



St Aloysius College (Autonomous)

Mangaluru

Re-accredited by NAAC with 'A' Grade with CGPA 3.62/4

Recognised by UGC as "College with Potential for Excellence"

Conferred "College with "STAR STATUS" by DBT, Government of India.

Centre for Research Capacity Building under UGC-STRIDE

Course structure and syllabus of

B.Sc.

BIOCHEMISTRY

CHOICE BASED CREDIT SYSTEM

(2019 – 20 ONWARDS)

ಸಂತ ಅಲೋಷಿಯಸ್ ಕಾಲೇಜು
(ಸ್ವಾಯತ್ತ)
ಮಂಗಳೂರು- 575 003



ST ALOYSIUS COLLEGE
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College with 'STAR STATUS' conferred by DBT, Government of India
3rd Rank in "Swacch Campus" Scheme, by MHRD, Govt of India

No: SAC 40/Syllabus 2019-20

Date: 18-07-2019

NOTIFICATION

Sub: Syllabus of **B.Sc. Biochemistry** under Choice Based Credit System.

Ref: 1. Decision of the Academic Council meeting held on 02-05-2019 vide
Agenda No: 28(2019-20)
2. Office Notification dated 18-07-2019

Pursuant to the above, the Syllabus of **B.Sc. Biochemistry** under Choice Based Credit System which was approved by the Academic Council at its meeting held on 02-05-2019 is hereby notified for implementation with effect from the academic year **2019-20**.


PRINCIPAL




REGISTRAR

To:

1. ~~The Chairman/Dean/HOD.~~
2. The Registrar Office
3. Library

G510.3

SEMESTER III ENZYMOLGY

Course Objectives

The objective of the course is to provide basic knowledge about enzymes and its role as biological catalysts. It is also aimed at understanding enzyme kinetics and regulation. The course also designed to outline the numerous applications of enzymes in industry for disease diagnosis, process development and therapy.

Course Outcomes

On successful completion of this course students will

- ✓ learn the types, nature and biological importance of enzymes in living systems
- ✓ gain insight into the classification, theories of enzyme specificity
- ✓ learn about the enzyme isolation, activity, units and catalysis
- ✓ It will throw lights on mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and importance of enzyme inhibitors
- ✓ learn to appreciate how enzymes are regulated and the physiological importance of enzyme regulation in the cell
- ✓ The course will introduce students to the applications of enzymes in research, medicine and industry.

UNIT I

1. INTRODUCTION

12 HOURS

History, general characteristics, nomenclature, IUB enzyme classification with suitable example, Definitions with example- Holoenzyme, apoenzyme, coenzyme, cofactors, Prosthetic groups, activators, inhibitors, metalloenzymes. Active site characteristics, Isoenzymes, monomeric enzymes, oligomeric enzymes, multienzyme complexes. **Enzyme specificity**, different types with suitable example, Theories of enzyme specificity- Lock and key model and Koshland's induced fit.

UNIT II

2. ENZYME ACTIVITY & PURIFICATION

12 HOURS

Enzyme activation-Zymogen activation, Eg Chymotrypsin, its physiological significance .Measurement & expression of enzyme activity- enzyme assays, **units of enzyme activity (unit & Katal), specific activity**, Methods of enzyme isolation, criteria, purification & characterization.(basis of selection of method for purification & principle). **Enzyme catalysis** -Mechanism of enzyme catalysis- acid-base catalysis, covalent catalysis. Role of cofactors in enzyme catalysis (Eg. NAD^+/NADH , pyridoxal phosphate), role of metal ions as cofactors.

UNIT III

3. ENZYME KINETICS

12 HOURS

Factors affecting rate of enzyme catalyzed reaction: substrate concentration, enzyme concentration, pH and temperature. Michaelis-Menten equation (derivation not required). Lineweaver - Burk plot, Significance of K_m & V_{max} . **Allosteric enzymes**-characteristic sigmoidal graph, effect of positive & negative modulators on sigmoidal kinetics of

allosteric enzymes. **Enzyme Inhibition** - Reversible and irreversible inhibition, Competitive, non-competitive and uncompetitive inhibition. Graphical representation by L-B plot, Application of competitive and irreversible inhibitors with suitable examples. Multienzymes, Isoenzymes, Allosteric enzymes. Enzyme regulations.

