ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc. Biotechnology (w.e.f:2023-24A.B)

Programme: B.Sc. Honours in Biotechnology (Major)

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Introduction to Classical Biology	5	4
		2	Introduction to Applied Biology	5	4
	II	3	Biomolecules and Analytical Techniques – (T)	3	3
			Biomolecules and Analytical Techniques – (P)	2	1
		4	Microbiology, Cell Biology – (T)	3	3
			Microbiology, Cell Biology – (P)	2	1
II	III	5	Plant and Animal Biotechnology -(T)	3	3
			Plant and Animal Biotechnology – (P)	2	1
		6	Molecular Biology – (T)	3	3
			Molecular Biology – (P)	2	1
		7	Genetic Engineering –(T)	3	3
			Genetic Engineering –(P)	2	1
		8	Metabolism – (T)	3	3
			Metabolism – (P)	2	1
	IV	9	Immunology – (T)	3	3
			Immunology – (P)	2	1
		10	Bioinformatics and Biostatistics – (T)	3	3
			Bioinformatics and Biostatistics – (P)	2	1
		11	Medical Biotechnology – (T)	3	3
			Medical Biotechnology – (P)	2	1
III	V	12	Industrial Biotechnology – (T)	3	3
			Industrial Biotechnology – (P)	2	1
		13	Food & Nutritional Biotechnology – (T)	3	3
			Food & Nutritional Biotechnology – (P)	2	1
		14	Gene Biotechnology (OR) Genomics & Proteomics – (T)	3	3
			Gene Biotechnology (OR) Genomics & Proteomics – (T)	2	1
		15	Nanotechnology & Pharmaceutical Biotechnology (OR) Applications of Biotechnology - (T)	3	3
			Nanotechnology & Pharmaceutical Biotechnology (OR) Applications of Biotechnology - (P)	2	1
	VI	**Internship**			
IV	VII	Courses will be available in due course of time			
	VIII	Courses will be available in due course of time			

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc. Biotechnology (w.e.f:2023-24A.B)
SEMESTER-I

COURSE 1: INTRODUCTION TO CLASSICAL BIOLOGY

Theory | Credits: 4 | 5 hrs/week

Learning objectives

The student will be able to learn the diversity and classification of living organisms and understand their chemical, cytological, evolutionary and genetic principles.

Learning Outcomes

1. Learn the principles of classification and preservation of biodiversity
2. Understand the plant anatomical, physiological and reproductive processes.
3. Knowledge on animal classification, physiology, embryonic development and their economic importance.
4. Outline the cell components, cell processes like cell division, heredity and molecular processes.
5. Comprehend the chemical principles in shaping and driving the macromolecules and life processes.

Unit 1: Introduction to systematics, taxonomy and ecology.

1.1. Systematics – Definition and concept, Taxonomy – Definition and hierarchy.

1.2. Nomenclature – ICBN and ICZN, Binomial and trinomial nomenclature.

1.3. Ecology – Concept of ecosystem, Biodiversity and conservation.

1.4. Pollution and climate change.

Unit 2: Essentials of Botany.

2.1. The classification of plant kingdom.

2.2. Plant physiological processes (Photosynthesis, Respiration, Transpiration, phytohormones).

2.3. Structure of flower – Micro and macro sporogenesis, pollination, fertilization and structure of mono and dicot embryos.

2.4 Mushroom cultivation, floriculture and landscaping.

Unit 3: Essentials of Zoology

3.1. The classification of Kingdom Animalia and Chordata.

3.2 Animal Physiology – Basics of Organ Systems & their functions, Hormones and Disorders

3.3 Developmental Biology – Basic process of development (Gametogenesis, Fertilization, Cleavage and Organogenesis)

3.4 Economic Zoology – Sericulture, Apiculture, Aquaculture

Unit 4: Cell biology, Genetics and Evolution

4.1. Cell theory, Ultrastructure of prokaryotic and eukaryotic cell, cell cycle.

4.2. Chromosomes and heredity – Structure of chromosomes, concept of gene.

4.3. Central Dogma of Molecular Biology.

4.4. Origin of life

Unit 5: Essentials of chemistry

5.1. Definition and scope of chemistry, applications of chemistry in daily life.

5.2. Branches of chemistry

5.3. Chemical bonds – ionic, covalent, noncovalent – Vander Waals, hydrophobic, hydrogen bonds.

5.4. Green chemistry

References

1. Sharma O.P., 1993. Plant taxonomy. 2nd Edition. McGraw Hill publishers.

2. Pandey B.P., 2001. The textbook of botany Angiosperms. 4th edition. S. Chand publishers, New Delhi, India.

3. Jordan E.L., Verma P.S., 2018. Chordate Zoology. S. Chand publishers, New Delhi, India.

4. Rastogi, S.C., 2019. Essentials of animal physiology. 4th Edition. New Age International Publishers.

5. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.

6. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.

7. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.

8. Karen Timberlake, William Timberlake, 2019. Basic chemistry. 5th Edition. Pearson publishers.

9. Subrata Sen Gupta, 2014. Organic chemistry. 1st Edition. Oxford publishers.

ACTIVITIES:

1. Make a display chart of life cycle of nonflowering plants.
2. Make a display chart of life cycle of flowering plants.
3. Study of stomata
4. Activity to prove that chlorophyll is essential for photosynthesis
5. Study of pollen grains.
6. Observation of pollen germination.
7. Ikebana.
8. Differentiate between edible and poisonous mushrooms.
9. Visit a nearby mushroom cultivation unit and know the economics of mushroom cultivation.
10. Draw the Ultrastructure of Prokaryotic and Eukaryotic Cell
11. Visit to Zoology Lab and observe different types of preservation of specimens
12. Hands-on experience of various equipment – Microscopes, Centrifuge, pH Meter, Electronic Weighing Balance, Laminar Air Flow
13. Visit to Zoo / Sericulture / Apiculture / Aquaculture unit
14. List out different hormonal, genetic and physiological disorders from the society

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SEMESTER-I

COURSE 2: INTRODUCTION TO APPLIED BIOLOGY

Theory | Credits: 4 | 5 hrs/week

Learning objectives

The student will be able to learn the foundations and principles of microbiology, immunology, biochemistry, biotechnology, analytical tools, quantitative methods, and bioinformatics.

Learning Outcomes

1. Learn the history, ultrastructure, diversity and importance of microorganisms.
2. Understand the structure and functions of macromolecules.
3. Knowledge on biotechnology principles and its applications in food and medicine.
4. Outline the techniques, tools and their uses in diagnosis and therapy.
5. Demonstrate the bioinformatics and statistical tools in comprehending the complex biological data.

Unit 1: Essentials of Microbiology and Immunology

1.1. History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.

1.2. Groups of Microorganisms – Structure and characteristics of Bacteria, Fungi, Archaea and Virus.

1.3. Applications of microorganisms in – Food, Agriculture, Environment, and Industry.

1.4. Immune system – Immunity, types of immunity, cells and organs of immune system.

Unit 2: Essentials of Biochemistry

2.1. Biomolecules I – Carbohydrates, Lipids.

2.2. Biomolecules II – Amino acids & Proteins.

2.3. Biomolecules III – Nucleic acids -DNA and RNA.

2.4. Basics of Metabolism – Anabolism and catabolism.

Unit 3: Essentials of Biotechnology

3.1. History, scope, and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.

3.2. Environmental Biotechnology – Bioremediation and Biofuels, Bio fertilizers and Bio pesticides.

3.3. Genetic engineering – Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical, and biological methods of gene transfer.

3.4. Transgenic plants – Stress tolerant plants (biotic stress – BT cotton, abiotic stress – salt tolerance). Transgenic animals – Animal and disease models.

