CVM UNIVERSITY

MASTER OF SCIENCE INTEGRATED BIOTECHNOLOGY PROGRAMME

Under Choice Based Credit Scheme

Structure with Effect From: 2020-21

M. Sc. Integrated Biotechnology Programme Details

Programme Objectives (POs):

The overall aim of the integrated biotechnology programme is to provide basic understanding of the core principles and working knowledge of modern day biotechnology which will be necessary for future scientific endeavours and make our students to pursue higher education and research in the field of allied areas of biotechnology. To make our students capable in the field of biotechnology and its allied areas by means of lecture series and a research project. To provide strong fundamentals of biotechnology and its industrial application. To empower students with the comprehensive understanding of the principles and practices in the field of biotechnology to produce responsible biotechnologist that can work in the area of social welfare and as an entrepreneur with strong ethics and communication skills. To maximize the benefits of biotechnology to nation and globe to solve problems which will improve the quality of life for those suffering from health related diseases and disorders.

Programme Specific Outcomes (PSOs):

After successfully completing this course, the student should be able to understand the core principles and topics of modern day biotechnology and other allied areas. Student can implement the knowledge in domain of advanced biotechnology empowering their applications in research and industry to deliver sustainable edge to present society. Students will exhibit contemporary knowledge in biotechnology and will develop problem solving skills and critical thinking to the allied fields of biotechnology. As biotechnology is rapidly developing field, ample of opportunities are available for students with biotechnology background at national and international level in the field of academics, research, pharmaceutical companies, fertilizer industry, food processing industries, entrepreneurship ventures, chemical industry, textile industry, aquaculture industries and environment sector.

Programme Structure:

M. Sc. Integrated Biotechnology is a five years course that a student can pursue after the completion of Class12th science. M. Sc. Integrated Biotechnology is divided in to ten semesters. After completion of five years M. Sc. Integrated Biotechnology degree is awarded, however on student demand after completion of three years B. Sc. Biotechnology degree can be awarded. Direct admission to 2 years M. Sc. Integrated Biotechnology is also possible.

Course Credit Scheme

Semester I

Type of course	Course Code	Name of Course	T/P	Credit	Exam Duration	Component of Marks		
						Internal	External	Total
						Total/ Passing	Total/ Passing	Total/ Passing
Core - 1	101160101	Chemistry-I	T	4	3 hrs	40/14	60/21	100/35
Core - 2	101160102	Biochemistry -I	T	4	3 hrs	40/14	60/21	100/35
Core - 3	101160103	Microbiology	T	4	3 hrs	40/14	60/21	100/35
Elective 1 (For B group)	101160104	Biomathematics	T	4	3 hrs	40/14	60/21	100/35
Elective 2 (For A group)	101160105	Plant and Animal science	T	4	3 hrs	40/14	60/21	100/35
	101160106	Practical based on 101160101and 101160102	P	4	3 hrs	40/14	60/21	100/35
	101160107	Practical based on 101160103and 101160104/101160105	P	4	3 hrs	40/14	60/21	100/35
Ability Enhancement	101160108	English Communication	T	2	2 hrs	20/7	30/11	50/18
Viva-Voce	101160109	Comprehensive Viva-Voce	V	1	--		50/18	50/18
Total Credit				27				

Course Wise Content Details for M.Sc. Integrated Biotechnology
CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER I
M.Sc. Integrated Biotechnology
SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160101: Chemistry-I

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of the fundamental principles of chemistry and to enable understanding of the nomenclature, structural, isomerism, stereochemistry of organic compounds. Student will understand acid-base concept and solution behaviour. It provide the fundamental knowledge of the properties of transition metals and basics of coordination chemistry.

Learning Outcomes:
At the end of this course, the student will be able to:

1. Understand the fundamental principles of organic chemistry that include chemical bonding,
2. Learn nomenclature, structural of various classes of compounds,
3. Develop concept of isomerism, stereochemistry, Chirality.
4. Acquire concept of Acidity, Alkalinity, applications of indicator. .

UNIT I: IUPAC nomenclature

- Introduction of organic compound and their classification. Physical Properties and systemic IUPAC nomenclature of different class of organic compounds including alkanes, alkenes, alkynes, cycloalkanes, bicyclic, spiro, aromatic and heterocyclic compounds.

UNIT II: Stereochemistry

- Elements of symmetry centre, plane and axis of symmetry. Isomers and classification of isomers. Configuration, conformational isomers. Separation of enantiomers. Absolute configuration (R and S).Conversion of projection formulas.
- Stereochemistry of compounds containing two asymmetric carbon atoms. Conformations around a C-C bond in acyclic compounds.
- Structure of cycloalkanes, Cyclohexane conformations. Stereochemistry of disubstituted cyclohexanes.

UNIT III: Ionic equilibrium in aqueous solutions

- Acids & Bases, Arrhenius theory of Acids and Bases, The Lowry – Bronsted Concept, Strength of Acids and Bases, The Lewis concept, pH Scale, pH and Buffers Structure and physical properties of water, Self-Ionization of water, Hydrolysis, Buffer Solutions, Indicator, Sparingly Soluble Salts, Common ion effect, Selective Precipitation, acid-base titration and use of indicators, mathematical treatment of acid-base titrations.

UNIT IV: Fundamental concept of coordination chemistry

- Position of d-block elements in the periodic table, Electronic configuration and Classification of d-block elements in 3d, 4d, 5d and 6d series. Definition of coordination compounds Werner's theory, Co-ordination number, Classification of ligands, Nomenclature of co-ordination compounds, Chelate, chelating ligand and Chelation, Uses of Chelates.

REFERENCE BOOKS:

1. Morrison R. T. & Boyd R. N., *Organic chemistry* (6^{th} edition).
2. IUPAC nomenclature by Robert M. Silverstein.
3. Stereochemistry by P. S. Kalsi.
4. A text book of organic chemistry by Arun Bahl & B. S. Bahl, 16^{th} Edition
5. Principles of Physical chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, 41^{th} Ed**.**
6. Biophysical chemistry, Principles and Techniques by Upadhyay, Upadhyay and Nath.
7. Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry,* Wiley
8. Elements of Physical Chemistry by S. Glasstone and D. Lewis

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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160102: Biochemistry -I

Course Objectives:

The course is aimed to provide insight into fundamentals of structures and functions of biomolecules. Student will able to understand basic structure of enzymes and mechanism of action. It also helps to understand the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids and their importance in biological systems and to develop skills to determine amino acid and nucleotide sequences of proteins and DNA respectively.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Understand chemical and physical characters of biomolecules to be known to the students.
2. Learn the structure, classification and functions of Carbohydrates, Lipid, Protein and Nucleic acid and enzyme
3. Different protein structure, their physical chemical properties

UNIT I: Introduction to Biomolecules

- Nature of biological material and general properties of biomolecules. **Carbohydrate**: Introduction, occurrence, physiological importance, classification of carbohydrates, monosaccharide, disaccharide, oligosaccharides and polysaccharides.
- Physiological properties of carbohydrates, asymmetric centre in monosaccharides, Optical isomerism, stereoisomerism, epimers, mutarotation, diasterioisomerism configuration in sugar, cyclic structure anomeric carbon atom, fisher's projection formula, Haworths representation.
- Chemical properties of carbohydrates, oxidation and reduction of sugars, action of mineral acids, hydrogen cyanide, and hydrazine on sugars due to hydroxyl groups, reducing action of sugars.
- Polysaccharides: occurrence, structure and physiological importance of starch, glycogen, cellulose, hemicellulose, dextrin, pectin, agar, hyalouronic acid, heparin and chondrotin sulphate.

UNIT II: Aminoacids and proteins

- Structure and classification of amino acids, rare aminoacids of proteins, non-protein aminoacids, Essential aminoacids, amphoteric nature of protein, titration curve of glycine. Physical properties of amino acids- stereospecificity and optical activity.
- Chemical properties of amino acids, chemistry of peptide linkage. Classification of proteins, solubility criteria: salting in and out of protein. Denaturation of proteins.

Structure of proteins with examples (Primary, secondary, tertiary, quaternary). Determination of sequence of proteins.

UNIT III: Lipids

- Definition, classification of lipids, fatty acids, essential fatty acids triacylglycerol, properties of triacylglycerol, phospholipids, glycolipids, sphingolipids, sterols, there properties, structures, functions. Lipoproteins.

UNIT IV: Nucleotides and nucleic acid

- Structure of nitrogen bases and sugars, structure of nucleosides and nucleotides, Ribose, Deoxyribose and their conformation. - Structure and properties of DNA, forms of DNA.
- **Enzymes:** Nomenclature and classification, chemical nature and properties of enzymes, factor affecting enzyme activity, active site, enzyme inhibition, enzyme specificity, Coenzymes.

REFERENCE BOOKS:

1. Biochemistry by Lubert Stryer, W. H. Freeman and Company. 4th /6th edition, 2000/2004 Hardback, ISBN 0716720094
2. Fundamentals of Biochemistry: Life at the Molecular Level, by D. Voet, J. G. Voet, and C. Pratt, 3rd Edition, John Wiley and Co John Wiley & Sons, Inc., New York, , 2008 ISBN **:** 0471214957; 9780471214953
3. Principles of Biochemistry by Albert Lehninger, W.H. Freeman & Company; 3rd edition (February 2000), ISBN-10: 1572591536
4. Harper's Biochemistry: Harper, 27th Edition, McGraw-Hill Publishing Co; Robert K. Murray, Daryl K. Granner, Victor W. Rodwell, 2006 ISBN-10: 0071461973
5. Outlines of Biochemistry by Conn E E , Stumps P E and and Doi, R.H., John Wiley and sons, Singapore, 5th Edition - 2001
6. Principles of Biochemistry by Horton,Morgan, Secrimgeour,Perry, Rawn , pearson International edition – 4th edition ISBN 978-1-4058-2573-3
7. Harper's Biochemistry: R. K. Murray and others. Appleton and Lange, Stanford. ISBN: 0838536905 25 edition (pb) 2000
8. Plummer, D.T. (1987). 3rd ed. An introduction of Practical Biochemistry. McGraw Hill Book Co.