UNIT IV

4. ENZYME IMMOBILIZATION

12 HOURS

Different methods of immobilization. Industrial & clinical applications of enzyme - Application in dairy, food, leather & detergent industry, enzymes for glucose production from starch, cellulose. Application of enzymes in medicine, therapeutic enzymes, diagnostic enzymes.

REFERENCES:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13:978-1-4641-0962-1 / ISBN: 10:1-4641-0962-1.
2. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
3. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2
4. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN: 0 19 850229.
5. Enzymes (2007) 2nd ed., Trvor Plamer and Philip Boner., Horwood Publishing Ltd., Chichester, UK, United Kingdom ISBN: 1904275273.
6. Biochemistry (2013) 4th ed., U. Satyanarayana and U. Chakrapani , Elsevier.
7. Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN: 978-0-07-176-576-3.

PRACTICALS – G 510.3P (Bioquantitation & Enzyme assay)

ENZYME ASSAYS

1. Estimation of sugar by DNS method
2. Estimation of protein by Lowry's method
3. Estimation of proteins by Biuret method
4. Salivary amylase
 - a) Qualitative determination of salivary amylase enzyme activity.
 - b) Determination of Unit activity of salivary amylase by DNS method.
 - c) Determination of specific activity of salivary amylase
 - d) Determination of pH optimum of salivary amylase
 - e) Effect of enzyme concentration of salivary amylase

- f) Effect of time on salivary amylase activity
- g) Effect of substrate concentration on salivary amylase enzyme activity
- 5. Acid phosphatase
 - a) Determination of Unit activity of Acid phosphatase with PNPP as substrate.
 - b) Determination of specific activity of acid phosphatase.
 - c) Determination pH optimum of acid phosphatase.
- 6. Isolation and Estimation of Urease enzyme from Soya bean
- 7. Glucose Oxidase assay by microtiter plate
- 8. Assessment of purity of starch.

G. 510.3E

30 Hours (1credit)

STEM CELLS

Course Objective

The course is aimed to impart basic understanding of stem cells and its applications in the field of medicine.

Course Outcomes

- Students will acquire basic information about the stem cells and its types
- Gain knowledge of ethical concerns in stem cell research
- Comprehend the applications of stem cell in regenerative medicine

UNIT-I

15 hours

Definition of Stem cells and characteristics. General applications. Pluripotent, Multipotent and Totipotent Stem cells; Primordial Germ Cells, Embryonic Stem Cells; Amniotic Fluid Derived Stem Cells. Characterization of Human stem Cells; FACS, Maintenance of Human Embryonic Stem Cells. Genomic Reprogramming, Fate Mapping of Stem Cells.

UNIT-II

15 hours

Neural Stem Cells in Neurodegenerative Diseases; Hematopoietic Stem Cell in Transplantation; Epithelial Stem Cells and Burns; Stem Cells and Heart Disease; Pancreatic Stem Cells and Diabetes. Embryonic Stem Cells in Tissue Engineering, Cancer Stem Cells, Aging and stem cell renewal, Stem Cell Banking, Ethical Concerns in Stem Cell Research.

References:

1. Essentials of Stem Cell Biology (2013), 3rd ed., Edited by Robert Lanza and Anthony Atala. Academic Press, CA, USA, ISBN:9780124095038.
2. Stem Cell Biology (2001) - Edited by Daniel R Marshak, Richard L. Gardner and David Gottlieb. Cold Spring Harbor Press, NY, USA, ISBN:978-0879695750
3. Stem Cell Now (2006) 2nd ed., Christopher Thomas Scott, Pearson Education, NJ, USA. ISBN: 978-0452287853
4. Biotechnology (2011) 1sted.,USatyanarayana, Books& Allied (P) Ltd. ISBN:81-87134-90-9.
5. Stem cell Technologies: Basics and applications (2009) 1st ed.,Satish T and Kaushik D. D.,McGraW-Hill publishers, New Delhi ISBN:9780071635721.