Unit 4: Analytical Tools and techniques in biology – Applications

4.1. Applications in forensics – PCR and DNA fingerprinting

4.2. Immunological techniques – Immunoblotting and ELISA.

4.3. Monoclonal antibodies – Applications in diagnosis and therapy.

4.4. Eugenics and Gene therapy

Unit 5: Biostatistics and Bioinformatics

5.1. Data collection and sampling. Measures of central tendency – Mean, Median, Mode.

5.2. Measures of dispersion – range, standard deviation and variance. Probability and tests of significance.

5.3. Introduction, Genomics, Proteomics, types of Biological data, biological databases- NCBI, EBI, Gen Bank; Protein 3D structures, Sequence alignment

5.4. Accessing Nucleic Acid and Protein databases, NCBI Genome Workbench

REFERENCES

1. Gerard J., Tortora, Berdell R. Funke, Christine L. Case., 2016. Microbiology: An Introduction. 11th Edition. Pearson publications, London, England.

2. Micale, J. Pelczar Jr., E.C.S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5th Edition. McGraw Education, New York, USA.

3. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.

4. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.

5. R.C. Dubey, 2014. Advanced Biotechnology. S. Chand Publishers, New Delhi, India.

6. Colin Ratledge, Bjorn, Kristiansen, 2008. Basic Biotechnology. 3rd Edition. Cambridge Publishers.

7. U. Sathyanarayana, 2005. Biotechnology. 1st Edition. Books and Allied Publishers pvt. ltd., Kolkata.

8. Upadhyay, Upadhyay and Nath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.

9. Arthur M. Lesk. Introduction to Bioinformatics. 5th Edition. Oxford publishers.

10. AP Kulkarni, 2020. Basics of Biostatistics. 2nd Edition. CBS publishers.

ACTIVITIES

1. Identification of given organism as harmful or beneficial.
2. Observation of microorganisms from house dust under microscope.
3. Finding microorganism from pond water.

4. Visit to a microbiology industry or biotech company.
5. Visit to a waste water treatment plant.
6. Retrieving a DNA or protein sequence of a gene'
7. Performing a BLAST analysis for DNA and protein.
8. Problems on biostatistics.
9. Field trip and awareness programs on environmental pollution by different types of wastes andhazardous materials.
10. Demonstration on basic biotechnology lab equipment.
11. Preparation of 3D models of genetic engineering techniques.
12. Preparation of 3D models of transgenic plants and animals.

[**NOTE**: In the colleges where there is availability of faculty for microbiology and biotechnology, those chapters need to be handled by microbiology and biotechnology faculty. In other colleges, the above topics shall be dealt by Botany and Zoology faculty]

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Course – I & II Model Paper (70 Marks)

SECTION A (Multiple Choice Questions) ***30 x 1 = 30 M***

30 Multiple Choice Questions (Each Unit 6 Questions)

SECTION B (Fill in the blanks) ***10 x 1 = 10 M***

10 Fill in the Blanks (Each Unit 2 Questions)

SECTION C (Very short answer questions) ***10 x 1 = 10 M***

10 Very short answer questions (Each Unit 2 Questions)

SECTION D (Matching) (From 5 Units) ***2 x 5 = 10 M***

1 A
B
C
D
E

2 A
B
C
D
E

SECTION E (True or False) ***10 x 1 = 10 M***

10 True or False (Each Unit 2 Questions)

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SEMESTER-II

COURSE 3: BIOMOLECULES AND ANALYTICAL TECHNIQUES

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about classification, structure and properties of Carbohydrates, Proteins and Lipids.
2. Learn about structure and function of DNA, RNA, Vitamins and Bioenergetics.
3. Learn about basic principles of Centrifugation, Chromatography and Electrophoresis.
4. Learn about principles of Spectroscopy, Microscopy and Techniques.
5. Learn about basics of Biostatistics.

II. Syllabus

Unit-I-Carbohydrates, Protein and Lipids

1. Classification, structure, properties of carbohydrates, amino acids, peptide bond and peptides.
2. Classification, structure (primary, secondary, tertiary, quaternary) and functions of proteins. Denaturation and renaturation of proteins.
3. Classification structure and properties of saturated and unsaturated fatty acids.

Unit-II- Nucleic acid, Vitamins, and Bioenergetics

1. Structure and functions of DNA and RNA.
2. Source, structure, biological role, and deficiency manifestation of vitamin A, B, C, D, E, and K. Free energy, entropy, enthalpy, and redox potential.
3. High energy compounds, Electron-Transport System and Oxidative Phosphorylation.

Unit-III-Centrifugation, Chromatography, and Electrophoresis

1. Basic principles of sedimentation and types of centrifugations.
2. Principle, instrumentation, and application of partition, absorption, paper, TLC, ion exchange, gel permeation, and affinity chromatography.
3. Basic principles and types of electrophoresis, factors affecting electrophoretic migration. PAGE (Native, SDS-PAGE). Introduction to 2D & Isoelectric Focusing.

Unit - IV-Spectroscopy, Microscopy and Laser Techniques

1. Beer-Lambert law, light absorption and transmission. Extinction coefficient, Design and application of photoelectric calorimeter and UV-visible spectrophotometer. Introduction to crystallography and application.
2. Types and design of microscopes - compound, phase contrast, fluorescent electron microscopy (TEM, SEM).
3. Introduction to radioisotopes, measurement of radioactivity (scintillation counter and autoradiography

Unit –V- Biostatistics

1. Mean, median, mode, standard deviation,
2. One-way ANOVA, Two-way Anova
3. t-test, F-test and chi-square.

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. learn about basic instruments and their operation
2. learn about Qualitative and Quantitaive analysis of carbohydrates
3. Learn about estimations nucleic acids and protein by various methods
4. learn about the separation of molecules by chromatography and electrophoresis
5. Learn about problems on mean median mode

SEMESTER-II

COURSE 3: BIOMOLECULES AND ANALYTICAL TECHNIQUES

Practical Credits: 1 2 hrs/week

1. Introduction to basic instruments (Principle standard operation procedure) demonstration and record
2. Calculation of molarity, normality, and molecular weight of compounds.
3. Qualitative analysis of carbohydrates (sugars)
4. Quantitative analysis of carbohydrates
5. Quantitative estimation of protein - Lowery method
6. Estimation of DNA by diphenylamine reagent
7. Estimation of RNA by orcinol reagent
8. Assay of protease activity
9. Preparation of starch from potato and its hydrolyze by salivary amylase
10. Preparation of standard buffer and pH determination
11. Separation of amino acids by paper chromatography
12. Separation of lipids of TLC
13. Agarose gel electrophoresis
14. Calculation of mean, median and mode

V. REFERENCES

1. Outlines of Biochemistry, 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Principles of Biochemistry, 4th edition, (1997), Jeffory Zubey; McGraw-Hill College, USA
3. Principles of Biochemistry, 5th Edition (2008), Lehninger, David Nelson & Michael Cox; W.H. Freeman and Company, NY
4. Fundamentals of Biochemistry, 3rd Edition (2008), Donald Voet & Judith Voet; John Wiley and Sons, Inc. USA
5. Biochemistry, 7th Edition, (2012), Jeremy Berg & Lubert Stryer; W.H.Freeman and Company, NY
6. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu. Pvt.Ltd. New Delhi, India
7. Biochemical Methods,1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
8. Textbook of Biochemistry with Clinical Correlations, 7th Edition, (2010), Thomas M. Devlin; John Wiley and Sons, USA
9. Proteins: biotechnology and biochemistry, 1st edition, (2001), Gary Walsch; Wiley, USA
10. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY
11. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K. Upadhyay, and N. Nath
12. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001), Palmer Trevor, Publisher: Horwood Pub. Co., England.
13. Analytical Biochemistry, 3rdedition, (1998), David Holmes, H.Peck, Prentice-Hall, UK
14. Introductory Biostatistics, 1st edition, (2003), Chap T. Le; John Wiley, USA.
15. Methods in Biostatistics, (2002), B. K. Mahajan –Jaypee Brothers.
16. Statistical methods in biology, (1995), Bailey, N. T.; Cambridge university press

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts preparation on vitamins

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SEMESTER-II

COURSE 4: MICROBIOLOGY, CELL BIOLOGY

Theory | Credits: 3 | 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about Scope and Techniques of Microbiology.
2. Learn about concept of Microbial species and strains,
3. Learn about cell structure and function.
4. Learn about cell signaling and control mechanisms.
5. Learn about genome organization of prokaryotic and eukaryotic organisms

II. Syllabus

Unit-I- Scope and Techniques of Microbiology

1. History and contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming.
2. Ultrastructure of bacteria and growth curve. Pure culture techniques.
3. Sterilization techniques, principles and application of physical methods (autoclave, hot air oven, incineration), chemical methods and radiation methods. Simple, gram and acid-fast staining.