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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160103: Microbiology

Course Objectives:

The main objective of this course is to give students comprehensive knowledge of the historical aspects and development of Microbiology. To make the students to understand the different aspects to the classification of Prokaryotes. Students will provide in-depth knowledge on the structure and functions of prokaryotic and eukaryotic cells. Student will learn properties of viruses and exhaustive knowledge of fungi. Further it gives insight into hands on training of basic microbial techniques which will give the student a strong base in scope of microbiology.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Acquire knowledge about history and scope of Microbiology.
2. Understand various methods of microbial classification.
3. Differentiate prokaryotic and eukaryotic cell structure and functions.
4. Learn about viruses and nutritional requirements and modes of reproduction in fungi.

UNIT I: Historical foundation of Microbiology

- Establishment of microbiology as a discipline: Spontaneous generation *vs* biogenesis, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology.
- Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A.Waksman. Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner.

UNIT II: Classification and Prokaryotic cell structure

- Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Classification in brief as per Bergey's Manual of Systematic Bacteriology.
- Overview of prokaryotic cell structure, prokaryotic cell membranes, prokaryotic cytoplasm, cytoplasmic inclusion bodies, cell wall, ribosome, and capsule. Bacterial endospores, exospores, and cyst. Bacterial motility. Bacterial chromosome, nuclear material, plasmid and episomes.

UNIT III: Eukaryotic cell structure and function

- Overview of eukaryotic cell structure, Eukaryotic membranes, Cytoplasmic matrix, Organelles of the biosynthetic-secretory and endocytic pathways, Ribosomes,

Mitochondria, Chloroplast, Nucleus, Structures external to the plasma membrane, Comparison of prokaryotic and eukaryotic cells.

UNIT IV: Viruses, Other Acellular Agents and Fungi

- Introduction to viruses, General properties of viruses, Viral reproduction, Cultivation of viruses, Virus purification and assays, Principles of virus taxonomy, Viroids and Virusoids, Prions. Lytic and lysogenic cycles.
- Introduction of fungi, Distribution, Structure, Nutrition and metabolism, Reproduction, Characteristics of fungal divisions and Economic significance.

REFERENCE BOOKS:

1. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
2. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
4. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. 3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education limited.
7. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
8. Dubey RC and Maheswari DK. A Text book of Microbiology. (2005).S. Chand & Company Ltd., New Delhi.

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SEMESTER I
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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160104 (for B group): Biomathematics

Course Objectives:

As the study of biological systems becomes more quantitative, the part that biomathematical analysis plays increases. This extends from the macroscopic, such as modelling the spread of a disease through a community, to the microscopic, such as determining the three-dimensional structure of proteins from knowledge of their sequence of amino acids. Understanding Equations and spectroscopy data analysis are to be very beneficial. Hands on module on various tools for Biomathematics especially excel is the key for future work as Statistical part is everywhere in research.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Understand mathematical modelling and applications of applied mathematics.
2. Extend the range of usage of mathematical models in biology, ecology and evolution problems.
3. Learn application of multivariable calculus, ordinary differential equations, stochastic models and partial differential equations.

UNIT I:

- **Scientific Notation, Powers and Prefixes** To write large and small numbers in scientific notation Convert between decimals and scientific notation Add, subtract, multiply and divide in scientific notation know all of the standard prefixes and use them in calculations, Convert between units and prefixes.
- **Amount and Concentration: Making and Diluting Solutions**. Calculate concentration from amount in g and volume in L and express in g/L, % w/v, % w/w, % v/v Convert amounts from g to mol and vice versa. Calculate concentration from amount in mol and volume in L and express in M with an appropriate prefix Convert between concentration in g/Land M Calculate amount/volume required to make a solution of a certain concentration (in g/L and M) Calculate volumes required to make a dilution and the concentration of the resulting solution

UNIT II:

- **Understanding Equations: Using, Rearranging and Manipulating Equations** To add, subtract, multiply and divide fractions using numbers and symbols, to carry out calculations with numbers and symbols using the correct order of operations
- **Spectrophotometry**: Describe the basic principles of spectrophotometry; State the Beer-Lambert Law and define the Molar Absorbance Coefficient, Calculate the Molar Absorbance Coefficient
- **Michaelis-Menten Equation**: sketch the shape of a curve from the equation; understand the difference between variable and parameter; understand the effect that changing the parameters has on the shape of the curve, how to derive the equation,

Rearrange an equation for a rectangular hyperbola into that of a straight line (eg the Lineweaver-Burke plot)

UNIT III:

- **Introduction to logarithms.** Rationale: What are logs for? Writing numbers in logarithmic notation Using a calculator to get the log and anti-log Using logs - understanding the pH scale
- **Manipulating logs.** Multiply and divide with logs Power of a power Using the rules of logs to derive the Henderson-Hasselbalch Equation Using the rules of logs to calculate the likelihood of a drug **crossing** a cell membrane from the stomach to the blood
- **Logs with different bases.** Sketching exponential growth and decay**,** Logs to the base 2**,** Changing the base What is "e"? What are "natural logs"? Using natural logs - calculating half-time**,** Using log graph paper

UNIT IV:

- **Statistics for Biology made simple using Excel**
  Descriptive statistics mean, median, mode, standard deviation, standard error, confidence interval Graphing data scatter graphs, bar, graphs, error bars, lines. Association statistics Pearson coefficient, Spearman coefficient, linear regression. Comparative statistics paired and unpaired, t-test, ANOVA. Frequency statistics χ^2-test.

REFERENCE BOOKS:

1. Mathematics for Biological Science by Jagdish Arya and Ladner.
2. Practical Skills in Biomolecular Sciences (4th eds.) By: Rob Reed, David Holmes, Jonathan Weyers, Allan Jones, British Library Cataloguing-in-Publication, 2013. ISBN 978-1-4082-4552-1.
3. Introduction to Mathematics for Life-Sciences by P. Batschelet – Springer - Verlag.
4. Biostatistics by P. N. Arora and P.K.Malhan.
5. Fundamentals of Biostatistics by Khan and Khanum.
6. https://camtools.cam.ac.uk/access/content/group/6041b37a-7fa4-4a47-808b-b20db3a36122/Module%202/Practice%20Questions/mod2/index.htm

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101160105 (for A group): Plant and Animal sciences

Course Objectives:

The major objective of this paper is to develop clear understanding of various aspects of Plants and animal science which includes identification of species based on classification, importance of individual phylum, importance of medicinal plants and economically important families, plant and animal diversity, histology etc. Students will gain an interest in learning about plants and animals by understanding the similarities in survival needs among all living things.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework.
2. Understand the importance of Bryophytes, Pteridophytes, Gymnosperms and Angiosperms and familiarize the traditionally useful medicinal plants.
3. Get a concrete idea of the evolution, hierarchy and classification of fascinating world of Animal kingdom.
4. Predict and understand organ behavior and function as tissues are the building blocks of virtually everything in the body.

UNIT I: Cryptogams

- Eichler's system of Classification. Algae: Introduction, Distribution and habitat, Morphology, Reproduction and Life Cycle of Spirogyra and Economic importance of Algae. Fungi: Introduction, Distribution and habitat, Morphology, Reproduction and Life cycle in Mucor.
- Lichens: Introduction and General account of Lichens. Bryophyta: Introduction, Distribution and habitat, Morphology, Reproduction and Life cycle in *Riccia*. Pteridophyta: Introduction, Distribution and habitat, Morphology, Reproduction and Life Cycle in Fern.

UNIT II: Phaenerogams

- Gymnosperms: Introduction, Distribution and habitat, Morphology, Reproduction and Life cycle in *Cycas*. Introduction, Classification (Bentham & Hooker), Morphology and Life Cycle of Maize and Sunflower.

- Study of the families and their Economic importance: Malvaceae, Cucurbitaceae, Solanaceae and Apocynaceae. Medicinal Plants: *Ocimum sanctum*, *Adhatoda vasica*, *Azadirachta indica*, *Calotropis procera*, and *Withania somnifera*.

UNIT III: Animal Diversity – Systematics (Non-chordates)

- Salient features and outline classification up-to classes with suitable examples (excluding minor Phyla). Phylum – Protozoa, Porifera, Coelenterata, Platyhelminthes, Nemathelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Hemichordata Animal Diversity – Systematics (Protochordates and Chordates).
- Salient features and outline classification upto classes with suitable examples. Protochordates –Urochordata, Cephalochordata. Chordates – Cyclostomata, Pisces, Amphibia, Reptilia, Aves, Mammalia.

UNIT IV: Histology

- Structure and functions of animal tissues (in detail with types and suitable examples). Epithelial tissue: Simple (Squamous, Columnar, Ciliated, Glandular, Sensory, Germinal, Psuedo-stratified) and Compound (Stratified, Transitional).
- Connective tissue: Connective tissue proper (Areolar, White fibrous, Yellow fibrous, Adipose), Skeletal (Cartilage – Hyaline, Fibro-cartilage, Elastic cartilage, Calcified cartilage, Mammalian bone), Fluid (Blood, Lymph).
- Muscular tissue: Smooth, Striated, Cardiac Nervous tissue: Structure and types of neuron and nerve fibers.

REFERENCE BOOKS:

1. Botany for degree students by A. C. Dutta, (18th Ed. 2005), Oxford University Press. ISBN: 13:978-0-19-563748-9, ISBN: 10:0-19-563748-8.
2. University Botany-I, Algae, Fungi, Bryophyta and Pteridophyta by S. M. Reddy, Publishers: New Age International (P) Limited, Mumbai. ISBN: 81-224-0840-0.
3. University Botany- II- Gymnosperm, Angiosperms by S. M. Reddy, Publishers: New Age International (P) Limited, Mumbai.
4. A Textbook of Zoology by PN Pandey & RD Vidyarthi, S Chand Publications, New Delhi.
5. Invertebrates by RL Kotpal, Rastogi Publications, Meerut.
6. Vertebrates by RL Kotpal, Rastogi Publications, Meerut

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SEMESTER I
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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160109: English Communication

Course Objectives:

English is now used almost exclusively as the language of science. The adoption of a de facto universal language of science has had an extraordinary effect on scientific communication: by learning a single language, scientists around the world gain access to the vast scientific literature and can communicate with other scientists anywhere in the world. Students will learn about various scientific terms and will be able to enhance skills. Verbal and Non-verbal communication, writing skills, reviewing will be remedy for the students to get better and better subjectively.

