measles, Mumps, Rabies, Hepatitis A & B, HIV, Protozoan Diseases − Amoebiasis, Malaria**,** Fungal Diseases: Candidiasis, Cutaneous mycoses.

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.

13MBG52L2 IMMUNOLOGY AND MEDICAL MICROBIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Studying the growth characteristics of pathogenic microbes using special media
- Estimating the protein and reducing sugar level in urine samples and learning its significance in the diagnosis of the diseases
- Diagnosing diseases by performing serological techniques

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 methods) Plasma Protein, Reducing Sugar, Cholesterol, Urea, Uric acid, Creatinine, Chloride, Phosphate, Bile Salts 02 Units
3. Blood grouping 01 Unit
4. Differential count of WBC 01 Unit
5. Coagulase test 01 Unit
6. WIDAL test 01 Unit
7. VDRL test 01 Unit
8. Spot ELISA 01 Unit
9. ODD; Ouchterlony Double Diffusion 01 Unit
10. RID; Radial Immunodiffusion 01 Unit
11. Study of AFB 01 Unit
12. Study of pathogenic microorganisms; *Shigella, Clostridium, Staphylococcus, Streptococcus, Entamoeba, Plasmodium,* and *Candida* (Slides) 01 Unit
13. Antimicrobial sensitivity test – Disc Diffusion method 01 Unit

13BCH5201: 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 of Biochemistry and its applications, 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's, glycosaminoglycan, cell wall components-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 the 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 Edition). New Age International Publishers, New Delhi.
Voet and Voet (1995), *Biochemistry* (2nd Ed.), John Wiley & Sons, New York.

13BCH52L1: BIOCHEMISTRY PRACTICAL V

1 Credit **Total: 30 Hours**

Objectives:

- Quantitative estimation of aminoacid,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 monosaccharide's 05 Units
2. Estimation of amino acids by formal titration 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

13BCH5202 ENZYME AND ENZYME TECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Basic Concepts in Enzymology 14 hrs

Introduction, Definition, International Classification of enzymes, Properties of enzymes, Enzyme specificity, Enzyme units, Definition of active sites; Theories of enzyme action- Lock and Key or template model and induced fit model, Extraction, purification and characterization of enzymes.

UNIT 2: Enzyme Kinetics and Enzyme Inhibitors 14 hrs

Enzyme kinetics-Derivation of Michalies Mentons equation, Significance of km and Vmax, 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 Immobilization and Production 10 hrs

Immobilized enzymes, Source and methods of immobilization, Effect of immobilization on enzyme activity; Applications of immobilized enzymes; Industrial Production and applications of enzymes- Amylase, Proteases, lipases and Pectinases.

UNIT 5: Applications of Enzymes 10 hrs

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

13BCH52L2 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 Alpha amylase activity	02 Units
7. Assay of Urease activity	02 Units
8. Effect of pH & temperature on the activity of alkaline phosphatase	02 Units

13GEN5201 RECOMBINANT DNA TECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Learn tools used for genetic engineering
- Understand the techniques.
- Comprehend the applications of RDT

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, polynucleotidekinase,exonuclease III, DNase I,Mung bean and S1 nuclease, DNA polymerase and klenow fragment,terminal nucleotidal tranferase,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*), For higher plants (Integrative DNA transfer − Agrobacterium vectors−Ti plasmid−Binary and Co integrated vectors, Animal viral vectors SV 40 (3 types), Retroviral and Vaccinia viral vector), Expression vectors in Prokaryotes and Eukaryotes.

UNIT 2: Technique for RDT **12 hrs**

Gel electrophoresis− AGE and SDS−PAGE; Hybridization− Southern, Northern, Western, Dot blots, Autoradiography, DNA sequencing − Sanger's Dideoxy 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.

13GEN52L1 GENETICS PRACTICAL V

1 Credit **Total: 30 Hours**

Objectives:

- Understand the principle and working of different instruments used for RDT.
- Quantification of DNA and RNA.
- Comprehend the techniques of RDT

1. Instrumentation− Microneedle, Magnetic Stirrer,UV Transilluminator, PCR 03 Units
2. Vecors− pBR 322 and Cosmid, YAC, Ti plasmid − Binary vector, SV 40 and Vaccinia. 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, 04 Units
8. Ligation of DNA fragment, Transformation− T complementation

13GEN5202 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 oncogences, 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, Euthenics, 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.

