

B.Sc. HONOURS MICROBIOLOGY

CURRICULUM STRUCTURE

SEMESTER 1

Sl. No	Course Code	Course Title	L T P	Credits
1	25MIC101	INTRODUCTORY BIOLOGY	2 1 0	3
2	25CHY105	CHEMISTRY	3 1 0	4
3	25ENG100	ENGLISH	2 1 0	3
4	25MIC102	INTRODUCTORY MICROBIOLOGY	2 1 0	3
5	25PHY106	PHYSICS	3 1 0	4
6	22ADM101	FOUNDATIONS OF INDIAN HERITAGE	2 0 1	2
7	22AVP103	MASTERY OVER MIND (MAOM)	1 0 2	2
8	25MIC181	INTRODUCTORY MICROBIOLOGY LAB	0 0 4	2
Total Credits				23

SEMESTER 2

Sl. No	Course Code	Course Title	L T P	Credits
1	25MIC111	MICROBIAL ECOLOGY, DIVERSITY & CLASSIFICATION	2 1 0	3
2	25BIO111	BIOCHEMISTRY	2 1 0	3
3	25ENG110	ENGLISH-CREATIVE WRITING & SOFT SKILLS	2 1 0	3
4	25CSA113	INFORMATION SYSTEMS	2 1 0	3
5	25MAT114	MATHEMATICS	3 1 0	4
6	22ADM111	GLIMPSES OF GLORIOUS INDIA	2 0 1	2
7	25PHY184	PHYSICAL SCIENCES LAB	0 0 4	2
8	25BIO181	BIOCHEMISTRY LAB	0 0 4	2
Total Credits				22

SEMESTER 3

Sl. No	Course Code	Course Title	L T P	Credits
1	25BIO201	MOLECULAR BIOLOGY	2 1 0	3
2	25MIC206	MYCOLOGY	2 1 0	3
3	25MAT204	BIostatISTICS	2 1 0	3
4	25BIO205	ANALYTICAL BIOCHEMISTRY	2 1 0	3
5	25MIC202	VIROLOGY	2 1 0	3
6	25BIF201	INTRODUCTORY BIOINFORMATICS	2 1 0	3
7	22ADM201	AMRITA VALUE PROGRAMME I (STRATEGIC LESSONS FROM MAHĀBHĀRATA)	1 0 0	1

8	25MIC281	GENERAL MICROBIOLOGY LAB	0 0 4	2
9	25BIO282	CELL AND MOLECULAR BIOLOGY LAB	0 0 4	2
Total Credits				23

SEMESTER 4

Sl. No	Course Code	Course Title	L T P	Credits
1	25BIO214	CELL BIOLOGY	2 1 0	3
2	25MIC211	MICROBIAL PHYSIOLOGY & METABOLISM	3 1 0	4
3	25BIO212	IMMUNOLOGY	2 1 0	3
4	25BIO213	ENZYME TECHNOLOGY	2 1 0	3
5	25BIO216	HUMAN PHYSIOLOGY	4 0 0	4
6	25MIC212	FOOD MICROBIOLOGY	2 1 0	3
7	25SSK201	SOFT SKILLS- I	0 1 0	1
8	22ADM211	AMRITA VALUE PROGRAMME II (LEADERSHIP FROM RĀMĀYANA)	1 0 0	1
9	25BIO283	IMMUNOLOGY LAB	0 0 4	2
10	25MIC282	FOOD MICROBIOLOGY LAB	0 0 4	2
Total Credits				26

SEMESTER 5

Sl. No	Course Code	Course Title	L T P	Credits
1	25BIF302	PYTHON FUNDAMENTALS FOR BIOLOGISTS	2 1 0	3
2	25MIC302	INDUSTRIAL MICROBIOLOGY	2 1 0	3
3	25MIC301	MEDICAL BACTERIOLOGY	2 1 0	3
4	25MIC303	ENVIRONMENT & AGRICULTURAL MICROBIOLOGY	2 1 0	3
5	25BIO300	RESEARCH METHODOLOGY	2 0 0	2
6	25SSK301	SOFT SKILLS-II	0 1 0	1
7	25MIC390*	LIVE-IN-LABS/OPEN ELECTIVE		3
8	25MIC383	INDUSTRIAL MICROBIOLOGY LAB	0 0 4	2
9	25MIC382	MEDICAL BACTERIOLOGY LAB	0 0 4	2
Total Credits				22

SEMESTER 6

Sl. No	Course Code	Course Title	L T P	Credits
1	25MIC314	INHERITANCE BIOLOGY	2 1 0	3
2	25BIO311	PHARMACOLOGY	4 0 0	4
3	25MIC312	PARASITOLOGY	2 1 0	3