Learning Outcomes:
At the end of this course, the student will be able to:

1. Understand the preparation of Well-organized presentation slides
2. Improve presenting skill
3. Learn biological, and Chemical vocabulary and Terminology
4. Understand verbal and Non-Verbal communication

UNIT I: Vocabulary and Presentation Skill Development

- Listening Skills, Speaking Skills, Reading Skills and Writing Skills (LSRW)
- Defining the Purpose & how to make an effective presentation (MS PowerPoint)
- Outline preparation
- Review / Content / Précis writing

UNIT II: Introduction and Language of Communication

- Theory of Communication, Types and Modes of Communication
- Verbal and Non-verbal (Spoken and Written)
- Personal, Social and Business Barriers and Strategies; Intra-personal, Inter-personal and Group communication, Expressing opinions

REFERENCE BOOKS:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

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101160106: LAB- I (Practical based on 101160101and 101160102)

PRACTICALS:

1. Volumetric analysis: Determination of concentration of Strong acid [HCl] and weak acids [oxalic acid/Acetic acid] by titrating against strong base [NaOH].
2. Volumetric analysis: Determination of concentration of transition metal salts (Cu, Ni, Zn) by titrating against EDTA.
3. Qualitative Analysis : Identification of Organic substance:
    - Salicylic acid
    - Cinnamic acid
    - Benzoic acid
    - α-Naphthol
    - β-Naphthol
    - o-nitroaniline
    - m-nitroaniline
    - p-nitroaniline
    - Naphthalene
    - m-dinitrobenzene
    - Anthracene.
4. Identification of biomolecules: Carbohydrate (Molisch's test), Protein (Biuret) & lipid (Saponification).
5. Qualitative analysis of carbohydrates: Molisch's test, Iodine test, Benedict's test, Fehling's test, Cole's test, Barfoed's test, Saliwanoff's test, Rapid furfural test, Osazone test, Mucic acid test, Inversion test.
6. Qualitative analysis of proteins: Precipitation test, Mercuric nitrate test, Lead acetate test, Sulphosalicyllic test, Potassium ferricyanide test, Tannic acid test, Alcohol test, Heller's test, Ammonium sulphate test.
7. Qualitative analysis of amino acids: Colour reactions, Biuret test, Ninhydrin test, Millon's test, Arginine test (Sakaguchi test), Xanthoproteic test, Hopkin's Cole test, Ehrlich test, Nitroprusside test.
8. Qualitative analysis of fat: Test for oil, Solubility test, Dichromate test, Emulsion test, Absorption test, Glycerol test, Acid value of oil, Saponofication test, Iodine test, Borax test, and Liebermann-Burchard test.
9. Estimation of protein by Biuret method.
10. Estimation of carbohydrate by DNS method.
11. Estimation of DNA by DPA method.

101160107: Practical based on 101160103 and 101160104/101160105

PRACTICALS:

1. Preparation and sterilization of culture media for bacterial cultivation
2. Study of different shapes of bacteria using permanent slides/ pictographs
3. Simple staining: Monochrome staining and Differential: Gram's staining
4. Endospore staining
5. Capsule staining
6. Determination of motility of bacteria by (i) hanging drop method (ii) Agar stab method
7. Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution]
8. Determination of CFU count.
9. Study of the following fungi by preparing temporary mounts: *Rhizopus* and *Aspergillus*.
10. To apply the concept of function in biosciences.
11. Use the concept of exponential & logarithmic function in the field of biosciences.
12. To make use of log function in some complex calculation of mathematics.
13. Problem related to Beer – Lambert Law.
14. Problem related Michaelis – Menten Equation.
15. To convert ungrouped data in to grouped data using Sturge's formula.
16. To study how to calculate descriptive statistics for the given data. (Mean mode, median, standard deviation and mean deviation).
17. Study of algae, fungi (mount preparations) and Lichen.
18. T.S. of cycas leaf and fern rachis.
19. Study of the families – *Malvaceae, Cucurbitaceae, Solanaceae & Apocynaceae.*
20. Study of grafting techniques.
21. Study of specimens of protozoa, Porifera, Coelenterata, Platyhelminthes, Nemathelminthes, Annelida, Arthropoda, Mollusca and Echinodermata.
22. Study of specimens of Protochordata and Vertebrata (Pisces, Amphibia, Reptilia, Aves and Mammalia)
23. Study of Histological slides of Mammalian tissues / Organs (Permanent): T.S. of Stomach, Small Intestine, Liver, Pancreas, Lung, Kidney, Testis, Ovary, Spinal cord and V.S. of Skin.

REFERENCE BOOKS:

1. Mendham, J., Denney, R. C., Barnes, J. D., Thomas, M. J. K., *Vogel's textbook of quantitative chemical analysis*, 6th Edition.
2. Pandey, O. P., Bajpai, D. N.,Giri, S., *Practical Chemistry*.
3. Ghoshal, Mahapatra ,Nad , *An Advanced course in Practical Chemistry*.

Course Credit Scheme

Semester II

Type of course	Course Code	Name of Course	T/P	Credit	Exam Duration	Component of Marks		
						Internal	External	Total
						Total/ Passing	Total/ Passing	Total/ Passing
Core – 1	101160201	Cell Biology	T	4	3 hrs	40/14	60/21	100/35
Core – 2	101160202	Biochemistry -II	T	4	3 hrs	40/14	60/21	100/35
Core – 3	101160203	Microbial Physiology	T	4	3 hrs	40/14	60/21	100/35
Elective 1	101160204	Chemistry II	T	4	3 hrs	40/14	60/21	100/35
	101160205	Practical based on 101160201 and 101160202	P	4	3 hrs	40/14	60/21	100/35
	101160206	Practical based on 101160203 and 101160204	P	4	3 hrs	40/14	60/21	100/35
Ability Enhancement	101160207	Environmental Science	T	2	2 hrs	20/7	30/11	50/18
Viva-Voce	101160208	Comprehensive Viva-Voce	V	1			50/18	50/18
	Total Credit			**27**				

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CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER II
M.Sc. Integrated Biotechnology
SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160201: Cell Biology

Course Objectives:

Cell biology is the study of structure and function of prokaryotic and eukaryotic cells. In this course the students will learn different areas of cellular biology including the structure and functions of cell, its organelles, synthesis and function of proteins, membrane structure and function; bioenergetics; cellular communication, division of cell and chromosomal separation in different stages of cell cycle.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Understand the structures and purposes of basic components of plant cell, Animal cells, prokaryotic and eukaryotic cells, especially macromolecules, membranes, and different cell organelles.
2. Learn how these cellular components are used to generate and utilize energy in cells.
3. Understand the cytoskeleton structure, protein sorting, Cell cycle, programme cell death and the cellular components underlying mitotic cell division.

UNIT I: Cell Structure and Function:

- Discovery, Origin of Cell and Cell theory, Cell as basic unit of life (Plant and Animal Cell structure, Comparison between plant and animal cells), Cell Wall, Differences between Prokaryotic and Eukaryotic cells, Structure and its function of Plasma membrane (Three dimensional), Chemical composition of Biological membranes, Membrane models, Fluid mosaic membrane model, Transport across membrane (Active and Passive transport, Facilitated diffusion, Gated channels, Na+ K+ Pump). Cell junction's structure and its types.

UNIT II: Cytoskeleton structure and functions:

- Overview of the Major Functions of Cytoskeleton. Microtubules: Structure, Composition and functions, Composition, Assembly and Disassembly, Structure, composition and functions of Centrioles and Basal bodies, Microtubules in Cilia and Flagella. Microfilaments and Intermediate filaments: Structure and Composition; Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III: Structure of Nucleus

- Nuclear membrane, nuclear pore, nucleolus, chromatin, structure of nucleic acids. Mitochondria – Ultra structure and function; Biogenesis of mitochondrial Genomes,

Chloroplast – Ultra structure and function, Genome biogenesis. Ribosomes detailed structure and its function with involvement in protein synthesis. Vacuoles, Lysosomes structure and functions.

UNIT IV: Cell cycle and Cell division

- The key roles of mitosis and meiosis during the life cycle. Types of cell divisions. Different Stages of mitosis and meiosis, highlighting similarities and differences. Significance of Mitosis and Meiosis.
- Overview of the Cell cycle and its control. Programmed Cell Death: Difference between necrosis and apoptosis.

REFERENCE BOOKS:

1. Cell Biology by C.B. Powar. (Reprinted-2004)Himalaya Publishing House, Mumbai.
2. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V.K. Agarwal (Reprinted -2007) Pub.S.Chand & Company Ltd.Ram Nagar, New Delhi-110055.
3. Cytology by P.S. Verma and V.K. Agarwal (Reprinted -2006) Pub:S.Chand & Company Ltd.Ram Nagar, New Delhi-110055.ISBN: 81-219-0814-0.
4. Molecular Biology of the cell by Albert et al.4th Edition, 2002, Garland Science, Taylor & Francis Group. ISBN: 0-8153-3218-1.
5. The Cell – A Molecular Approach By Geoffrey M. Cooper And Robert E. Hassman. 3rd Edition, 2004, ASM Press, Sinauer Associates, Inc.ISBN:0-87893-214-3.

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SEMESTER II
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101160202: Biochemistry -II

Course Objectives:

The aim of this course is to associate concepts in the areas of bioenergetics and metabolism. The focus is on the main metabolic pathways involved in carbohydrate, lipid, and protein metabolism, how these pathways are regulated and disrupted in disease and how energy is obtained to meet the cell's needs. Other objectives are to engage students in discussions on topics of Bioenergetics and Metabolism, have them think and raise questions, train their critical reading of scientific literature in this field, and develop skills in presentation and scientific discussion

Learning Outcomes:

At the end of this course, the student will be able to:

1. Understand basics of bioenergetics to be known to the students.
2. Learn metabolism of carbohydrate.
3. Understand metabolism of amino acid and protein.
4. Acquire knowledge of metabolism of Nucleic acid and lipid.

UNIT I: Basic of Bioenergetics

- Energy transformation, Laws of thermodynamics, entropy, free energy of reaction, Biological oxidation-reduction reactions, standard redox potentials, Hydrolysis of energy rich intermediates and ATP ,Respiratory transport, Electron Transport and Proton pump, Oxidative Phosphorylation and ATP synthesis, conformational changes and chemiosmotic theory, central dogma of energy transduction.

UNIT II: Metabolism of Carbohydrate

- Glycolysis, Gluconeogenesis, Regulation of glycolysis and Gluconeogenesis, Pentose Phosphate Pathway, TCA cycle, ATP Stoichiometry of the TCA Cycle, Regulation of TCA Cycle Activity, Glyoxylate Cycle.

UNIT III: Amino acid metabolism

- Source of amino acid, Protein turn over, Transamination and deamination reaction, metabolism of ammonia, urea cycle and its regulation, link between urea cycle and TCA cycle,. Overall anabolic and catabolic pathways of pyruvate family, aspartate family, aromatic family.