Unit-II-Microbial Taxonomy and Metabolism

1. Concepts of microbial species and strains. Classification of bacteria based on morphology, nutrition and environment. General characteristics, transmission and cultivation of viruses.
2. Structure and properties of plant (tobacco mosaic virus, TMV), animal (Newcastle disease virus, NDV), human (Human immunodeficiency virus, HIV) and bacterial viruses (T4 phage). Emerging and reemerging viruses (dengue) and zoonotic viruses (rabies, SARS-CoV-2).
3. Microbial production of penicillin. Bacterial toxins, tuberculosis, typhoid. Introduction to fungi, algae and mycoplasm.

Unit-III- Cell Structure and Functions

1. Structure, properties and functions of cellular organelles (E.R, Golgibodies, Mitochondria, Ribosomes lysosomes , nucleus) of eukaryotic cells.
2. Cell cycle and its regulation
3. cell division (mitosis and meiosis).

Unit-IV- CELL SIGNALLING

1. Chemical composition and dynamic nature of the membrane,
2. Cell Surface Receptors
3. cell signaling and communication(GPCR .- cAMP,cGMP,IP3-DAG)

Unit – V - Central Dogma of Molecular Biology

1. Genome organization of prokaryotic and eukaryotic organisms
2. Enzymes involved in Replication, Transcription, and Translation
3. DNA repair Mechanism

III. Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about preparation of media for culturing of various microorganisms
2. Learn about isolation of microrganisms from different sources
3. Learn about staining techniques and biochemical identification of bacteria
4. Learn about different stages of cell division

SEMESTER-II

COURSE 4: MICROBIOLOGY, CELL BIOLOGY

Practical | Credits: 1 | 2 hrs/week

1. Cleaning and preparation of glassware
2. Preparation of nutrient agar medium for bacteria
3. Preparation of PDA medium for fungi
4. Sterilization techniques (autoclave, hot air oven, filter)
5. Isolation of bacteria from soil
6. Simple staining technique
7. Differential staining technique
8. Microbial counting by Haemocytometer
9. Identification of different bacteria
10. Motility test by hanging drop
11. Biochemical identification of bacteria
12. Preparation of pure culture by slab, slant, streak culture
13. Study of stages of cell division

14 Extraction and isolation of DNA from bacteria

V. REFERENCES

1. Microbiology–6th Edition, (2006), Pelczar M.J., Chan E.C.S., Krieg N.R.; The McGrawHill Companies Inc. NY
2. Prescott's Microbiology, 8th edition, (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton; McGrawHill Science Engineering, USA
3. Textbook of Microbiology, Anantnarayan and Paniker (2017)
4. Brock biology of microorganisms, 2003, Brock, T. D., Madigan, M. T., Martinko, J. M., & Parker, J.; Upper Saddle River (NJ): Prentice-Hall, 2003.
5. Genes XI, 11th edition, (2012), Benjamin Lewin; Publisher - Jones and Barlett Inc. USA
6. Molecular Biology of the Gene, 6th Edition, (2008), James D. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R.; Cold Spring Harbour Lab. Press, Pearson Pub.
7. Molecular Biology, 5th Edition, (2011), Weaver R.; McGraw Hill Science. USA
8. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi; Oxford University Press.
9. Molecular Biology: Genes to Proteins, 4th edition (2011), Burton E Tropp Jones& Bartlett Learning, USA.
10. Cell and Molecular Biology: Concepts and Experiments, 6th Edition, Karp, G. 2010.; John Wiley & Sons. Inc.

VI. CO-Curricular Activities

a) **Suggested Co-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on Replication, cell cycle, cell signaling

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Single Major
Model Question Paper
SEMESTER-II
B.Sc. Biotechnology

Paper: Biomolecules and Analytical Techniques

Time:3hrs *MAX MARKS: 70 M*

SECTION – A

Answer any 5 questions. Each question carries 4 marks (5 X 4 = 20M)
(Total 8 questions, questions 1-5 from Units 1-5 & questions 6-8 from any of the units)

1. Peptide bond
2. Enthalpy
3. Partition coefficient
4. Beer-Lambert's law
5. t-test
6. 2D electrophoresis
7. Autoradiography
8. RNA types

SECTION – B

Answer all the questions. Each question carries 10 marks. (5 X 10 = 50M)
(Each question (both 'A' or 'B') from each Unit.

9). a) Discuss about classification, structure and properties of carbohydrates.
(OR)
b) Discuss in detail about structure and functions of proteins.

10) a) Write about biological role and deficiency symptoms of fat soluble vitamins.
(OR)
b) Discuss in detail about oxidative phosphorylation.

11) a) Explain in detail about SDS Poly Acrylamide Gel Electrophoresis (PAGE).
(OR)
b) Define centrifugation. Discuss about different types of centrifugation.

12) a) Discuss in detail about principle, working and applications of UV-visible Spectrophotometer.
(OR)
b) Explain about principle, instrumentation and application of scanning electron microscope.

13. a) Explain in detail about measures of dispersion.
(OR)
b) Define ANOVA. Explain about two-way ANOVA.

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Single Major
Model Question Paper
SEMESTER-II
B.Sc. Biotechnology

Paper: Microbiology & Cell Biology

Time:3hrs *MAX MARKS: 70 M*

SECTION – A

Answer any 5 questions. Each question carries 4 marks (5 X 4 = 20M)
(Total 8 questions, questions 1-5 from Units 1-5 & questions 6-8 from any of the units)

1. Sterilization by Radiation
2. Zoonotic virus
3. Ribosomes
4. CAMP
5. Nucleosome
6. HIV
7. Lysosomes
8. Topoisomerase

SECTION – B

Answer all the questions. Each question carries 10 marks. (5 X 10 = 50M)
(Each question (both 'A' or 'B') from each Unit.

9) a) Explain contributions made by Leeuwenhoek, Louis Pasteur, Robert Koch.
(OR)
b) Discuss in detail about ultrastructure of bacteria

10) a) Write about classification of bacteria based on nutrition
(OR)
b) Explain microbial production of penicillin

11) a) Write about structure, properties and functions of cellular organelles
(OR)
b) Write in detail about meiotic cell division

12) a) Write in detail about chemical composition and functions of cell membrane
(OR)
b) Discuss in detail about cell surface receptors

13) a) Write in detail about about transcription
(OR)
b) Discuss in detail about DNA repair mechanism

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SEMESTER-III
COURSE 5: PLANT AND ANIMAL BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about plant tissue culture techniques and secondary metabolites production.
2. Learn about transgenesis and molecular markers.
3. Learn about animal tissue culture techniques
4. Learn about transgenic animals and gene therapy.
5. Learn about Bioethics, Biosafety and IPR.

II. Syllabus

Unit – I Plant tissue culture techniques & secondary metabolites production

1. totipotency, media preparation – nutrients and plant hormones; sterilization techniques; establishment of cultures – callus culture, cell suspension culture
2. applications of tissue culture-micro propagation; Somatic embryogenesis
3. synthetic seed production; protoplast culture and somatic hybridization - applications. Cryopreservation, Plant secondary metabolites- concept and their importance

Unit – II Transgenesis and Molecular markers

1. Plant transformation technology—Agrobacterium-mediated Gene transfer (Ti plasmid), hairy root features of Ri plasmid, Transgenic plants as bioreactors.
2. Herbicide resistance – glyphosate, Insect resistance- Bt cotton
3. Molecular markers - RAPD, RFLP and DNA fingerprinting-principles and applications.

