



**REGULATIONS, SCHEME AND SYLLABUS**

**FOR**

**M.Sc. BIOCHEMISTRY PROGRAMME**

**(UNDER CSS)**

**AT**

**AFFILIATED COLLEGES OF**

**MAHATMA GANDHI UNIVERSITY**

**KOTTAYAM, KERALA**

**(W.E.F 2012-2013)**

## **REGULATIONS, SCHEME & SYLLABUS OF M.Sc. DEGREE PROGRAMME IN BIOCHEMISTRY**

### **1. ELIGIBILITY & ADMISSIONS**

A candidate seeking admission to M.Sc Biochemistry must have at least 55% marks in Biological Sciences (Zoology, Botany, Biochemistry, Biotechnology, Microbiology) or Chemistry at the graduate level.

The admission to the M.Sc Biochemistry PG Programme shall be as per the rules and regulations of the university.

### **2. CURRICULUM**

The M.Sc. Biochemistry Programme under the Credit and Semester system(CSS) consisting of 4 semesters shall extend Over a Period of 2 years. Semester means a term Consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days each. A student has to complete a minimum of 80 credits which would be distributed as following.

#### **Core Course (PC)**

- (a) Theory - 45 Credits
- (b) Practicals - 16 Credits

#### **Elective Course (PE)**

- (a) Theory - 12 Credits
- (b) Project - 4 Credits
- (c) Viva Voce - 3 Credits

‘Course’ means a segment of subject matter to be covered in a semester.

‘Credit’ (Cr) of a course is a measure of the weekly unit of work assigned for that course in a semester.

**‘Course Credit’** One credit of the course is defined as a minimum of one hour lecture/ minimum of 2 hours lab /field work per week for 18 weeks in a semester. The course will be considered as completed only by conducting the final examination. No regular student shall register for more than 24 credits and less than 16 credits per semester. The total minimum credits required for completing a PG programme is 80.

**‘Programme Core Course’ (PC)** means a course that the student admitted to a particular programme must successfully complete to receive the Degree and which cannot be substituted by any other course.

**‘Programme Elective Course’ (PE)** means a course which can be substituted by equivalent course from the same subject and a minimum number of courses is required to complete the programme.

**‘Programme Project** means a regular project work with stated credits on which the student undergo a project under the supervision of a teacher in the parent department/ any appropriate research centre in order to submit a dissertation on the project work as specified.

**‘Academic week’** is a unit of five working days in which distribution of work is organized from day one to day five, with five contact hours of one hour duration in each day. A sequence of 18 such academic week constitute a semester.

**Zero Semester** means a semester in which a student is permitted to opt out due to unforeseen genuine reasons.

**Examination:**

To be conducted as per rules and regulations framed under credit and semester system.

- There shall be University examination at the end of each semester.
- Practical examinations shall be conducted by the University at the end of each semester.

- Project evaluation and viva voce shall be conducted at the end of the programme only. Project evaluation and viva -voce shall be conducted by two external examiners and one internal examiner.
- There shall be one end semester examination of 3 hours duration in each lecture based course and practical course
- A question paper may contain short-answer type /annotation, short essay type questions/ problems and long essay type questions. Different type of questions shall have different weightage to quantify their range. Weightage can vary from course to course depending on their comparative importance but a general pattern may be followed by the Board of Studies.

## **EVALUATION AND GRADING**

Evaluation: The evaluation scheme for each course shall contain two parts, (a) Internal evaluation and (b) external evaluation. 25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation, and the ratio and weightage between internal and external is 1:3 Both internal and external evaluation shall be carried out using Direct- grading system.

### **Internal evaluation**

The internal evaluation shall be based on predetermined transparent system involving Periodic written test, assignments, seminars and attendance in respect of theory courses and based on written tests, lab skill/ records/ viva and attendance in respect of practical courses. The weightage assigned to various components for internal evaluation is as follows.

### **Component Weightage**

- |      |                     |   |
|------|---------------------|---|
| i.   | Assignment .....    | 1 |
| ii.  | Seminar.....        | 2 |
| iii. | Attendance.....     | 1 |
| iv.  | Two Test paper..... | 2 |

Letter Grade	Performance	Grade point (G)	Grade Range
A	Excellent	4	3.50 to 4.00
B	Very Good	3	2.50 to 3.49
C	Good	2	1.50 to 2.49
D	Average	1	0.50 to 1.49

### Grades for Attendance

% of attendance	Grade
<90%	A
Between 85 and 90	B
Between 80 and below 85	C
Between 75 and below 80	D
<75	E

### Assignment

Component	Weight
Punctuality	1
Review	1
Content	2
Conclusion	1
Reference	1

### Seminar

Components	Weights
Area/Topic Selected	1
Review/ Reference	1
Content	2
Presentation	2
Conclusion	1

**Practical - Internal**

Components	Weights
Attendance	1
Laboratory Involvement	2
Written/Lab test	2
Record	2
Viva-Voce / Quiz	1

**PROJECT EVALUATION****Internal**

Components	Weights
Punctuality	1
Experimentation / Data Collection	1
Compilation	1
Content	1

**External**

Components	Weights
Area/Topic Selected	1
Objectives	2
Review	1
Materials & Methods	2
Analysis	2
Presentation	2
Conclusion / application	2

## DIRECT GRADING SYSTEM

Direct Grading System based on a 5 point scale is used to evaluate the performance (External and internal examinations of students)

The overall grade for a programme for certification shall be based on CGPA with a 7- point scale given below.

CGPA	Grade
3.80 to 4.00	A+
3.50 to 3.79	A
3.00 to 3.49	B+
2.50 to 2.99	B
2.00 to 2.49	C+
1.50 to 1.99	C
1.00 to 1.49	D

A separate minimum of C Grade for Internal and External are required for a pass for a course. For a pass in a programme a separate minimum grade C is required for all the courses and must score a minimum CGPA of 1.50 or an overall grade of C and above.

After the successful completion of a semester, semester grade point average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of a semester, a student should pass all courses and score a minimum SGPA of 2.0. However a student is permitted to move to the next semester irrespective of her/his SGPA.

For instance if a student has registered for 'n' courses of credits  $C_1, C_2, \dots, C_n$  in a semester and if she/he has scored credit points  $P_1, P_2, \dots, P_n$  respectively in these courses, then SGPA of the student in that semester is calculated using the formula.

$$SGPA=(P_1+P_2+\dots\dots\dots+P_n)(C_1+C_2+\dots\dots\dots C_n)$$

$$CGPA=\{(SGPA)_1 \times S_1+(SGPA)_2 \times S_2+(SGPA)_3 \times S_3+(SGPA)_4 \times S_4\}/S_1+S_2+S_3+S_4$$

Where S1,S2,S3and S4 are the total credits in semester 1,Semester2, Semester3 and Semester4.

### **Pattern of Questions**

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/she shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type/problem solving type and long essay type questions.

**Weight:** Different types of questions shall be given different weights to quantify their range as follows.

Sl.No	Type of Questions	Weight	Number of Questions to be answered
1	Short Answer type Questions (not exceeding one page)	1	5 out of 8
2	Short essay/Problem solving type questions(not exceeding 2 pages	2	5 out of 8
3	Long Essay type questions	5	3out of 6



### **Grade Card**

The University under its seal shall issue to the students, a grade card on completion of each semester which shall contain the following information. Name of the University, Name of the college, Title of the PG programme, Name of Semester, Name and Register number of students, code number, Title and credits of each course opted in the semester. Title and credits of the project work etc.

In addition to these the grade card shall contain internal, external and total grade, Grade point(G) Letter grade and credit point(P) in each course opted in the semester, the total credit, total credit points and SGPA in the semester.

The final Grade card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final Grade Card shall show the CGPA and the overall letter grade of a student for the entire programme.

**M.Sc. BIOCHEMISTRY PROGRAMME UNDER CREDIT  
AND SEMESTER SYSTEM**

Semester	Course Title	Hours/ Week	Credit	Total Credit
I	BC1MOO1PC1 BIOCHEMISTRY	4	4	1 9
	BC1MOO1PC2 BIOPHYSICS, BIO INSTRUMENTATION AND BIO INFORMATICS	4	4	
	BC1MOO1PC3 PHYSIOLOGY AND BIostatISTICS	4	4	
	BCI MOOI PC4- CELL BIOLOGY AND GENETICS	3	3	
	BCIMOOIPPI-LABORATORY COURSE I	10	4	
II	BC2MOO2PC5-GENERAL MICROBIOLOGY	4	4	1 9
	BC2MOO2 PC6- IMMUNOLOGY	4	4	
	BC2MOO2 PC7- MOLECULAR BIOLOGY AND GENETIC ENGINEERING	4	4	
	BC2MOO2PC8- METABOLISM AND BIOENERGETICS	3	3	
	BC2MOO2PP2-LABORATORY COURSE-II	10	4	
III	BC3MOO3PC9-ENZYMOLGY	4	4	1 9
	BC3MOO3PC10-PLANT BIOCHEMISTRY	4	4	
	BC3MOO3PC11-MOLECULAR ENDOCRINOLOGY	4	4	
	BC3MOO3PC12-NEUROBIOLOGY	3	3	
	BC3MOO3PP3-LABORATORY COURSE-III	10	4	
IV	BC4MOO4PE1-CLINICAL BIOCHEMISTRY	5	4	2 3
	BC4MOO4PE2-ENVIORNMENTAL SCIENCES	5	4	
	BC4MOO4PE3-NUTRITION HEALTH AND LIFE STYLE DISEASES	5	4	
	BC4MOO4PP4-LABORATORY COURSE IV	10	4	
	BC4MOO4PD-PROJECT///OR DISSERTATION	-	4	
	VIVA-VOCE	-	3	
Additional Electives of IV <sup>th</sup> Semester	BC4MOO4 PE4-RESEARCH METHODOLOGY IPR AND BIOETHICS	5	4	
	BC4MOO4PE5-PLANT AND ANIMAL CELL CULTURE	5	4	
	BC4MOO4PE6-BIOCHEMICAL TOXICOLOGY	5	4	

# **SEMESTER I**

**BC1MOO1PC1: Core Course I****BIOCHEMISTRY**

Hours/Week-4

Credit:-4

**UNIT I**

**Biomolecules:** Composition; basic structure and function of biomolecules: carbohydrates, lipids, proteins, nucleic acids and vitamins and minerals.

**Free radicals in biological systems:** Pro oxidants and antioxidants in biological systems

**UNIT II****Complex Carbohydrates**

**Oligosaccharides:** Glycosidic bonds; Classification: glycoproteins (O-linked and N-linked) glycolipids; Nature of carbohydrate moiety attached; Functions; as cell recognition factors, in intracellular targeting; Purification and Characterization of oligosaccharides from cell membranes

**Polysaccharides:** Classification: Homopolysaccharides (Cellulose, Starch, Chitin, and Glycogen), Heteropolysaccharides (bacterial peptidoglycans, glycosaminoglycans, hyaluronic acid, and heparin); Structural characteristics and functions of above mentioned polysaccharides; Exopolysaccharides from bacterial systems and their uses; Purification and Characterization of Polysaccharides from biological systems.