UNIT IV: Metabolism of Nucleic acid and Lipid

- Metabolism of Nucleic acid: - Biosynthesis of purines and pyrimidines, Degradation of purines and pyrimidines, Regulation of purines and pyrimidines biosynthesis.
- Metabolism of lipid: Overall pathways and regulation of fatty acid synthesis and breakdown. Regulation of complex lipid.

REFERENCE BOOKS:

1. Biochemistry by Lubert Stryer, W. H. Freeman and Company. 4th /6th edition, 2000/2004 Hardback, ISBN 0716720094.
2. Fundamentals of biochemistry: Life at the Molecular Level, by D. Voet, J. G. Voet, and C. Pratt, 3rd Edition, John Wiley and Co John Wiley & Sons, Inc., New York, , 2008 ISBN : 0471214957; 9780471214953.
3. Principles of Biochemistry by Albert Lehninger, W.H. Freeman & Company; 3rd edition (February 2000), ISBN-10: 1572591536.
4. Harper's Biochemistry: Harper, 27th Edition, McGraw-Hill Publishing Co; Robert K. Murray, Daryl K. Granner, Victor W. Rodwell, 2006 ISBN-10: 0071461973
5. Outlines of Biochemistry by Conn E E , Stumps P E and and Doi, R.H., John Wiley and sons, Singapore, 5th Edition – 2001.
6. Principles of Biochemistry by Horton,Morgan, Secrimgeour,Perry, Rawn , pearson International edition – 4th edition ISBN 978-1-4058-2573-3.
7. Harper's Biochemistry: R. K. Murray and others. Appleton and Lange, Stanford. Mcgraw-hill book company ISBN: 0838536905 25 edition (pb) 2000.

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VALLABH VIDHANAGAR
SEMESTER II
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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160203: Microbial Physiology

Course Objectives:

The major objective of this course is to educate the students to develop a clear understanding of the fundamental concepts of microbial physiology and metabolism occurring inside microbes. The students will understand nutritional classification of microbes. Students will understand pure culture techniques and methods of culturing, preservation and maintenance of microorganisms. This course will aid students to acquire skills and competence in microbiological laboratory practices.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Design synthetic media for screening of specific culture.
2. Describe and differentiate type of growth requirement for specific microbial culture.
3. Describe and evaluate the growth of microorganisms and factors affecting it.
4. Describe the microbial photosynthesis and depict the role of pigments associated with microbes.

UNIT I: Microbial Nutrition

- Nutritional types: Requirement of nutrients for microbes and classification of microorganisms based on carbon, energy and electron sources viz. Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph. Primary and secondary active transport; Passive and facilitated diffusion. Effect of oxygen on growth, classification on the basis of oxygen requirement and tolerance (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe).

UNIT II: Media type, control and Preservation

- Role of macro and micro-nutrients. Components of media: Natural, Synthetic, Complex, Selective media, Differential Media, Enriched and enrichment media. Methods for culturing aerobic and anaerobic bacteria; Colony and broth culture characteristics.
- Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation. Chemical methods of microbial control: disinfectants, types and mode of action. Maintenance and preservation techniques for microorganisms (Sub culturing, Oil overlay, Sand cultures, Storage at low temperature, Lyophilisation, Liquid Nitrogen).

UNIT III: Microbial Growth

- Growth in Microbes (growth phases, generation time, growth curve and specific growth rate). Measurement of cell mass and cell number; Factors affecting microbial growth;

Continuous and batch cultures; details of synchronous and Diauxic growth curve. Physical factors influencing growth: Temperature; pH; Atmospheric Pressure; Salt Concentration. Chemical factors: heavy metal (copper), surfactants. Control of Microorganisms: patterns of microbial death, control of microorganism growth by antiseptics.

UNIT IV: Microbial Photosynthesis

- Concept of photosynthesis and associated pigments in microbes; photosynthetic apparatus in pro and eukaryotes; anoxygenic and oxygenic photosynthesis; light and dark reaction; photorespiration and its significance; Effect of light, temperature; pH and CO_2 concentration on photosynthesis; measurement of net photosynthetic yield. Electron transport chain in photosynthetic bacteria.

REFERENCE BOOKS:

1. Moat A.G. and Foster S.W. Microbial Physiology (4th Ed.) (2004). John Wiley and Sons, New York.
2. Gerald Karp. Cell Biology (3rd Ed.) (2003). McGraw Hill Book Company, New York.
3. Stanier R. Y, Ingrahm J. I, Wheelis M. L and Painter P. R. General Microbiology. (5th Ed.) (1987). McMillan Press. UK.
4. Dubey R. C and Maheswari D. K. A Text book of Microbiology. (2005).S. Chand & Company Ltd., New Delhi.
5. Nelson D. L. & Cox M. M. Lehninger's Principles of Biochemistry, 4th edition. (2005). W. H. Freeman & Co. NY.
6. Pelczar Jr, M. J, Chan E. C. S., Krieg N R, Microbiology, (5th Ed.), (2001). McGraw Hill Book Company, NY.
7. Madigan M. T, Martinko J. M and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson/Benjamin Cummings.
8. Reddy S. R. and Reddy S. M. (2005). Microbial Physiology. Scientific Publishers India.

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SEMESTER II
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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160204: Chemistry II

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of the basics of quantitative analysis. Understanding of the standardization and student can apply theoretical knowledge to prepare solutions and basic chemical analysis methods. Student will understand clearly reaction kinetics and thermodynamic parameters of reaction and their application in biological system.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Preparations of solution and to learn concentration units.

2. To understand some of the basics of analytical chemistry.

2. To learn fundamentals of thermodynamic chemistry and chemical kinetics.

3. Develop concept of physical properties of solutions.

4. To apply theoretical concepts in order to solve numerical problems. .

UNIT: I General Introduction of analytical chemistry
Introduction, Qualitative and Quantitative analysis, Types of titrations. Requirements for titrimetric analysis. Concentration systems: molarity, formality, normality, wt%, ppm, milliequalence and millimoles-problems. Primary and Secondary standards, criteria for primary standards. Preparation of standard solutions, standardization of solutions. Limitation of volumetric analysis, endpoint and equivalence point.
Introduction, Instrumental and Chemical Methods of analysis, Applications of Chemical Analytical Chemistry, Sampling of Solid, Liquid and Gas, Stages of Analysis, Interferences, Selection of Methods, limitations of Analytical Methods.

UNIT: II Thermodynamics
Terminology of thermodynamics, First law of thermodynamics, internal energy, enthalpy of a system, heat capacity, spontaneous process, Second law of thermodynamics, concept of entropy, entropy of mixing, standard entropies, criteria for reversible and irreversible process, Gibbs-Helmholtz equation, Third law of thermodynamics, determination of absolute entropies

of elements and compounds. Applications of first and second law of thermodynamics in living cells,

UNIT: III Chemical Kinetics

Introduction, Rate of reaction, Rate constant, Half life time, Determination of Half life time of reaction, Order of reaction Derivation of First law, second order rate reaction constant for (a=b) and (a≠b). Derivation of third order. Mathematical problems. Catalysis characteristics of catalysis, Types of catalysis, homogeneous and heterogeneous catalysis, enzyme catalyzed reaction and derivation mechanism.

UNIT: IV Physical properties of liquids

Surface tension: surface energy, factors affecting surface tension, interfacial tension, surface active agents, measurements of surface tensions.

Viscosity: units of viscosity, factors affecting viscosity, measurement of viscosity, application of viscometer, significance of viscosity in biological system**.**

REFERANCE BOOKS

1. Quantitative analysis by R. A Day, Jr. & A. L. Underwood 6th Edition, Printice Hall of India Private Limited New Delhi. 2005. ISBN: 61-203-0793-3, 9788120307933.
2. Basic concept of Analytical Chemistry by S. M. Khopkar, New age International Publishers, 2004. ISBN 81-224-2092-3.
3. Vogel's Text book of Quantitative Chemical Analysis by J. Mendhan, R. C. Denney, M. Thomas, B. Sivasankar. 6th Ed. Pearson 2009. ISBN : 978-81-317-2325-8.
4. Biophysical chemistry, Principles and Techniques by Upadhyay, Upadhyay and Nath, Himalaya Publishing House, 2019. ISBN978-98-5142-227-3
5. Principles of Physical chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, 41th Ed. Vishal Publishing Co. 2012. ISBN: 81-88646-00-8
6. Lehninger's principles of biochemistry by David Nelson and Michel Cox. 5th Ed. W. H. Freeman Company, New York. 2005. ISBN: 978-0-23022699-9.
7. An advance course in practical Chemistry by Ghoshal, Mahapatra, Nad. New central book agency, Kolkata, 2004. ISBN: 81-7381-302-7.

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SEMESTER II
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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160207: Environmental Science

Course Objectives:

The major objective of this paper is to develop clear understanding of various aspects of environment which includes ecosystem, biodiversity, conservation of biodiversity, Indian hotspots, endangered flora and fauna of India. It also develops an attitude of concern for the environment and acquiring skills to help the concerned individuals in identifying and solving environmental problems.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment.
2. Understand biodiversity, threats to it and modern environmental concept like how to conserve biodiversity.
3. Understand the importance of environmental issues and problems at local, national and international levels.

UNIT I: Introduction to environmental studies and Ecosystems

- Scope and importance of environmental science.
- What is an ecosystem? Structure and function of ecosystem; Ecological pyramids.
- Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT II: Biodiversity and Conservation

- Levels of biological diversity: genetic, species and ecosystem diversity
- Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation;
- Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

REFERENCE BOOKS:

1. Ecology - Principles and Applications by J.L. Chapman & M.J. Reiss. (2008) (2nd Ed.) Cambridge University Press, U.K. (ISBN: 978-0-521-68920-5)
2. Ecology and Environment by P.D. Sharma. (2010). (10th Ed.) Rastogi Publications, Meerut (India). (ISBN: 978-81-7133-905-1)
3. Elements of Ecology by Thomas Smith & Robert Smith. (2007) (6th Ed.) Dorling Kindersley Press. (South Asia). (ISBN: 81-317-1557-4)
4. Fundamentals of Ecology by Eugene Odum & Gray Barrett. (2009) (5th Ed.) Cengage Learning & Nelson Education Press. (ISBN: 978-81-315-0020-0)
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
7. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
8. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.

