Kristu Jayanti College
AUTONOMOUS Bangalore
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DEPARTMENT OF LIFE SCIENCES

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

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 24th January, 2015 in the panel room P.G block, Kristu Jayanti College, Bangalore.

MEMBERS PRESENT **SIGNATURE**

1. Dr. Calistus Jude A.L
   Dean – Faculty of Sciences, KJC

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

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

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

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

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

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

8. Dr. Vijayanand S
   Assistant Professor, Department of Life Sciences, KJC

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

10. Dr. Shalini Prabhu
    Assistant professor, Department of Life Sciences, KJC

11. Mr. John Caleb T.D
    Assistant professor, Department of Life Sciences, KJC

12. Ms. Apoorva Udhayashankar
    Assistant professor, Department of Life Sciences, KJC

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

1. Curriculum overview

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

2. Syllabus

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

3. Panel of Examiners:

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

CURRICULUM OVERVIEW

1. Aim of the Programme

To prepare the students to be true professionals in various fields of biotechnology and to make them fit to be employable in industries such as pharma−biotech, food, fermentation, 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	I
V	NSS/NCC/Extra – Curricular/Co−curricular and Social Outreach		1x3	3	I, II, III

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

4. Attendance

- A student should have 75 percentage of attendance in each course
- Any student who is not complying to this requirement will not be allowed to appear for End Semester Examination
- In case a student does not appear for the examination due to shortage of attendance, the student has to repeat that semester to make up for the attendance and the student will have to pay the fees for that semester as applicable

5. Passing Criteria for UG

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

6. Orientation and Bridge Programme

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

7. Value Added Courses

Semester II	Bio−analytical skills
Semester III	Food Processing and Preservation
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 will be 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
ENG151201	General English	Lang	4	3	30	70	100
AEN151201	Additional English	Lang	4	3	30	70	100
KAN151201	Kannada						
HIN151201	Hindi						
BTG151201	Cell Biology	MC	4	3	30	70	100
BTG1512L1	Cell Biology Practical	MC Lab	2	1	15	35	50
BCH151201	Biophysical Chemistry	MC	4	3	30	70	100
BCH1512L1	Biochemistry Practical I	MC Lab	2	1	15	35	50
GEN151201	Fundamentals of Cell Biology	MC	4	3	30	70	100
GEN1512L1	Genetics Practical I	MC Lab	2	1	15	35	50
NCS150101	Computer Fundamentals **	NC	2	1	5*	45*	50*
	Total		**28**	**19**	**260**	**390**	**650**

II Semester

Course Code	Course Title	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
ENG152201	General English	Lang	4	3	30	70	100
AEN152201	Additional English	Lang	4	3	30	70	100
KAN152201	Kannada						
HIN152201	Hindi						
BTG152201	General Microbiology		4	3	30	70	100
BTG1522L1	General Microbiology Practical	MC Lab	2	1	15	35	50
BCH152201	Biomolecules	MC	4	3	30	70	100
BCH1522L1	Biochemistry Practical II	MC Lab	2	1	15	35	50
GEN152201	Principles of Genetics	MC	4	3	30	70	100
GEN1522L1	Genetics Practical II	MC Lab	2	1	15	35	50
NHU150101	Indian Constitution **	NC	2	1	5*	45*	50*
	Total		**28**	**19**	**260**	**390**	**650**

III Semester

Course Code	Course	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
ENG153201	General English	Lang	4	3	30	70	100
		Lang	4	3	30	70	100
AEN153201	Additional English						
KAN153201	Kannada						
HIN153201	Hindi						
BTG153201	Bioinstrumentation and Biostatistics	MC	4	3	30	70	100
BTG1532L1	Bioinstrumentation Practical	MC Lab	2	1	15	35	50
BCH153201	Bio analytical Techniques	MC	4	3	30	70	100
BCH1532L1	Biochemistry Practical III	MC Lab	2	1	15	35	50
GEN153201	Cytogenetics	MC	4	3	30	70	100
GEN1532L1	Genetics Practical III	MC Lab	2	1	15	35	50
NHU150101	Environment Studies & Civic Sense **	NC	2	1	5*	45*	50*
	Total		**26**	**18**	**260**	**390**	**650**

IV Semester

Course Code	Course	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
ENG154201	General English	Lang	4	3	30	70	100
		Lang	4	3	30	70	100
AEN154201	Additional English						
KAN154201	Kannada						
HIN154201	Hindi						
BTG154201	Molecular Biology	MC	4	3	30	70	100
BTG1542L1	Molecular Biology Practical	MC Lab	2	1	15	35	50
BCH154201	Human Physiology	MC	4	3	30	70	100
BCH1542L1	Biochemistry Practical IV	MC Lab	2	1	15	35	50
GEN154201	Molecular genetics	MC	4	3	30	70	100
GEN1542L1	Genetics Practical IV	MC Lab	2	1	15	35	50
	Total		**26**	**18**	**195**	**390**	**650**

V Semester

Course Code	Course	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
BTG155201	Genetic Engineering and Environmental Biotechnology	MC	4	3	30	70	100
BTG1552L1	Genetic Engineering and Environmental Biotechnology Practical	MC Lab	2	1	15	35	50
BTG155202	Immunology and Animal Biotechnology	MC	4	3	30	70	100
BTG1552L2	Immunology and Animal Biotechnology Practical	MC Lab	2	1	15	35	50
BCH155201	Advanced Bimolecular Chemistry	MC	4	3	30	70	100
BCH1552L1	Biochemistry Practical V	MC Lab	2	1	15	35	50
BCH155202	Enzyme & Enzyme Technology	MC	4	3	30	70	100
BCH1552L2	Biochemistry practical VI	MC Lab	2	1	15	35	50
GEN155201	Recombinant DNA Technology	MC	4	3	30	70	100
GEN1552L1	Genetics Practical V	MC Lab	2	1	15	35	50
GEN155202	Basic Human Genetics	MC	4	3	30	70	100
GEN1552L2	Genetics Practical VI	MC Lab	2	1	15	35	50
	Total		**36**	**24**	**360**	**540**	**900**

VI Semester

Course Code	Course	Nature of the Course	Hrs / Week	Credits	CIA	ESE	Max Marks
BTG156201	Plant Biotechnology	MC	4	3	30	70	100
BTG1562L1	Plant Biotechnology Practical	MC Lab	2	1	15	35	50
BTG156202	Industrial Biotechnology	MC	4	3	30	70	100
BTG1562L2	Industrial Biotechnology Practical	MC Lab	2	1	15	35	50
BCH156201	Intermediary Metabolism	MC	4	3	30	70	100
BCH1562L1	Biochemistry Practical VII	MC Lab	2	1	15	35	50
BCH156202	Clinical Biochemistry	MC	4	3	30	70	100
BCH1562L2	Biochemistry Practical VIII	MC Lab	2	1	15	35	50
GEN156201	Developmental and Population Genetics	MC	4	3	30	70	100
GEN1562L1	Genetics Practical VII	MC Lab	2	1	15	35	50
GEN156202	Applied Genetics	MC	4	3	30	70	100
GEN1562L2	Genetics Practical VIII	MC Lab	2	1	15	35	50
	Project			3			

	Total		**34**	**27**	**360**	**540**	**900**

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

Credit structure

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

I SEMESTER

BTG151201 CELL BIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Understand the structure and basic components of prokaryotic and eukaryotic cells
- Comprehend the structure and functions of cellular organelles
- Understand the cellular components underlying mitotic and meiotic cell division.