6. The World of the Cell (2009), 7th ed., Becker W.M., Kleinsmith, L.J., Hardin., J., Bertoni, and G.P., Pearson Benjamin Cummings (CA), ISBN: 978-0-321-55418-5.
7. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN: 978-0-87893-300- 6.
8. Molecular Cell Biology (2013) 7th Ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M.,Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., Macmillan International Edition (NewYork), ISBN:13: 978-1-4641-0981-2.

G510.4

**SEMESTER IV
METABOLISM**

Course Objective

The objective of this course is to provide an understanding of metabolism of biomolecules like, carbohydrate, lipids, amino acids and nucleic acids, the enzymes involved in various metabolic pathways and regulation. The course also aims to outline the importance of such pathways in relation to metabolic defects.

Course Outcomes

The students will be able to:

- ✓ Understand the concepts of general metabolism, characteristics of each metabolic pathways and methods used to study these pathways.
- ✓ Gain holistic knowledge of various catabolic and anabolic pathways in the body
- ✓ Understand mechanism of the regulation of various pathways
- ✓ Able to obtain knowledge about the diseases caused by defects in metabolism.
- ✓ Understand different assays in the laboratory to obtain compressive knowledge on the metabolic pathways.

UNIT I

1. INTRODUCTION TO METABOLISM

12 HOURS

General features of metabolism, use of bacterial mutants & radioactive isotopes to study metabolism.

Carbohydrate metabolism: Glycolysis- reactions & energetics, Fates of pyruvate, alcoholic & lactic acid fermentation, Gluconeogenesis and its physiological significance. Importance of Cori's cycle, Reactions & energetic of TCA cycle. Glycogen metabolism – glycogenolysis & glycogenesis. Reactions of Pentose phosphate pathway & its physiological significance.

UNIT II

2. PHOTOSYNTHESIS

12 HOURS

Photosynthesis-Ultra structure of Chloroplast, photosynthetic pigments, photoreaction & calvin cycle in brief review, cytochrome, phytochrome & Bacterial photosynthesis.

Mitochondrial electron transport: Electron transport chain & oxidative phosphorylation-structure of mitochondria, sequence of electron carriers, flow chart of transport of electrons from reducing potential to O₂. inhibitors of ETC, oxidative phosphorylation, uncouplers of oxidative phosphorylation, ATP synthase- structure, Hypothesis of ATP synthesis – Binding change mechanism.

UNIT III

3. LIPID METABOLISM

12 HOURS

Hydrolysis of triacylglycerols, transport of fatty acids into mitochondria, Beta-oxidation of even numbered saturated fatty acids, Energetics of β -oxidation. Biosynthesis of even number saturated fatty acids (Scheme only). Significance & source of Ketone bodies and ketosis.

Outline of Cholesterol biosynthesis & regulation. Biosynthesis of phospholipids (scheme only).

UNIT IV

4. AMINOACID & NITROGEN METABOLISM

12 HOURS

General reactions of aminoacid metabolism- transamination, oxidative deamination & decarboxylation, Urea cycle, flow chart of degradation & biosynthesis of amino acids, gluogenic & ketogenic aminoacids.

Sources of the atoms in the purine & pyrimidine molecules, Schematic flow chart of purine & pyrimidine *denovo* synthesis, salvage pathway of purines, role of thymidylate synthase and its inhibitors in cancer therapy, end products of purine & pyrimidine catabolism, cause of gout.

References:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4641-0962-1. 2.
2. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Freeman and Company (New York), ISBN: 10:1-4292-2936-5, ISBN: 13:978-1-4292-2936-4.
3. Fundamentals of Biochemistry (2005) by J.L Jain, 6th Ed, S. Chand & Co Ltd.
4. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
5. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN: 13: 978-0470-23396-2.
6. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New Jersey), ISBN: 978-0-470-28173-4. 3.
7. Biochemistry (2013) 4th ed., U. Satyanarayana and U. Chakrapani, Elsevier.
8. Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN: 978-0-07-176-576-3.

G. 510.4E

30 Hours (1 credit)

MOLECULES OF LIFE

Course Objectives

The course aims to provide students with an understanding of four biomolecules, which are the basic building units of human body. It emphasizes on structure, types and biological importance molecules protein carbohydrate, lipids and nucleic acids.