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CHARUTAR VIDYAMANDAL UNIVERSITY
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SEMESTER II
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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160205: Lab I
(Practicals based on 101160201 and 101160202)

PRACTICALS:

1. Structure and working of microscopes (Simple microscope, Compound microscope)
2. Structure of a plant cell (through chart/model)
3. Structure of animal cell (through chart/model)
4. Observation of Prokaryotic and Eukaryotic cells (plant and animal cells)
5. Preparation of Buccal smear and Identification of Barr Body
6. Localization of chloroplast
7. Localization of lipids
8. Structure of cell organelles adopting preparations/charts/models
    - Mitochondria
    - Chloroplast
    - Ribosomes
    - Endoplasmic reticulum
    - Nucleus
9. Mitosis–Squash preparation of Onion root-tip
10. Meiosis-Squash preparation of anther lobes
11. Estimation of protein by Folin-Lowry method.
12. Estimation of RNA by orcinol method.
13. Estimation of total sugar by Cole's method.
14. Estimation of reducing sugar by Benedict's method.
15. Estimation of SGOT by enzymatic method.
16. Estimation of SGPT by enzymatic method.
17. Separation of amino acid by TLC method

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SYLLABUS EFFECTIVE FROM: JUNE-2020-21

101160206: Lab II
(Practicals based on 101160203 and 101160204)

PRACTICALS:

1. Introduction of media and its constituents for microbial growth.
2. Different methods for isolation and maintenance of microorganisms.
3. Isolation of microbes using differential media.
4. To study and plot the growth curve of *E. coli* using spectrophotometric method and to calculate specific growth rate and generation time.
5. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.
6. To study the effect of temperature of Aspergillus niger by dry weight method.
7. Demonstration of the thermal death time and decimal reduction time of E. coli.
8. Isolation of Photosynthetic bacteria.
9. Preservation of bacterial cultures.
10. Preparation of normal/molar solutions of acids and bases.
11. Preparation and standardization of primary and secondary standard solution.
12. Volumetric analysis of Weak Acid/ Strong Base.
13. To determine the amount of carbonate and bicarbonate in a given mixture by titrating it against sulphuric acid/ hydrochloric acid.
14. To determine the concentration of a solution for the given liquid by determination of surface-tension of a liquid by drop-volume method at various concentration.
15. To determine the viscosity of the given liquid with the help of Ostwald's viscometer.
16. To determine the percentage composition of the given solution by Ostwald's viscometer.
17. To determine the molecular weight of given polymer using Ostwald's viscometer.
18. Determination of Pka value of amino acid (glycine).
19. Potentiometric titration of Acid / Base.

Course Credit Scheme

Semester III

Type of course	Course Code	Name of Course	T/P	Credit	Exam Duration	Component of Marks		
						Internal	**External**	**Total**
						Total/ Passing	**Total/ Passing**	**Total/ Passing**
Core – 1	101160301	Plant Physiology	T	4	3 hrs	40/14	60/21	100/35
Core – 2	101160302	Genetics	T	4	3 hrs	40/14	60/21	100/35
Core – 3	101160303	DNA structure function and repair	T	4	3 hrs	40/14	60/21	100/35
Elective 1	101160304	Bioinstrumentation	T	4	3 hrs	40/14	60/21	100/35
	101160305	Lab I (Practical based on 101160301 and 101160302)	P	4	3 hrs	40/14	60/21	100/35
	101160306	Lab II (Practical based 101160303 and 101160304	P	4	3 hrs	40/14	60/21	100/35
Ability Enhancement	101160307	Biophysics	T	2	2 hrs	20/7	30/11	50/18
Viva-Voce	101160308	Comprehensive Viva-Voce	V	1			50/18	50/18
	Total Credit			**27**				

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SEMESTER III

SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160301-Plant Physiology

Course Objectives:

This course teaches processes of various plant functions such as plant water relationship, mechanism of water absorption, transpiration, ascent of sap, plant movement and absorption of mineral salts, photosynthesis with emphasis on mechanism of abiotic stresses at physiological and molecular level with reference to crop productivity.

Course Learning Outcomes:

Unit I: The students are learning the basic knowledge of water movement of materials into and out of cells and mechanism of water absorption. The absorption of water and minerals, transpiration and ascent of sap and their cell activity and its application.

Unit II: Be able to learn the photosynthesis activity, their different mechanism and its application crop productivity.

Unit III: Students learn the role of different growth hormones and their application in plant growth and development process. Photoperiodism and vernalization for crop cultivation and their utility.

Unit IV: This course also learns the plant movement and stress physiology and their molecular mechanisms.

Contents

UNIT-I

- Water – structure, physical properties and significance to plant life
- Movement of materials into and out of cells – diffusion, osmosis, osmotic pressure, plant cell as osmotic systems, significance of osmosis in plants
- Plasmolysis, its advantages and imbibition.
- Mechanism of water absorption - Active (osmotic and non osmotic) and passive absorption. External factors affecting water absorption.

- Transpiration – kinds of transpiration, mechanism of stomatal transpiration and its significance & factors affecting the rate of transpiration, antitranspirants.
- Ascent of Sap, Path of Ascent Sap. Vital theories, root pressure theory, physical forces theory, transpiration pull and cohesion of water theory
- Absorption of mineral salts: - Mechanism of mineral salt absorption – ion-exchange, passive and active absorption, the carrier concept theory.

UNIT-II

- Photosynthesis: Photosynthetic apparatus, Photosynthetic pigments and absorption of light energy.
- Excited states of atoms or molecules – Fluorescence, Phosphorescence, Quantum requirement and quantum yield
- Mechanism of photosynthesis : Light reaction (Hill reaction) and Dark reaction (Calvin cycle), Blackman's law of limiting factors, factors affecting photosynthesis, significance of photosynthesis to mankind

UNIT-III

- Growth & Growth Hormones: Growth, Kinetics of growth (Growth curve or sigmoid curve). Natural growth hormones - Auxins, Gibberellins, kinetin & cytokinins, ethylene, abscisic acid (ABA) (Discovery, Chemical nature, physiological effects and practical applications).
- Photoperiodism and Vernalization – Classification of plants on the basis of photoperiods, importance of photoperiodism. Vernalization – conditions necessary for vernalization, mechanism of vernalization, practical utility of vernalization

UNIT-IV

- Movements of locomotion – Autonomic and Paratonic (tactic)
- Movements of curvature – Autonomic and paratonic (tropic) growth movements,
- Paratonic Variation movements (Nastic movements) and hygroscopic movements.
- Stress physiology – Introduction, water deficit and drought resistance, salt stress and salt resistance, cold injury and cold resistance, chilling injury and chilling resistance, freezing injury (frost) and freezing resistance, high temperature(heat) stress and high temperature(heat) resistance, heavy metal stress and heavy metal resistance.

REFERENCE BOOKS

1. Jain, V.K. (2007) Fundamentals of plant physiology (10th Edition) S. Chand and Co., New Delhi, India. ISBN; 81 - 219 – 0462 – 5, Code; 03 020.
2. S.N. Pandey & B.K.Sinha (2008) Plant Physiology (4th Edition) Vikas Publishing House Pvt. Ltd., A-22, Sector-4, Noida (UP), ISBN : 81-259-1879-5.
3. S. Mukherji & A. K. Ghosh (2006) Plant physiology, New Central Book Agency (P) Ltd.,8/1 Chintamony Das Lane, Kolkata-700 009 India. ISBN: 81-7381-478-3
4. Salisbury, F.B. and Ross, C.W. (1992) Plant physiology (4th Edition), Wadsworth Publishing Co., California, USA. ISBN: 10: 0534151620.

5. Mohr, H. and Sehopfer, P. (1995) Plant physiology, Springer-Verlag, Berlin, Germany. ISBN: 3-540-58016-6.
6. S. K. Verma and Mohit Verma, A text book of Plant physiology, Biochemistry and Biotechnology, S. Chand & Co., New Delhi, India. ISBN; 81-219-0627- Code; 03A 202.
7. Devlin and Witham, Plant physiology
8. Noggle and Fritz, Introduction to Plant physiology, Printice Hall, India.

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CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER III

SYLLABUS EFFECTIVE FROM: JUNE-2021-22
101160302: Genetics

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of Classical and modern Mendelian genetics, success of Mendel's experiment, Chromosomal theory of inheritance. The objectives also include Allelic and non-allelic gene interaction along with the genetic linkage and crossing over along with the determination of sex in various species as well as aberration of chromosome with population genetics.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Learn Mendelian Genetics, Mendel's law of segregation, Independent assortment, pedigree
2. Will get knowledge of Gene interaction at different level, dominant and recessive gene.
3. Develop concept of linkage of gene and its exchange during crossing over and extra chromosomal Inheritance.
4. Acquire the knowledge of sex determination in mammals, plants and animals, structure of X and Y Chromosomes.
5. Develop concept of chromosomal aberrations, Hardy Weinberg law, and evolutionary genetics.

UNIT I: Fundamentals of Genetics:

Historical developments in the field of genetics, Mendel's experimental organism and its significance, Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment, Test and back crosses. Chromosomal theory of inheritance (Sutton-Boveri). Applications of Mendel's Principles (Punnett square method, Forked-line method, Probability method), Pedigree, Symbols used in pedigree studies.

UNIT II: Interaction of Genes:

Allelic interactions: Concept of dominance, recessiveness, Concept of pseudo-alleles, Co-dominance, Incomplete dominance, Pleiotropy, Penetrance, Expressivity (Example of each), lethal allele.

Non allelic interactions: Epistasis (dominant & recessive), Duplicate gene action (15:1), Complementary gene action (9:7), Supplementary gene action (9:3:4), Inhibitory gene action (13:3),

Masking gene action (12:3:1), Polymeric gene action (9:6:1), Additive gene action (1:4:6:4:1), Molecular basis for gene interaction.

UNIT III: Genetic linkage, Crossing over and Chromosomal aberrations

Introduction, Chromosome theory of Linkage, Coupling and Repulsion phase, Types of Linkage, Linkage groups and Linkage maps. Recombination of genes in a chromosome crossing over, Molecular mechanism of crossing over. Genetic disorders, Alteration in chromosome structure - Deletions, duplications, inversions and translocations Alterations in chromosome number - Ploidy-Aneuploidy and Euploidy, Hardy Weinberg law (prediction, derivation and proof).