## UNIT III

### Complex Lipids

**Glycerophospholipids:** Structure and function of (Phosphatic acid, cardiolipin, Phosphatidyl serine, Phosphatidyl ethanolamine, Phosphatidyl Glycerol, Phosphatidylcholine, Phosphatidyl inositol, plasmalogens) CDP-diacylglycerol, Lung surfactants.

**Glycosphingolipids:** Structure and function of (Sphingosine, ceramides & sphingomyelins, cerebrosides, globosides, gangliosides, sulfatides)

**Eicosanoids:** Prostaglandins, Leukotrienes and Thromboxanes: Chemistry, formation and physiological function.

**Steroids:** Steroids in animal system: Glucocorticoids, mineralocorticoids and Sex hormones (Site of biosynthesis and functions. Sterols in Plant system: Phytohormones: Brassinosteroids (function); Sterols in microbial system.

## UNIT IV

**Protein structure and function:** Primary, Secondary, Tertiary and Quaternary structure of Proteins w.r.t: Globular protein (eg: Hemoglobin and Myoglobin), Fibrous protein (Collagen), Membrane Protein (ATP synthetase); Structural implication of the peptide bond-rigid planar peptide unit-cis and trans configuration-conformations of a pair of linked peptide units- torsion angles: phi and psi- steric hindrance- allowed and disallowed conformation – Ramachandran diagram – conformational maps of glycine and other natural amino acids. Protein structure and molecular approach to medicine: introduction Sickle cell anemia, p53 and its role in Cancer.

## UNIT V

**Nucleic acid structure and function:** Types of DNA-A, B and Z. Supercoiling of the DNA molecule; topoisomers and superhelixes; Higher orders of DNA Structure: Chromatin Structure: Histones and Nucleosomes; Conformation of Chromatin fibers; Organization of the DNA Sequence: Genes, pseudogenes, extragenic regions (beta globin gene and gene family) duplicated genes; Reassociation kinetics, Repetitive DNA sequences: Tandem repeats (Satellites, minisatellites, and microsatellites), Interspersed repeats (LINE, SINEs) Single copy genes; RNA Structure: Types of RNA; structure of mRNA, tRNA, siRNA, micro RNA with emphasis on importance of structure to its function.

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2. Introduction to Biophysics by Pranab Kumar Banerjee(2008) Publishers: S.Chand & Company Ltd ISBN:81-219-3016-2
3. Lehninger, Principles of Biochemistry, Fourth Edition by David L.Nelson Michael. M Cox Publisher: W.H.Freeman; Fourth Edition (April 23,2004) ISBN-10:0716743396 ISBN-13:978-0716743392
4. Biochemistry[with CDrom](2004) by Donald Voet, Judith G Voet Publisher: JohnWiley & SonsInc ISBN:04711935X ISBN-13: 9780471193500, 978-0471193500
5. Principles of Biochemistry,4/e(2006)by Robert Horton H,Laurence A Moran, GrayScrimgeour K Publisher Pearsarson ISBN:0131977369, ISBN-13:9780131977365,9780131977365
6. Biochemistry 6<sup>th</sup> Edition (2007)by Jeremy M. Berg John L.tymoczko LubertStryer Publisher:B.I Publications Pvt.Ltd ISBN:071676766X ISBN-13:9780716767664, 978716767664

7. Biochemistry (2008) by Rastogi, Publisher: Mcgraw Hill ISBN: 0070527954 ISBN-13:9780070527959, 978-0070527959
8. Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter Publisher: Garland Science; 5 edition ISBN-10: 0815341059 ISBN-13: 978-0815341055
9. Genes IX by Benjamin Lewin(2008)Publisher: J&b ISBN:0763752223 ISBN-13: 9780763752224, 978-0763752224
10. Molecular Biology of the Gene 5/e(s)by James D Watson, Tania A Baker, Stephen P Bell (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177581813 ISBN-13: 9788177581812, 978-8177581812
11. Cell and Molecular Biology by S. SundaraRajan (2003) Publisher: Anmol Publications ISBN: 8126113553 ISBN-13: 9788126113552, 978-8126113552

**BC1MOO1PC2-Core Course2****BIOPHYSICS, BIOINSTRUMENTATION AND BIOINFORMATICS**

Hours per week: 4

Credits-4

**UNIT I**

**Structural levels of proteins and stabilizing forces.** 3D structure of immunoglobulin. Methods for studying the structure of macromolecules- CD, ORD, X Ray and NMR.

**UNIT II**

**Macromolecular interactions** Protein DNA interaction-helix turn helix, helix loop helix, zinc fingers, homeo box. Protein RNA interaction-RNA recognition motif Protein-protein interaction-leucine zippers, bHLH, bZip motifs.

**UNIT III****Spectroscopic techniques for the study of Biomolecules**

Principle, Instrumentation, and Applications of UV-Visible spectroscopy, Infra Red spectroscopy, Fluorescence spectra, and luminescence. Principle methods and applications of polarimetry, cytometry and flow cytometry.

**Isotope techniques**

Ionising and nonionising radiation, radiation units, dosimetry, applications of radioisotopes in blotting techniques, Radioimmunoassay and tracer studies.



## UNIT IV

### **Separation techniques**

Principle, Instrumentation, methods and Application of all types of Adsorption and Partition Chromatography-Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Affinity chromatography, Ion –exchange chromatography and HPLC and HPTLC.

**Centrifugation-** Principle, methods and application, Ultra centrifugation.

Principle, Instrumentation, methods and Applications of Free and zone Electrophoresis-Paper electrophoresis, Gel electrophoresis, Polyacrylamide gel electrophoresis, SDS PAGE, Capillary electrophoresis, Isoelectric focusing, agarose gel electrophoresis, isotachopheresis, and pulse field gel electrophoresis.

## UNIT V

### **Bioinformatics**

Introduction to bioinformatics, data mining, application of data mining in Bioinformatics, Biological databases and search tools, data organization, sequence databases, structural data bases, derived and specialized data bases, DNA and RNA sequence databases, protein sequence databases, genomic databases, mutation and polymorphism databases, data deposition. Three dimensional structure of proteins, prediction of structural classes, motifs, folds and domains, classification of three dimensional structures in Brookhaven protein data bank (HSSP, SCOP, FSSP, CATH); protein structure prediction, structural alignment methods, homology modelling, dynamical programming, molecular simulation, rational drug design and docking, Applications of bioinformatics.

## REFERENCES

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2. Practical Biochemistry-Principles and techniques. Keith Wilson and John Walker (Eds), University Press, Cambridge UK.
3. Modern Experimental Biochemistry. Rodney F Boyer. Benjamin/Cummings Publishing Company Inc. Redwood City, California.
4. Chromatographic methods. A Braithwaite and FJ Smith. Chapman and Hall, New York.
5. Gel Electrophoresis of Nucleic acids-A Practical approach. Rickwood D and BD Hames. IRL Press, New York
6. Spectrophotometry and Spectrofluorimetry: A Practical Approach. Harris DA and CL Bashford (Ed.) IRL Press, Oxford.
7. Introduction to Spectroscopy. Donald L. Pavia Gary M. Lipman, George S Kriz. Harcourt Brace College Publishers, Orlando, Florida
8. Introduction to Biophysics-Sokal R.R & Rohlf F.J
9. Introduction to Bioinformatics; Attwood T K and Parry-Smith D J Pearson Education Ltd.
10. An Introduction to Computational Biochemistry; C. Stan Tsai, Wiley India Pvt. Ltd
11. Inferring Phylogenies; Joseph Felsenstein, Sinauer Associates.
12. Basic bioinformatics, S. Ignachimuthu, SJ Narosa Publishing House
13. Introduction to Bioinformatics, Arthur M Lesk, Oxford.
14. Bioinformatics sequence, structure and database; Des Higgins, Willie Taylor.
15. Introduction to Bioinformatics; V Kothekur DHRUV Publications.

**BCIMOOIPC3 Core Course 3**  
**PHYSIOLOGY AND BIOSTATISTICS**

Hours/week-4

Credits-4

**UNIT-1**

Introduction to physiology, scope of human physiology, Elementary tissues, epithelial tissue, connective tissue, muscle tissue, nervous tissue homeostasis, blood buffers, acid-base balance, hormones.

Salivary gland and secretion, gastric gland and secretion, secretion of pepsinogen, HCl secretion and regulation, pancreas, liver and bile.

**UNIT –II**

Muscle and cardiovascular physiology Muscle classification, skeletal muscle, smooth muscle, muscle contraction, membrane excitation, neuromuscular junction, rigor mortis.

Heart, cardiac muscle, action potential in cardiac muscle, cardiac cycle, heart sounds, conducting mechanism, heart beat and regulation, cardiac output, ECG, blood pressure, cellular content of blood erythrocytes, leukocytes, thrombocyte, hematopoiesis, hemoglobin, blood groups, blood transfusion, lymph.

**UNIT-III**

Renal and Respiratory physiology Kidney, nephron, renal circulation, GFR, renal regulation of water and electrolyte balance.

Organization of respiratory system, respiratory membrane, pulmonary ventilation, pulmonary volumes and capacities, alveolar ventilation, surfactants, exchange of gases, transport of gases, regulation of respiration,

hypoxia, cyanosis, hyper capnia, dyspnea, apnea, periodic breathing, artificial respiration.

#### **UNIT –IV**

**Plant physiology**-scope of plant physiology, plant cell-tissues, organs; water balance and transport in plants, osmosis and diffusion, water potential, measuring of water potential, osmotic potential, membrane potential, diffusion pressure deficit, solute transport, mass flow, transpiration. Roots and mineral absorption, essential minerals, mineral assimilation, active and passive absorption, Xylem transport, Phloem transport. Seed dormancy and viability, concept of seed vigour, seed invigoration, physiology of tuber and bulb formation, juvenility and senescence, physiological and biochemical changes during ripening, Physiological effects of biotic and abiotic stress on plants with special reference to temperature, draught, salinity and heavy metals.

#### **UNIT –V**

**Biostatistics**-Introduction, scope, probability and probability distribution analysis, variables in biology, collection, classification and tabulation of data, graphical and diagrammatic representations-scatter diagrams, histograms, frequency polygon, frequency curve, logarithmic curves, Descriptive statistics, measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic means, Measures of dispersion, Standard deviation, standard error, Variance, coefficient of variation, correlation and regression, Principal component analysis test of significance, Basic idea of Significance test, hypothesis testing, levels of significance, Chi-square test and goodness of fit, comparison of means of two samples, three or more samples, statistical packages, use of statistical softwares, Excel, SPSS, Anova.