13GEN52L2 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

13MBG6201 FOOD AND DAIRY MICROBIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Understand the scope and importance of food microbiology
- Study the significance of microbes in food industry
- Learn the different methods of food preservation

UNIT 1: Contamination and Spoilage of food **09 hrs**

Food as a substrate for microorganisms, sources of contamination of food, spoilage of canned food, cereals, fruits, vegetables, meat and fish.

UNIT 2: Food preservation **11 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, botulism and salmonellosis, Mycotoxins produced by fungi; Aflatoxin in stored food and grains, Microbial examination of food − DMC, viable colony count, examination of faecal *Streptococci*, Microorganisms as food − Single cell proteins; Yeast and *Spirulina*, Single cell oil, Food sanitation and control.

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 flavours fermentation, gassy fermentation and proteolysis, Methods of preservation of milk and milk products; Pasteurization, sterilization and dehydration; Condensed and dried milk, Rapid platform tests; Organoleptic, Clot on Boiling (COB), titrable acidity, alcohol test, sedimentation test and pH; SPC, reductase test − MBRT, Resazurin test.

UNIT 5: Fermented Milk Products **12 hrs**

Types & Production of Cheese, Cheddar & Cottage, Cultured butter milk; Fermented Milk Products − Yogurt, Kefir and Kumiss,Genetic Engineering and Dairy industry.

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.

13MBG62L1 FOOD AND DAIRY MICROBIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Test the quality of food by various microbiological techniques
- Study and analyse the composition and characteristics of milk
- Study the various food pathogens and its identification features

1. Adulteration in milk 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/ Resazurin test 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 and detection of Aflatoxins from fungi by paper chromatography and bioassay of aflatoxins. 02 Units
9. Study of food borne pathogens − *Clostridium*, *Staphylococcus* and *salmonella* . 01 Unit
10. Study of mastitis milk. 01 Unit

13MBG6202 INDUSTRIAL MICROBIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Learn the basics of fermentation technology
- Getting to know the process parameters and downstream processing of biotechnological products
- Learn the techniques of production of Industrially important microbial products

UNIT 1: Introduction **11 hrs**

History, scope and development of industrial microbiology, Isolation and screening of industrially important microorganisms − primary and secondary screening, maintenance of strains, strain improvement; mutant selection and recombinant DNA methods. Introduction, basic layout of fermentation technology.

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 regulation, pH and foam control.

UNIT 3: Fermentors **12 hrs**

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

UNIT 4: Down Stream Processing **12 hrs**

Solid − liquid separation (filtration, flocculation, centrifugation, sedimentation), release of intracellular products; physical, enzymatic, chemical, concentration, purification – Chromatographic techniques (affinity, column, HPLC, ion exchange and GLC) and formulation.

UNIT 5: Production of Microbial Products **13 hrs**

Production of alcohol, production of 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).

References:

Bisen P.S (1994), *Frontiers in Microbial Technology* (1st Ed.), CBS Publishers, New Delhi.

Glazer A.N. & NIkaido. 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.

13MBG62L2 INDUSTRIAL MICROBIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Train the students in a Industrial oriented production techniques
- Perform the various titrimetric method to estimate the acid and alcohol contents
- Lab scale production of various fermented products

1.	Algal and fungal culture: *Spirullina*, *Agaricus*, 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 Alcohol by specific gravity method	02 Units
9.	Visit to Industries/ Institutes	

13BCH6201 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-oxidation, 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.

13BCH62L1 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

13BCH6202 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-betalipoproteinemia-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-Cysteinuria, 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:

Burtis A Carl and Edward R Ashwood (2005), *Tietz text book of clinical chemistry* (4th Ed.), Saunders publishers, Philadelphia.

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.

Phlip 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.

13BCH62L2 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	02 Units

13GEN6201 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 Pant 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.

13GEN62L1 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.

13GEN6202 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 Pant 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.

13GEN62L2 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