UNIT IV: Sex determination and Sex linkage:

Difference between Autosomes and Allosomes, Structure of X and Y chromosomes, Mechanisms of sex determination, Environmental factors and Chromosome theory of Sex determination: XX- XY, XX-XO, XO-XX, ZZ-ZW, ZO-ZZ system, Genic balance theory of Bridges, sex determination, Sex determination in animals (Drosophila, Reptiles and Mammals,) and Plants, Barr bodies, dosage compensation, Genetic balance theory (X/A index), Fragile-X- syndrome and chromosome, sex influenced dominance, sex limited gene expression, and sex linked inheritance.

REFERENCE BOOKS:

1. Principles of Genetics (2010) 5th ed. And 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.

2. Genetics (2000), P.S.Verma and V.K. Agarwal, S. Chand and Company. (ISBN:81-219-0262-2), New Delhi.

3. Genetics. P. K. Gupta, Rastogi Publications. ISBN: 81-7133-779-1. Shivaji Road Meerut, India.

4. Fundamentals of Genetics. (2004), B.D. Singh, Kalyani Publishers. (ISBN: 81-272-1331-4).1.

5. Principles of Genetics by Gardener, John Wiley & Sons, New York, USA, (ISBN 9971-51-346-3)

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CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER III
SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160303: DNA Structure, Function and Repair

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of DNA structure along with its different forms of DNA, DNA as a genetic material. Students will be introduce to genome organization, Central dogma of molecular biology and the mechanism of replication for synthesis of DNA in context with prokaryotes and Eukaryotes, recombination and transposition of DNA along with the Mutation and its detection method and mechanism of DNA repair.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Structure of DNA and RNA, pyrimidine and purines and genomic organization.
2. Replication of DNA in prokaryotes and Eukaryotes, mechanism of supercoiling of DNA.
3. Develop concept of Homologous recombination and method of DNA transposition.
4. Acquire concept of Mutation and its type and different mechanism of DNA repair system.

UNIT I: Structure of DNA & Genes and Genomic organization:

Structural aspects– Purines and pyrimidine's, Nucleosides & Nucleotides, Properties and Structure of RNA and DNA (Watson - Crick Model) and its difference, various forms of DNA (A, B & Z forms of DNA). Base pairing rule, Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment),

Genome and its organisation: Definition of gene, Nucleosome structure (Solenoid model) and packaging of DNA into higher order structures, denaturation and denaturation of DNA, melting temperature (Tm),

UNIT II: Replication of DNA in prokaryotes:

Central Dogma of Molecular Biology, Models of DNA replication (Semi-conservative, semi-discontinuous, bidirectional replication) Origin of DNA replication, enzymes and proteins in DNA

replication, stages of replication of *E. coli* chromosome (Initiation, Elongation and Termination), Function and properties of DNA polymerase I, II and III. Supercoiling of DNA and its importance, topoisomerases.

UNIT III: Replication of DNA in Eukaryotes:

Relationship between replication and cell cycle, Importance of multiple origin in eukaryotes, Mechanism and Stages of Eukaryotic chromosome replication (Initiation, Elongation and Termination). Enzymes and proteins involved in replication, Formation and Activation of Pre Replicative complex (PreRC) in cell

cycle, Importance of Cyclin dependent kinase (Cdk and Ddk), Telomere end replication, End replication problem in disease, Comparison of replication in prokaryotes and eukaryotes.

UNIT IV: Genetic Recombination, Mutations & DNA repair

Homologous recombination, Types of Recombination, Models of Homologous recombination (Holliday model) proteins and enzymes in recombination, Transposon and Retrotransposons, Mechanism of Transposition,

Mutation & DNA repair: Mutation and its type, Ames test, Replica plating technique, Mutagen, Chemical and physical mutagen and its types. Replication errors and mismatch repair system, direct damage reversal, base excision repair, nucleotide excision repair, Photoreactivation. SOS response system for repair.

REFERENCE BOOKS:

1. DNA structure and function by Richard R. Sinden, Academic Press ISBN: 978-0-12-645750.
2. 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.
3. 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.
4. Gene IX (2008) by B. Lewin. John & Bartlett Publishers. London. ISBN: 0-7637-5222-3.
5. Genomes 3 (2007) T. A. Brown. Garland Science. New York. ISBN: 0-8153-4138-5.
6. Genetics.P. K. Gupta, Rastogi Publications. ISBN: 81-7133-779-1. Shivaji Road Meerut, India.

Content Details for M.Sc. Integrated Biotechnology

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER III

SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160304- Bioinstrumentation

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of the fundamental principles of some basic instrumentation and to enable understanding of the pH meter, microscopy, centrifugation, chromatography and electrophoresis.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Understand the fundamental principles of pH meter and knowledge of different types of microscopes such as Compound microscope, Dark field, Bright field, Fluorescent microscope, Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM).
2. Enrich the concept and application for separation of molecules by different types of centrifugation techniques.
3. The separation of molecules by different types of chromatographic techniques will be learnt.
4. Learn the separation of analyte by horizontal and vertical gel electrophoresis and the principle of analysis of samples by UV, Visible spectroscopy.

UNIT I: Electrochemistry and Microscopy

Working principle structure and application of pH meter, pH indicator.

Introduction to microscopy, Numerical aperture, focal length, resolution, magnification image formation by lens; Principle, ray diagram, components and application of compound, phase contrast, fluorescence, atomic force, confocal, scanning and transmission electron microscopy, sample preparation for SEM and TEM.

UNIT II: Separation by centrifugation

Principle of centrifugation of spherical and non-spherical particle, Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

UNIT III: Chromatography

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV: Electrophoresis and Spectroscopy

Principle of horizontal vs vertical gel electrophoresis; Principle, methodology and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, Polymerization of SDS-PAGE, 2D gel electrophoresis.

Spectrometry: Concept and application of calorimeter and spectrophotometer; Beer-Lambert Law, absorptivity, molar extinction coefficient, deviation from Beer-Lambert Law, instrumentation and application of UV and Visible spectrophometer.

REFERENCE BOOKS:

1. Microscopy and Micro-technique: R. Marimuthu (ISBN 81-8094-035-7)
2. Physical Biochemistry Principles and techniques of practical biochemistry and Molecular Biology: Wilson & Walker, Cambridge University Press, Cambridge, 6th eds. 2005. (ISBN 0-521-69180-X).
3. Instrumental methods of chemical analysis: Chatwal and Anand, Himalaya Publishing House Pvt. Ltd. 5th eds. (ISBN 978-81-8318-802-9).
4. Biophysical Chemistry (Principles and Techniques) Upadhaya, Upadhaya & Nath, Himalaya Publishing House Pvt. Ltd. 4th eds. 2008. (ISBN: 978-81-83188-65-4).
5. Instrumental Analysis: Douglas A Skoog, F. James Holler and Timothy A. Nieman, Saurabh Printers Pvt. Ltd., 3rd eds. 2009. (ISBN – 13:978-81-315-05427).
6. Quantitative analysis of pharmaceuticals formulations: Sethi PD (1996), CBS Publishers and Distributors. (ISBN 81-239-0439-8)

Course Wise Content Details for M.Sc. Integrated Biotechnology

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER III

SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160307: Biophysics

Course Objectives:

In current scenario of advance integrated biotechnology applications, the primary objective of biophysics course is to give exposure and orientation of different aspects of biophysics to the students coming with a background of physical and biological sciences.

1. Understand how the scientific method is applied in the natural and physical sciences.
2. Apply the principles of physical sciences to understand and solve biological complexities.
3. Students will demonstrate a core knowledge base in the theory and practice of biophysics.
4. Students will read and evaluate primary literature in the discipline of biohysics.
5. Individuals with aptitude and skill in research areas of biophysics prepare students to be competitive in pursuing employment or advanced degrees in various fields.
6. Young leaders who offer their service to the betterment of the community.
7. Understand the need for ethical scientific research and conduct.

Learning Outcomes:
At the end of this course, the student will be able to:

1. Learn nature of electromagnetic waves and its interaction with biological compounds
2. Spectroscopy techniques will be helpful gathering qualitative and quantification information about bio molecules.

UNIT I: Light and Optics

The electromagnetic spectrum, Principles of superposition, Constructive and destructive Interference, Type of Interference, Newton's rings, Resolving power of microscope, Polarization of light waves, Polaroid, Types of lenses, Cardinal points, Huygens eyepiece, Ramsden eyepiece, Basic principles of electromagnetic radiation, energy, wavelength, wave numbers and frequency. Absorption and emission spectra

UNIT II: Electricity, Magnetism and Advanced Physics

Coulomb's law, Electric Field-Electric field lines, electric potential, Energy of a point charge distribution, Energy of a continuous charge distribution, Magnetic force of moving charge, Hall effect, Three types of magnetic substances, Magnetization M, Hysteresis, the B-H curve, electromagnet, NMR, CD, ORD.

Introduction to X-Rays: Production of X-rays, X-ray diffraction (XRD) and its biological applications. Introduction to the crystal structure, Unit cell, seven crystal systems

REFERENCE BOOKS:

1. Engineering physics, by R.K. Gaur and S.L.Gupta, Dhanpat Rai Publication. ISBN: 978-81-89928-22-3.
2. Element of spectroscopy by H.V. Sharam, S.L. Gupta, V. Kumar. ISBN: 9789386633699, 9386633698.
3. Instrumental method of chemical analysis by Gurdeep R. Chatwal and And Shyam Anand, Himaliya Publishing House. ISBN Number: 978-93-5142-088-0.
4. Optics 4E by Ajoy Gathok, 4th Edition, Tata McGraw-Hill Education India. ISBN: 9780070262157, 0070262152

Course Wise Content Details for M.Sc. Integrated Biotechnology
CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER III
M.Sc. Integrated Biotechnology
SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160305: LAB- I (Practicals based on 101160301and 101160302)

PRACTICALS:

1. Demonstration the phenomenon of osmosis using potato osmoscope.
2. Measurement of diffusion pressure deficit of plant cell.
3. Demonstrate the phenomenon of Imbibitions.
4. Determination of osmotic pressure of cell sap by plasmolytic method.
5. To demonstrate the transpiration by four leaves method.
6. Measurement of root pressure and water lifting power of transpiration.
7. To demonstrate O2 evolved during photosynthesis by inverted funnel method.
8. To compare rate of photosynthesis under different conditions.
9. Demonstration of CO_2 is necessary for photosynthesis (By Moll's half leaf experiment.
10. Separation of Chloroplast pigments by TLC / Paper Chromatography.
11. Demonstration of plant movements.
12. Problems in different topics of Genetics - Introduction to Mendelian genetics.
    (I) Mendel's law of inheritance a) Law of Dominance. b) Law of segregation. c) Law of Independent assortment. (II) Back Cross & Test Cross
    Monohybrid back cross and test cross b) Dihybrid back crosses and test cross.
13. Problem related to Interaction of genes:-
    Incomplete dominance (b) Co-dominance (c) Problems related to monohybrid cross (d) Problems related to dihybrid crosses. (e) Problem related to sex linked inheritance (f) Linkage (g) Crossing over
14. Variation in chromosomes structure and number - by charts
15. Problems related to sex determination.
16. Pedigree charts of some common characters like blood group and color blindness
17. Mitotic Chromosome preparation and Karyotyping