Course Outcomes

On successful completion of the course students will be:

- Able to understand the structure and importance of biomolecules. .
- Aware of the significance individual biomolecules.
- Able to independently identify various biomolecules based on structures and associated disorders.

UNIT-I

15 hours

Carbohydrate: Introduction, Biological importance, classification. Monosacharides, Disaccharides and polysaccharides (Definition, sources and examples). Blood sugar and diabetes mellitus, obesity (causes, symptoms and treatment). **Amino acids:** Definition and nutritional classification. Amino acid metabolic disorders: Phenylketonuria and albinism. **Protein:** Definition, biological importance and nutritional classification. Peptide bond, biologically important peptides. Malnutrition: Kwashiorkor and Marasmus.

UNIT-II

15 hours

Lipids: Classification and properties. **Fatty acids:** Classification and properties of fatty acids (rancidity and Saponification). **Lipoproteins:** types and function. Serum lipid profile, Hypercholesterolemia and atherosclerosis. **Nucleic acids:** Introduction, nitrogenous bases - purines and pyrimidines, nucleosides, nucleotides, phosphodiester bonds. Types and functions of DNA and RNA. Biological importance of DNA and RNA. **Gout** (Causes, symptoms and treatment).

References:

1. Fundamentals of Biochemistry (2005) by J.L Jain, 6th Ed, S. Chand & Co Ltd. ISBN:81-219-2453-7.
2. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10:1-4292-3414-8.

3. Physical Biochemistry (2009) 2nd ed., Sheehan, D., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.
4. The Tools of Biochemistry (1977; Reprint 2011) Cooper, T.G., Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.
5. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN: 978-1180-25024.
6. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2
7. Biochemistry (2013) by U. Satyanarayana and U. Chakrapani, 4th edition, Elsevier.
8. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New Jersey), ISBN: 978-0-470-28173-4. 3.

PRACTICALS –G 510.4P (Estimation of metabolites)

1. Estimation of pyruvate
2. Estimation of lactate
3. Estimation of tryptophan
4. Estimation of phenolics
5. Estimation of amino acid (glycine) by formal titration
6. Estimation of amino acid by Ninhydrin method
7. Estimation of cholesterol by Zak's method
8. Estimation of glucose by Nelson Somogyi method / Folin Wu method
9. Estimation of nucleic acid
10. Isolation & Estimation of glycogen

MOLECULAR BIOLOGY

Course Objective

The objective of the course is to introduce to the students, the basic concepts of genome, DNA structure, genes, chromatin and chromosomes. It provides comprehensive understanding of DNA replication, recombination, mutations and repair processes in a way that students can apply this knowledge in understanding the life processes and develop an interest to pursue high quality research.

Course Outcomes

- ✓ Students will acquire basic information about the structure of DNA and various forms of DNA, about organization of genome in various life forms, supercoiling of DNA and its significance
- ✓ Students will learn about the molecular basis of processes like DNA replication, recombination and transposition and understand the significance of these processes
- ✓ acquire basic knowledge about the processes of transcription and translation in prokaryotes and eukaryotes
- ✓ learn about the features of the genetic code and various experimental approaches used to crack the code
- ✓ develop understanding of the molecular basis of RNA processing and RNA splicing
- ✓ learn about the various ways in which these biological processes are regulated and the significance of regulation in maintaining life forms
- ✓ Students will learn about the various ways in which the DNA can be damaged leading to mutations and lesions and different ways to repair DNA damage, DNA recombination.

UNIT I

1. DNA & RNA

10 HOURS

Nucleic Acids: Isolation of DNA from tissue sample. Chargaff's rule. Watson and Crick model of DNA, Circular DNA, hyperchromicity, T_m & Cot curve. RNA: Isolation of total cellular RNA. Composition & types of RNA mRNA, tRNA, and rRNA, Secondary structures of tRNA- clover leaf model, Ribozymes. **Chromosomes:** Circular & linear chromosomes, structure of eukaryotic chromosome and nucleosome.