Unit – III Animal tissue culture techniques

1. cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, cell lines,stem cell cultures;
2. Tests: cell viability and cytotoxicity, Cryopreservation.
3. Transfection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications.

Unit – IV Transgenic animals & Gene Therapy

1. Production of vaccines, diagnostics, hormones and other recombinant DNA products in medicine (insulin,somatostatin, vaccines),IVF,
2. Concept of Gene therapy,
3. Concept of transgenic animals – Merits and demerits -Ethical issues in animal biotechnology

Unit V Bioethics, Biosafety and IPR

1. Bioethics in cloning and stem cell research, Human and animal experimentation, animal rights/welfare.
2. Bio safety-introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GLP,GMP
3. Introduction to IP-Types of IP: patents, trademarks & copyright

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about different plant tissue media
2. Learn about the induction of callus from explants
3. Learn about plant propagation of through various tissue culture
4. Learn about cell lines

Learn about cell viability by various methods

SEMESTER-III
COURSE 5: PLANT AND ANIMAL BIOTECHNOLOGY

Practical Credits: 1 2 hrs/week

1. plant culture media and composition of MS media
2. Raising of aseptic seedlings
3. Induction of callus from different explants
4. Plant propagation through Tissue culture (shoot tip and Nodal culture)
5. Establishing a plant cell culture (both in solid and liquid media)
6. suspension cell culture
7. Cell count by hemocytometer.
8. Establishing primary cell culture of chicken embryo fibroblasts.
9. Animal tissue culture – maintenance of established cell lines.
10. Animal tissue culture – virus cultivation.
11. Estimation of cell viability by dye exclusion (Trypan blue).
12. ELISA – Demonstration

V. REFERENCES

1. .Introduction to Plant Tissue Culture..M.K. Razdan ,2003,Science Publishers

2. Plant Tissue Culture, kalyan Kumar De,199 M7,New Central Book Agency

3. Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan,1998

4. Biotechnology – By U. Satyanarayana ;1997

5. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and A. Reinhard ,2001

6. Introduction to Plant Tissue Culture,M. K. Razdan, 2003,Science Publishers

7. A Textbook of Biotechnology,R C Dubey,S. 2014,Chand Publishing

8. Elements of Biotechnology,P. K. Gupta, 1994,Rastogi Publications

9. R. Ian Freshney, "Culture of animal cells – A manual of basic techniques" 4th edition, John Wiley & Sons, 2000 ,Inc, publication, New York

10. Daniel R. Marshak, Richard L. Gardner, David Gottllieb "Stem cell Biology" edited by Daniel 2001,Cold Spring Harbour Laboratory press, New York

11. M.M. Ranga, Animal Biotechnology; Agrobios (India) ,2006.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on different medias
4. Visit to plant tissue culture lab

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SEMESTER-III

COURSE 6: MOLECULAR BIOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about genome structure and organization.

2. Learn about mechanism and enzymes of DNA replication.

3. Learn about enzymatic synthesis and features of transcription.

4. Learn about regulation of gene expression.

5. Learn about genetic code and protein synthesis.

II. Syllabus

Unit I Genome Structure

1. Watson and Crick model of DNA; Genome organization with specific reference to prokaryotic and eukaryotic genomes; Genome size.
2. Concepts of Genetic Material, Gene, Chromosome and Genome.
3. Experiments to prove DNA as genetic material (Griffith experiment, Hershey- Chase experiment)

Unit II DNA Replication

1. Enzymology of replication (DNA polymerase I, pol II and III, helicases, topoisomerases, single strand binding proteins, DNA melting proteins, primase.
2. Proof of semiconservative replication, Replication origins,
3. Rolling circle replication of DNA

Unit III Transcription:

1. Enzymatic synthesis of RNA: Basic features of transcription, the structure of prokaryotic RNA polymerase (core enzyme and hollo enzyme, sigma factor),
2. concept of promoter (Pribnow box, -10 and -35 sequences),
3. Four steps of transcription (promoter binding and activation, RNA chain initiation, chain elongation, termination and release). Reverse transcription.

Unit IV Gene Expression and regulation

1. Regulation of gene expression; Clustered genes
2. the operon concepts - Negative and positive control of the Lac Operon, trp operon,
3. Control of gene expression. Poly and Mono cistronic m-RNA,

Unit V Genetic Code and Protein Synthesis

1. Genetic code: Features of genetic code, Structure of m RNA, brief structure of tRNA,
2. The adaptor hypothesis, attachment of amino acids to tRNA.
3. Codon-anticodon interaction - the wobble hypothesis. Initiation, elongation, termination protein.

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about Quantitative estimation of Nucleic Acids
2. Learn about isolation of DNA from different sources
3. Learn about purity analysis of DNA

SEMESTER-III
COURSE 6: MOLECULAR BIOLOGY

Practical | Credits: 1 | 2 hrs/week

1. Effect of UV radiations on the growth of microorganisms.
2. Determination of absorption maxima of DNA and RNA and their quantification
3. Quantitative estimation of RNA
4. Quantitative estimation of DNA
5. Isolation of plasmid DNA from bacteria
6. Isolation of genomic DNA from *E.coli*
7. Isolation of DNA from sheep liver
8. Isolation of DNA from plant leaves (Rice or Tobacco or any other plant)
9. Separation of DNA by Agarose gel Electrophoresis
10. Purity analysis of the Nucleic acids

V. REFERENCES

1. Cell and Molecular Biology, 8th edition. De Robertis, E.D.P. and De Robertis, E.M.F. 2006; Lippincott Williams and Wilkins, Philadelphia.
2. Cell Biology, (2017), De Robertis & De Roberis, Blaze Publishers & Distributors Pvt. Ltd.
3. The Cell: A Molecular Approach. 5th edition. Cooper, G.M. and Hausman, R.E. 2009. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. The World of the Cell, 7thedition, Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 Pearson Benjamin Cummings Publishing, San Francisco.
5. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
6. P.Gunasekaran. 2007. Laboratory Manual in Microbiology. New Age International.
7. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
8. Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by Ron Jon Publishing. Incorporated.
9. Gunasekaran, P. 2009. Laboratory Manual in Microbiology. 1st Edition. New Age International Publishers.
10. Dr. T. Sundararaj. Microbiology Laboratory Manual. 2005. Dr.A.L. MPGIBMS, University of Madras, Taramani, Chennai – 600 113.
11. James G. Cappuccino and Natalie Sherman. 2013. Microbiology: A Laboratory Manual. 10th Edition. Benjamin Cummings.
12. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.
13. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Narosa Publishing House.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on Replication, Transcription, and Translation

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SEMESTER-III
COURSE 7: GENETIC ENGINEERING

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about the history and tools of genetic engineering
2. Learn about vectors used in genetic engineering
3. Learn about Hybridization techniques
4. Learn about vectors and their screening techniques
5. Learn about gene editing tools

II. Syllabus

UNIT-I

1. Basics, history, scope, and recent developments in Genetic Engineering; guidelines; strategies in plant and animal genetic engineering.
2. Molecular tools in genetic engineering- Restriction enzymes: Endo & Exonucleases. Modifying enzymes
3. Ligation (cohesive & blunt end ligation) – linkers & adaptor.

UNIT-II

1. Cloning vectors: plasmid - definition, properties and types. pUC19 & pBR322- phage vectors (λ & M13),
2. Cosmid vectors, Shuttle and expression vectors; YAC (S.cerevisiae as a model)& BAC (E.coli);
3. Screening and selection of recombinants; Gene transfer methods

UNIT-III

1. Hybridization techniques: Probes (radioactive & non-radioactive), detection.
2. Polymerase Chain Reaction (PCR) – Principle , Applications and types of PCR
3. Labeling of DNA- Nick translation, Random priming method & labeling by primer extension.