UNIT 1: Introduction and History **14 hrs**

Introduction; History of cell biology; Cell theory, protoplasm theory, organismal theory; Techniques in cell biology; Microscopy− numerical aperture, resolving power; Compound microscope and stereo microscope

UNIT 2: Structural Organization of the Cell **14 hrs**

Cell as a basic unit of life; structure of a prokaryotic and eukaryotic cell; Plant and animal cell; Plasma membrane: chemical composition, ultra structure; Fluid mosaic model and functions of plasma membrane: Osmosis, phagocytosis, pinocytosis; Microvilli and Desmosomes

UNIT 3: Cellular Organelles **14 hrs**

Structure and functions of Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus; Nuclear envelope and Nuclear pore complex, Nucleolus, Nucleoplasm and Chromatin; Vacuole; Cytosol and Cytoskeletal structures: Microtubules, Microfilaments and Intermediate filaments

UNIT 4: Cell Motility **04 hrs**

Amoeboid, ciliary and flagellar movements; Types of flagella, structure of bacterial flagella

UNIT 5: Cell Division and Cell Death **14 hrs**

Cell Cycle: Interphase, G1, S, G2 and M phase; Mitosis, mitotic apparatus and stages, mitotic blockage, stimulation of cell division, significance of mitosis; Meiosis − stages, synaptonemal complex, crossing over, chiasma formation, significance of meiosis; Cell senescence and death , mechanism of programmed cell death

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.

BTG1512L1 CELL BIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Familiarize the technique in handling microscopes
- Learn the pattern of cell division through staining technique
- Perform the basic isolation techniques

1.	Microscopy	02 Units
2.	Basic staining techniques: Simple staining– Positive and Negative staining	02 Units
3.	Use of Micrometer: Calibration, measurement of Onion epidermal cells and Yeast	03 Units
4.	Study of Mitosis using Onion root tip	02 Units
5.	Study of Meiosis using grasshopper testes	02 Units
6.	Isolation of Chloroplasts	01 Unit
7.	Vital staining of Mitochondria	01 Unit
8.	Isolation of Nucleus	02 Units

BCH151201 BIOPHYSICAL CHEMISTRY

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Measurement and Atomic Structure 12 hrs

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

UNIT 2: Chemical Bonding 12 hrs

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

UNIT 3: Acids Bases and Electrolytic Dissociation 12 hrs

Modern concepts of acids and bases, Ionisation of acids; Dissociation of water; Ionic product of water; Hydrogen ion concentration (pH), determination of pH; Dissociation of weak acids, Effects of salt on dissociation of acids, Interaction of acids with bases-strong and weak electrolytes; Activity and activity coefficient, relationship between activity coefficient and ionic strength; Common ion effect, 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 Langmuir adsorption isotherm with derivations, applications of adsorption; Determination of viscosity of liquids using Oswald's viscometer, relation of viscosity and shape of molecules; Definition and determination of surface tension of liquids using Stalagmometer, effects of surfactants.

UNIT 5: Radioactivity 12 hrs

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

References:

Arun Bahl and Tuli, G.D. (2006), *Essentials of Physical Chemistry* (5th Ed.), S Chand Co ltd, New Delhi.

Cantor Charles Schimmel and Paul, R (1980), *Biophysical chemistry*(1st Ed.),Chand and Co Publishers, New Delhi.

Emil, S. Smith., (1983), *Principles of Biochemistry* (7th Ed.), McGraw-Hill publishers, New York.

Frederick George Mann., (1978), *Organic chemistry* (4th Ed.), Longman publishers, New York.

Whittaker A. G and Mount, A.R., (2001), *Physical Chemistry* (4th Ed.), Viva Publishers, New Delhi.

Pandey (2009), *A Text book of Practical organic chemistry* (5th Ed.), S Chand and Co publishers, New Delhi.

Puri, B. R and Sharma, S. L. R., (1986), *Principles of Physical Chemistry* (19th Ed.), S Chand Co Ltd, New Delhi.

Upadhyay., (2002), *Biophysical chemistry-Principles & Techniques* (3rd Ed.), Himalaya Publishers, Mumbai.

BCH1512L1 BIOCHEMISTRY PRACTICAL I

1 Credit **Total: 30 Hours**

Objectives:

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

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

GEN151201 FUNDAMENTALS OF CELL BIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Understand the life cycle and genetic significance of model organisms.
- Become familiar with the various sub−cellular structures and organelles inside eukaryotic cells.
- Understand the basic events of the cell cycle and the importance of programmed cell death (apoptosis)

UNIT 1: Model Organisms **14 hrs**

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

UNIT 2: Cell Structure and Function **14 hrs**

Discovery of cells; Basic properties of cells; Cell theory; Cell complexity, Cell size & shape; Different classes of cells − Prokaryotic cell and Eukaryotic cell; Cell wall − Chemical composition and Function; 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), significance of apoptosis.

References:

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., (2002), *Molecular Biology of the Cell* (4th Ed.), Garland Science, New York.

Becker, W. M. and Klein smith, L. J., (2005), *World of the Cell* (6th Ed.), Benjamin Cummings.

Cooper, G. M., (2000), *The Cell* (2nd Ed.), Sinauer Associates, Sunderland

Gupta, P. K. (2003), *Cell and Molecular Biology* (2nd Ed.), Rastogi Publication, Meerut

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

Stern, K.R. (2002), *Introduction to plant Biology* (8th Ed.), Mc−Graw Hill, Boston
Verma, P. S., and Agarwal, V. S., (2005), *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology* (14th Ed.), S. Chand & Company Ltd, New Delhi.

GEN1512L1 GENETICS PRACTICAL I

1 Credit **Total: 30 Hours**

Objectives:

- Mount and stain a specimen on a slide for microscopic observation.
- Learn to operate compound, stereo and dissection microscope.
- 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: Virus (TMV infected leaves), Bacteria (*E.coli* slides), *Neurospora* slides, *Caenorhabditis elegans*,, *Drosophila melanogaster*, Culex mosquito, *Bombyx mori*, *Arabiodopsis thaliana*.	05 Units
3.	Staining of RNA & DNA using Methyl green and Pyronin	01 Unit
4.	Staining of Mitochondria − Janus green	01 Unit
5.	Observation of mitotic stages in permanent slide	01 Unit
6.	Temporary squash preparation of onion root up for mitosis	03 Units
7.	Observation of permanent slide of Meiosis	02 Units
8.	Study of Meiosis using Grasshopper testes.	04 Units

II SEMESTER

BTG152201 GENERAL MICROBIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Learn the fundamental aspects that underpins all the basics in Microbiology
- Acquaint students with prokaryotic and eukaryotic micro organisms
- Getting to know growth and nutritional requirements of microorganisms

UNIT 1: Introduction and Scope of Microbiology **10 hrs**

Introduction and history of Microbiology, contributions of microbiologists− Anton Van Leuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming; Importance and scope and relevance of microbiology and branches of microbiology.