4	25MIC315	MICROBIAL PATHOGENESIS	2 1 0	3
5	25MIC313	RECOMBINANT DNA TECHNOLOGY	3 0 0	3
6	25BIF314	ARTIFICIAL INTELLIGENCE FOR BIOLOGY	2 1 0	3
7	25BIO382	GENETIC ENGINEERING LAB	0 0 4	2
Total Credits				21

SEMESTER 7

Sl. No	Course Code	Course Title	L T P	Credits
1	25BIO401	METABOLIC ENGINEERING	2 1 0	3
2	25BIO404	RESEARCH ETHICS, SCIENCE COMMUNICATION AND IPR MANAGEMENT	2 1 0	3
3	25BIO402	APPLIED BIOANALYTICAL METHODS	2 1 0	3
4		ELECTIVE 1	3 0 0	3
5	25BIO403	ADVANCED PHARMACEUTICAL BIOSCIENCES	2 1 0	3
6	25BIO481	ADVANCED MOLECULAR GENETICS AND GENE EXPRESSION LAB	0 0 4	2
Total Credits				17

SEMESTER 8

Sl. No	Course Code	Course Title	L T P	Credits
B.Sc. Hons. By Research				
1	25MIC499	PROJECT		12
B.Sc. Hons. (Regular)				
1	25MIC496	MINI PROJECT		6
2		ELECTIVE II	3 0 0	3
3		ELECTIVE III	3 0 0	3
Total Credits				12

Total credits for program completion	166
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ELECTIVES I – SEMESTER 7				
Sl. No	Course Code	Course Title	L T P	Credit
1	25BIO431	EMBRYOLOGY	3 0 0	3
2	25BIO432	HOST-PATHOGEN INTERACTION AND HUMAN MICROBIOME	3 0 0	3

3	25BIO433	MOLECULAR FLUORESCENCE: APPLICATIONS IN CHEMICAL BIOLOGY	3 0 0	3
ELECTIVES II & III – SEMESTER 8				
Sl. No	Course Code	Course Title	L T P	Credit
1	25BIO441	CANCER BIOLOGY	3 0 0	3
2	25BIO442	PHAGE BIOLOGY	3 0 0	3
3	25BIO443	CELL SIGNALLING	3 0 0	3
4	25BIO444	BIOMIMICRY	3 0 0	3
5	25BIO445	NEUROSCIENCE	3 0 0	3
6	25BIO446	REGENERATIVE BIOLOGY & STEM CELLS	3 0 0	3

SYLLABUS

SEMESTER 1

25MIC 101

INTRODUCTORY BIOLOGY

2 1 0 3

LEARNING OBJECTIVES:

The course introduces the principles of molecular biology, cell biology, genetics, evolution, basics of cell structure and function, importance of cytoskeleton remodelling and their role in disease conditions.

SYLLABUS:

Unit 1

Themes in the Study of Life - Adaptations-Physical, Behavioural. Physical- Types of Camouflage- Cryptic Coloration, Disruptive colouration, Mimicry, Counter shading, importance of biochromes in camouflage; Behavioural adaptation: Hibernation, Migration; Biodiversity: Phylogeny and the Tree of Life, Bacteria and Archaea, Protists, Plant Diversity, Fungi, Animal Diversity, Beauty & Utility of Biodiversity in Sustainable Development

Unit 2

Transmission of genetic information – Unity in Diversity at Cellular, Sub-cellular, Molecular Levels: The Composition of Cells, Cell Metabolism, Fundamentals & Central Dogma of Molecular Biology, Expression and Transmission of Genetic Information-Structure of chromosomes, genes, alleles, Types of chromosomes, Scientific Inquiry: Making Observations & Testing Hypotheses.

Unit 3

Structure and Function of Cells – Fundamentals of Cell Theory, Cell Organelles- Nucleus, Endoplasmic Reticulum, Golgi Apparatus, Mitochondria, Chloroplast, Lysosome & Peroxisome.

Unit 4

Cytoskeleton - Structure and Organization of Microfilaments, Microtubules and Intermediate Filaments, Cell Movement, Motor Proteins.

Unit 5

Extracellular Matrix - Plasma membrane & Transport, Cell Wall, ECM, Cell-Cell Interactions, Cell-Matrix interactions

REFERENCES:

1. *Campbell Biology* – 12th Edition - Lisa A. Urry, Michael L. Cain, Las Cruces, Steven A. Wasserman, Peter V. Minorsky, Rebecca Orr, Pearson (2021).
2. *The Cell: A Molecular Approach* 8e, by Geoffrey M. Cooper. Sinauer Associates, Inc.
3. *Molecular Biology of the Cell*. Alberts B. et al., (2008) 5th edition. Garland Science.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe the basics of evolution, diversity of life, transmission of genetic information, framing and testing hypothesis.