UNIT-IV

1. Construction of genomic & c DNA libraries.
2. Vector engineering & codon optimization, strategies of gene delivery, invitro translation
3. Expression in bacteria, yeast, insects, plant & mammalian cells

UNIT-V

1. Chromosome engineering, targeted gene replacement,
2. gene editing, gene regulation & silencing. Site-directed mutagenesis.
3. DNA sequencing – Maxam Gilbert (chemical) & Sanger's, Nicolson sequencing, Pyrosequencing. Gene therapy, Human Genome Project.

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about problems in genetic engineering
2. Learn about restriction digestion
3. Learn about isolation of Plasmid
4. Learn about activity of enzymes

SEMESTER-III
COURSE 7: GENETIC ENGINEERING

Practical | Credits: 1 | 2 hrs/week

1. Problem in Genetic engineering.
2. Transformation in Bacteria using plasmid
3. Restriction digestion of DNA and its electrophoretic separation.
4. Ligation of DNA molecules and their testing using electrophoresis.
5. Activity of DNAase and RNAse on DNA and RNA.
6. Isolation of Plasmid DNA
7. Demonstration of PCR

V. REFERENCES

1. Textbook of Biotechnology - 2007, By H.K. Das (Wiley Publications)
2. Principles of Gene Manipulation - 7th edition, 2006, By R.W. Old & S.B. Primrose, Publ: Blackwell
3. Molecular Biology & Biotechnology- 1996, By H.D. Kumar, Publ: Vikas
4. Molecular Biotechnology - 4th edition, 2010, G.R. Click and J.J. Pasternak, Publ: Panima
5. Genes and Genomes – 1991, By Maxine Singer and Paul Berg
6. Genes VII- 2000, By B. Lewin - Oxford Univ. Press
7. Molecular Biology - 4th Edition, 2008, By D. Freifelder, Publ: Narosa Publishing house New York, Delhi
8. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
9. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
10. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
11. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7thedition. Blackwell Publishing, Oxford, U.K.
12. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rdedition. Cold Spring Harbor Laboratory Press.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topic
3. Visit to instrumentation labs

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SEMESTER-III
COURSE 8: METABOLISM

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about Carbohydrate metabolism
2. Learn about Lipid metabolism
3. Learn about Amino Acid metabolism
4. Learn about nomenclature and specificity of enzymes
5. Learn about enzyme kinetics of enzyme

II. Syllabus

Unit I : Carbohydrate metabolism

1. Anabolism & catabolism , Photosynthesis – light and dark reactions. C3 cycle, C4 pathway,
2. Glycolysis – formation of lactate and pyruvate, TCA cycle and its regulation
3. gluconeogenesis, HMP stunt pathway , Disorders of Carbohydrate metabolism- Diabetes mellitus

Unit II : lipids metabolism

1. Denovo synthesis of Fatty Acids , Biosynthesis & degradation of TAG (Triacyl Glycerol),
2. Disorders of Lipid metabolism
3. Biosynthesis of cholesterol , Ketogenesis

Unit III :Amino acid Metabolism

1. General reactions of amino acids, deamination, decarboxylation & transamination.
2. Urea cycle. Biosynthesis of creatine
3. Inborn errors of aromatic and branched-chain amino acid metabolism.

UNIT IV Enzymes:

1. Difference between chemical and biological catalyst, definitions of Holoenzyme apoenzyme coenzyme
2. Classification and nomenclature of enzymes.
3. Enzyme specificity , interaction between enzyme and substrate -lock and key and induced fit models.

UNIT – V Enzyme kinetics:

1. Michaelis-Menten equation, Factors affecting enzyme activity- substrate concentration, enzyme concentration,pH a n d temperature.
2. Enzyme inhibition kinetics - competitive, uncompetitive, and non-competitive
3. Immobilized enzymes and their applications

III . Skills Outcome

On Successful Completion of this Course, the Student shall be able to

1. Learn about assay of enzymes from various sources
2. Learn about estimations of glucose by various methods
3. Learn about titrations of glucose and carbohydrates

SEMESTER-III
COURSE 8: METABOLISM

Practical Credits: 1 2 hrs/week

1. Immobilization of enzymes / cells by entrapment in alginate gel 19. Effect of temperature / pH on enzyme activity
2. Assay of protease activity.
3. Assay of alkaline phosphatase
4. Preparation of starch from Potato and its hydrolysis by salivary amylase
5. Isolation of urease and demonstration of its activity
6. Estimation of amino acids by ninhydrin method
7. Estimation of protein by Biuret method
8. Estimation of glucose by DNS method
9. Estimation of glucose by Benedicts titrimetric method
10 Estimation of total carbohydrates by anthrone method

V. REFERENCES

1. Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1997
3. Principles of enzymology for food sciences: Whitaker Marc Dekker 1972.
4. Principles of Biochemistry, White. A, Handler, P and Smith.
5. Biochemistry, Lehninger A.L.
6. Biochemistry, Lubert Stryer.
7. Review of physiological chemistry, Harold A. Harper.
8. Text of Biochemistry, West and Todd.
9. Metabolic pathways – Greenberg.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on cycles – carbohydrate , lipid, amino acid metabolism

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SEMESTER-IV

COURSE 9: IMMUNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about types of immunity and cells of immunity
2. Learn about Antigen and Antibody
3. Learn about cell , humoral immunity and MHC molecules
4. Learn about Hypersensitivity and vaccines
5. Learn about immunological techniques

II. Syllabus

UNIT I Immune system:

1. History and scope of immunology, cells of imthe mune system -Tcells , B cells
2. Immunity, innate immune mechanism, Acquired immune mechanism
3. Organs of the immune system (Bone marrow, spleen thymus MALT)

UNIT II Antibody and Antigen:

1. Antibody structure and classes(Ig G,Ig M Ig A Ig E I g D , Antibody diversity
2. Antigen -Types of Antigens Antigenicity (factors affecting antigenicity).
3. Antigenic determinants – adjuvants and haptens , epitopes

UNIT III Immunity:

1. Humoral immunity, cell-mediated immunity -TC-mediated immunity, NK cell-mediated immunity, ADCC,
2. brief description of cytokines , Interleukins
3. Major histocompatibility complex (MHC)-Structure and Functions of Class I ,II , MHC Molecules

UNIT IV Hypersensitivity and vaccination :

1. General features of hypersensitivity, various types of hypersensitivity,
2. Vaccination: Discovery, principles, significance,
3. Types of Vaccines -live, attenuated, killed , recombinant, subunit

UNIT V Immunological Techniques

1. Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, - Radial immune diffusion, ouchterlony , double immune diffusion
2. Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.
3. ELISA , RIA , immunoelectrophoretic , Rocket electrophoresis

III . Skills Outcome

On Successful Completion of this Course, the Student shall be able to

1. Learn about the determination of blood group
2. Learn about immunodiffusion methods
3. Learn about production of antibodies

SEMESTER-IV

COURSE 9: IMMUNOLOGY

Practical | Credits: 1 | 2 hrs/week

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Antigen – antibody reaction – determination of Blood group , Cross reactivity
2. Pregnancy test
3. Widal test
4. Ouchterloney immunodiffusion
5. Radial immunodiffusion
6. ELISA
7. Isolation of casein by isoelectric precipitation
8. Production of antibodies and their titration

V. REFERENCES

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.
4. Immuno diagnostics, 1996, By S.C. Rastogi, Publ: New Age
5. Introduction to Immunology- 2002, C. V. Rao- Narosa Publishing House

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on cell mediated immunity
4. Models on antibodies

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SEMESTER-IV

COURSE 10: BIOINFORMATICS AND BIOSTATISTICS

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about concept and branches of bioinformatics
2. Learn about searching sequences using databases
3. Learn about computer phylogenetics
4. Learn about the measurement of central tendency
5. Learn about test hypothesis

II. Syllabus

UNIT – I

1. Scope of computers in biological research, Introduction to Bioinformatics: Definition, nature and scope of bioinformatics.
2. Bioinformatics versus computational biology.
3. Branches of bioinformatics. Basic concepts in bioinformatics.