UNIT 2: Microbial Techniques **14 hrs**

Microscopy − construction and working principles of compound, dark field, phase contrast and fluorescence microscope; Electron Microscope − scanning and transmission; Stains and staining techniques − principle of staining, types of staining− simple, structural and differential; Sterilization technique: physical methods − autoclave, hot air oven, laminar airflow, membrane filter; Chemical methods − alcohol, aldehydes, phenols, halogens and gaseous agents; Radiation methods − UV rays and Gamma rays.

UNIT 3: Microbial Nutrition and Growth **10 hrs**

Nutritional requirements and categories of microorganisms, growth factors, microbial growth, cell cycle, viable count, batch culture, growth curve, synchronous growth, continuous culture, fed batch culture, measurement of microbial count− plate count, haemocytometer, colony counter, turbidometry; Influence of environmental factors on microbial growth − temperature, pH, oxygen concentration and hydrostatic pressure.

UNIT 4: Acellular Entities and Prokaryotic Microorganism **13 hrs**

Virus, characteristics and structure of virus; Cubic viruses, helical viruses, complex viruses, Viral multiplication; Viriods and Prions; Plant viruses − TMV; Animal viruses − Hepatitis B, Bacterial virus− Lambda phage; Bacteria− ultra structure of bacterial cell, flagella, endospore and capsule; Classification of bacteria based on morphology (shape, flagella), staining reaction, nutrition and extreme environment

UNIT 5: Eukaryotic Microorganisms **13 hrs**

Fungi − occurrence and distribution, vegetative structure, nutrition, ecological groups, reproduction − sexual and asexual and general classification**;** Algae − habit and habitat, range of vegetative structures, pigmentation, nutrition, cellular organization, reproduction, economic importance and general classification.

References:

Black, J.G. (2005), *Microbiology*−Principles *and exploration*, John wiely, USA

Dubey, R.C. and Maheshwari, D.K (2000), *General Microbiology*, S. Chand, New Delhi

Dubey, R.C and Maheshwari, D.K (2006), *Practical Microbiology*, S. Chand & Co, New Delhi

Gopal Reddy, M. Reddy, M.N. and Sai Gopal, (2007), *Laboratory Experiments in Microbiology*, (2nd Ed.), Himalaya Publishing house, Mumbai.

Pelczar, M. J., chan, E.C.S. and Kreig, N. R.(1993), *Micriobiology*, (5th Ed.), Tat Mc Grawhill Publishing Co., Ltd., New Delhi.

Prescott, M.J., Harley, J.P and Klein, D.A (2002), *Microbiology*, (5th Ed.), WCB Mc grawhill, Newyork.

Reddy, S.M., and Reddy S.R., (1998), *Microbiology − practical Manual*, (3rd Ed.), Sri Padmavathi publications, Hyderabad.

Stanier, R.Y., Adelberg, E.A and Ingrarn, J.L. (1991), *General Microbiology*, (5th Ed.), Prentice hall of India Pvt. Ltd., New Delhi.

BTG1522L1 GENERAL MICROBIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Buttress the basis of techniques and instrumentations in Microbiology
- Familiarize with the staining techniques to identify Microorganisms
- Learn the various techniques in isolation of Microorganisms

1. Safety measures in microbiology laboratory	01 Unit
2. Cleaning and sterilization of glass wares	01 Unit
3. Study of instruments − Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow chamber	02 Units
4. Staining Techniques Simple, Negative staining, Gram's staining, Endospore, Fungal staining	03 Units
5. Media preparation − Nutrient agar, Nutrient broth and MRBA	02 Units
6. Isolation of bacteria and fungi from soil, air, and water−serial dilution and pour plate methods.	02 Units
7. Estimation of microorganisms− total count (hemocytometer)	01 Unit
8. Antibiotic sensitivity test− paper/ Antibiotic disc method	01 Unit
9. Biochemical tests − Starch hydrolysis, catalase & gelatin liquefaction	01 Unit
10. Study of *Rhizobium* from root nodules of legumes.	01 Unit

BCH152201 BIOMOLECULES

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Carbohydrates 12 hrs

Definition, classification, stereochemistry, cyclic structures and anomeric forms, Haworth projections; Monosaccharides: reactions, characteristics of aldehyde and ketone groups, Action of acids and alkalis on sugars, Reactions of sugars due to hydroxyl groups; Disaccharides: structure, chemistry and function; Sucrose, Lactose, Maltose and Cellobiose; Trisaccharides; structure of Raffinose; Polysaccharides Homopolysaccharides − Starch, glycogen, cellulose, chitin, dextrin and inulin, Heteropolysaccharides − hyaluronic acid, chondroitin sulfate and heparin; Artificial sweeteners: Saccharin, Aspartame.

UNIT 2: Amino Acids and Peptides 12 hrs

Definition, amino acids as ampholytes; Structure and classification of amino acids based on chemical nature, chemical reaction of amino acids due to 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.

BCH1522L1 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) Monosaccharides - Glucose, Fructose, Galactose, Mannose, Pentose	02 Units
b) Disaccharides - Sucrose, Maltose and Lactose	01 Unit
c) Polysaccharides - Starch and Dextrin	01 Unit

2. Analysis of Amino Acids

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

3. Lipid Analysis [Group Experiments]

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

4. Demonstration Experiments

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

GEN152201 PRINCIPLES OF GENETICS

3 Credits **Total: 60 Hours**

Objectives:

- 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 calculations − Punnett's square, factor method; Terminology − trait, gene, locus/loci, allele, diploid, haploid, phenotype, genotype, homozygous, heterozygous, dominant, recessive; Incomplete or partial dominance, co-dominance, multiple alleles − ABO blood groups, Rh factor in humans; Problems on Mendelian genetics

UNIT 3: Elements of Biometry 14 hrs

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

UNIT 4: Gene Interactions 11 hrs

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

UNIT 5: Sex Determination 11 hrs

Chromosomal theory of sex determination – XX−XY, XX−XO, ZZ−ZW; 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.

GEN1522L1 GENETICS PRACTICAL II

1 Credit **Total: 30 Hours**

Objectives:

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

1.	Study of floral structure of Pea plant, Maize and 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

BTG153201 BIOINSTRUMENTATION AND BIOSTATISTICS

3 Credits **Total: 60 Hours**

Objectives:

- Understand the working principle, construction and application of various instruments
- To study the application of statistical tools in biology

UNIT 1: Analytical Techniques **13 hrs**

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

UNIT 2: Separation Techniques **13 hrs**

Centrifuge− principles of sedimentation, relative centrifugal force (RCF), types of centrifuges − bench top, clinical, high speed refrigerated, ultracentrifuge: preparative and analytical. Safety aspects in the use of centrifuge; Electrophoresis−principle, types of electrophoresis−paper, gel, column, agarose gel, polyacrylamide gel, Immunoelectrophoresis.