## REFERENCES

1. Vander's Human Physiology-The mechanism of Body function, Widmaier, Raff, strang.
2. Text book of Medical Physiology. Arthur.C.Guyton & John.E.Hall
3. Physiological basis of Medical Practice, John.B.West.
4. Review of Medical Physiology-William F.Ganong
5. Essentials of Medical Physiology K.Sembulingam &Prema Sembulingam
6. Statistical methods in Biology-Briely N.J.T.
7. Introductory Practical Biochemistry, S.K.Sawhney & Randhir Singh (eds), Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, P195-303.
8. Standard Methods of Biochemical Analysis, S.K.Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, P12-18.
9. Expeimental Biochemistry, A Student companion, Beedu Sasidhar Rao and Vijay Deshpande(ed), I.K.International Pvt.Ltd, NewDelhi, ISBN 81-88237-41-8, PB13-17, P 49-72.
10. Practical Biochemistry, R.C.Gupta S.Bhargava(eds) CBS Publishers and Distribuors, New Delhi ISBN 81-239-0124-0 P9-27

## BCIMOOIPC4- CELL BIOLOGY & GENETICS

### Core Course-4

Hours/Week-3

Credits-3

#### UNIT I

**Cell and its constituents-**Mitochondria, Chloroplast, Endoplasmic Reticulum Golgi complex, Peroxisomes, Lysosome, Ribosome, Nucleolus, Centrosome, chromosomes, Nucleosomes, Histones, Genome.

**Biological membranes:** Types and sub cellular location; Chemical composition; Gap and tight junctions; Model; Fluid Mosaic mode, membrane rafts; Membrane: Types, Preparation and properties; Physical and biochemical methods to study membrane structure and function; Specialized forms of membranes: brush border; flagella, red cell membranes, microsomal membrane functions.

**Membrane functions: Membrane Transport:** Endocytosis and exocytosis; Nutrient transport across membranes; porins facilitated diffusion, porter molecules; Facilitated transport: symport, antiport, uniport, anion porter, glucose porter; Active transport: proton pumps;  $\text{Na}^+$   $\text{K}^+$  pumps,  $\text{Ca}^{+}$  pumps; Ionic channels : general characteristics of ionic channels, types of ionic channels and structural characteristics; **Energy transduction:** Mitochondrial, Chloroplast and other membrane systems involved in energy transduction; **Membrane receptors:** Types of receptors; Structure and function; Methods of studying membrane receptor function; Purification and Characterization of receptors. Cell –Cell interaction and cell matrix interaction.

## UNIT II

**Cell cycle**-Different stages, variations, checkpoints, regulations of cell cycle, maturation Promoting factor, cells, cyclins, ubiquitin, protein ligases. Anaphase Promoting complex, inhibitors of CdK, growth factors and D Cyclins, Rb protein and E2F transcription factors. Cell cycle control; Receptor serine/threonine kinases; Other protein kinases; Phosphoprotein Phosphatases.

**Cancer**-Stages in cancer development, causes, properties of cancerous cells, tumour Viruses, oncogenes, functions of oncogene products. Oncogene and signal Transduction, oncogene and G proteins, oncogene and cell survival. Tumor Suppressor gene, functions of tumour suppressor gene products. Cancer Pathways: MAPK, P13K, TP53 network, NF $\kappa$ B pathways; Signalling by TGF  $\beta$  factor, Diagnosis, prevention and treatment of cancer

## UNIT III

**Cell Differentiation**-Stages of development, regulation of development, cascade control/Differentiation in *Drosophila*, maternal, Segmentation and homeotic Genes, Genetic control of embryonic development, *Bi thorax* mutant, *Antennapedia* mutant, Hemeobox

**Aging** Process of aging, theories of aging, Arking's contribution Oxidative stress, Telomere problem. DNA repair defects.

**Cell Death** Necrosis and Apoptosis, Differences between necrosis and Apoptosis, stages in Apoptosis, mitochondrial damage, DNA ladders, transglutaminase activity, programmed cell death in *Ceanorhabditiselegans* CED 3, CED 4, CED 9 and their roles in Apoptosis Bax, Bid, BC12 protein.

## **UNIT IV**

### **Classical Genetics**

Genetics, the evolution of the subject through pre Mendelian, and post Mendelian Periods. Mendelism-the basic principles of inheritance, gene interactions-allelic and non allelic. Environment and gene expression, penetrance and expressivity. Multiple alleles and polygenic inheritance, Heritability and genetic advance. Linkage and linked genes with special reference to inheritance, Chromosome mapping with their point test crosses.

### **Organelle Genetics and Population Genetics**

Organelle Genetics and cytoplasmic inheritance. Population Genetics- type of gene variations, Measuring genetic variations, Hardy Weinberg principle and its deviations. Medical genetics-an introduction.

## **UNIT V**

### **Genetic system in Microbe, Yeast and Neurospora**

Plasmids & bacterial sex. Types of plasmids. Plasmids copy number and incompatibility, Replication of plasmid. Plasmid as cloning vector. Episomes. Transposable element-IS element and transposon, Integrons and Antibiotic resistance cassettes, Multiple antibiotic resistant bacteria, Mu-virus. Gene mapping in Bacteria. Bacteriophage genetics-Plaque formation & phage mutants, genetic recombination in lytic cycle. Genetic system in Yeast & Neurospora.



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2. Genetics, Robert Weaver and Philip Hendricks, W.H.C Brown Publishers, Iowa
3. Basic human Genetics, E J Mange and A P mange, University of Massachusetts, Rastogi Publishers, India.
4. Fundamentals of Genetics BD Singh, Kalyani Publishers
5. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbert , Suzuki and Miller, Freeman's and Co, New York
6. REA's Problem Solvers in Genetics, Research Education Association, 61, Ethel Road west, New Jersey
7. Modern Genetic Analysis, Griffiths, Lewontin, Gelbert, and Miller, Freeman's and Co, NewYork.
8. Cell Biology, Smith and Wood
9. Cell and Molecular Biology by Gerald Karp, Academic Press
10. Cell and Molecular Biology by Cooper

**BCIMOOIPPI-LABORATORY COURSE –I**

Hours/week-10

Credits-4

**Biochemistry: Number of Hours/Week:9****1. Preparation of Solutions:**

- Percentage solutions,
- Molar solutions,
- Normal solutions
- Dilution of Stock solutions

**2. Preparation of buffers using the Henderson Hasselbach equation****3. Spectrophotometric experiments:**

- Determination of UV-Visible spectrum of compounds
- Determination of Concentration of molecules from Molar Extinction coefficient values.

**Quantitative Analysis-Any five**

- Quantitative estimation of reducing sugars by Dinitrosalicylic acid method
- Quantitative estimation of glucose by Nelsons Somogi method
- Quantitative estimation of glucose by orthotoluidine method
- Estimation of fructose by Roe and Papadopoulos method
- Estimation xylose by orcinol method
- Quantitative estimation of tyrosine by Folin's method
- Estimation of Cholesterol by Zak's method
- Estimation of protein by biuret method.
- Estimation of protein by Lowry's method
- Estimation of protein by BCG method
- Quantitative estimation of Methionine by Nitroprusside method

- Estimation of total aminoacids by Ninhydrin method
- Determination of Saponification value, acid value, iodine number of oils or fats.

#### **4. Chromatographic techniques**

- Separation of amino acids by Paper chromatography(Descending or Ascending)
- Separation of Plant pigments/lipids/sugars by Thin layer chromatography
- Separation of any biomolecule by column chromatography

#### **5. Extraction of Polysaccharides** (Starch, glycogen), Proteins from appropriate source:

Quantification of isolated polysaccharides (anthrone method), protein (Lowry's method) and lipids

6. Qualitative analysis of Carbohydrate mixtures (a combination of polysaccharide, disaccharide and monosaccharide) following systematic analysis. General reactions of amino acids, proteins and lipids.
7. Demonstration of stages of mitosis, meiosis and counting chromosome numbers

#### **8. Physiology experiments**

Determination of haemoglobin concentration

Determination of haematocrit

Enumeration of bloodcells:

Erythrocytes by haemocytometry,

Total leukocyte by haemocytometry

Preparation of Blood smears for differential count and cell morphology

Determination of Erythrocyte sedimentation rate

#### **9. Bioinformatics practicals**

1. Familiarizing with the different data bank mentioned in the syllabus.

2. Retrieve a document reporting recent work on a genomic analysis of human disease.
3. Retrieve one sequence both DNA and protein from database retrieval systems.
4. Retrieve nucleotide sequences and construct a distance tree.

## **REFERENCES**

1. Introductory Practical Biochemistry, S .K. Sawhney & Randhir Singh ( eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, P195-303
2. Standard Methods of Biochemical Analysis, S.K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12-18
3. Hawk's Physiological Chemistry, Bernard L.Oser(ed) TATA McGraw Hill Publishing Company LTD, New Delhi, p 60-127, 1317-1334

# **SEMESTER II**

**BC2MOO2PC5-CORE COURSE 5  
GENERAL MICROBIOLOGY**

Hours/Week-4

Credits-4

**Unit I**

The historical foundations and development of microbiology. An overview of microbial world. Microbial diversity-Prokaryotic and eukaryotic microbial diversity. The bacteria and the archaea. Principles of bacterial taxonomy Molecular methods in taxonomy. Interspecies classification of bacteria. Morphology and structure of bacteria. Surface structures and inclusions of bacteria. Viruses-unique properties, morphology and structure. Virion, Viroids and Prions. Viral replication. Viral diversity-bacterial, plant and animal viruses. Fungi properties and classification.

**Unit II**

Factors influencing microbial growth. Environmental and nutritional factors. Nutritional types of bacteria. Microbial locomotion-flagellar motility, gliding motility and amoeboid motion. Chemotaxis, Phototaxis and other taxes. Cultivation of bacteria-culture media and methods. Measurement of bacterial growth. Bacterial growth curve. Binary fission, Growth cycle, Microbial growth at different temperature, pH and oxygen level. Continuous cultures. Maintenance and transport of cultures.

**Unit III**

Identification of bacteria. Staining reactions. Cultural, physiological and biochemical properties. Molecular methods for identification. Sterilization-Principles and methods, physical and chemical methods. Disinfectants-modes of action. Testing of disinfectants. Antibiotics- mechanism of action. Drug resistance in bacteria. Antibiotic sensitivity tests.

### **Unit IV**

Genetic materials in bacteria. Bacterial chromosome. Extrachromosomal genetic elements. Plasmid, Transposons. Mutation, Site Directed Mutagenesis, DNA repair, Mutant selection. Mechanism of gene transfer- transformation, transduction and conjugation.

### **Unit V**

Microbial metabolism. Central pathways, Glycolysis, Pentosephosphate pathway, EntnerDoudoroff pathway, TCA cycle, Electron transport chain, Aerobic and anaerobic respiration. Fermentation. Anaplerotic reaction. Peptidoglycan synthesis, Bacterial photosynthesis.

### **REFERENCES**

1. Russel AD, Hugo WB & Ayliffe GAJ (1999) *Principles and practice of disinfection, preservation, and sterilisation* (Blackwell Science, Oxford) 3<sup>rd</sup> ed
2. Bryan LE (1984) *Antimicrobial Drug Resistance* (Academic Press, Orlando)
3. Topley WWC, Wilson GS, Parker T & Collier LH (1990) *Topley and Wilson's Principles of Bacteriology, Virology and Immunology*. Edward Arnold, London. 8<sup>th</sup> ed.
4. Davis BD (1990) *Microbiology* (Lippincott, Philadelphia) 4<sup>th</sup> ed.
5. Zinsser H & Joklik WK (1992) *Zinsser Microbiology* (Appleton & Lange, Norwal, CT) 20<sup>th</sup> Ed.
6. Gerhardt P (1994) *Methods for General and Molecular Bacteriology*. American Society for Microbiology, Washington, D.C)
7. Pelezar MJ, Chan ECS, & Krieg NR (1993) *Microbiology : concepts and applications* Mc Graw-Hill. 5<sup>th</sup> ed.
8. Prescott LM, Harely JP, & Klein DA (2005) *Microbiology* (McGraw-Hill, Boston; London) 6<sup>th</sup> ed.