UNIT – II

1. Basic concepts of system biology. Protein Data Bases -visualization of proteins using database
2. Overview of computer-aided drug design.
3. Searching sequence database using BLAST. Concept of genomics and proteomics

UNIT – III

1. Computational phylogenetics – various applications.
2. Phy lip software. Microarray,
3. Bio informatics – Experimental design & Over view of data analysis.

UNIT – IV

1. Measurement of central tendency (mean, mode and range)
2. Dispersion (standard error and standard deviation).
3. Probability and distribution. Poisson and binomial distributions. Normal distribution

UNIT – V

1. Population and sampling test of significance. Test hypothesis.
2. Student t-test for small samples. ANOVA ,Chi^2 test for analysis, correlation and regression.
3. Computer applications in Biotechnology

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about problems of mean median mode
2. Learn about test hypothesis
3. Learn about sequence Retrieval from NCBI

SEMESTER-IV

COURSE 10: BIOINFORMATICS AND BIOSTATISTICS

Practical | Credits: 1 | 2 hrs/week

1. Mean, Median, Mode
2. Standard deviation, variance and coefficient of variation
3. Testing of hypotheses regarding population mean
4. Testing of hypotheses about the difference between population means
5. Chi-square test
6. Testing of Correlation Coefficient
7. Fitting of simple linear regression
8. Sequence retrieval (protein and gene) from NCBI, Structure download (protein and DNA) from PDB

V. REFERENCES

1. Fowler, J., Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology. John Wiley and Sons, 2nd ed. .
2. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
3. Finney, D.J. (1980). Statistics for Biologists.Chapman and Hall Ltd.
4. Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley and Sons, 7th ed.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on data bases

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SEMESTER-IV

COURSE 11: MEDICAL BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about diseases caused by microbial sources
2. Learn about epidemiology, pathogenicity, laboratory, diagnosis, prevention and control of bacterial diseases
3. Learn about fungal, viral and protozoan diseases
4. Learn about gene therapy and vectors used in gene therapy
5. Learn about drug discovery, therapeutic applications

II. Syllabus

UNIT-I

1. Diseases, introduction , types : genetic, chromosomal aberrations, numerical and structural autoimmune disorders
2. Disease caused by microbial sources . mechanism of pathogenicity, pathogenic islands , molecular basis of diseases
3. Antimicrobial compounds and their mode of action

Unit -II

1. Characteristics of infectious diseases, herd immunity
2. Disease cycle (source of disease , reservoir, carries) , transmission of pathogens (air borne , contact transmission , and vector transmission)
3. Bacterial diseases – epidemiology, pathogenicity, laboratory, diagnosis, prevention and control of the following diseases – tuberculosis, typhoid, tetanus, leprosy

Unit -III

1. General account of fungal diseases : mycosis , subcutaneous and deep
2. General account of viral and protozoan diseases- pneumonia, mumps, AIDS, malaria
3. Brief account of sexually transmitted diseases

Unit -IV

1. Gene therapy – *Exvivo, Invivo, Insitu* gene therapy
2. strategies of gene therapy , gene augmentation
3. Vectors used in gene therapy , biological vectors – retrovirus , adeno virus, herpes. Synthetic vectors - liposomes , receptor medicate gene transfer

Unit -V

1. Introduction to drug discovery. Stem cell based drug discovery , drug screening and toxicology
2. Therapeutic applications – neurological disorders - Parkinson's diseases , Alzheimer's disease
3. Antiviral therapy for AIDS, DNA/RNA based diagnosis, hepatitis

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about Laboratory Safety Regulations
2. Learn about staining techniques
3. Learn about Culture of bacteria and its cultural characteristics
4. Learn about serological diagnosis of diseases

SEMESTER-IV

COURSE 11: MEDICAL BIOTECHNOLOGY

Practical | Credits: 1 | 2 hrs/week

1. Laboratory Safety Regulations
2. Culture media & isolation of pure culture
3. Smear Preparation & Simple stain
4. Gram stain
5. Culture of bacteria and its cultural characteristics
6. C Reactive protein test
7. Widal test
8. Serological diagnosis of tuberculosis
9. Serological diagnosis of HIV
10.

V. REFERENCES

1. Text book of microbiology R. Ananthanarayana and C.K. Jayaram Paniker, Orient longman 1997
2. Medical microbiology , vol 1 microbial infections : Mackie and MaCarty, Churcil Livingsione 1996
3. Bailey and Scotts Diagnostic microbiology : Baron EJ Peterson LR and Finegold SM Mosby 1990
4. Broude A.I (1981) Medical microbiology and infectious diseases , W.B Saunders &Co Philadelphia

VI. CO-Curricular Activities

a) **Suggested Co-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts / models on bacterial/fungal/ viral / protozoan diseases

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SEMESTER-V

COURSE 12: INDUSTRIAL BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about industrially important microorganisms
2. Learn about bioreactor and it types
3. Learn about production of different substances through fermentation
4. Learn about industrially enzymes
5. Learn about industrially produced amino acids and vitamins.

II. Syllabus

Unit I

1. Isolation, Screening, Preservation and Improvement of Industrially Important Microorganisms.
2. Synthetic and Natural Medium, Precursors, Antifoams,
3. Sterilization Methods and Inoculum Preparation.

Unit II

1. Definition of bioreactor, basic principles of bioreactor.
2. Classification of bioreactors.
3. Analysis of batch, continuous, fed batch and semi-continuous bioreactors.

Unit III

1. Ethanol Production by Fermentation using Molasses, Starchy Substances.
2. Production of Alcoholic Beverages like Beer and Wine.
3. Production of Citric Acid by Submerged and Solid State Fermentations.

Unit IV

1. Sources of Industrial Enzymes, Production of Microbial Enzymes like Amylase and protease.
2. Backer's Yeast and SCP Production.
3. Production of Antibiotics : Penicillin strepomycin

Unit V

1. Amino Acid Production
2. Vitamin Production- Vitamin B12
3. Production Of Recombinant Proteins Having Therapeutic And Diagnostic Applications

(Insulin, Growth Hormone, Recombinant Vaccines, Monoclonal Antibody).

III. Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about different isolations of microorganisms from various sources
2. Learn about production of alcohol and wine
3. Learn about citric acid fermentation

SEMESTER-V

COURSE 12: INDUSTRIAL BIOTECHNOLOGY

Practical | Credits: 1 | 2 hrs/week

1. Isolation of industrially important microorganisms from soil.
2. Isolation of amylase producing organisms from soil.
3. Production of α – amylase from *Bacillus Spp.* by shake flask culture.
4. Production of alcohol or wine using different substrates.
5. Estimation of alcohol by titrimetry.
6. Estimation of alcohol by calorimetric method .
7. Production of citric acid.
8. Citric acid production by submerged fermentation.
9. Estimation of citric acid by titrimetry.

V. REFERENCES

1. Industrial Microbiology by A.H.Patel,2009
2. Prescott & Dum (2002) Industrial Micrbiology, Agrabios (India) ,2005,Publishers
3. Creueger W. & Crueger A.A Text of Industrial Microbiology,2000, 2nd Edition, Panima Publishers corp.

VI. CO-Curricular Activities

a) **Suggested Co-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Industrial visit to nearby industries

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SEMESTER-V

COURSE 13: FOOD & NUTRITIONAL BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about food Preservation and microorganisms associated with it
2. Learn about packaging of different foods
3. Learn types of Foods and their nutritional values
4. Learn about components of foods and their deficiency disorders
5. Learn about Essential minerals , BMR and RDA

II. Syllabus

Unit I

1. Principles of food preservation. Microorganisms associated with foods.
2. Infection, food intoxication, definition of self-life, perishable foods .Food preservation by freezing, refrigeration.
3. Storage at high temperature: sterilization, pasteurization, blanching, drying, dehydration, evaporation and irradiation.