UNIT 3: Spectroscopy **13 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 4: Fundamentals of Biostatistics **11 hrs**

Importance and applications of statistics in biology; Tabulation and classification of data, frequency distribution and graphical distribution of data, measure of central tendencies: Mean, Median, Mode and their properties; Measures and dispersion mean deviation, Variance, Standard Deviation and Coefficient of Variation.

UNIT 5: Hypothesis Testing and Probability **10 hrs**

Hypothesis testing− Student T and Chi square tests; probability and distribution concepts; problems on probability; Binomial poisson, normal distribution and their applications; Different models of data presentation with special reference to biological samples

References:

Bliss., C.I.K, (1967), *Statistics in Biology*, Vol.1 Mc Graw Hill, New York.

Campbell, R.C., (1974), *Statistics for Biologists*, Cambridge Univ. Press, Cambridge

Daniel, (1999), Biostatistics (3rd Ed.) Panima publishing Corporation

Keith Wilson and Kenneth H. Goulding., (1992), *Biomedical Instrumentation and Measurement* (3rd Ed.), Orient Longman publishers, New York.

Khan, (1999), *Fundamentals of Biostatistics*, Panima publishing Corporation.

Mathews CK and Holde K E V (1996), *Biochemistry*, The Benjamin /Cummings Pub. Co.,

Nelson D L and Cox M M (2004), *Lehninger Principles of Biochemistry*, CBS publishers and distributors, New Delhi

Okotore R.O., (1998), *Basic Separation Techniques in Biochemistry*, New Age International Publishers, New Delhi.

Stryer L (1995), *Biochemistry*, (4th Ed), W H Freeman and Co, NewYork.

Upadhyay and Nath., (2002), *Biophysical chemistry– Principles & Techniques* (3rd Ed.), Himalaya Publishers, Mumbai.

Zubey G L., Parson W W and Vance D E (1994), *Principles of Biochemistry*, *W.C.* Brown Pub, Oxford.

BTG1532L1 BIOINSTRUMENTATION PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Learn to use the various instruments
- Familiarize with the various separation techniques

1. Instrumentation: Centrifuge, Ultracentrifuge, Electrophoretic unit, Spectrophotometer, Gas Chromatography, HPLC 03 Units
2. Separation of amino acids by paper chromatography 02 Units
3. Separation of leaf pigments by paper/ column chromatography 02 Units
4. Isolation and separation of DNA by agarose gel electrophoresis 02 Units
5. Separation of protein by PAGE 02 Units
6. Estimation of chlorophyll by spectrophotometry 02 Units
7. Determination of growth curve of microbial cells (bacteria) by colorimetry 02 Units

BCH153201: 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, 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 centrifuges − bench top, 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.

BCH1532L1: 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.	pH metric titration of an amino acid	01Unit
3.	Separation of amino acids by paper chromatography	02 Units
4.	Separation of biomolecules by TLC	02 Units
5.	Separation of proteins by SDS- PAGE electrophoresis	03 Units
6.	Isolation and separation of DNA by agarose gel electrophoresis	03 Units

GEN153201 CYTOGENETICS

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Chromosomes **14 hrs**

Chromosome theory of inheritance; Eukaryotic chromosome − 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, Lampbrush, B chromosomes.

UNIT 2: Linkage **14 hrs**

Coupling and repulsion hypothesis; Chromosome theory of linkage; Kinds of linkage− complete and incomplete linkage; Linkage groups; Linkage in maize and *Drosophila*; Factors affecting linkage− distance, age, temperature, X−rays; Significance of linkage; Linkage maps in maize and *Drosophila*; Meiotic behavior of chromosomes and non−disjunction; Bridge's 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 (nullisomy, monosomy & trisomy); 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.

GEN1532L1 GENETICS PRACTICAL III

1 Credit **Total: 30 Hours**

Objectives:

- Culture *Drosophila* and study different mutants in *Drosophila*.
- Observe and study special chromosomes.
- Study chromosomal aberrations with examples and solve genetic problems on linkage and crossing over.

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

BTG154201 MOLECULAR BIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Understand the molecular basis of life
- Comprehend the central dogma of molecular biology
- Understand gene structure and expression

UNIT 1: Structure of Nucleic Acids **12 hrs**

Molecular basis of life, experimental proof of DNA and RNA as genetic material, structure of DNA and RNA, Watson and Crick model of DNA, other forms of DNA: A and Z; Functions of DNA and RNA including ribozymes.

UNIT 2: DNA Replication and Repair **12 hrs**

DNA Replication− Prokaryotic and Eukaryotic, enzymes and proteins involved in replication, Theta model and rolling circle model; DNA repair− causes; DNA repair mechanisms: photo reactivation, excision repair, mismatch repair, SOS repair.

UNIT 3: Transcription **15 hrs**

Transcription mechanism in prokaryotes and eukaryotes − initiation, elongation and termination; Enhancers, promoters and transcription factors, RNA polymerase; Post transcriptional modifications, transcriptional inhibitors; Modifications of eukaryotic mRNA− 5' capping and 3' poly A tailing; mRNA splicing.

UNIT 4: Translation **10 hrs**

Genetic code, properties and Wobble hypothesis; Amino acid activation; Mechanism of translation in prokaryotes and eukaryotes- initiation, elongation and termination; post translational modifications of proteins.

UNIT 5: Gene Structure and 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; Gene organization and expression in Mitochondria and Chloroplast.

References:

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., (2002), *Molecular Biology of the Cell*, Garland Pub., (4th Ed.), New York.

Glick B.R. and Pasternak J.J., (1998), *Molecular Biotechnology, Principles and applications of recombinant DNA*, ASM press, Washington DC.

Karp.G., (2002), *Cell & Molecular Biology*, (3rd Ed.), John Wiley & Sons; INC. Jayaram.

Sambrook J and Russell, (2000), *Molecular cloning*, (Volumes I, II & III), Cold Spring Harbor Laboratory Press, New York, USA.

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

Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., (2004), *Molecular Biology of the gene*, (5th Ed.), Pearson Education, Singapore.

BTG1542L1 MOLECULAR BIOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Quantitatively estimate Nucleic acids
- Analysis of proteins
- Learn osmotic and detergent lysis of RBC

1.	Study of DNA by preparing models	01Unit
2.	Estimation of DNA by DPA method	02Units
3.	Estimation of RNA by orcinol method	02Units
4.	Detergent lysis of RBC	01 Unit
5.	Osmotic lysis of RBC	01 unit
6.	Extraction and estimation of protein from animal or plant source by salt precipitation & organic solvent method	02 Units
7.	Protein separation by Polyacrylamide gel electrophoresis.	02 Units
8.	Study of Conjugation, Transformation, Transduction by preparing charts	01 Unit

BCH154201 HUMAN PHYSIOLOGY

3 Credits **Total: 60 Hours**

Objectives:

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

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

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

UNIT 2: Components of Blood and Respiration **14 hrs**

Composition and function of red blood cells, hemoglobin, white blood cells and platelets, Blood coagulation, blood groups and blood transfusion; Respiration- diffusion of gases in lungs, transport of oxygen from lungs to tissues through blood, factors influencing the transport of oxygen, transport of CO_2 from tissues to lungs through blood, factors influencing the transport of CO_2.