**BC2MOO2PC6- CORE COURSE 6****IMMUNOLOGY**

Hours/Week-4

Credits-4

**Unit I**

Infection, Source of infection, Methods of transmission. Types of immunity. Mechanisms of innate immunity-barriers, inflammation, phagocytosis-mechanisms, Pattern recognition receptors- Scavenger receptors and the Toll-like receptors etc. Organs and cells with immune functions. Lymphocytes and lymphocyte maturation.

**Unit II**

Antigens, Antigenicity, Epitopes, Antibodies, Immunoglobulin- structure, classes and functions Fc receptors. Monoclonal antibodies- production and application, Antibody engineering. Antigenic determinants on Ig-Isotype, Allotype, Idiotype. Genetic basis of antibody diversity, Organization and Expression of Immunoglobulin Genes, V(D)J rearrangements, somatic hypermutation and affinity maturation, Class-switching, Antigen- antibody reactions, Agglutination, Precipitation, Complement fixation, Radioimmuno assay, Immunofluorescence, ELISA, Western blotting, Flow cytometry etc.

**Unit III**

Receptors on T and B cells for antigens, MHC, Antigen processing and presentation, Complement system, Complement activation, regulation, Biological effects of complements, B cell generation, activation, differentiation, Humoral Immune response- Antibody formation, Primary and secondary immune response, Clonal selection theory. T-cell maturation, activation and differentiation, Cell mediated Immune response, Cytokines, Primary and secondary immune modulation, activation and



differentiation, Cell mediated Immune response, Cytokines, Primary and Secondary immune modulation.

#### **Unit IV**

Immunology of organ and tissue transplantation-Allograft reaction and GVH reaction Factors influencing allograft survival, Immunology of malignancy-Tumour antigens, Immune response in malignancy, Immunotherapy of cancer, Immunohematology- ABO and Rh blood group system, Immunology of blood transfusion, Hemolytic disease of new born.

#### **Unit V**

Immunological Tolerance, Autoimmunity- Mechanisms of autoimmunity, Autoimmune diseases. Inflammation, Hypersensitivity-immediate and delayed reactions, Clinical types of hypersensitivity, Immunodeficiency diseases, Immunoprophylaxis-Vaccines-types of vaccines, DNA vaccine and recent trends in vaccine development, Immunoregulation.

#### **REFERENCES**

1. Roitt IM & Delves PJ(2001) *Roitt's essential Immunology* Blackwell Science Oxford. 10<sup>th</sup> ed.
2. Kindt TJ, Goldsby RA, Osborne BA&KubyJ (2006) *Kuby Immunology*. W.H Freeman, New York. 6<sup>th</sup> ed.
3. Murphy K, Travers P, Walport M, &JanewayC(2008) Janeway's Immunobiology. Garland Science, NewYork 7<sup>th</sup> ed.
4. Chapel H(2006)Essentials of clinical Immunology. Blackwell, Malden, mass; Oxford. 5<sup>th</sup> ed.
5. Kimball JW(1986)Introduction to Immunology. Macmillian, London 2<sup>nd</sup> ed.
6. PanikerCKJ (2006) Ananthanarayanan & Panicker's Textbook of microbiology. Orient Longman 7<sup>th</sup> ed.

## BC2MOO2PC7-Core Course 7

### MOLECULAR BIOLOGY & GENETIC ENGINEERING

Number of Hours/Week:4

Credits:4

#### UNIT-1

**DNA Replication**-Process of DNA replication, Semiconservative, discontinuous uni and bidirectional, Okazaki fragments, DNA polymerases in eukaryotes and prokaryotes, Klenow fragment, modes of replication, theta, rolling circle, D-loop replication, Primasome, SSB, Helicase, Ligase, methylation and control, repetitive DNA sequences, minisatellite, microsatellite, DNA protein interaction, DNA Linking number and topoisomerase, Inhibition of replication.

#### UNIT-2

**Transcription**-Process of transcription, stages in transcription, RNA polymerases in prokaryotes and eukaryotes, sigma factor in prokaryotes, Rho dependent and Rho independent termination. Enhancers, Transcription factors in Eukaryotes, Differences in transcription between prokaryotes and Eukaryotes, post transcriptional modifications, Polyadenylation, capping, r-RNA processing, Splicing-Splicesome, lariat structure, Group I, II and III Introns, Ribozyme, Importance of ribozyme, properties, application, RNaseP, RNase III, RNase II, monocistronic and polycistronic m-RNA, Joint transcript of r-RNA and tRNA in prokaryotes and their processing. Transplicing, alternate splicing, inhibitors of Transcription.

Molecular mechanism of gene regulation in prokaryotes- Transcriptional regulation in prokaryotes; Inducible & repressible system, +ve, &-ve regulation; Operon concept, structure of operon, Lac, Trp, ArC operon, Catabolic repression, attenuation. Role of Hormones in gene

regulation. RNA World, RNA based technology-Molecular mechanism of Ribozyme, Antisense RNA, SiRNA, MicroRNA, Ribozwitches and their applications; Telomerase structure and function. Nucleic acid as therapeutic agent.

### **UNIT3**

#### **Translation**

Process of translation. Stages in translation, genetic code, properties, wobble hypothesis, eukaryotes and prokaryotes ribosomes, m-RNAs, tRNAs, aminoacyl t-RNA synthetases, protein factors initiation complex, peptidyltransferases, releasing factors, differences between prokaryotic and eukaryotic systems, inhibition of translation. Post translation modification by cleavage, self assembly, assisted self assembly chaperones, acylation, phosphorylation, acetylation and glycosylation. Histone acetylation and deacetylases, chromosome remodelling complex. Intein splicing. Protein targeting, cotranslational import, post translational import, SRP-structure and function, Blobel's concept, Lysosome targeting, M6P address Glycosylation, core glycosylation terminal glycosylation, Dolichol phosphate.

### **UNIT IV**

#### **Tools and techniques for genetic Engineering**

History of rDNA Technology, Cohen And Boyer Patents, Isolation of DNA and RNA from different sources, enzymes used in genetic engineering with special reference to restriction enzymes, ligases, and other DNA modifying enzymes. Modification of restriction fragments, vaccinia topoisomerases, TA cloning, and homopolymer tailing.

Vectors for E coli with special reference to plasmid vectors(pSC101), pBR322,pUC,their development , features and selection procedures),direct selection plasmid vectors, low copy number plasmid vectors,runaway plasmid vectors , Bacteriophages(  $\lambda$  and M13) with special reference to Charon phages,  $\lambda$ EMBL,  $\lambda$ WES  $\lambda$ B',  $\lambda$ ZAP-their development, features, selection procedures, in vitro packaging mechanisms, cosmids, features, advantages and cosmid cloning schemes, phagemids with special reference to pEMBL,pBluescript, pGEM3Z, pSP64,pcDNA, pLITMUS Construction of genomic libraries and cDNA libraries, procedures for recombinant selection and library screening, PCR enzymes, types, primer design, real time PCR, RT PCR, Nested PCR, Inverse PCR, Assymmetric PCR, applications of PCR Cloning, Chemical synthesis of DNA, DNA sequencing-plus and minus sequencing, Sangers dideoxy sequencing Maxam and Gilert method, advanced sequencing procedures – pyrosequencing, Illumina, ABI / SOLID and their applications.

## UNIT V

### Applications of Genetic Engineering

Applications of transgenic Technology Improving quality and storage life of fruits and vegetables. Plants with novel features, Engineering metabolic pathways, Pharming. Animal cloning, Ethics of cloning. Applications of Molecular Biology in forensic sciences, medical science, archeology and paleontology.

## REFERENCES

1. REA's Problem Solvers in Genetics, Research Education Association, 61, Ethel Roadwest, New Jersey
2. Modern Genetic Analysis, Griffiths, Lewontin, Gelbart,and Miller Freeman's and Co, New York

3. Cell Biology, Smith and Wood
4. Cell and Molecular Biology by Gerald Karp, Academic Press
5. Cell and Molecular Biology by Cooper
6. Cell Biology by DeRobertis
7. Molecular Biotechnology-Glick and Pasternae
8. Principles of gene manipulation-Old, Twyman and Primrose
9. Gene cloning and DNA analysis-T.A Brown
10. Genes-Benjamin Lewin

## BC2MOO2PC8-Core Course 8

### METABOLISM AND BIOENERGETICS

Hours/Week-3

Credits-3

#### UNIT I

**Metabolism of Carbohydrates**-glycolysis-reactions, Metabolism of sugars other than glucose, fructose galactose and mannose-energetics and regulation(hormonal, allosteric and feed back)

Gluconeogenesis-reactions and regulation.Coricycle, glyoxylate pathway, pentose phosphate pathway.Alternative oxidative pathway of glucose.Uronic acid pathway, phosphoketolase pathway.

**Metabolism of glycogen**Glycogen breakdown, synthesis, regulation.

**Citric acid cycle**-reactions, enzymes amphibolic nature of the cycle, anaplerotic reactions.Regulation.

#### UNIT II

**Lipid Metabolism:Fatty acid oxidation-  $\alpha$ ,  $\beta$ ,  $\omega$  oxidation.** Catabolism of unsaturated fatty acids, formation and utilization of ketone bodies.

Fatty acid biosynthesis-regulation

Synthesis and breakdown of triacylglycerols-regulation.Phospholipids and glycolipid metabolism-glycerophospholipids, sphingolipids, sphingoglycolipids.

**Cholesterol metabolism** Cholesterol biosynthesis and regulation.

Transport of cholesterol-LDLreceptor pathway.Cholesterol catabolism-

Synthesis of bile acid.Lipoprotein metabolism-Chemical composition, biological functions and metabolic fate of VLDL,LDL and HDL.

Arachidonic acid metabolism-leukotrienes and prostaglandins.

### UNIT III

**Metabolism of proteins and amino acids:** Catabolism of proteins and individual amino acids-regulation.

**Biosynthesis of urea-** Conversion of aminoacids to histamine, polyamines, serotonin, epinephrine, and norepinephrine  
 $\gamma$  aminobutyrate.

**Metabolism of purine and pyrimidine nucleotides-** biosynthesis and catabolism-inter conversion - uric acid formation, regulation, Heme synthesis and degradation

### UNITIV

**Hormonal regulation of metabolism-**Role of Insulin, glucagon, epinephrine-intracellular receptor and cell surface receptors signalling: Cyclic AMP-dependent protein kinase; Cyclic GMP-dependent protein kinase; Protein kinase C;  $Ca^{2+}$ -calmodulin-dependent protein kinases; AMP-dependent protein kinases. Receptor tyrosine kinases, Regulation of glycogen synthesis, degradation and glucose transport.

**Metabolomics-**Introduction to the origin of metabolomics, definition metabolite,metabolome, applications of metabolomics in toxicity assessment, toxicology, metagenomics.