Unit II

1. Food packing, methods of cooking – dry, moist, frying and microwave cooking.
2. Advantages, disadvantages and effects of various cooking methods of food.
3. Canning, fermentations, pasteurization and adulteration. Food additives..

Unit III

1. Animal and sea foods - their importance, nutritional values, and preservation methods
2. Microbiology of milk, milk products – cheese, yoghurt, butter, ice – cream, milk powder and their preparation.
3. Food preservation by salting, smoking, curing and crystallization

Unit-IV

1. Components of food: Carbohydrates, Fats, Proteins and their importance in daily diet.
2. Deficiency disorders: Protein deficiency disorders, Calorie maintenance diet, Malnutrition, Kwashiarkar, Maranus, Starvation.
3. Vitamins: types of vitamins, sources of various vitamins. Essential vitamins and their biological role in metabolisms. Vitamin deficiency disorders

Unit V

1. Basal Metabolic Rate (BMR) and its determination. Calorific values of foods, Atherosclerosis and obesity. Body Mass Index (BMI).
2. Recommended dietary allowances, Food allergy and its importance in health, Controlling measures
3. Essential minerals: Ca, Mg, Fe, I, Co, Mo, Zn, Se & F. Their role and deficiency disorders. Nutrition for pregnant, lactating women and for infants

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about Qualitative analysis of food
2. Learn about preservation methods
3. Learn about isolation on food spoiling Microrganisms

SEMESTER-V

COURSE 13: FOOD & NUTRITIONAL BIOTECHNOLOGY

Practical | Credits: 1 | 2 hrs/week

1. Quantitative analysis of food for a) Moisture b) ash c) Iron d) Calcium
2. Isolation of Glycogen from sheep liver
3. Preparation of chloroplast from green leaves / carotenes from carrots.
4. Determination of pH of different foods using pH meter.
5. Study of food preservation methods
6. Nutritional labeling of food
7. Preparation of yoghurt
8. Isolation and identification food spoiling microorganisms.

V. REFERENCES

1. "Food Biotechnology" by Elsayed Abdel-Aal and Andy Khatwa (2019)
2. "Introduction to Food Biotechnology" by Perry Johnson-Green (2016)
3. "Food Biotechnology" by Kalidas Shetty and Gopinadhan Paliyath (2005)
4. "Food Biotechnology, Second Edition" by Klaus Buchholz and Volker Kasche (2013)
5. "Nutritional Biochemistry and Metabolism: With Clinical Applications" by Maria Luz Fernandez and Jose M. Ordovas (2014)
6. "Biotechnology in Functional Foods and Nutraceuticals" edited by Debasis Bagchi and Francis C. Lau (2010)

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on deficiency disorders

SEMESTER-V

COURSE 14: GENE BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about history and concept of genetic material
2. Learn about Mendel laws and their deviations
3. Learn about chromosome alterations and mutations
4. Learn about microbial genetics
5. Learn about banding techniques

II. Syllabus

UNIT I

1. History of Classical and Modern Genetics, Concept and organization of Genetic material in Bacteria, Plant and Animal;
2. Structure, types, forms and functions of DNA and RNA.
3. Genetic model organisms and their significance (*E.coli, Arabidopsis thaliana, Caenorhabditis elegans*).

UNIT II

1. Mendelian laws of inheritance; Non-Mendelian inheritance;
2. Chromosomal theory of inheritance. Back cross and Test cross.
3. Linkage and crossing over. Epistasis. Concept of multiple alleles.

UNIT III

1. Structural and numerical alterations of chromosome - Deletion, inversion, duplication, translocation. Ploidy and their genetic implications.
2. Mutation- (Spontaneous and Induced) mutagen. Biochemical basis of mutation.
3. Light induced repair, excision repair and mismatch repair, post replication repair, Rec gene and its role in DNA repair SOS repair and SOS response.

UNIT IV

1. Microbial Genetics: Methods of Gene transfer – Transformation, Transduction
2. Mapping genes by interrupted Matting, fine structure analysis of genes.
3. Retroposans , repeated sequences

UNIT V

1. Human karyotype, Banding techniques, Human genetic diseases. Pedigree analysis
2. Karotype in man, in herited disorders: Allosomal & autosomal. Banding techniques
3. Structure and Molecular basis of AC-DS transposition in maize, "P" element of Drosophila and hybrid dysgenesis, Yeast "T_7" element

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Identify different stages of mitosis
2. Identify the chromosomal aberrations
3. Identify the pedigree charts

SEMESTER-V

COURSE 14: GENE BIOTECHNOLOGY

Practical | Credits: 1 | 2 hrs/week

1. Study of different phases of mitosis in onion root tips.
2. Mutation of DNA by UV light
3. Problems and assignments in Mendilian genetics.
4. Chemical induced mutation in bacteria.
5. Induction of chromosomal aberrations by chemical mutagenesis in any plant.
6. Isolation of auxotrophic mutants (plants or insects).
7. Repair of DNA by Photo activation of Photolyase in bacteria.
8. Mutation of bacteria by UV.
9. Karyotype
10. Pedigree analysis

V. REFERENCES

1. Human Genetics: Concept and Application by Ricki Lewis 10th Edition
2. Vogel and Motulsky's Human Genetics: Problems and Approaches
3. The Principles of Clinical Cytogenetics by Steven L. Gersen, Martha B. Keagle 3rd edition.
4. Human Cytogenetics: Constitutional Analysis: a Practical Approach by Denise E. Rooney.

VI. CO-Curricular Activities

a) **Suggested Co-Curricular Activities**

1 Assignments
2. Seminars, Group Discussions on related topics
3. Charts on pedigree analysis and karyotyping

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
Single Major B.Sc. Biotechnology (w.e.f:2023-24A.B)

SEMESTER-V

COURSE 14: GENOMICS & PROTEOMICS

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about mapping techniques
2. Learn about sequencing analysis
3. Learn about ORF and Gene location
4. Learn about proteomics
5. Learn about determination of proteins

II. Syllabus

UNIT I

1. Introduction of Genomics , Studying the Genome, DNA data bases.
2. Genetic Mapping-Markers for Genetic Mapping; RFLP, SSLP - VNTR's, STR's, SNP's;
3. Physical Mapping - In situ hybridization, Sequence Tagged Sites Mapping.

UNIT II

1. Determination of nucleotide sequence: Chemical degradation method, Sanger's di-deoxynucleotide synthetic method.
2. Direct DNA sequencing using PCR,
3. Sequencing by conventional shotgun method, Whole genome shot gun method, Clone contig method.

UNIT III

1. ORF scanning – Codon bias, Exon-Intron boundaries - Exon trapping, CpG island,
2. Gene location – Southern and Northern blotting hybridization, Zoo blotting.
3. Studying a transcriptome – Microarray or chip analysis, SAGE.

UNIT IV

1. Proteomics - ID–SDS-PAGE, 2D-PAGE.
2. Detection and quantitation of proteins in gels.
3. Protein staining techniques. Affinity purification of proteins.

UNIT V

1. Basics of Mass Spectroscopy- MALDI-TOF
2. ESI and their applications in proteomics.
3. Tandem MS/MS spectrometry , De novo sequencing using mass spectrometric data

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Carry out protein structure prediction experiments.
2. Search and analyze genomic sequence databases using tools.
3. Carry out sterility testing of commercial pharmaceuticals.