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

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

UNIT 4: Muscular and Nervous System **14 hrs**

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

UNIT 5: Physiology of Reproduction **12 hrs**

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

References:

Agarwal G.R and Agarwal R.A., (1999), *Text book of Biochemistry* (1st Ed.), Jaypee Brothers *Medical* Publishers, New Delhi.

Chatterjee C.C (2006), *Human Physiology* (11th Ed.), Medical Allied Agency Publishers, Kolkata.

Chatterjee M.N (2003), *Text book Medical Biochemistry* (11th Ed.), Jaypee Brothers Medical Publishers, New Delhi.

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

BCH1542L1 BIO CHEMISTRY PRACTICAL IV

1 Credit **Total: 30 Hours**

Objectives:

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

I. Colorimetry

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

II. Titrimetry

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

III. Separation Techniques (Demonstration)

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

GEN154201 MOLECULAR GENETICS

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Chemical Basis of Heredity **12 hrs**

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

UNIT 2: Genome Organization **12 hrs**

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

UNIT 3: Recombination **12 hrs**

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

UNIT 4: Mutation **12 hrs**

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

UNIT 5: Applications of Molecular Genetics **12 hrs**

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

References:

Becker, W.M. & Klein smith, L. J.(2005), *World of the cell* (6th Ed.), Benjamin Cummings,Washington DC.

Cooper, G.M.(2000), *The Cell* (2nd Ed.).Sinauer Associates,Sunderland.

Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. &Gelbart, W. M.(2000) *An Introduction to Genetic Analysis* (7th Ed.), Freeman, New York.

Hames, B. D. & Hooper, N. M.(2002). *Instant Notes in Biochemistry* (2nd Ed.). Viva Books.

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

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

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

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

GEN1542L1 GENETICS PRACTICAL IV

1 Credit **Time: 30 Hours**

Objectives:

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

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

V SEMESTER

BTG155201 GENETIC ENGINEERING AND ENVIRONMENTAL BIOTECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Equip students with basic concepts in Genetic Engineering
- Knowledge on various techniques in Genetic Engineering
- Understand the role of Biotechnology in environmental issues

UNIT 1: Tools for Genetic Engineering **10 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, Bacteriophage − M13, Cosmids, Ti plasmid, SV40

UNIT 2: **Cloning, Transformation and Expression** **10 hrs**

Isolation of passenger DNA from bacteria, Gene Libraries− genomic DNA and cDNA, cloning technique; Transformation of rDNA into target host organism − calcium chloride mediated, *Agrobacterium* mediated, electroporation, microinjection, liposome fusion, particle gun bombardment; Screening and selection of recombinant host cells −insertional inactivation, *in situ* colony hybridization and immunological techniques

UNIT 3: **Techniques in Genetic Engineering** **10 hrs**

Blotting techniques − Southern, western, northern, dot blot; Nucleic acid sequencing− Maxam and Gilbert method, Sanger's method; Site directed mutagenesis; Auto radiography; Organo chemical synthesis of DNA, amplification through PCR and application of rDNA technology in human health− production of Insulin, hepatitis B vaccine, Human Growth Hormone

UNIT 4: Energy Production and Bioremediation **15 hrs**

Renewable and nonrenewable energy resources, conventional energy resources, biomass energy, methanogenic bacteria, Biogas production technology, conversion of sugar to alcohol and Gasohol; Bioremediation− technique: *in situ* and *ex situ*, bioremediation of pesticides, aromatic and chlorinated hydrocarbons and petroleum products, role of genetically modified organisms in bioremediations; Phytoremediation.

UNIT 5: Waste Management and Bioleaching **15 hrs**

Treatment of municipal solid waste and industrial effluents, preliminary treatment− grit chambers and screeners, primary treatment − sedimentation, secondary treatment− aerated lagoons, activated sludge process, sequence batch reactor, trickling filter, rotating biological contractor, packed bed process, pond treatment system− aerobic, anaerobic, and facultative. Tertiary treatment − solid, nitrogen, phosphorous removal and disinfection; Bioleaching − microbes used in leaching, mechanism (direct and indirect), leaching process − slope, heap and *in situ* leaching, case studies related to bioleaching (Copper and Uranium)

References:

Davis R.W.D and Roth J.R., (1990), *A manual for genetic Engineering*, Cold Spring Harbor Laboratory Press, New York.

Hurst, C.J. (1973), *Manual of Environmental Microbiology*, (3rd Ed.). Washington D.C. ASM Press.
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Tropp, E, B., (2012), *Molecular Biology – Genes to proteins*, (4th Ed.), Jones and Bartlett India Pvt. Ltd., New Delhi.
Glynn Henry.J., Gary. W. Heinke., (2004), *Environmental Science and Engineering* (2nd Ed.), Pearson education Pte. Ltd, Indian Branch, Delhi
Agarwal. S. K., (2005), *Advanced Environmental Biotechnology*, APH publishing corporation, New Delhi.
Pradipta Kumar Mohaptra, (2006), *Textbook of Environmental Biotechnology*, I.K. International Publishing House, Pvt.Ltd, New Delhi.
Parihar (2008), *Environmental Biotechnology, Fundamentals and Application*, Agrobios, (India) Jodhpur.

BTG1552L1 GENETIC ENGINEERING AND ENVIRONMENTAL BIOTECHNOLOGY PRATICAL

1 Credit **Total: 30 Hours**

Objectives:

- Learning the various techniques in Genetic Engineering
- Perform the various techniques in Environmental biotechnology

1.	Isolation of genomic DNA from bacteria (*E.coli*)	01 Unit
2.	Isolation of Genomic DNA from Plant (Cauliflower)	02 Units
3.	Isolation of Genomic DNA from Animal Tissue (chicken/sheep Liver)	01 Unit
4.	Isolation of Plasmid DNA from *E.coli* (pBSK strain)	02 Units
5.	Separation of DNA by Agarose gel electrophoresis	01 Unit
6.	Restriction digestion of DNA	01 Unit
7.	Demonstration of SDS−PAGE	01 Unit
8.	Estimation of Biological Oxygen Demand(BOD)	02 Units
9.	Estimation of Total Dissolved Solids (TDS) in water sample	02 Units
10.	Bacterial Examination of water by Most Probable Number (MPN) method	02 Units

BTG155202 IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Understanding the components of the immune system
- Comprehend the various immunological reactions and response.
- Fortify the knowledge on Animal tissue culture and its applications

UNIT 1: Overview of the Immune System **10 hrs**

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

UNIT 2: Antigens and Antibodies **10 hrs**

Antigen 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 of Immunoglobulins; Antigen − antibody reaction; *In vitro* tests: Precipitation, immunoelectrophoresis, haemagglutination, labeled antibody; RIA, ELISA and immunofluorescent techniques