UNIT II

2. CENTRAL DOGMA DNA REPLICATION

10 HOURS

Central dogma of molecular biology and its modification (reverse transcription). DNA as genetic material- Griffith, Avery–MacLeod–McCarty & Hershey Chase experiment. DNA replication: Meselson and Stahl experiment. Over view of DNA replication- Semi conservative mechanism, replication fork, Okazaki fragments. Mechanism of replication in prokaryotes and special features of eukaryotic replication. Transcription: Prokaryotic RNA synthesis: Role of RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis. Reverse transcription, outlines of mRNA splicing, characteristics of eukaryotic pre-mRNA (introns & exons) and mature mRNA - 5' cap, poly A tail.

UNIT III

3. GENETIC CODE & TRANSLATION 10 HOURS

General features of genetic code, Khorana's experiment and Wobble hypothesis. Ribosome structure, A- & P- sites, activation of amino acids, aminoacyl tRNA synthesis & its role in decreasing the translational errors. Translational initiation, elongation and termination in prokaryotes. Special features of eukaryotic translation & post translational modification in eukaryotes- glycosylation. Antibiotics as translation inhibitors (Eg: Tetracycline, puromycin & chloramphenicol)

UNIT IV

4. REGULATION OF GENE EXPRESSION & MUTATION 10 HOURS

Concept of Operon, Lac operon and catabolite repression. Molecular basis of mutation and types of mutations- Eg: Transition, Transversion, frame shift, insertion, deletion, germinal & somatic, dominant & recessive mutations, spontaneous & induced mutations. Mutagens - effect of HNO₂, Alkylating agents, interchelating agents and UV-radiation. DNA repair- UV repair systems in *E. coli*, Significance of thymine in DNA. DNA recombination mechanism: Mechanism in prokaryotes - Homologous and non homologous types (Holliday model). Mechanisms of Gene transfer in bacteria - conjugation, transformation and transduction.

References:

- 1 Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN: 0-321-50781 / ISBN: 978-0-321-50781-5.
- 2 Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
- 3 Principles of Genetics (2010) 5th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons Asia, ISBN: 978-0-470-39842-5.
- 4 Molecular Biology-Instant notes. P.C. Tumer, A.G. McLennan, A.D. Bates and M.R.H. White, 2001. Viva Books Pvt. Ltd., New Delhi.
- 5 Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4641-0962-1. 2.
- 6 Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Freeman and Company (New York), ISBN: 10:1-4292-2936-5, ISBN: 13:978-1-4292-2936-4.
- 7 Fundamentals of Biochemistry (2005) by J.L Jain, 6th Ed, S. Chand & Co Ltd.

- 8 The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.
- 9 Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.
- 10 The World of the Cell (2009), 7th ed., Becker W.M., Kleinsmith, L.J., Hardin., J., Bertoni, and G.P., Pearson Benjamin Cummings (CA), ISBN: 978-0-321-55418-5.
- 11 Molecular Cell Biology (2013) 7th Ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M.,Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., Macmillan International Edition (NewYork), ISBN:13: 978-1-4641-0981-2.

G510.5b

SEMESTER V

GENETIC ENGINEERING AND BIOTECHNOLOGY

Course objectives

The objective of the course is to teach the basics of theoretical and practical aspects of recombinant DNA technology and various techniques for DNA manipulation in prokaryotes and eukaryotes. Plant tissue culture and plant manipulation techniques are also outlined in this course. Applications of these techniques in production of beverages, vitamins and other therapeutic agents at industrial scale.

Course Outcome

The students will be able to understand:

- ✓ The process for isolation and engineering of DNA using restriction and modification enzymes.
- ✓ Use of cloning and expression vectors.
- ✓ The methods for creation of genomic and cDNA libraries, their applications and use.
- ✓ Understand IPR and ethical issues in Biotechnology
- ✓ Gain knowledge on tissue culture media and techniques
- ✓ Understanding the methods for antibiotic alcoholic and non alcoholic production at industry.

UNIT I

1. GENETIC ENGINEERING

10 HOURS

Scope of genetic engineering, Cutting of DNA by Restriction Endonucleases –staggered cut and blunt end. Steps in DNA cloning, Characteristics of plasmids: pBR322 & pUC 19, insertion of foreign DNA into vectors- transformation & Transfection, CRISPER-Cas 9 gene editing. Principle of polymerase chain reaction and application. Blotting techniques- Principle of Southern, Northern blotting and Western Blotting. Application of Genetic engineering- transgenic plants, transgenic animals and gene therapy.