CO2: Explain the concepts of cell theory, the structure of different cell organelles and their function.

CO3: Understand the formation and function of cytoskeletal elements like microfilaments, intermediate filaments and microtubules, cell movement and extracellular matrix.

25CHY 105

CHEMISTRY

3 1 0 4

LEARNING OBJECTIVES:

The main objective of the course is to make the students understand the basic theories, laws and mechanisms of the chemistry and further to make them prolific in extending this basic knowledge into the understanding and development of the biochemistry and related interdisciplinary fields.

SYLLABUS:

Unit 1

Solutions

Concentration Units, Principles of Solubility, Colligative Properties of Nonelectrolytes, Colligative Properties of Electrolytes

Rate of Reaction

Reaction Rate, Reaction Rate and Concentration, Reactant Concentration and Time, Models for Reaction Rate, Reaction Rate and Temperature, Catalysis, Reaction Mechanisms

Unit 2

Gaseous Chemical Equilibrium

The N_2O_4 – NO_2 Equilibrium System, The Equilibrium Constant Expression, Determination of K, Applications of the Equilibrium Constant, Effect of Changes in Conditions on an Equilibrium System

Acids and Bases

Bronsted-Lowry Acid-Base Model, The Ion Product of Water, pH and pOH, Weak Acids and Their Equilibrium Constants, Weak Bases and Their Equilibrium Constants, Acid-Base Properties of Salt Solutions, Extending the Concept of Acids and Bases: The Lewis Model

Equilibria in Acid-Base Solutions

Buffers, Acid-Base Indicators, Acid-Base Titrations

Unit 3

Complex Ion and Precipitation Equilibria

Complex Ion Equilibria; Formation Constant (K_f), Solubility, Solubility Product Constant (K_{sp}), Precipitate Formation, Dissolving Precipitates

Spontaneity of Reaction

Spontaneous Processes, Entropy S, Free Energy G, Standard Free Energy Change ΔG , Effect of Temperature, Pressure, and Concentration on Reaction Spontaneity, The Free Energy Change and the Equilibrium Constant

Unit 4

Electrochemistry

Voltaic Cells, Standard Voltages, Relations Between E° , ΔG° , and K , Effect of Concentration on Voltage, Electrolytic Cells, Commercial Cells

Complex Ions

Composition of Complex Ions, Naming Complex Ions and Coordination Compounds, Geometry of Complex Ions, Electronic Structure of Complex Ions

Unit 5

Organic Chemistry

Saturated Hydrocarbons: Alkanes, Unsaturated Hydrocarbons: Alkenes and Alkynes, Aromatic Hydrocarbons and Their Derivatives, Functional Groups, Isomerism in Organic Compounds, Organic Reactions, Heterocyclic chemistry

REFERENCES:

1. *Chemistry*, Raymond Chang, McGraw-Hill; 10th Edition (2007).
2. *Organic chemistry* Solomons & Fryhle, John Wiley (Wse); 8th Edition (2004).
3. *Physical Chemistry*, Atkins & de Paula, Oxford; 9th Edition (2010)

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall the fundamental concepts of chemistry to predict the structure, properties and bonding of engineering materials

CO2: Understand the principle of electrochemistry/photochemistry and applications of various energy storage systems

CO3: Explain the crystal structure, defects, and free electron theory.

CO4: Demonstrate the mechanism and application of conductive polymers in various electronic devices.

25ENG 100

ENGLISH

2 1 0 3

LEARNING OBJECTIVES:

To provide students with an ability to build and enrich their communication skills. To make them familiar with different types of communication. To understand the barriers to effective communication. Engage students in meaningful communication through effective tasks. Identify the basic principles of communication. Analyze the various types of communication. Make use of the essential principles of communication. Identify the prominent methods and models of Communication.