UNIT 3: Reactions of the Immune System and Vaccines **10 hrs**

Complement system− structure, components, properties and functions; Hypersensitivity and allergic reactions; Blood cell components, ABO blood grouping, Rh typing; Vaccines and immunization, passive and active immunization, types of vaccines − inactivated, attenuated and recombinant vaccines; Peptide and DNA vaccines

UNIT 4: Animal Cell Culture **15 hrs**

Introduction, history and scope of Animal Biotechnology; terminologies in animal cell culture; Media constituents, physiochemical properties of a media, types of animal cell culture media: natural−plasma clot, biological fluids, tissue & embryo extracts. Importance of serum in media, artificial−chemically defined media, choice of medium and serum; Isolation of tissue, Primary culture: disaggregation of tissue− enzymatic, mechanical, and primary explant technique; Secondary cultures− transformed cells and continuous cell lines; Cell lines and cloning.

UNIT 5: Applications of Animal Biotechnology **15 hrs**

Transfection of animal cell line, selectable markers, transplantation of cultured cells, expression of cloned proteins in animal cell− expression vectors, over production and downstream processing of expressed proteins, production of vaccines in animal cell lines, Hybridoma technology − Monoclonal Antibodies and its application; Growth factors− promoting proliferation of animal cells EGF, FGF, PDGF, and erythropoietin; Transgenic animals − methodology, retroviral mediated, embryonic stem cell method, DNA microinjection; Transgenic mice, sheep and its applications

References:

Vaman Rao, (2002), *An introduction to immunology*, Narosa Publishing House, New Delhi.

Chakravarthy, A.K. (2006), *Immunology and Immunotechnology*, Oxford University Press, New Delhi
Klaus, D. E., (1996), *Immunology – understanding immune system*, Wiley Liss. New York.
Kuby, J, (2007), *Immunology*, (6th Ed.), WH Freeman and company, New York.
Hannigan, B.M., Moore, C.B.T. and Quinn, D.G., (2009), *Immunology* (2nd Ed.), Scion Publishing Ltd., UK
Peter, L., Whelan, A. and Fanger, M., (2012), *Immunology* (3rd Ed.), Garland Publishers, New York
Roitt, I.M, (2001), *Essentials of Immunology*, ELBS, Blackwell Scientific Publishers, London
Ballinic C.A., Philips J.P and Moo Young M (1989), *Animal Biotechnology*, Pergamon press, New York.
Davis John. M., (2011), *Animal Cell Culture Essential Methods*, John Wiley & Sons
Ian Freshney R. (2005), *Culture of Animal Cells* – a manual of basic technique (5th Ed.), John Wiley & Sons

BTG1552L2 IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Learn the techniques in Immunology
- Perform the various immunological assays and tests

1.	Blood grouping	01 Unit
2.	Differential count of WBC	02 Units
3.	Widal test and VDRL	02 Units
4.	ELISA− Demonstration	02 Units
5.	DOT ELISA− Demonstration	01 Unit
6.	Ouchterlony Double Diffusion	01 Unit
7.	Radial Immuno Diffusion	01 Unit
8.	Isolation of liver parenchyma cells	02 Units
9.	Rocket electrophoresis	01 Unit
10.	Separation of serum from blood & precipitation of Immunoglobulins	02 Units

BCH155201: ADVANCED BIOMOLECULAR CHEMISTRY

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Introduction **08 hrs**

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

UNIT 2: Carbohydrates **14 hrs**

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

UNIT 3: Amino Acids and Proteins **12 hrs**

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

UNIT 4: Lipids and Membranes **14 hrs**

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

UNIT 5: Bioenergetics and Biological Oxidation **12 hrs**

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

References:

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

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

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

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

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

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

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

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

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

BCH1552L1: BIOCHEMISTRY PRACTICAL V

1 Credit **Total: 30 Hours**

Objectives:

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

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

BCH155202 ENZYME AND ENZYME TECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Basic Concepts in Enzymology 14 hrs

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

UNIT 2: Enzyme Kinetics and Enzyme Inhibitors 14 hrs

Enzyme kinetics-derivation of Michalies Menton 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 Production and Immobilization 10 hrs

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

UNIT 5: Applications of Enzymes 10 hrs

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

References:

Alan Welshman (1993), *Hand book of enzyme biotechnology* (2nd Ed.), Brown Publishers, New Delhi.

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

Malcolm and Edwin C. *Webb Dixon., (1964), Enzymes* (2nd *Ed.),* Academic Publishers, New York.

Martin *Chaplin* and Christopher *Bucke., (2004), Enzyme Technology* (2nd Ed.), Wiley Press, New York.

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

Plummer T (2008), *An introduction to practical biochemistry* (2nd Ed.), McGraw-Hill Publishers, New York.
Sadasivam A. Manickam (2004), *Biochemical methods* (2nd Ed.), New Age International Publishers, New Delhi.
Trevor Palmer (1991), *Understanding enzymes* (3rd Ed.), Ellis Harwood Publishers, New York.

BCH1552L2 BIOCHEMISTRY PRACTICAL VI

1 Credit **Total: 30 Hours**

Objectives:

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

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

GEN155201 RECOMBINANT DNA TECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

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

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

Introduction to genetic engineering, DNA manipulative enzymes− Restriction enzymes, Ligases and other DNA modifying enzymes; Brief account of alkaline phosphatase, polynucleotide kinase, exonuclease III, DNAase I, Mung bean and S1 nuclease, DNA polymerase and Klenow fragment, terminal 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*), integrative DNA transfer using *Agrobacterium* vectors, Ti plasmid, Binary and co-integrated vectors, animal viral vectors - SV 40, Retroviral and Vaccinia viral vectors; Expression vectors in Prokaryotes and Eukaryotes.

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

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

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

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

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

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

UNIT 5: Applications **14 hrs**

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

References:

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

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

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

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

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

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

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

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

GEN1552L1 GENETICS PRACTICAL V

1 Credit **Total: 30 Hours**

Objectives:

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

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

GEN155202 BASIC HUMAN GENETICS

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Human Chromosomes **06 hrs**

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

UNIT 2: Genetic Diseases and Inheritance Pattern **14 hrs**

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

UNIT 3: Immunogenetics **12 hrs**

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

UNIT 4: Cancer Genetics **14 hrs**

Properties of cancer cells; Types− Proto 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 and 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.

GEN1552L2 GENETICS PRACTICAL VI

1 Credit **Total: 30 Hours**

Objectives:

- Determine the frequencies of a dominant or recessive traits occurring in a given population.
- Identify the sex chromatin
- Learn to draw and analyze pedigree charts
- Learn to record and study dermatoglyphic prints.