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101160306: LAB- II (Practical based on 101160303and 101160304)

PRACTICALS:

1. Estimation of concentration of DNA by DPA (diphenylamine) method.
2. Estimation of concentration of RNA by Orcinol method.
3. Introduction and preparation of Agarose Gel for Electrophoresis
4. Isolation of Genomic DNA from Bacterial sources by TE method
5. Quantification of isolated DNA and RNA at A260/280nm using UV spectrophotometer.
6. Determination of the melting temperature ™ and GC content of DNA.
7. Introduction and calibration of pH meter
8. Introduction to microscopy and micrometry
9. Separation of cells by density gradient centrifugation
10. Separation of chlorophyll by Paper Chromatography
11. Separation of amino acids by TLC
12. Determination of partition coefficient

Course Credit Scheme

Semester IV

Type of course	Course Code	Name of Course	T/P	Credit	Exam Duration	Component of Marks		
						Internal	**External**	**Total**
						Total/Passing	**Total/Passing**	**Total/Passing**
Core -1	101160401	Gene expression and regulation	T	4	3 hrs	40/14	60/21	100/35
Core -2	101160402	Animal Physiology	T	4	3 hrs	40/14	60/21	100/35
Core -3	101160403	Microbial Genetics	T	4	3 hrs	40/14	60/21	100/35
Elective -1	101160404	Developmental Biology	T	4	3 hrs	40/14	60/21	100/35
	101160405	LAB I (Practical based on 101160401 and 101160402)	P	4	3 hrs	40/14	60/21	100/35
	101160406	LAB II (Practical based on 101160403 and 101160404)	P	4	3 hrs	40/14	60/21	100/35
Skill Enhancement	101160407	Bioinformatics	T	2	2 hrs	20/07	30/11	50/18
Viva-Voce	101160408	Comprehensive Viva-Voce	V	1			50/18	50/18
	Total Credit			**27**				

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CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER IV

SYLLABUS EFFECTIVE FROM: JUNE-2021-22
101160401: Gene Expression and Regulation

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of the Bio-synthesis of RNA (mRNA, tRNA and rRNA) by the mechanism of transcription and also the synthesis of protein by translation procedure along with its post modification. It provide the knowledge of Genetic code and the gene expression of gene related to prokaryotes and Eukaryotes system with its regulation.

Learning Outcomes:
At the end of this course, the student will be able to:

1. Transcription of different types of RNA in both prokaryotes and eukaryotes
2. Post transcriptional and post translation modification.
3. Biosynthesis of protein by translation mechanism.
4. Concept of operon system, Lactose (*lac*) and tryptophan (*trp*) operon system.
6. Regulation of gene expression, RNA Interference (SiRNAs and miRNAs).

UNIT I: Biosynthesis of RNA in prokaryotes:

Prokaryotic RNA polymerases, transcription cycle in bacteria, sigma factor, bacterial promoters ("-10" TATA BOX and "-35" TTGACA sequences), identification of DNA binding sites by DNA foot-printing, the three stages of RNA synthesis (Initiation, elongation and termination) rho-dependent and rho-independent termination. Inhibitors of transcription and applications as anti-microbial drugs, Comparison of Replication and Transcription.

UNIT II: Biosynthesis of RNA in eukaryotes:

Eukaryotic RNA polymerase, Transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, various types of RNA processing, transcription by RNA polymerase I and III. Comparison of fidelity of transcription and replication. Chemistry of Intron

splicing (Group I, Group II, Group III and Group IV), Capping and Polyadenylation, the spliceosome machinery, Alternative splicing, Alternative poly (A) processing, RNA editing.

UNIT III: Genetic code & Proteins translation in prokaryotes & Eukaryotes:

The Genetic Code table, Features and properties of Genetic code. Codon Anticodon interaction, wobble hypothesis,

Charging of tRNA, aminoacyl tRNA synthetases, Shine Dalgarno sequence, Kozak sequences, Mechanism of initiation, elongation (Ef-Tu-Ts cycle, eEF 1α and eEF 1β cycle EF-G cycle) and termination of translation in prokaryotes and eukaryotes, Use of antibiotics in understanding protein synthesis and its applications in medicine Post translational modification (Proteolytic cleavage, Chemical modification, Hsp70, Hsp 60, GroEL).

UNIT V: Regulation of Gene expression in prokaryotes and Eukaryotes:

Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, regulation of lactose (lac) operon concept and Tryptophan (trp) operon, Regulation of Gene expression (steroid hormones, peptide hormones, hormone response elements (HREs). temperature: The heat shock gene), transcriptional regulation in λ bacteriophage, Regulation of gene expression by RNA Interference (SiRNAs and miRNAs).

REFERENCE BOOKS:

1. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P.
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-
3. Genetics.P. K. Gupta, Rastogi Publications. ISBN: 81-7133-779-1. Shivaji Road Meerut, India.
4. Genomes 3 (2007) T. A. Brown. Garland Science. New York. ISBN: 0-8153-4138-5.
5. The Cell – A Molecular Approach By Geoffrey M. Cooper And Robert E. Hassman. 3rd Edition, 2004, ASM Press, Sinauer Associates, Inc.ISBN:0-87893-214-3.
6. Gene VIII (2004) by B. Lewin. Pearson Education Ltd. London. ISBN: 0-13-123826-4.

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CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER IV

SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160402: Animal Physiology

Course Objectives:

- To familiarize students with the principles and basic facts of Animal Physiology and with some of the laboratory techniques and equipment used in the acquisition of physiological data. The course will focus on organ-system physiology; however, cellular and molecular mechanisms will be discussed in order to present a current view of physiological principles. Where appropriate, basic chemical and physical laws will be reviewed in order to enhance and to promote student understanding.
- The laboratory component of the course is designed to reinforce the topics discussed in lecture, as well as to familiarize students with some of the laboratory techniques and equipment used in the acquisition of physiological data.

Student Learning Outcomes: Upon successful completion of lecture portion of this course, the students will be able to describe, identify, and/or explain:

- ✓ The various physiological organ-systems and their importance to the integrative functions of the human body. Study digestive system organs and their functions.
- ✓ Structure and functions of the cardiovascular system, including the mechanical and electrical properties of cardiac muscle function. Regulation of blood pressure.
- ✓ Organization structural and functional organization of the nervous system. The resting membrane potential, the action potential, action potential propagation along the axon. Structure and functions of the kidney nephrons, including glomerular filtration, tubular reabsorption, tubular secretion, and excretion. The renin-angiotensin-system.
- ✓ Principles of hormone action, including structure, mechanism of release from endocrine cell, mode of transport in blood, mechanism of action in target cells, and systemic effects of important hormones. Focus on classic endocrine glands, including the hypothalamus and the pituitary glands, thyroid and parathyroid glands, adrenal glands, endocrine pancreas.

Unit:-I: Physiology of Digestion

- Structural organization and functions of gastrointestinal tract and associated glands;
- Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.

Unit: -II: Blood & Physiology of Heart

- Components of blood and their functions; Structure and functions of haemoglobin; Haemostasis: Blood clotting system, Haemopoiesis; Blood groups: Rh factor, ABO and MN
- Structure of mammalian heart; Coronary circulation; Origin and conduction of cardiac impulses; Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation

Unit: -III: Nervous System & Renal Physiology

- Structure of neuron, resting membrane potential, Origin of action potentialand its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action.
- Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance.

Unit: -IV: Endocrine System

- Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action;
- Classification of hormones; Regulation of their secretion; Mode of hormone action, Signal transduction pathways for steroidal and non-steroidal hormones; Placental hormones.

REFERENCE BOOKS

1. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.
2. Animal physiology by Verma, Tyagi and Aggarwal, Pub. S. Chand & Company Ltd. New Delhi. ISBN-81-219-0351-3.
3. A textbook of Animal physiology by A. K. Berry, Emkay Publications, Delhi. ISBN-81-85712-03-4.
4. Animal physiology by Mohan P. Arora, Himalaya publishing House. ISBN-81-7866-723-1.
5. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.

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CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER IV
M.Sc. Integrated Biotechnology
SYLLABUS EFFECTIVE FROM: JUNE-2021-22
101160403: Microbial Genetics

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of structure and properties of plasmid along with its different types, the objectives also include Gene transfer by the mechanism of Transformation, conjugation and transduction along with the genetics of Agrobacterium and Ti plasmid transfer with restriction and modification system.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Learn about biology of plasmid and its types and genetics of phage
2. Develop concept of Agrobacterium genetics including restriction and modification system.
3. Will get knowledge about Molecular mechanism of transformation.
4. Develop concept of conjugation along with the Hfr cell and conjugal gene mapping
5. Acquire the knowledge of Generalized and specialised transduction, Restriction and modification system.

UNIT I: Plasmid Biology and Agrobacterium genetics:

Plasmid Biology: Structure, properties and types of plasmids (R plasmid, F plasmid, ColE1 plasmid, Degradative plasmid), Incompatibility plasmid, regulation of plasmid copy number (Regulation by complementary RNA, Coupling, method), Plasmid Replication (Rolling circle mechanism), Stringent and Relaxed plasmid.

Agrobacterium genetics: Ti plasmid, Interkingdom gene transfer (Key early experiments, vir regulon, protein secretion apparatus, conjugation model of T-DNA transfer).

UNIT II: Transformation:

(Natural transformation in *Bacillus subtilis*, *Streptococcus pneumonia* and *Haemophilus influenza*). Competence factor and its development, Transformation by inducing artificial competence, Gene linkage and Genetic Mapping in Bacteria by Transformation. Different method of transformation (Electroporation, Gene gun method). Fungal Genetics (Tetrad analysis).