SYLLABUS:

Unit 1

Introduction to language aspects: LSRW Skills, English as Second Language, Developing the essential skills of English

Unit 2

A selection in poetry

To daffodils (Robert Herrick), Yussouf (J R Lowell), Ozymandias (P B Shelley), The slave's dream (H W Longfellow), The Ballad of Father Giligan (WB Yeats), Elegy (extract) (Thomas Gray), The Fly (William Blake)

Unit-3

Language practice (Basic grammatical categories for communication)

Parts of speech, Determiners, Modal auxiliaries, Tenses, Phrasal verbs, Connectors expressing purpose, means, cause and effect, comparison and contrast, Concord of number, person, gender, pronoun and antecedent, Voice: Impersonal passive, Modifiers, Nominal compounds, Abbreviations and acronyms, Spelling and Affixation, Punctuation

Unit 4

Language lab, activities related to improving English, Language games

Unit 5

Presentation of skit

REFERENCES:

1. Doff, Adrian and Christopher Jones. *Language in Use*. Upper Intermediate. CUP, 1999
2. Grellet, Françoise. *Developing Reading Skills*. A Practical Guide to Reading Comprehension Exercises. CUP, 2003.
3. Hancock, Mark. *English Pronunciation in Use*. CUP, 2003.
4. McCarthy, Michael and Felicity O'Dell. *English Vocabulary in Use* (Upper Intermediate) CUP, 2001.
5. Alexander, Harriet Semmes. *American and British poetry: a guide to the criticism, 1925-1978*. Athens, Ohio: Swallow Press, 1984.
6. *Contemporary poets*. Ed. James Vinson. 5th ed. New York: St. Martin's Press, 1991

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand any text in English listening to the inputs given by the teacher in the classroom.

CO2: Interpret the rules of language unconsciously and tune to deduce language structure and usage.

CO3: Demonstrate face-to-face or telephone conversations on familiar topics containing complex grammatical structures with appropriate word choice or grammatical accuracy

CO4: Use the mechanism of language for success in competitive examinations and job-related speaking and writing tasks.

25MIC 102

INTRODUCTORY MICROBIOLOGY

2 1 0 3

LEARNING OBJECTIVES:

A basic course introducing the prokaryotic world with specific reference to the metabolic, physiological, and morphological characteristics of microbes.

SYLLABUS:

Unit 1

Basic Concepts of Microbiology – Spontaneous generation, Germ theory of diseases, Cell theory. Contributions of Antonie van Leeuwenhoek, Joseph Lister, Robert Koch, Louis Pasteur, Edward Jenner, John Tyndall, Sergei N. Winogradsky, Selman A Waksman, Alexander Fleming, Paul Ehrlich, Fannie Hesse, Elie Metchnikoff, Kary Mullis. Development of pure culture methods.

Unit-2

Prokaryotic Cell Ultra-Structure: Peptidoglycan structure and Archaeal cell wall composition, and Acid-fast cell wall. Antibiotics introduction and multidrug resistance crisis. Cytoplasmic matrix and components: Inclusion bodies, Flagella, Pili, Endospores

Unit-3

Microbial Control: Sterilization and disinfection- Definitions, Principles. Methods of sterilization- Physical methods (Heat, Filtration), Radiation, and Chemical methods. Control of sterilization and testing of sterility.

Unit-4

Concepts of Microscopy – Principles, Light microscope, Phase Contrast, Darkfield, Bright field, Fluorescent, Interference microscope (Stereo microscope), Confocal, Inverted microscope, and Electron microscope (TEM and SEM) and Atomic force microscope. Measurement of Microorganisms- Micrometry. Staining- Simple, Gram staining, Negative staining, Capsule staining, Spore staining, Flagellar staining, Nuclear staining and Acid-fast staining.

Unit-5

Physiology of Microbes: Microbiological media, composition and types: selective and differential media Growth curve and growth kinetics. Influence of environmental factors on microbial growth. Nutritional groups of bacteria: Overview Estimation of Microbes- Direct Microscopic count, Turbidometric assay, TVC- Indirect Method- CO₂ liberation- Protein estimation- Maintenance and Preservation of cultures. Determination of decimal reduction time: D value and Z value. Introduction to biofilms.

REFERENCES:

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel: Microbiology 7th edition Mc Graw Hill Book R. Krieg, 1986 Company.
3. Stainer R.Y. Ingraham J.L. Wheelis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentice-Hall.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Retrieve the contributions of pioneers in Microbiology.

CO2: Explain the prokaryotic cell structure and functions.

CO3: Illustrate the concept of microscopy and basic microbiology techniques.

CO4: Understand the basics of microbial nutrition and methods of determining growth curves of bacteria.

25PHY 106

PHYSICS

3 1 0 4

LEARNING OBJECTIVES:

Physics course offered to undergraduate students by School of Biotechnology is a basic course which builds a bridge between physics and Biology. The learning objectives of the course are to develop. Knowledge and ability to use various problem-solving strategies of physics to Biology. Ability to justify and explain specific approaches to solving problems. Ability to synthesize knowledge from different areas of physics and apply it to biological situations. Ability to work in teams for written and oral communication skills

SYLLABUS:

Unit 1

Mechanics: Motion along a straight line, motion in two- and three-dimension, projectile motion, circular motion, relative motion. Force, Friction, Work, Energy, Power. System of particle, collisions, Rotational motion, combined rotational and translational motions.