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

VI SEMESTER

BTG156201 PLANT BIOTECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

- Emphasis on the basic *in vitro* techniques in plant tissue culture
- Understand the biotechnological applications in plant for the sustainable development in agriculture, horticulture and forestry

UNIT 1: Introduction to Plant Tissue Culture **11 hrs**

In vitro methods in plant tissue culture, aseptic techniques, initiating tissue culture; Nutrient media − components of tissue culture media and use of growth regulators − auxins, cytokines and gibberellins; Clonal propagation of elite species − Micro propagation, methods of auxiliary bud, adventitious bud and meristem tip culture and stages, applications and factors affecting micro propagation.

UNIT 2: Tissue and Organ Culture **13 hrs**

Organ Culture − anther, embryo and endosperm culture and their applications; *In vitro* fertilization−ovary and ovule culture, applications and limitations; Organogenesis and Somatic embryogenesis − technique and applications; Protoplast culture − isolation, mechanical method, enzymatic method, culture of protoplast and plant regeneration and viability test.

UNIT 3: Variant Production and Selection **13 hrs**

Somatic hybridization, method of protoplast fusion − chemical and electro fusion, applications and cybridization; Somaclonal variants – production and screening methods of somaclonal variations and its significance; Gametoclonal variations.

UNIT 4: Transgenics and Edible Vaccines **13 hrs**

Transgenic plants−technique of transformation (*Agrobacterium* mediated and physical methods− micro projectile, electroporation and chemical methods), application of transgenic plants; Edible vaccines, recombinant subunit vaccine production in plants, transformation of banana with Hepatitis B vaccine, transformation of musk melon with rabies virus vaccine.

UNIT 5: Application of Plant Tissue Culture and Intellectual Property Rights **10 hrs**

Role of tissue culture in agriculture, horticulture, and forestry, *In vitro* production of secondary metabolites, technique and application; Biotechnology and Intellectual property rights, patents, patent for transgenic plants, trade secrets, copyright, trademark, choice of Intellectual property and Plant Genetic Resources, GATT and TRIPS, Plant breeders right (PBR) Biosafety of GMOs, risk assessments.

References:

Bhan, (1998), *Plant Tissue Culture*, Mittal Publications, New Delhi.

Islan A.C., (1996), *Plant Tissue Culture*, Oxford & IBH Publishing Co. Pvt. Ltd.

Lydiane Kyte & John Kelyn, (1996), *An introduction to Micropropogation* (2nd Ed.) Timber Press, Partland.

Ravishankar G.A. and Venkataraman L.V. (1997), *Biotechnology Applications of plant Tissue & culture*, Oxford & IBH Publishing Co, Pvt. Ltd

Chrispcel M.J. and Sdava D.E. (1994), *Plants, Genes and Agriculture*, Jones and Barlett Publisher Boton.

Reinert J. And Bajaj Y.P.S. (1997), *Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture*, Narosa Publishing House.

BTG1562L1 PLANT BIOTECHNOLOGY PRACTICAL

1 Credit **Total: 30 Hours**

Objectives:

- Understand organization of the plant tissue culture laboratory and its set up
- Learn to prepare the various plant tissue culture media
- Perform the aseptic and *In vitro* techniques in plant propagation

1.	Plant tissue culture laboratory organization	01 Unit
2.	Aseptic techniques and surface sterilization of explants	01 Unit
3.	Instrumentation	02 Units
4.	Preparation of plant tissue culture media MS − 1962	02 Units
5.	*In vitro* generation of a plantlet using seed culture	02 Units
6.	Isolation of explants and establishment and maintenance of callus, subculture of callus	02 Units
7.	Micro propagation techniques −auxiliary and apical bud culture	02 Units
8.	Production of synthetic seeds	01 Unit
9.	Isolation of protoplast	02 Units

BTG156202 INDUSTRIAL BIOTECHNOLOGY

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Screening and Selection of Strains **11 hrs**

Introduction, basic layout of fermentation technology; Isolation and screening of microorganisms−primary and secondary screening, maintenance of strains, strain improvement: Mutant Selection, Recombinant DNA methods.

UNIT 2: Fermentation Media and Process Parameters **12 hrs**

Fermentation media−natural and synthetic media, components of an essential media sterilization, process of aeration, agitation, temperature regulation and foam control

UNIT 3: Fermentors and Fermentation Process **12 hrs**

Types of Fermentors−Typical, Airlift, Tower and Bubble cap fermentor, Immobilized enzyme and cell bioreactors; Types of Fermentations− Solid State, submerged, shake flask, batch, fed batch and continuous.

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

Solid− liquid separation (filtration, flocculation, centrifugation, sedimentation), release of intracellular products−physical, enzymatic, chemical, concentration, purification 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 corporation, Delhi.

Prescott & Dum (2002), *Industrial Microbiology,* Agro bios (India) Publishers, Jodhpur.

Stanbury P.F, Whitaker H. Hall S.J. (1978), *Principle of Fermentation Technology*, Pergamone Press, Oxford

BTG1562L2 INDUSTRIAL BIOTECHNOLOGY 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 Unit
7.	Preparation of wine.	02 Units
8.	Estimation of alcohol by specific gravity method.	02 Unit
9.	Visit to Industries/ Institutes	

BCH156201 INTERMEDIARY METABOLISM

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Biochemical Investigations and Introduction to Metabolism 10 hrs

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

UNIT 2: Carbohydrate Metabolism- I 14 hrs

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

UNIT 3: Carbohydrate Metabolism- II 12 hrs

Glucuronic acid cycle and glyoxylate cycle (ED pathway) Metabolism of other hexoses-Fructose and galactose; Biological oxidation-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 and 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.

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

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

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

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

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

BCH1562L1 BIOCHEMISTRY PRACTICAL VII

1 Credit **Total: 30 Hours**

Objectives:

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

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

BCH156202 CLINICAL BIOCHEMISTRY

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Disorders of Carbohydrate Metabolism 14 hrs

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

UNIT 2: Disorders of Lipid Metabolism 14 hrs

Plasma lipids and lipoproteins, Introduction to Hyperlipoproteinemia- Types I, II, III, IV and V, Alpha lipoproteinemia, Hypolipoproteinemia-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 and 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:

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.

BCH1562L2 BIOCHEMISTRY PRACTICAL VIII

1 Credit **Total: 30 Hours**

Objectives:

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

I. Blood Analysis:

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

II. Qualitative analysis

1. Analysis of urine sample-Normal and Abnormal constituents	02 Units

GEN156201 DEVELOPMENTAL AND POPULATION GENETICS

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Animal and Plant Development **14 hrs**

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

UNIT 2: Evolutionary Genetics **10 hrs**

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

UNIT 3: Population Genetics **10 hrs**

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

UNIT 4: Quantitative Inheritance **12 hrs**

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

UNIT 5: Biometrical Genetics **14 hrs**

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

References:

Balinsky, B. I. (1975). *Introduction to Embryology* (4th Ed). Saunders, Philadelphia.
Charles, W., Wolf. J. B. (2006). *Evolutionary Genetics*, Oxford University press, New York.
Cooper, G. M. (2000). *The Cell* (2nd Ed.). Sunderland: Sinauer Associates.
Falconer, D. (1995).*Introduction to Quantitative Genetics*.(4th Ed.). Longman, London.
Gilbert S. F. (2003). *Developmental biology* (7th Ed.). Sunderland: Sinauer Associates.
Gurbachan, S. M (2006) *Developmental Genetics*, I.K. International Publishing House, New Delhi.
Lynch, M., Walsh, B. (1997). *Genetics and Analysis of Quantitative traits*.Senauer Associates, Sunderland.
Phundhan, S. (2001).*Elements of 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.