**UNIT V-**Laws of the thermodynamics, concept of enthalpy and entropy, Redox potential, Nernst equation.

**Bioenergetics:** High energy molecules, Functional significance of the mitochondrial respiratory chain and oxidative phosphorylation, Electron transport chain: structural components of the chain, complexes, free elements; Structure and functional properties of cytochrome, ferrosulphurated proteins and CoQ; Generation of the electrochemical proton gradient:Chemiosmosis ATP synthesis: structural and functional properties of ATP synthesis; Inhibitor agents

and decoupling agents of the respiratory chain and ATP synthesis;  
Transport processes across the internal mitochondrial membrane.

Photosynthetic electron transport and photophosphorylation-  
Transduction of light energy by photosystems. Carbondioxide  
fixation-Regulation of stromal enzymes by light.

## REFERENCES

1. Lehninger, Principles of Biochemistry Fourth Edition by David L.Nelson Michael M.Cox Publisher:W.H.Freeman; Fourth Edition (April23,2004)ISBN-10:0716743396ISBN-13:978-0716743392
2. E.S.West,W.RTodd,H.S Mason and T.J van Bruggen, A Text Book of Biochemistry , Oxford and IBH Publishing Co.,New Delhi,1974
3. Biochemistry[with CDrom](2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN:047119350XISBN-13: 9780471193500, 978-0471193500
4. Principles of Biochemistry (1995) by Geoffrey L Zubay, WilliamW Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company-Koga ISBN: 0697142752 ISBN-13: 97806971142757, 978-0697142757
5. Principles of Biochemistry, 4/e(2006) by Robert Horton H, Laurence A Moran, GrayScrimgeour K Publisher:Pearsarson ISBN:0131977369, ISBN-13:9780131977365, 978-0131977365
6. Biochemistry 6<sup>th</sup>Ediion (2007) by JeremyM.berg John L.tymoczko LubertStryer Publisher: B.I publications Pvt.Ltd ISBN:071676766X ISBN-13:9780716767664, 978-716767664
7. Biochemistry (2008) by Rastogi Publisher:Mcgraw Hill ISBN: 0070527954 ISBN-13: 9780070527959, 978-0070527959



**BC2MOO2PP2-Practical**  
**LABORATORY COURSE-II**

Hours/Week-10

Credits-4

**(Microbiology, Immunology, Molecular Biology and Genetic Engineering)**

**MICROBIOLOGY AND IMMUNOLOGY**

- Microscopic examination of bacteria in living conditions
- Testing of motility
- Staining procedures-Gram's, Volutin, Spore, Capsule, Negative, Fungal staining etc.
- Cultivation of bacteria and fungi
- Sterilization methods
- Study of cultural characteristics and biochemical reaction of bacteria
- Testing of disinfectants
- Bacterial growth curve
- Antibiotic sensitivity tests-disc diffusion, MIC
- Sterility testing of solution,vaccines, drugs and surgical methods
- Raising of immune sera
- Serological tests for the diagnosis of microbial infections
- Agglutination and precipitation tests
- Immunodiffusion in gel
- ELISA

**MOLECULAR BIOLOGY AND GENETIC ENGINEERING**

- PAGE-Protein separation
- DNA and RNA isolation
- Agarose gel electrophoresis of nucleic acids
- Estimation of DNA and RNA

- Polymerase Chain Reaction
- Restriction enzyme digestion
- Ligation, Bacterial transformation and blue white screening
- Expression and purification of recombinant proteins
- Comparison of microbial genome size
- Online sequence analysis, BLAST
- Phylogenetic analysis

## **REFERENCES**

1. Cheesbrough M (2006) District Laboratory Practice in Tropical Countries. Vol.2 Cambridge University Press 2<sup>nd</sup>ed.
2. Collee JG & Mackie TJ (1996) Mackie and McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh. 14<sup>th</sup>ed.
3. Gradwohl RBH, Sonnenwirth AC, & Jarett L (1980) Gradwohl's Clinical Laboratory Methods and Diagnosis. Mosby, St Louis, Mo.; London 8<sup>th</sup> ed.
4. Dubey RC & Maheshwari DK (2002) Practical Microbiology (S.Chand & Company Limited).
5. Aneja KR (2003) Experiments In Microbiology, Plant Pathology And Biotechnology. New Age International.
6. Sambrook J. and Russell D. 2001. Molecular Cloning: A Laboratory Manual, 3<sup>rd</sup> edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
7. Sambrook J, Fritsch E.F, and Maniatis T. 1989 Molecular Cloning: A Laboratory Manual, 2<sup>nd</sup> edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York

# **SEMESTER-III**

**BC3MOO3PC9 Core Course – 9  
ENZYMOLGY**

**Number of Hours/ Week : 4**

**Credits:4**

**UNIT I:**

**Introduction to enzymes:** Holoenzyme, apoenzyme, and prosthetic group; Interaction between enzyme and substrate- lock and key model, induced fit model, Features of active site, activation energy, Rate Enhancement through Transition State Stabilization, Chemical Mechanisms for Transition State Stabilization, The Serine Proteases: An Illustrative Example; Enzyme specificity and types; Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes, Abzymes. Coenzymes and their functions- NAD, NADP+, FAD, FMN, lipoic acid, TPP, Pyridoxal phosphate, biotin and cyanocobalamin.

Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katal, enzyme turnover number and specific activity, Isolation of enzymes and the criteria of purity; Characterization of enzymes.

**UNIT II:**

Enzyme kinetics: Importance, order of reaction, study of the factors affecting the velocity of enzyme catalyzed reaction-enzyme concentration, temperature,pH, substrate concentration, inhibitors and activators (explanation with graphical representation). Derivation of MichaelisMenten equation and  $K_m$  value determination and its significance, Definition of  $V_{max}$  value of enzyme and its significance, Lineweaver-Burk plot; Bi- substrate reactions : Classification, Reaction mechanisms; Using the king Altman Method to Determine Velocity Equations; Allosteric enzymes: Examples of

Cooperativity and Allostery in Proteins, Models of Allosteric Behavior, Effects of Cooperativity on Velocity Curves, Sigmoidal Kinetics for Nonallosteric Enzymes.

### **UNIT III:**

**Enzyme inhibition:** Reversible and irreversible-examples. Reversible-competitive, non-competitive and uncompetitive inhibition; Graphic determination of inhibitor type, Dose- response curves of Enzyme inhibition. Mutually Exclusive Binding of Two inhibitors; Structure-Activity Relationships and Inhibitor Design; Tight Binding Inhibitors: Identifying Tight Binding Inhibition, examples; Time-Dependent Inhibition: examples; Distinguishing between modes of inhibitor interaction with enzyme.

### **UNIT IV:**

**Regulation of Enzyme activity:** Covalently modulated enzymes with examples of adenylation and phosphorylation; Zymogen form of enzyme and zymogen activation; Multienzyme complexes and their role in regulation of metabolic pathways; Allosteric regulation: example of Aspartate transcarbamoylase, Isoenzymes- Lactate dehydrogenase and creatine phosphokinase.

### **UNIT V:**

**Application of enzymes:** Industrial uses of enzymes: production of glucose from starch, cellulose and dextrans, use of lactase in dairy industry, production of glucose fructose syrup from sucrose, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes; Enzyme engineering

**REFERENCES**

1. Fundamentals of Enzymology: The cell and molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis stevens (2000) Publisher: Oxford University Press, USA ISBN: 019850229x ISBN-13: 9780198502296, 978-0198502296
2. Enzyme Kinetics: A modern Approach Book: Enzyme Kinetics: A Modern Approach by Alejandro G. Marangoni (2003) Publisher: Wiley-interscience ISBN: 0471159859 ISBN\_13:9780471159858, 978-0471159858
3. Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISBN 8184890478 ISBN-13: 9788184890471, 978-8184890471
4. Enzyme Mechanism by P.K Sivaraj Kumar (2007) Publisher: RBSA Publishers ISBN: 8176114235 ISBN -13:9788176114233, 978-8176114233
5. Enzymes and Enzyme Technology by kumar (2009) Anshan Pub ISBN: 1905740875,ISBN-13:9781905740871, 978-1905740871
6. Enzymes in Industry: Production And Applications by Aehle W (2007) Publisher: John Wiley & Sons Inc ISBN: 3527316892 ISBN -13: 9783527316892, 9783527316892, 9783527316892 Enzymes: Biotechnology, Clinical Chemistry (second Edition)by Trevor Palmer, Philip Bonner (2007) Publisher: Horwood Publishing Limited ISBN: 1904275273 ISBN-13: 978-1904275275

**BC3 M003 PC10-CORE COURSE 10****PLANT BIOCHEMISTRY**

Number of Hours/week: 4

Credits:4

**Unit I**

**Photosynthesis:** Ultra Structure and organization of chloroplast membranes, lipid composition of chloroplast membranes, electron transport chain. Thylakoid membrane protein complexes Calvin cycle: Biochemistry of RuBp Carboxylase or oxygenase, activation of Rubisco, Hatch and slack pathway, CAM plants; productivity of C<sub>4</sub> plants, Photorespiration and compensation point, photosynthetic efficiency and plant productivity,

**Unit II**

**Nitrogen Metabolism:** Nitrogen fixation, nitrogenase complex, electron transport chain and mechanism of action of nitrogenase. Structure of 'NIF' genes and its regulation, Hydrogen uptake and bacterial hydrogenases, Nitrate Metabolism: Enzymes of nitrate metabolism, regulation of their synthesis and activity. Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and GDH, Water and mineral balance in plants.

**Unit III**

**Plant growth regulators:** Auxins; gibberellins, cytokines, abscisic acid and ethylene - biosynthesis and their metabolic functions, synthetic growth hormones, inhibitors. Stress response in Plants.

**Unit IV**

**Major chemical classes of secondary metabolites:** A brief account of the following classes: Alkaloids, terpenoids, flavonoids, Phenolics and phenolic

acids,steroids, coumarins, quinines, acetylenes, cyanogenic glycosides, amines and nonprotein amino acids,gums, mucilages, resins etc. (Structures not necessary. Give examples of the compounds and the plants in which present and their importance). Importance of secondary metabolites: Protection of the producer plant from predators and insects; importance to man as active principles exerting physiological effects to mammalian systems. Uses of secondary metabolites to man: as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.

### **Unit V**

General biosynthetic pathways of the following classes of secondary metabolites (structures of intermediates not necessary): **Terpenoids:** Isoprene as Precursor, hemi , mono, sesqui, di, triterpenes and polyterpenes with examples and important members; their functions. **Phenols:** simple phenols, phenol carboxylic acids, phenylpropanes, flavan derivatives, and phenolic glycosides. Broad outline of their biosynthesis and functions in plants and uses Alkaloids, definition of true and pseudo alkaloids, Phenyl ethylamines, pyrrolidone alkaloids, Piperidine alkaloids, Pyridine alkaloids ,tropane alkaloids, quinoline and isoquinoline alkaloids,Indole alkaloids, purine alkaloids, isoprenoidal alkaloids, Steroidal alkaloids.