SEMESTER-V

COURSE 14: GENOMICS & PROTEOMICS

Practical Credits: 1 2 hrs/week

1. Genome Viewers, SNP Analysis
2. Microarray Analysis
3. Protein Structure Prediction
4. Proteome Analysis
5. Network & Pathway Analysis
6. Calculation of phi and psi angles in proteins.
7. Structure validation and Protein Data Bank
8. Structural and functional motifs in proteins

V. REFERENCES

1. Discovering Genomics, Proteomics, & Bioinformatics (2003). Campbell & Heyer Pearson Education,
2. Bioinformatics, Methods of Biochemical Analysis (2001), Series Vol. 43, Baxevanis & Ouellette, John Wiley & Sons,
3. Computational Molecular Biology. Pevzner, P.A. (2000) MIT Press
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins(2004). Andreas D. Baxevanis & B. F. Francis Ouellette. 3rd Edition. Wiley & Sons,

VI. CO-Curricular Activities

a) **Suggested Co-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Charts on molecular markers

SEMESTER-V

COURSE 15: NANOTECHNOLOGY & PHARMACEUTICAL

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about concept and types of nanoparticles
2. Learn about methods of nanobiotechnology
3. Learn about bio nanoelectronics and applications of nanobiotechnology
4. Learn about Pharmacology and drugs &its types
5. Learn about tissue engineering and production of biological substances

II. Syllabus

UNIT I

1. Nanobiology – concepts, definitions, prospects; nanoparticles – size, shape, properties.
2. Bio nanoparticles – nano starch, nano composites – dendrimers.
3. Hot – Dot nanoparticles. Types of biomaterials. Biodegradable polymers.

UNIT II

1. Methods of nanobiotechnology – Analysis of bimolecular nanostructures by Atomic Force Microscopy, Scanning Probe Electron Microscopy.
2. Nanofabrication - lithography. Drug nanoparticles - structure and preparation ,Liposomes, Cubosomes and hexosomes.
3. Lipid based nanoparticles-liquid nano dispersion, solid liquid nanoparticles

UNIT III:

1. Nanotubes, Nanorods, Nanofibers and Fullerenes for nanoscale drug .
2. Bio nanoelectronics. Applications of nanobiotechnology in medicine, drug designing and cancer treatment.
3. Medical, social and ethical considerations of nanobiotechnology.

UNIT-IV

1. History & principle of pharmacology. Drug names & classification systems.
2. General principle of drug action – Pharmacokinetics, Pharmacodynamics. Measurement of drug action.
3. Chemotherapeutic drugs – Protein Synthesis Inhibitors, Anti-Inflammatory, Antibacterial, Antifungal, Antiviral, Antihelminthic, Anticancer Drugs.

UNIT-V

1. Production of biological – Human insulin, HGH, Erythropoietin's, IFN, TNF, IL, Clotting factor VIII
2. Synthetic therapy: Synthetic DNA, therapeutic ribozymes, synthetic drugs.
3. Tissue Engineering: Skin, Liver, Pancreas. Recombinant vaccines, Cell adhesion based therapy: Integrins, Inflammation

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about biological assays of antibiotics
2. Learn about Minimum Inhibitory Concentration (MIC) of Antibiotic
3. Learn about Sterility testing of commercial pharmaceuticals

SEMESTER-V

COURSE 15: NANOTECHNOLOGY & PHARMACEUTICAL

Practical | Credits: 1 | 2 hrs/week

1. Estimation of penicillin/streptomycin by biological assay.
2. Estimation of penicillin/streptomycin by chemical assay.
3. Assay of antimicrobial activity of Penicillin, Chloramphenicol, streptomycin
4. Determination of Minimum Inhibitory Concentration (MIC) of Antibiotic
5. Determination of shelf life of antibiotics (Expired drugs)
6. Sterility testing of commercial pharmaceuticals.
7. Study of microbial spoilage of pharmaceuticals.
8. Sterility testing of injectable as per IP.
9. Effect of chemical disinfectant on growth of bacteria

V. REFERENCES

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E.Lemons. Biomaterials Sciences: An Introduction to Materials in Medicine 2nd Edition.

2. David L. Nelson and Michael M. Cox, 2006 Lehninger's Principles of Biochemis try, 4th Edition.

3. M.Niemayer, Chad A. Mirkin, 2004. Nanobiotechnology: Concepts, applications and perspectives, Wiley VCH publishers.

4. David. S. Goodsell., 2006. Bionanotechnology: Lessons from Nature, Jhonwiley.

5. K.K. Jain, Naobiotechnology: Molecular Diagnosis, Tailor L. Francis Group.

VI. CO-Curricular Activities

a) **Suggested C0-Curricular Activities**

1 Assignments
2. Seminars, Group Discussions on related topics
3. Charts on drug action, chemotherapeutic drugs

ADIKAVI NANNAYA UNIVERSITY: RAJMAHENDRAVARAM
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SEMESTER-V

COURSE 15: APPLICATIONS OF BIOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. LEARNING OUTCOMES

On successful completion of the course, the students will be able to

1. Learn about concept of culturing of stem cells and tissues
2. Learn about Applications of recombinant DNA technology
3. Learn about Intellectual Property Rights and Patenting issues
4. Learn about energy resources
5. Learn about Microbial treatment and degradation

II. Syllabus

UNIT-I

1. Culture of cells and tissues (including Stem cells and their application)
2. In vitro fertilization and embryo transfer technology, Methods of gene transfer – Microinjection and viral mediated gene transfer techniques
3. Production of transgenic animals and molecular pharming, Principles of Ex vivo and In vivo gene therapy

UNIT-2

1. Mass cultivation of cell cultures and process engineering – batch and continuous cultures, Bioreactors
2. Production of commercially useful compounds by plant cell culture, Methods of gene transfer techniques (*Agrobacterium*, Microprojectile bombardment)
3. Applications of recombinant DNA technology in agriculture, Production of therapeutic proteins from transgenic plants

UNIT-III

1. Primary and secondary metabolic products of microorganisms
2. Commercial production of fuels and chemicals by microbial fermentations
3. Animal cells as bioreactors, Intellectual Property Rights and Patenting issues

UNIT-IV

1. Renewable and non-renewable energy resources
2. Conventional energy sources and their impact on environment.
3. Non-conventional fuels and their impact on environment

UNIT-V

1. Microbiological treatment of municipal and industrial effluents
2. Microbial degradation of pesticides and toxic chemicals
3. Biopesticides and Biofertilizers (Nitrogen fixing, phosphate solubilizing microorganisms), Microbial ore leaching

III . Skills Outcome

On Successful Completion of this Course, Student shall be able to

1. Learn about different isolations of microorganisms from various sources
2. Learn about production of alcohol and wine
3. Identify the purity of sample
4. Identify the DO/ BOD/COD in different sample
5. Learn about isolation on food spoiling Microorganisms

SEMESTER-V

COURSE 15: APPLICATIONS OF BIOTECHNOLOGY

Practical | Credits: 1 | 2 hrs/week

1. Isolation of industrially important microorganisms from soil.
2. Production of alcohol or wine using different substrates.
3. Detection of coliforms for determination of the purity of potable water.
4. Determination of dissolved oxygen concentration of water sample
5. Determination of biological oxygen demand of sewage sample
6. Determination of chemical oxygen demand (COD) of sewage sample.
7. Quantitative analysis of food for a) Moisture b) ash c) Iron d) Calcium
8. Isolation and identification food spoiling microorganisms.

V. REFERENCES

1. Industrial Microbiology by A.H.Patel,2009
2. Prescott & Dum (2002) Industrial Micrbiology, Agrabios (India) ,2005,Publishers
3. Creueger W. & Crueger A.A Text of Industrial Microbiology,2000, 2nd Edition, Panima Publishers corp.
4. K. Vijaya Ramesh, Environmental Microbiology, 2004,MJP Publishers, Chennai.
5. A.G. Murugesan, C. Raja Kumari, Environmental Science & Biotechnology - Theory &
6. Techniques, 2005,MJP Publishers
7. "Food Biotechnology" by Elsayed Abdel-Aal and Andy Khatwa (2019)
8. "Introduction to Food Biotechnology" by Perry Johnson-Green (2016)

VI. CO-Curricular Activities

a) **Suggested Co-Curricular Activities**

1. Assignments
2. Seminars, Group Discussions on related topics
3. Awareness on waste water management