UNIT II

2. PLANT BIOTECHNOLOGY

10 HOURS

Introduction, *Agrobacterium* mediated gene transfer. Selection, identification and recovery of transformed cells. Applications of gene transfer in plants (e.g.: insect resistant -Bt cotton, Bt brinjal, Golden Rice and edible vaccines). Cybrids, Germplasm conservation: Introduction, methods and types of cryoprotectants and applications. Biotechnology: Ethical issues and necessity of bioethics. Basic concepts of IPR (Context of India).

UNIT III

3. TISSUE CULTURE

10 HOURS

Brief history of plant tissue culture, Principle, Laboratory requirements and general techniques involved in micro propagation techniques (Equipments, Media-types, preparation, explants, sterilization techniques) role of micro, macronutrients, pH and gelling agents and growth regulators. Protoplast Isolation Culture - Principles, isolation of protoplasts, factors affecting the viability, testing of viability of isolated protoplast and applications.

UNIT IV

4. INDUSTRIAL BIOTECHNOLOGY

10 HOURS

Methods for screening and selecting micro-organisms for the purpose of production. Primary and secondary metabolites. Continuous culture methods; principles and applications; the Chemostat and its application in industrial fermentations – alcoholic beverages (beer and wine), cheese, amino acids (lysine), antibiotics (penicillin and tetracycline) and vitamins (Riboflavin). Single cell protein- spirulina.

References:

- 1 Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.
- 2 Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK) ISBN: 13: 978-1-4051-3544-3.
- 3 Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).
- 4 Principles of Gene Manipulation and Genomics (2006) 7th ed., Sandy Primrose, By Black Well Publishers.
- 5 Gene Cloning and DNA analysis (2004) 2nd ed., Brown T.A. By ASM press.
- 6 Molecular biotechnology: Principles and applications of recombinant DNA, (2010) 4th ed., Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten., By ASM press.
- 7 Molecular cloning: a laboratory manual (2001) 3rd ed., Joseph Sambrook, David William Russell, Volume 3, By CSHL Press, New York.
- 8 Recombinant DNA. (1992) 2nd ed., James D. Watson, Michael Gilman, Jan Witkowski, Mark Zoller, W. H. Freeman and Company, New York.
- 9 Introduction to Plant Biotechnology (2015) 3rd ed., H.S Chawla, Oxford & IBH Publishing Co.Pvt.Ltd New Delhi ISBN:974-81-204-1732-8.
- 10 A Text Book Microbiology (2014) 3rd ed., R.C Dubey & D.K Maheshwari, S.Chand & Company Pvt .Ltd. ISBN: 81-219-2620-3.
- 11 Biotechnology (2012) 4th ed., B.D Singh Kalyni Publishers, New Delhi, ISBN:978-93-272-2298-2.
- 12 Biotechnology (2011) 1st ed., U Satyanarayana, Books & Allied (P) Ltd. ISBN:81-87134-90-9.

PRACTICALS – G 510.5P (Molecular Biology and Biotechnology)

1. Extraction of DNA from coconut onion.
2. Quantification of extracted DNA by diphenylamine method.
3. Extraction of total RNA from yeast/Liver.
4. Quantification of extracted RNA by Orcinol method
5. Isolation of mitochondria / chloroplast
6. Estimation of DNA/ RNA / protein using UV Spectroscopy.
7. Preparation of MS Media.
8. Explant culture
9. Embryo culture
10. Preparation of synthetic seeds
11. Agarose gel electrophoresis

12. Wine production

13. SDS PAGE

14. Estimation of alcohol by specific gravity method

G510.6a

**SEMESTER VI
MICROBIOLOGY AND IMMUNOLOGY**

Course Objective

This course describes the basic concepts in microbiology and immunology. It emphasizes on molecular and cellular basis of the development and function of the immune system. The course will provide the basic framework in techniques of microbiology and immunology. It also cover the major topics including bacteria, fungus, viruses, microbial staining and culture, sterilization, types of immunity, antibodies and antigens, Humoral and cell mediated adaptive immune response, hypersensitivity, autoimmunity, immune deficiency disorder, complement system and grafting.