GEN1562L1 GENETICS PRACTICAL VII

1 Credit **Total: 30 Hours**

Objectives:

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

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

2. Biometrical problems in Quantitative Inheritance 08 Units
   Problems on Kernel color in Wheat, Ear length in Maize, Body size in Poultry & Rabbits; Genetic problems on portioning polygenic variability; Genetic problems on Heritability; Problems in population genetics.

GEN156202 APPLIED GENETICS

3 Credits **Total: 60 Hours**

Objectives:

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

UNIT 1: Genetic Resources and Biodiversity 10hrs

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

UNIT 2: Heterosis in Animals and Plants 14 hrs

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

UNIT 3: Introduction to Plant Tissue Culture 12 hrs

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

UNIT 4: Genetics in Medicine, Industry and Forensic Science 14 hrs

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

UNIT 5: Bioinformatics 10 hrs

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

References:

Atherly, A. G., Girton, J. R & Donald, M. C., (1999) *The Science of Genetics,* Saunders College Publications, Harcourt Brace.
Brown, T. A. (2002). Genetics: *A Molecular Approach* (2nd Ed.), Garland Science, New York.
Desmond, S. T. N. (2002). *An introduction to Genetic Engineering* (2nd Ed.), University Press, Cambridge.
Glick, B. R. & Pasternak, J. J. (1998).*Molecular Biotechnology* (2nd Ed), ASM Press, Washington, D.C.
Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. &Gelbart, W. M.(2000) *An Introduction to Genetic Analysis* (7th Ed.), Freeman, New York.
Gupta, P. K. (2003). *Elements of Biotechnology* (2nd Ed.),Rastogi Publication, Meerut.
Pennington, S. R. & Dunn, M. J. (2002). Proteomics, Viva Books, New Delhi
Phundhan, S. (2001).*Elements of 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.

GEN1562L2 GENETICS PRACTICAL VIII

1 Credit **Total: 30 Hours**

Objectives:

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

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

NON CORE PAPERS

NHU150102 INDIAN CONSTITUTION

1 Credit **TOTAL: 30 Hours**

Objectives:

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

UNIT 1: Introduction **06 hrs**

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

UNIT 2: Union Parliament **07 hrs**

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

UNIT 3: Union Executive **07 hrs**

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

UNIT 4: Judiciary **05 hrs**

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

UNIT 5: Issues **05 hrs**

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

References:

Austin, Granville (1999), *Indian constitution: cornerstone of a nation* New Delhi

Bakshi, P.M (2002), The Constitution of India – Universal Law publishers.

Basu, Durga Das (1995), *Introduction to the constitution of India* New Delhi: Prentice –hall of India Pvt.

Basu, Durga Das (2002), *Introduction to the Constitution of India* New Delhi: Wadhwa and Company Law Publishers.

Kabburi, S.K (2006), *Indian constitution-institutions and process.*

Kagzi, M.C. (2001), *The Constitutional of India Vol.1 & 2.*New Delhi: India law house.

Pylee, M.V (2002), C*onstitution Government and Politics* New Delhi: Universal Law publishing Co.Pvt.Ltd.

Raj, Hans (1998), *The Constitution of India*: New Delhi: Surjeet Publications.

NCS150101 COMPUTER FUNDAMENTALS

1 Credit **Total: 30 Hours**

Objectives:

- To provide basic knowledge of Computer and its Usage.

UNIT 1: Introduction to Computers 05 hrs

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

UNIT 2: Computer Organization 05 hrs

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

UNIT 3: Computer Hardware and Software 10 hrs

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

UNIT 4: Microsoft Office 05 hrs

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

UNIT 5: Computer Networks 05 hrs

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

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

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

Creating a folder and saving a document	02 sessions.
Simple MS. DOS commands	01 session
Windows operating system – icons, menus and submenus, my computer	02 sessions
Desktop publishing – preparation of a document using MS.WORD	02 sessions
Installation of a software, virus scanning – illustrations	01 session.
Spreadsheet calculations using MS.EXCEL	01 session.
BASIC programming – illustrations	01 session.
Internet use.Surfing, browsing, search engines, E-mail.	02 sessions.

References:

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

NHU150101 ENVIRONMENTAL STUDIES AND CIVIC SENSE

1 Credit **Total: 30 Hours**

Objectives:

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

UNIT 1: Nature of Environmental Studies: 03 hrs

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

UNIT 2: Ecosystems 03 hrs

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

UNIT 3: Biodiversity and its Conservation 03 hrs

Introduction-Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option value, Biodiversity at global, national and local levels, India as a mega-diversity nation, Western ghat as a bio-diversity, Hot-spots of

biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife Conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ, Conservation of biodiversity.

UNIT 4: Environmental Pollution **03 hrs**

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

UNIT 5: Social Issues, Human Population and Environment **06 hrs**

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

CIVIC SENSE

Objectives:

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

UNIT I: Introduction to Civic Sense / Social Ethics **03 hrs**

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

UNIT II: Issues of Promoting Civic Sense **03 hrs**

Spitting, urinating and defecating in public, lettering, shop lifting, consuming alcohol in public, smoking in public, consuming drugs, mugging, vandalizing public property, vulgar graffiti on public spaces, loud and rude behavior, argumentativeness, lack of humility and conduct, general disregard to the law of the land, disrespect to elders, ragging, eve teasing, women subjugation,

stalking, lack of traffic discipline, jay walking, honking without reason, willful noise pollution, road rage, use of cell phones while driving. Reporting Instances of Poor Civic Sense**:** Highlighting the manifestations and ramifications including the moral and the legal consequences of the victims and the accused. Preventive / precautionary measures for the innocent victims who are soft targets.

UNIT III: Promotion of Civic Sense **02 hrs**

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

UNIT IV: Success stories signifying good Civic Sense within India and Foreign Countries **01 hr**

UNIT V: Group Project – Sensitizing students to the practice and inculcation of civic sense. **01 hr**

References:

Agarwal, K.C., (2001) *Environmental Biology*, Nidi Publ. Ltd. Bikaner

Bharucha Erach, *The Biodiversity of India*, Mapin publishing Pvt. Ltd. Ahmedabad-

Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. (2001) Environmental Chemistry, Wiley Eastern Ltd.,

Heywood, Vh & Watson R.T. 1995 Global biodiversity Assement Cambridge Univ.

Jadhav H & Bhosle V.M. 1995 Environmental Protection and laws. Himalayas Pub. House Delhi, 284p

Mckinney M.L. & Schocl R.M. 1996 Environmental Science systems & Solutions Web.Enhanced edition 639p.