UNIT III: Conjugation:

Conjugation (F-factor mediated Conjugation in E. coli, Hfr conjugation and chromosomal transfer, F-prime conjugation and merodiploids, Conjugation of fertility inhibited F-like plasmids, Non conjugative mobilizable plasmids, chromosomal mobilization of non-F plasmids, Episomes, Interrupted mating and conjugational mapping)

UNIT IV: Transduction Restriction modification systems:

Generalized transduction, specialized transduction (Generalized transduction in P22, P1 and T4 bacteriophages, homologous recombination with recipient's chromosome, measuring transduction (co-transduction of markers. Restriction modification systems: Types of RM systems, Role of RM systems, salient features and insights into evolution of diverse types of Restriction endonucleases and Methyl transferases, Regulation of RM systems.

REFERENCE BOOKS:

1. Prescott, Harley, and Klein's Microbiology seventh edition The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. Copyright © 2008 ISBN 978–0–07–299291–5
2. Molecular Genetics of Bacteria- Larry Snyder and Wendy Champness. Third Edition, United States of America ISBN-10:1-155581-399-2
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. Modern Microbial Genetics-Second edition, 2002; Edited by Uldis Streips and Ronald Yasbin, ISBNs: 0-471-38665
5. Genetics (2000), P.S.Verma and V.K. Agarwal, S. Chand and Company. (ISBN:81-219-0262-2), New Delhi.
6. Genetics.P. K. Gupta, Rastogi Publications. ISBN: 81-7133-779-1. Shivaji Road Meerut, India.
7. Fundamentals of Genetics. (2004), B.D. Singh, Kalyani Publishers. (ISBN: 81-272-1331-4).

Course Wise Content Details for M.Sc. Integrated Biotechnology

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER IV

SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160404: Development Biology

Course Objectives:

The main objective of the paper is to educate the students to develop the knowledge of the fundamental development process in animals and plants. Students are also enable to understand the importance of experimental and applied embryology. It also provide the fundamental knowledge of apomixis, polyembryony, parthenocarpy in plants and sex determination and regeneration concepts in animals.

Learning Outcomes:

At the end of this course, the student will be able to:

1. Understand morphology and evolution of angiosperms
2. Learn structure and development of male and female reproductive organs in plants and embryogenic process in monocot and dicot
3. Develop concept of animal development like Gametogenesis and spermatogenesis, parthenogenesis
4. Acquire concept of cleavage, gastrulation process and medical implications of animal development biology

Unit:-I

- Morphology of an Angiosperm plant with the understanding of evolution, Compound leaf is advanced than the simple leaf, Apetalae is advanced than the gamopetalae and polypetalae, Fibrous root is advanced than the tap root system, Parallel venation is advanced than the reticulate venation, Herbs are advanced than the shrubs and trees, Annuals are advanced than the perennials, Monocots are advanced than the dicots, Aquatic plants and epiphytes are advanced than the terrestrial, Evolution of angiosperm leaf and flower (Telome theory & flower is a modified shoot), Evolution of seed through heterospory (comparison of *Nephrolepis* and *Selaginella* with *Cycus*), Life cycle of an angiosperm plant showing alternation of generation
- **Experimental and Applied Embryology: Artificial** pollination and sexual incompatibility, methods to overcome incompatibility

Unit: -II

- Structure and development of microsporangium and male gametophyte, Structure and development of megasporangium and female gametophyte, Endosperm with types, Embryogeny in Monocot and Dicot, Polyembryony, Apomixis, Parthenocarpy
- **Applications of Embryology in Crop improvement** – Haploid production, Nucellus, Ovule, Ovary, Seed culture, Genetic transformation

Unit: -III

- Introduction to animal development: Definition, Scope and History of embryology, Branches of Embryology, Phases in Ontogenic Development
- Gametogenesis - Spermatogenesis, Oogenesis
- Types of eggs, Egg membranes
- Fertilization: Encounter of spermatozoa and ova, Capacitation and contact, Acrosome reaction and penetration, Activation of ovum, Migration of pronuclei and amphimixis.
- Parthenogenesis

Unit:-IV

- **Cleavage:** Patterns and Types of cleavage, Brief account on Holoblastic and Meroblastic cleavages.
- Morulation and Blastulation
- Fate Maps – Construction of fate maps by natural marking
- Gastrulation (Epiboly and Emboly)
- Growth and Differentiation
- **Medical implications of Animal Development Biology:** Genetic errors of Human development, Infertility, Teratogenesis

REFERENCE BOOKS

1. Taxonomy Evolution at Work by M. Daniel. Pub. Narosa Publishing House, ISBN:9788173199592.
2. A textbook of Botany (Vol. 1&2) by Bhattacharya, Hait and Ghosh. Pub. New Central Book Agency (P) Ltd., ISBN: 8173815500.
3. Structure, Development and Reproduction in Angiosperms by RC Pandey and DK Jain, Rastogi Publications, Meerut (ISBN: 81-7133-706-6)
4. Embryology of Angiosperms by SS Bhojwani and SP Bhatnagar, 4th Revised & Enlarged Ed., Sangam Books Pvt. Ltd., New Delhi (ISBN: 978-0706999129)
5. Developmental Biology by Sastry and Shukal, Rastogi Publications, Meerut (ISBN: 81-7133-734-1)
6. Chordate Embryology (Developmental Biology) by PS Verma and VK Agarwal, S.Chand Publishers, New Delhi (ISBN: 81-219-0261-4)
7. Developmental Biology by Scott F Gilbert, 8th Ed., Sinaur Publishers, USA (ISBN: 0-87893-250-X)

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CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER IV

SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160407: Basics of Bioinformatics

Course Objectives:

The course will enable the students to understand the concept of bioinformatics, various types databases and their importance. This course will enable to students for algorithms and concept of sequence alignments, understanding the phylogenetic relationship among the organisms in evolution. Students will also able to know the 2D structure and 3D structure of protein which ultimately enable the students to understand the active site prediction, drug design & development.

Course Learning Outcomes:

Unit I: Focuses on the concept of bioinformatics and its application. It provides the knowledge of various databases, nucleic acid databases, protein sequence databases, formats of various databases and their importance. Students will understand process after sequencing and how to submit to the online database with the importance of it. They will understand, how to search and surf databases on the basis of experimentation requirement.

Unit II: Gathers information regarding concept of scoring matrix, search of databases, algorithms of the BLAST and FASTA. The students will learn the basic concepts of pairwise sequence alignment and multiple sequence alignments. Apart from this student will be able to understand Important segment of Bioinformatics which deals with evolution study through computational approach. Here, they will be able to understand and learn, how to construct, study and compare the phylogenetic trees. The study on the importance of tree construction will boost analysis practice after sequencing. They will also be able to gain the knowledge of structure of protein, prediction of 2-dimentional, 3-dimentional structure of protein and their algorithms. Students will enable to predict the active site of protein, folding of protein, protein modelling and drug design using software.

UNIT-I

Introduction to Bioinformatics:

Overview, Internet and bioinformatics, Applications.

Introduction and Bioinformatics Resources:

Knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, Literature databases: Nucleic acid sequence databases: GenBank, EMBL, DDBJ
Protein sequence databases: SWISS-PROT, PDB, SCOP, CATH
Genome Databases at NCBI, EBI
Other Databases of Patterns/Motifs/System Biology (Gene and protein network database and resources)
Various file formats for bio-molecular sequences: genbank, fasta, cvv, gtf etc.
Basic concepts of sequence similarity, identity and homology, Definitions of homologues, orthologues, paralogues, xenologus.

UNIT-II
Sequence analysis: -
Sequence-based Database Searches: what is sequence-based database search, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA.
Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series.
Pairwise and Multiple sequence alignments: basic concepts of sequence alignment and algorithms
Phylogenetic Evolution Study: Definition and description of phylogenetic trees and various types of trees, Molecular basis of evolution, Method of construction of Phylogenetic trees, Tools used for analysis
Molecular Modelling: -
Structural classification of proteins, Protein structure analysis structure alignment and comparison, Classes, folds, motif, domain, Secondary structure and evaluation, Methods to study 3D structure, Active site prediction, Protein folding, Protein modelling and drug design.

REFERENCES BOOKS

1. Mount DW, Bioinformatics: Sequence and Genome Analysis (2nd edition). Spring Harbor Press.
2. Arthur Lesk. Introduction to Bioinformatics. Oxford University Press.
3. S. C. Rastogi, Namita Mendiratta, Parag Rastogi, Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery) 4th Edition
4. Ghosh Z and Mallick B, Bioinformatics-Principles and Applications, Oxford University. Press (First Print: 2008; Second Print: 2009)
5. Creighton TE, Protein Structure: A Practical Approach
6. Essential Bioinformatics by Xi, Xiping.
7. Leach AR, Molecular Modeling: Principles and Application
8. Bourne PE, Weissig H, Structural Bioinformatics, Wiley Schlick T. Molecular Modelling and Simulation an Inter disciplinary Guide, Springer

Course Wise Content Details for M.Sc. Integrated Biotechnology
CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHANAGAR
SEMESTER IV
M.Sc. Integrated Biotechnology
SYLLABUS EFFECTIVE FROM: JUNE-2021-22

101160405: LAB- I (Practical based on 101160401and 101160402)

PRACTICALS:

1. Isolation of Genomic DNA from plant tissue by CTAB method
2. Isolation of genomic DNA from Human/Animal Blood sample.
3. To study Induction of Lactose operon (Lac operon) in bacteria by β-Galactosidase Assay.
4. Introduction and Demonstration of Polymerase chain reaction (PCR).
5. Detection of single nucleotide polymorphism (SNP) by PCR technique.
6. Determination of ABO Blood group
7. Enumeration of red blood cells and white blood cells using haemocytometer
8. Estimation of haemoglobin using Sahli's haemoglobinometer
9. Preparation of haemin crystals
10. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney
11. Determination of amylase activity in saliva
12. Urine analysis

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101160406: LAB- II (Practical based on 101160403and 101160404)

PRACTICALS:

1. Isolation and enumeration of bacteriophage
2. Demonstration of Lysogeny
3. Conjugation in E. coli.
4. Diauxic growth curve.
5. Replica Plating
6. Demonstration- evidences of the evolution of flower from shoot as gynandrophore in Capparidaceae & Passifloraceae and Staminods in *Cana indica* and Wild rose.
7. Floral morphology of dicot and monocot flower.
8. T.S. of an anther.
9. T.S. of an ovary.
10. Embryo dissection.
11. Artificial pollination by emasculation (bagging method)
12. Pollen germination (*in vitro*)
13. Embryology of Chick
14. Demonstration of Chick embryo