**REFERENCES**

1. Plant Metabolism by H.D Kumar and H.N Singh (1980) Publisher. Macmillan (Mar 1980) ISBN-10: 0333256387: ISBN-13:978-0333256381.
2. Biotechnology: Secondary Metabolites by K.G Ramawat, (2000) Publisher: Science Publishers, U.S. ISBN-10: 1578080576 ISBN-13: 978-1578080571
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749
4. Plant Metabolism by Prof David T. Dennis, Prof David H. Turpin, Dr Daniel D. Lefebvre and Dr David B. Layzell(Editors) (1997) publisher: Longman; ISBN-10: 0582259061, ISBN-13:978-582259065
5. Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004)publisher: Academic ISBN-10: 0120883910 ISBN- 13: 978-0120883912
6. The Principals of Plant Biochemistry by Muriel Wheldale Onslow (1931) Publisher: Cambridge University Press ASIN: BOO2BJMXIM

**BC3 MOO3 PC 11-CORE COURSE-II**  
**MOLECULAR ENDOCRINOLOGY**

Hours/Week-4

Credits-4

**UNIT I**

**Introduction**, History of Endocrinology, Classification of hormones, Overview of circulation, modification and degradation. Target tissue, feed back control. Hormone receptors- general features, structure and regulation. Mechanism of hormone action. Signal transduction. Plasma membrane receptors, adenylate kinase, Role of G Proteins, protein kinases, tyrosine kinases, inositol phosphates, calcium and calmodulin. Steroid hormone receptors.

**UNIT II**

**Hypothalamus and Pituitary hormones**- Biochemistry and mechanism of action. Regulation of synthesis and secretion. Hypo and hyper activity of pituitary hormones- gigantism, dwarfism, acromegaly, diabetes insipidus, syndrome of inappropriate ADH secretion.

**UNIT III**

**Thyroid hormones**- synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Antithyroid agents. Thyroid diseases, thyrotoxicosis, goiter, hypothyroidism, Graves' disease, Hashimoto's disease. Thyroid function tests.

**Parathyroid Hormone and Calcitonin**- Biological actions, regulation of calcium and phosphorus metabolism. Calcitriol. Pathophysiology.

**UNIT IV**

**Adrenal hormones**- Adrenal cortex- glucocorticoids and mineralocorticoids- synthesis, secretion, transport and mechanism of action. Metabolic fate and

biological actions. Adrenal androgens- metabolic effect and functions. Adrenal medulla- catecholamines- synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Abnormal secretion of adrenal hormones- Addison's disease, Cushing's syndrome, Congenital adrenal hyperplasia, pheochromocytoma.

**Gonadal hormones-** Androgens and estrogens- synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Ovarian cycle, Pregnancy, Biochemical changes in pregnancy.

## **UNIT V**

**Pancreatic hormones-** Islets of Langerhans and Hormone secretion. Biosynthesis, secretion and mechanism of action. Biological actions. Receptors, intracellular mediators and signaling pathways of insulin and glucagon. Somatostatin, Pancreatic polypeptide and insulin like growth factors.

**Gastrointestinal hormones-** producing cells, synthesis, structure, secretion and functions, GIP, VIP, gastrin, CCK and other peptides.

**Hormones secreted from other organs and tissues** like, liver, kidney, heart, thymus and pineal gland

## **REFERENCES**

1. Williams Textbook of Endocrinology Larsen et al
2. Mechanisms of enzyme action Autin and short
3. Harpers Biochemistry- Murray et al
4. Principles of Biochemistry- Nelson Cox
5. Principles of Biochemistry- Donald J Voet and Judith Voet
6. Endocrinology- Mac Hadley

**BC3 MOO3 PC12-Core Course12**  
**NEUROBIOLOGY**

**Number of Hours / Week:3**

**Credits: 3**

**Unit I-Neuron**

Neurocellular anatomy, neural membrane, classification of neuron, nerve fibers, axonal transport, neural growth, neuroglia, nervous system, blood brain barrier, cerebrospinal fluid

**Unit II – Neuronal signaling**

Membrane potentials, ion channels, recording neuronal signals, ionic basis of resting potential and action potential, propagation of action potential

**Unit III- Synaptic transmission**

Synapse, Electrical synapse transmission, chemical synaptic transmission, Synaptic transmitter release, synaptic potentials, synaptic delay, synaptic plasticity, molecular mechanism of synaptic transmission, myoneural junction

**Unit IV- Neurotransmitters**

Chemistry, synthesis, storage, release, receptors and function- acetyl choline, catecholamines, serotonin, histamine, glutamate, aspartate, GABA, glycine, neuropeptides, nitric oxide

**Unit 5- Neural processing and neurodegenerative disorders**

Learning and memory, neurochemical basis of drug abuse, neurodegenerative disorders, Parkinson's disorder, Alzheimer's disorder, Amyotrophic Lateral Sclerosis, Senile Dementia.

**REFERENCES**

1. Basic Neurochemistry. Molecular, Cellular and Medical aspects- George J. Siegel, Bernard W. Agranoff, R. Wayne Albers, Stephen K. Fisher & Michael D. Uhler.
2. From Neuron to Brain- John G. Nicholls, A. Robert Martin, Bruce G. Wallace & Paul A. Fuchs.
3. Ion channels. Molecules in Action- David J. Aidley & Peter R. Stanfield
4. Neurobiology Molecules, Cells and System- Gary G. Matthews
5. The Neurobiology of Memory, Concepts, Findings, Trends- Yadin Dudai
6. The physiology of Excitable Cells- David J. Aidley

**BC3 MOO3 PP3- PRACTICAL  
LABORATORY COURSE III**

**Hours/ Week-10**

**Credis-4**

**1. Estimation of proteins from plant or animal sources.**

Total protein by biuret method, Lowry method

Albumin by Bradford method, BCG method

Total liver protein by Lowry and Biuret method

**2. Estimation of carbohydrates from plant or animal sources**

Glucose, lactose, glycogen by OT method, Folin-wu method, anthrone method, phenol sulphuric acid method

**3. Estimation of lipids from plant or animal sources.**

Cholesterol by Zaks method,

Triglycerides by Van Handel and Zilversmit method

Phospholipids by Zilversmit and Davis

**4. Determination of enzymatic activity in biological tissues- serum, plasma, liver, plant extracts, etc(Any five)**

Alanine transaminase (GPT)

Aspartate transaminase(GOT)

Lactate dehydrogenase

hexosaminidase

Amylase

Trypsin

Urease

**5. Enzyme kinetics (Any four)**

Effect of substrate concentration on enzymatic activity

Effect of pH on enzymatic activity

Effect of enzyme concentration on enzymatic activity

Effect of temperature on velocity of enzyme catalysed reaction

Determination of Q 10

Effect of activators on velocity of enzyme catalysed reaction

Determination of type of inhibition using line weaver Burk plot-

## **6. Extraction of enzymes and assay**

1 Acid phosphatase from fresh potato.

( Solonumtuberosum)

2 amylase from sweet potato.

( Ipomoeabatates)

3 Urease from Jackbean

( Canavalia ensiformis)

4 Phytase from seeds.

## **7. Extraction, Isolation and analysis of phytopharmaceuticals;**

1. Different extraction protocols:-

Infusion ,Decoction, Maceration, Soxhlet- extraction.

2. Extraction of High molecular weight carbohydrates

3. Extraction of total alkaloids

4. Estimation of total phenols.

5. Estimation of Flavanols.

## **8. Extraction and assay of Enzymes**

1. polyphenol oxidase

2. Peroxidase

3. Phenyl alanine ammonia lyase

## **REFERENCES**

1. Introductory practical Biochemistry SK Sawhnefy and Randhir Singh (eds)

Narosa publishing House, New Delhi, ISBN 81-7319-302-9 P, 195-303

2. Standard Methods of Biochemical Analysis, S.K. Thimmaiah (ed), Kalayani

Publishers, Ludhiana ISBN 81-7663-067-5, p 12-18.

3. Hawk's physiological Chemistry, Bernad L. Osker (ed) TATA MC GRAW Hill publishing Company Ltd, New Delhi.
4. Experimental Biochemistry: A student Companion Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt Ltd, New Delhi ISBN 81-88237-41-8.
5. Practical Biochemistry, R.C Gupta and S. Bharghava (eds) CBS Publishers and Distributors, New Delhi, ISBN/81-239-0124-0
6. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi.
7. Enzymes Assays, Jeans-Louis Reymond (ed) Wiley- Vch Publishers, Germany, ISBN-13; 978-3-527-31095-1 ISBN-10: 978-3-527-31095-9
8. Practical Enzymology, H. Bisswanger (ed) ISBN:3-527-30444-4
9. Medical Biochemistry- Principles and Experiments, John F Van Pilsum and Robert J Roon(eds) University of Minnesota press, Minneapolis ISBN 0-8166-1344-3.
10. Biotechnology Procedures and Experiments handbook, S. Harisha (ed) Infinity science Press LLC, New Delhi ISBN: 978-1-934015-11-7.

# **SEMESTER IV**



**BC 4 MOO4 PEI-Elective**  
**CLINICAL BIOCHEMISTRY**

Hours/Week-5

Credit-4

**UNIT I**

**Automation in the clinical biochemistry:** Precision, reliability, reproducibility and other factors in quality control. Normal values in health and diseases, radio isotopes in diagnosis; Specimen collection and processing (blood, urine and faeces); Storage of specimens; Quality control; Pre-analytical, analytical post analytical variables in quality analysis.

**UNIT II**

**Kidney, liver and gastric function tests-**Renal function tests,osmolarity and free water clearances, acute and chronic renal failure,Liver function tests : clinical features and test based on excretory functions, metabolic capacity of liver, synthetic functions of liver, serum enzymes.Gastric function tests: collection of gastric contents, examination of gastric residium, FTM, stimulation tests, tubeless gastric analysis.