Course Outcomes

Upon completion of this course, a student will be able to

- ✓ Trace the history and developments in microbiology.
- ✓ Have an overview of the culture and staining techniques for bacteria, viruses and microbial nutrition
- ✓ Understand the immune system including cells, organs and types of immunity.
- ✓ Describe the basic mechanism, differences and functional interplay of innate and adaptive immunity
- ✓ Understand Antigens & its Recognition, antigen processing and presentation
- ✓ Understand the structure & functions of different classes of Immunoglobulins, and techniques like ELISA, RIA and immunodiffusion
- ✓ Define the cellular and molecular pathways of humoral and cell-mediated immune responses
- ✓ Describe the mechanisms involved in different types of hypersensitivity
- ✓ Explain the autoimmunity and grafting
- ✓ Understand complement pathways in detail

UNIT I

1. HISTORY & TECHNIQUES IN MICROBIOLOGY 10 HOURS

Definition, Scope and History of Microbiology (Antony van Leeuwenhoek, Spallanzani, Edward Jenner, Louis Pasteur, Robert Koch, Alexander Flemming); Differences between the prokaryotic and eukaryotic microorganisms. Sterilization – Physical and chemical methods of sterilization. Serial dilution, pour plate method, spread plate method and streak plate method. Culture media preparation: simple and complex media. Classes of microorganisms- bacteria- Gram positive and Gram negative, fungi-yeast and mold. General structure and bacterial differentiation based on morphology, shape, and colony characteristics. Staining- Gram stain and acid fast stain, endospore staining.

UNIT-II

2. MICROBIAL GROWTH & NUTRIENTS 10 HOURS

Growth of microorganisms, factors influencing growth- nutrition, carbon source, nitrogen source, temperature, pH, oxygen. Growth curve, phases of growth curve. **Viruses:** Classification based on genetic material with examples. Plant viruses –TMV, morphology, General characteristics and its replication, Animal viruses- RNA (Eg: HIV) and DNA viruses (Eg: Herpes simplex virus). **Bacteriophage:** Morphology, general characteristics of bacteriophage. Lysogenic and lytic life cycle of T4 phage.

UNIT III

3. BASIC IMMUNOLOGY

10 HOURS

Introduction to immunology: Innate & adaptive immune system and its components, Role of immunologically important organs and cells -bone marrow, thymus, spleen and lymphocytes. **Antigens & antibodies:** Antigens, Antigenicity and immunogenicity. Definition of Haptens and Epitopes. Adjuvants and its effects. Antibodies- basic structure, Classes of antibodies and their biological functions. Monoclonal & polyclonal antibodies. Abzymes-characteristics. Antigen - antibody interactions-principle, precipitation reaction in gels and agglutination reactions, their applications, Principle & applications of RIA & ELISA. **Cellular basis of immunity:** Cellular and Humoral immunity, Functions of T-lymphocytes, (Helper T-cells and Killer T-cells), B –lymphocytes and macrophages

UNIT IV

4. COMPLEMENT & IMMUNE DISORDER

10 HOURS

Complement system: Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation. **Immune disorder:** Autoimmunity, Organ specific (Myasthenia gravis & Hashimoto's thyroiditis) & systemic (Rheumatoid arthritis & Systemic lupus erythematosus) autoimmune diseases. Immune deficiency diseases- AIDS and SCID. Hypersensitive reactions- 4 types based on immune mechanism. **Transplantation:** Types of transplants, Graft rejection, process of graft rejection-sensitization and effector stage, role of immunosuppressive agents in clinical situation.

References:

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- 10 Sherris Medical Microbiology: An Introduction to Infectious Diseases. (2010). KennethJ. Ryan, C. George Ray, Publisher: McGraw-Hill. ISBN-13: 978-0071604024 ISBN-10: 0071604022
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CLINICAL & MEMBRANE BIOCHEMISTRY**Course Objective**

The objective of this paper is to offer insights into the basic clinical aspects, associated disorder, and structure as well as function of a cell membrane. It also covers topics of radiochemistry and cancer. The course also aims to impart understanding of cell transport, cell death, endocytosis and various techniques of cell biology. It describes mechanism of cancer, treatment, carcinogens and properties of radioactive materials.

Course Outcomes

- ✓ Learn about urine, blood and related disorder in detail.
- ✓ They will understand the cell membrane structure, functions, ionophores and active transport mechanism
- ✓ Introduced to basic concepts radioactivity, its measurements
- ✓ Gain knowledge about the radiation hazards and safety
- ✓ Get knowledge about the carcinogens, cancer and its types
- ✓ Acquire insight into cancer diagnosis and treatment

UNIT I**1. CLINICAL BIOCHEMISTRY****10 HOURS**

Urine: Normal and abnormal constituents of urine-volume, pH, specific gravity. Constituents-urea uric acid, creatinine, pigments and their clinical significance in brief. **Blood:** Normal constituents of blood-Glucose, bilirubin, urea, uric acid, creatinine, cholesterol and their variation in pathological conditions particularly Atherosclerosis and Diabetes mellitus. Serum lipid profile- and its significance. Differentiation of Serum and plasma. **Clinical enzymology:** Clinical application of enzyme- Alkaline and acid phosphatase, SGOT and SGPT for liver test, CPK and LDH, Amylases and lipases for pancreatitis. **Genetic disorder:** Sickle cell anemia, Phenylketonuria, Neimannpick disease and Haemophilia.

UNIT II**2. MEMBRANE BIOCHEMISTRY****10 HOURS**

Structure, composition and functions of biological membranes – fluid mosaic model & sandwich model; chemistry and molecular organization of membrane components. The unit membrane hypothesis; Membrane transport system – active versus passive transport systems; Transport of Glucose; Ion channels - voltage-gated ion channels (Na^+ / K^+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor). Ionophores. Functions of plasma membrane – Receptor mediated endocytosis and phagocytosis.

UNIT III

3. RADIOACTIVITY

10 HOURS

Radioactivity, types, properties, radioactive decay, half life, measurement of radioactivity & its units. Detection of radioactivity– GM Counter; Solid & liquid scintillation counter. Commonly used radioactivity in medicines, radiation hazards. Safety measures, Free radicals: generation, detection & uses.

UNIT IV

4. BIOCHEMISTRY OF CANCER

10 HOURS

Definition, types, properties of cancer cells, characteristics, carcinogens, mechanism of carcinogenesis. Oncogenes and tumour suppressor genes. Role of drugs & enzymes in cancer treatment. Tumour markers – Definition, characteristics, classification & clinical significances.

References:

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PRACTICALS – G510.6P (Microbiology & Clinical Biochemistry)

1. Qualitative analysis of normal and abnormal constituents in urine.
2. Estimation of uric acid
3. Estimation of Urea by DAM method.
4. Estimation of creatinine
5. Culturing of microorganisms by streak plate, spread plate & pour plate method
6. Gram staining
7. Spore staining
8. Simple staining (methylene blue)
9. Micrometry-Determination of size of micro organisms (Ocular, stage micrometers).
10. Antimicrobial activity / test – Disc diffusion method
11. Radial immunodiffusion
12. Double immunodiffusion
13. Staining of human blood cells
14. Estimation of antioxidant activities by DPPH method
15. Glucose utilization assessment in yeasts cells by using glucose Oxidase method
16. Determination of esterase enzyme activity (Time based estimation).

PROJECT REPORT - 50 MARKS

OR

EXTRA EXPERIMENTS– 50 MARKS

1. Estimation of total lipid from egg yolk / liver
2. Isolation & quantification of mitochondria
3. Enzyme assay urease
4. Extraction of oil by Soxhlet extraction
5. Estimation of minerals
6. Antimicrobial activity of essential oils
7. Preparation of aspirin .Estimation of salicylic acid in urine sample (veg / non veg)
8. Erythrocytic lysis
9. Agglutination reaction
10. LDH Assay
11. Extraction of invertase from yeast, precipitation & purity check
12. Determination of catalase activity