**UNIT III**

**Disorders of metabolism :** Carbohydrate metabolism: Diabetes mellitus, insulin receptors and C-peptide, assay of insulin, proinsulin and insulin antibodies. Hemoglobin A1C, fructosamines, insulin tolerance test, Glycogen storage diseases, galactosemia ,fructosuria, pentosuria; plasma lipids and lipoprotein abnormalities: hypercholesterolemia- lipidosis and hypolipoproteinemias, Tay Sachs and Niemann Picks diseases. Disorders of nucleic acid metabolism-hypo and hyperuricemia, gout; Disorders of erythrocyte metabolism- hemoglobinopathies, thalassemias and anemias

## **UNIT IV**

**Inherited disorders of metabolism:** Newborn screening: PKU, tyrosinemia, aminoacidurias, organic acidurias, porphyrias. Biochemical monitoring of therapy; prenatal diagnosis of inborn errors of metabolism, amniotic fluid and fetal blood examination; Acetylcholinesterase and other tests on amniotic fluid; chromosomal abnormalities by cytogenetics

## **UNIT V**

**Molecular diagnosis of genetic defects:** Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, Hemachromatosis, thalassemias, sickle cell diseases) DNA probes; restriction fragment length polymorphism (RFLP); polymerase chain reaction (PCR); amplification of mRNA. AIDS, Clinical diagnosis. Oncogenic enzymology: acid phosphatase, alkaline phosphatase, lactate dehydrogenase. Body fluid constituents of use in oncology

## **REFERENCES**

1. Notes on Clinical Biochemistry by John K. Candlish (1992) publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
2. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M. Ed. S.M (ed) Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
3. Biochemistry by John K. Joseph (2006) Publisher: Campus Books International ISBN: 8180301109 ISBN -13: 9788180301100, 978-8180301100
4. Basic Medical Biochemistry: A Clinical Approach by Dawn B PH.D. Marks, Allam D. Marks colleen M. Smith (1996) Publisher; Lippincott

Williams & Wilkins; illustrated edition ISBN -10: 068305595X ISBN-13:  
978-0683055955

5. Clinical Chemistry, 6/e 1e by William J Marshall, Stephen K Bangert(2008) Publisher: Else ISBN: 0723434603, ISBN-13:978-0723434603
6. Tictz fundamental of clinical Chemistry, 6/e by Carl A Burits, Edward R Ashwood (2008) publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742,978-8131213742

**BC4MOO4PE2-Elective****ENVIRONMENTAL SCIENCES**

Hours/Week-5

Credits-4

**Unit 1: Basic Concepts Of Ecology and Environment**

Atmosphere; Hydrosphere; Lithosphere- Principles and Concepts of ecosystem- Structure of ecosystem- cybernetics and Homeostasis- Energy transfer in an ecosystem-Food chain. Food web-Ecological efficiencies- Trophic structure and energy pyramids- Principles Pertaining to limiting factors; Biogeochemical cycles(N, C, P cycles)

Biodiversity: Types of diversity; Genetic diversity,Species diversity and Ecosystem diversity-Morphological and molecular characterization of biodiversity-Molecular taxonomy –Methods of biodiversity conservation- Gene banks; Cryopreservation- Assessing, analyzing and documenting biodiversity – Vulnerability and extinction of biodiversity- Introduction to biodiversity database: endangered animals, endemism and Red data books- Global biodiversity information system.

**UNIT II: Chemistry of Environment**

Properties of water- water quality parameters- pH, Dissolved Oxygen (DO),Chemical Oxygen demand (COD); Biological Oxygen demand(BOD); Atmospheric toxicants- CO, NO<sub>2</sub>, CO<sub>2</sub>, SO<sub>2</sub>-; Toxic heavy metals- Radionuclides -Sampling of air and water pollutants- Monitoring techniques and methodology; Chemistry of soil: Formation; Constituents and properties of soils; Composition and type of soil;

Chemical factors affecting the soil quality; Adsorption of contaminants in soil.

Organic chemicals in the environment; Aliphatic/aromatic hydrocarbons (hydrocarbon decay, environmental effects); Soaps and surfactants (cationic, anionic and nonionic detergents, modified detergents); Pesticide residue – classification, degradation, analysis, pollution due to pesticides; phenols and petrochemicals

### **UNIT III: Treatment Technologies for Polluted Environment**

Biosensors- types and applications in environmental pollution detection and monitoring, Traditional Biological treatment: stabilization pond, aerated lagoon, activated sludge process trickling filter anaerobic treatment

Environment-friendly use of microbes (bacteria and fungi) in biodegradation and Biotransformation: Bioremediation *In situ* and *Ex situ* bioremediation; Constrains and priorities of bioremediation; Evaluating Bioremediation; Bioremediation of VOCs; Biodegradation- Factors affecting process of biodegradation; Methods in determining biodegradability. Microbial transformation; Accumulation and concentration of metals; Biosorption- Oil field microbiology; Improved oil recovery; Biotechnology and oil spills- Use of plants in biodegradation and environment cleaning- phytoremediation. Xenobiotics; Persistence and biomagnifications of Xenobiotic molecules; Microbial interactions with xenobiotics; Phase I and Phase II reactions; Cyt P<sub>450</sub> mediated reactions- Terratogens and Carcinogens: Assesment of toxicity; Assessment of environmental risks.

## **UNIT IV : Technology for Sustainable Agriculture**

**Biodegradation of agricultural chemicals; GM Crops and their impact on environment;** Biological nitrogen fixation; Phosphate solubilization; Biofertilizers; Biological control of insect pests; Role of biopesticides/ insecticides; Biocontrol of plant pathogens; Integrated pest management-practical implementation

## **Unit V: Technology for Resource Management and Environment Policies**

Role of biotechnology in management of resources- Reclamation of wasteland: Biomass production: Biogas and biofuel production ; Development of environment-friendly processes such as integrated waste management

Nature of Environmental Policies; International Agreements and Treaties:Stockholm Conference (1972); Rio Conference (UNCED) (1992); Merits of the Conference (Agenda 21): Failures of the Conference Johnesburg treaty; GAAT and Environment; CITES; Montreal protocol National Policy on Environment, Constitutional provisions for Environmental Protection, National Environmental Legislation related to water, air, mining. National Legislation on Forest, Wildlife

### **Reference:**

1. Fundamentals of Ecology- E.P Odum
2. Applied and Environmental microbiology- Amann, R.I. Stromely .J. Stahl
3. Environmental chemistry, B.K.Sharma
4. Chemicals in the environment, Y. Mido& M. Satake

5. Text book of Environmental Chemistry-O.D. Tyagi and M.Mehra.
6. Biotechnology: A textbook of Industrial Microbiology, Crueger and Crueger
7. Environmental, Biotechnology: Principals and Applications, 2<sup>nd</sup> Edition –Brace Rittman, Perry L. Mc Carty.
8. Biodegration and Bioremediation, 2<sup>nd</sup> Edition –Martin Alexander.
9. An Introduction to Environmental Biotechnology-Milton Wainwright.
10. Physiology and Biochemistry of metal Toxicity and tolerance in plants-M.N.V. Prasad Kazimierz strzalka,
11. Environmental Laws in India-Pares Distn.

**BC4MOO4-ELECTIVE****NUTRITION HEALTH AND LIFE STYLE DISEASES**

Hours/Week-5

Credit-4

**Unit-I**

An overview of nutrition, food choices, the nutrients, Nutrition assessment, diet and health, planning a healthy diet, digestion absorption and transport of food, regulation of digestion and absorption The carbohydrates, sugars, Starch and fibers, Glucose in the body, Health effects and recommended intakes of sugars, starch and fibers. Alternatives to sugar, lipids in the body, Recommended intake of lipids. Alternative to fat. Proteins-energy malnutrition, Health effects of protein, Vegetarian diets

**Unit II**

Energy balance and body composition, The Kcalories of foods provide, body weight, body composition and health, weight, management, overweight-and underweight, Causes of obesity, Treatments of obesity.

An overview of Vitamins, water and major minerals, Trace minerals Antioxidant nutrients and phytochemicals in disease prevention. Calcium roles in the body, calcium deficiency. Iron deficiency, Iron toxicity, Osteoporosis and calcium, Zinc deficiency, zinc toxicity, Functional foods.

**Unit-III**

Life Cycle nutrition, pregnancy and lactation, Nutrition during pregnancy and lactation. Maternal health, Practices incompatible with pregnancy, Fetal alcohol syndrome, Nutrition in infancy, childhood Nutrition and adolescence The early development of chronic diseases, Nutrition in adulthood and later years. Illness and nutrition status, Nutrition Medications and complementary therapies Nutrition intervention



## **Unit-IV**

Nutrition and disorders of the gastro intestinal tract, parenteral nutrition . Nutrition in Severe stress, Nutrition and diabetes mellitus, Complication of diabetes mellitus, Treatment of diabetes, Medical Nutrition therapy for diabetes, Mastering diabetes control. Nutrition and disorders of the heart blood vessels and lungs. Atherosclerosis, hypertension, prevention and treatment of heart disease, Diet strategies, Drug therapy, Acute respiratory failure, The metabolic syndrome.

## **Unit V**

Nutrition and Renal disease, kidney stones and treatment, the nephrotic syndrome, Renal failure, kidney transplants and diet, Dialysis and Nutrition, Nutrition and liver disorders, Fatty liver and hepatitis, Cirrhosis, Gall stones, Nutrition, cancer and HIV infection , How cancer develops, Consequence of cancer, Treatment for cancer, Medical Nutrition therapy. How HIV develops, Consequences of HIV infection. Medical Nutrition Therapy. Ethical issues in Nutrition care

## **REFERENCES**

1. Understanding normal and Clinical nutrition, Whitney, Cataldo of holfes Sixth edition
2. Nutritional Biochemistry- Tom Brody.
3. A text Book of Medical Biochemistry- M.N Chatterje and R. Shindea, Jaypeepub.
4. Harpers Illustrated Biochemistry- R.K murray, D.kGarnnes. And V.V Rodwell, McGraw Hill.
5. Medical Physiology- A.C. Guyton and J.E Hall, Saunders pub.
6. Human Physiology. C.C. Chatterjee, medical and Allied Agency
7. Nutritional Biochemistry- Swaminathan
8. Life span nutrition- Conception through life- S.R Rolfes, LK De Bruyne and E.N Whitney.
9. Normal and Therapeutic nutrition CH Robinson and MR Lawler.

**BC4 MOO4 PP4- Practical 4**  
**LABORATORY COURSE IV**

**Hours/ Week – 10**

**Credits-4**

**Clinical Biochemistry Experiments**

**1. Liver function tests**

Estimation of total proteins in serum

Estimation of serum albumin by BCG method

Estimation of albumin – globulin ratio in Serum

Estimation of serum bilirubin

Assay of SGOT& SGPT-DNPH method

Assay of alkaline phosphatase-King &Amstrong method

**2. Renal Function tests**

Estimation of blood urea by diacetyl monoxime method

Urea clearance test

Estimation of creatinine by Jaff ‘s method

Creatinine clearance test

Estimation of uric acid-caraway method

Estimation of plasma bicarbonate

**3. Glucose tolerance test**

**4. Fructose tolerance test**

**5. Analysis of normal and abnormal urine.**

**6. Check the reliability of various methods using Levy Jenning plot**

**REFERENCES**

1. Introductory Practical biochemistry, S.K sawhney&Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195-303
2. Standard Methods of Biochemical Analysis, S.K Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5, p12-18
3. Experimental Biochemistry: A Student companion, BeeduSasidharRao& Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13-17, p 49-72
4. Practical Biochemistry, R.C Gupta &Bhargava (eds) CBS Publishers and distributors, New Delhi, ISBN 81-239-0124-0 p 9-27
5. Practical Clinical Chemistry, Harold Varley, CBS Publishers and distributors, New Delhi.
6. Gradwhols Clinical Laboratory Techniques. Stanley & Raphael. W.E. company, London, UK

**BC4MOO4PE4-ELECTIVE. (1)****RESEARCH METHODOLOGY IPR AND BIOETHICS**

Hours/ week -5

Credits – 4

**Unit-I** : **Science and Research** – definition history- evolution of Scientific Inquiry Verification Versus falsification- objectivity Facts, Theory and concepts- epistemology

**Goals of Research** – Characteristics and purpose of research, essential qualities of a researcher- Scientific temperament and attitude

**Methods of research-** Scientific method versus arbitrary method, requisites for Scientific methods – Logical Scientific methods, patterns of defective inductive logical process, Different type of inductive logical deductive methods- methods of casual connections, method of difference- method of concomitant Variation- Methods of residues- method of agreement- and difference, other logical methods of description and classification- evolutionary methods.

**Unit-II**

Various types of research:- descriptive analytical- fundamental-applied, qualitative quantitative – Conceptual empirical- surveys- longitudinal- cross Sectional Correlation- experimental, quasi experimental, Ex Post facto research- Critical and action oriented research – biographical, phenomenological ethnographical, case studies.

**Data and Method of data Collection:-**

Observations – field investigations- direct studies- reports, records or experimental observations, type of data, categorical, nominal or ordinal, Continuous or mixed, primary data, secondary data-limitations and precautions in data collections.

**Steps in doing research**-Review of literature, primary and secondary sources, National institutions useful in search of literature –NISCAIR- Library

resources – Journals/periodicals-reviews- abstracts treatise –monographs – searching of web resources- electronic databases-critical review of literature – identification of research gaps-Defining or selection or identification of a research topic or problem-formulation of a hypothesis, significance of hypothesis ,types of hypothesis relevance and assumptions in research, developing of a research plan-execution of research work-exploration-description-diagnosis experimentation-meaning and nature of experimental research, treatments-variation and variables-Simple populations. General laboratory etiquette –rules and regulations, safety measures.

### **Unit –III**

**Scientific writing and presentation of scientific data.** Research proposals, Research reports, Dissertation or thesis, style of scientific writing, structure and language, Title rules ,preparation of Abstracts-Introduction rules, rules for presenting materials and methods-rules for presenting results –concept of discussion-method of conclusion concept of acknowledgement . Reference styles-presentation of tables and figures. Matrix of rows and columns representing variables, figures-visual organization of data/observations-pictures, pie charts, bar charts, flow charts, organizational charts, cartogram charts, Gantt charts, scatter plot charts, symbols and legends, photographs and micrographs-peer review-editing the final drafts ,manuscript submission. Presentation tool, features and functions ,creating presentation, customizing presentation, showing presentation, oral and poster presentation Microsoft power point and pdf slides, open office or similar tool.

### **Unit IV**

**Intellectual Property Rights (IPR)** objectives of the patent system, basic principles and general requirements of patent law, legal, development,

patentable subjects and protection in biotechnology, international convention for the protection of new varieties Strasbourg convention, UPOV Convention.

The patentability of micro organisms-claims, Characterization and repeatability disposition in the culture collections, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology, patentability of inanimate products of nature vectors, FDA, FPA, Patent office practice, trade secrets, copy right infringement problems, harmonization of patent law.IPR and plant genetic resources

## **Unit V**

**Bioethics-Bioethical issues-** bio-safety environmental impacts, ecological ethics, rights of future generations-issues of commercialization-intellectual property rights- problems related to trade of biological items-ethics in publications-plagiarism

## **REFERENCES**

1. Panneerselvam R (2004) Research Methodology, Prentice Hall of India, New Delhi.
2. Jerrord HZ (1999) Biostatistical analysis, Prentice Hall International, London
3. ImreLakatos (1970) Falsification and the Methodology of Scientific Research Programme. In ImreLakatos and Alan Musgrave (eds), Criticism and the Growth of Knowledge, Cambridge University Press
4. Wayne C booth, Gregory G Colomb, and Joseph M Williams (1995). The Craft of Research , Chicago University of Chicago Press.
5. Dina A. Zinnes (1980) Three Puzzles in Search of a Researcher, International Studies Quarterly, vol. 24 (September), pp 315-342

6. Catherine Marshall and Gretchen B. Rossman (1989). *Designing Qualitative Research* Newbury Park, London and New Delhi: Sage Publications
7. Montgomery, Douglas C. (2007), *Design and Analysis of Experiments*, Wiley India.
8. Carlos CM (2000). *Intellectual Property Rights, the WTO and Developing countries; The TRIPS agreement and policy options*, Zed Books, New York
9. Day RA (1992) *How to write and publish a scientific paper*, Cambridge University Press, London
10. Golafshani N (December 2003) Understanding reliability and validity in qualitative research. *The Qualitative Report*, 8(4) 597-607.
11. Leedy PD and Ormrod JE (2004) *Practical Research: Planning and design*, Prentice Hall India, New Delhi
12. Anthony M, Graziano AM and Raulin ML (2009) *Research Methods: A process of Inquiry*, Allyn and Bacon
13. Bordens K and Abbott B (2005) *Research designs and methods: A process approaches (6<sup>th</sup>Ed)*. Columbus, OH: McGraw-Hill Higher Education. ISBN: 978-0-0728-8764-8

**BC4 MOO4 PE5- ELECTIVE**  
**PLANT AND ANIMAL CELL CULTURE**

Hours/Week-5

Credits-4

**Unit I**

Animal Cell Culture : Historical Background, Importance and progress in Animal Cell Culture Technology, Biology of Animal Cell; Cellular interactions, Laboratory setup and equipments, aseptic technique, different cell culture media and supplements, Importance of Serum and Serum Free Media, preparation and sterilization of cell culture media and supplements

Conventional plant breeding, tissue culture as a technique to produce novel plants and hybrids, tissue culture media (composition and preparation), Sterilization and agents of sterilization, initiation and maintenance of callus and suspension cultures, single cell clones . organogenesis, somatic embryogenesis. Transfer and establishment of whole plants in soil. Shoot tip culture, rapid clonal propagation and production of virus free plants, embryo culture and embryo rescue.

**Unit II**

Different tissue culture techniques; Disaggregation of tissue and primary culture; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation ; Continuous cell lines; Passaging number; Anchorage and Anchorage independent cells and cultures; Suspension culture; Organ culture and Histotypic cultures: tissue specific stem cells; embryonic hematopoietic and neural stem cells, classification and sources.

Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids, anther, pollen and ovary culture for production of haploid plants and homozygous lines. Somaclonal variation. In vitro mutation-sexual incompatibility



and male sterility; Cryopreservation; Slow growth cultures and DNA banking for germplasm conservation.

### **Unit III**

Division, growth forms, measurement of viability and cytotoxicity; characterization of cultured cell; cell cloning and selection; Cell synchronization; Transfection and transformation of cell; Maintenance of cell lines; cryopreservation and germplasm storage; Common cell culture contaminants. Plant transformation technology- Basis of tumor formation; Hairy root; Features of Ti and Ri plasmids; Mechanism of DNA transfer; Role of virulence genes; Use of Ti and Ri as Vectors; Binary vectors; use of scaffold attachment regions; Methods of nuclear transformation; viral vectors and their applications; multiple gene transfer; vector less or direct DNA transfer Particle bombardment, electroporation, micro injection; Transformation of monocots; Transgene stability and gene silencing.

### **Unit IV**

Commercial scale production of animal cells, stem cells & their application; Over view of embryonic and adult stem cells for therapy; Neuro degenerative disease; Parkinsons, Alzheimer, Spinal cord injuries and other brain syndromes; Tissue system failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure, Cancer, Hemophilia, Application of animal cell culture for invitro testing of drugs and testing of toxicity of environmental pollutants; Application of cell culture technology in production of human and animal vaccines and pharmaceutical proteins; Hybridoma technology and its application; three dimensional culture and tissue engineering.

### **Unit V**

Cell culture reactors; Scale up in suspension; Mixing and aeration; Roating chambers; perfused suspension cultures; Fluidized bed reactors for suspension culture; scale up in monolayers; Multi surface propagators; Multiarray disks, spirals and tubes; Roller culture; Micro carries; Perfuse monolayer cultures;

Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Immobilized cell culture.

## REFERENCES

1. Freshney, culture of Animal cell, 5<sup>th</sup> edition
2. Ed. John R.W Masters Animal cell culture-Practical approach 3<sup>rd</sup> edition, Oxford university press-2000
3. In vitro cultivation of Animal cells. Elsevier India PVT LTD-17-A/1 Main Ring Road, New Delhi-110024
4. R. Sasidhara, Animal Biotechnology MJP publishers-Chennai.
5. Plant biotechnology-J Hammond, et.al; Springer Verlag.
6. Biotechnology in crop improvement –H S chawla.
7. Practical application of plant molecular biology-R J Henry, Chapman&Hall.
8. Elements of biotechnology; P K Gupta
9. An introduction to plant tissue culture-M K Razdam.
10. Cell culture and somatic cell genetics of plants (Vols.1to3)-A K Vasil, A,Press.
11. Principles of plant biotechnology: An introuduction to genetic engineering in plants SH Mantell,etal
12. Advances in biochemical engineering/ Biotechnology-Anderson, et.al.
13. Plant cell and tissue culture-S Narayanswamy, Tata Mc

**BC4 MOO4PE6 – Elective**  
**BIOCHEMICAL TOXICOLOGY**

**Number of Hours / week: 5**

**Credit: 4**

**Unit I:**

Fundamentals of Toxicology and dose-Response Relationships: Introduction Biomarkers Criteria of Toxicity New Technologies Evaluation of Toxicity Interactions; Dose Response; Measurement of Dose-Response; Relationships Linear Dose Response Hormesis; Hazard and Risk Assessment Duration and Frequency of Exposure and Effect

**Unit II:**

Factors Affecting Toxic Responses: Disposition : Absorption ,Sites of absorption, distribution, Excretion; Metabolism: types of Metabolic change phase I reactions; Phase 2 reactions; control of Metabolism, Toxication vs. Detoxication

**Unit III:**

Toxicity testing; Test protocol, Genetic toxicity testing & Mutagenesis assay: *In vitro* test systems: bacterial mutation tests-Reversion test, Ames test, Fluctuation test, and Eukaryotic mutation test. *In vivo* test system Mammalian mutation test-Host mediated assay and Dominant Lethal test. Biochemical basis of toxicity: Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium homeostasis, Covalent binding to cellular macromolecules&genotoxicity, Tissue specific toxicity

**Unit IV:**

Toxic Responses to Foreign Compounds: Direct Toxic Action: Tissue Lesions; Mechanism and response in cellular toxicity, pharmacological, physiological and Biochemical effects; Developmental Toxicology-

Teratogenesis; Immunotoxicity Genetic Toxicity; Chemical Carcinogenesis

### **Unit V:**

Biochemical Mechanisms of Toxicity:Tissue Lesions: Liver Necrosis; kidney Damage; Lung Damage, Liver damage, Cardiac damage; Neurotoxicity; Exaggerated and Unwanted pharmacological effects; Physiological effects; Biochemical Effects: Lethal Synthesis and Incorporation, Interaction with specific Protein Receptors; Teratogenesis; Immunotoxicity; multi-Organ Toxicity

### **REFERENCE**

1. Principles Of Toxicology by: Karen E Stine, Thomas M Brown 2006 Publisher. Crc Press ISBN: 084932856X ISBN: -13: 9780849328565,978-0849328565
2. Principles of Biochemical Toxicology by John A. Timbrell Publisher: Informa Healthcare ISBN: 0849373026 ISBN-13: 9780849373022, 978-0849373022
3. Environmental Toxicology by Sigmund F. Zakrzewski, (2002) Publisher: Oxford University Press, USA ISBN: 0195148118 ISBN-13: 9780195148114, 9780195148114