Unit 2

Waves and Oscillations: Oscillations: Oscillatory systems, Harmonic motion, Simple harmonic oscillator, applications of simple harmonic motion. Types of oscillations, Resonance. Waves: Types, Wave equation-power, intensity, principle of superposition- interference, standing waves – reflection, resonance. Sound-properties, interference, vibrating system and sources of sound, beats, Doppler effect, Effects at high-speed ultrasonics.

Unit 3

Light: Electromagnetic spectrum, Properties of light, Reflection, Refraction, Optical fiber, Interference-Thin film interference, Diffraction- Single slit, double slit, multipleslit diffraction, grating. X-ray diffraction, Polarization-Types, production and detection of polarized light. Dichroism, polarizing sheets. Laser - principle, types, uses.

Unit 4

Properties of Matter: *Properties of solids:* elasticity, stress-strain relation, Crystalline solids, crystal structure and Systems, Bragg's law, X-ray diffraction, semiconductors, IC's, Mems, introduction to Nanotechnology. Superconductors – properties, materials, SQUIDS, Cryogenics. ***Properties of liquids:*** Pressure in liquids, Pressure transmission: Pascal's law and its applications, Buoyancy: Archimedes principle and its applications. Surface tension, capillarity. Fluid flow: streamlines, Bernoulli's Equation- Applications, Viscosity, Viscometers. ***Properties of gases:*** Ideal gas, Kinetic theory of gases, gas laws, ideal gas equation.

Unit 5

Dielectrics and Magnetism: Properties of dielectrics, non-polar and polar dielectrics, Dielectric strength, Ferroelectrics, piezoelectric applications. Magnetic materials: Magnetism, magnetic materials, classification of magnetic materials, types of magnetic materials, soft magnetic materials, hard magnetic materials, applications.

REFERENCES:

1. Physics – David Halliday, Robert Resnick, Kenneth S Krane, Vol. 1, 5th (e), Willey Student Edition, 2002.
2. Physics – David Halliday, Robert Resnick, Kenneth S Krane, Vol. 2, 5th (e), Willey Student Edition, 2002.
3. College Physics – Raymond A Serway, Jerry S. Faughn, Chris Vuille, Charles A Bennett, Vol. 1, Thomson Brooks/Cole, 2006.
4. College Physics – Raymond A Serway, Jerry S. Faughn, Chris Vuille, Charles A Bennett, Vol. 2, Thomson Brooks/Cole, 2006.

COURSE OUTCOMES:

After completing this course, students will be able to:

- CO1: Describe the fundamentals of mechanics
CO2: Explain the concepts of waves and oscillations
CO3: Illustrate the behavior of light and its applications
CO4: Demonstrate the properties of matter across different states
CO5: Demonstrate dielectrics and magnetic materials and their technological relevance

22ADM101 FOUNDATIONS OF INDIAN HERITAGE 2 0 1 2**LEARNING OBJECTIVES:**

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

SYLLABUS:

- Unit 1 -Educational Heritage of Ancient India
Unit 2 - Life and Happiness
Unit 3 - Impact of Colonialism and Decolonization
Unit 4-A timeline of Early Indian Subcontinent
Unit 5 - Indian approach towards life
Unit 6 - Circle of Life
Unit 7-Pinnacle of Selflessness and ultimate freedom
Unit 8-Ocean of love; Indian Mahatmas.
Unit 9 -Become A Strategic Thinker (Games / Indic activity)
Unit 10 -Man's association with Nature
Unit 11 -Celebrating life 24/7
Unit 12 - Metaphors and Tropes
Unit 13 - India: In the Views of foreign Scholars and Travelers.

Self-Study/ Self-reading

- Unit 14 - Personality Development Through Yoga.
Unit 15 - Hallmark of Indian Traditions: Advaita Vedanta, Theory of oneness

Unit 16 - Conversations on Compassion with Amma

COURSE OUTCOMES:

After completing this course, students will be able to:

CO1: Understand the concept of decolonizing and making a student ready to get connected to the Indian Knowledge Systems

CO2: Understand the ancient wisdom of Yajna concept as one of the sustainable frameworks of thoughts to address modern day challenges.

CO3: Explain the different layers of human personality as presented by vedantic model.

CO4: Understand the concept of Dharma from the scriptures in modern context.

CO5: Implement the idea of self, extending it to collectives like family, nation and society.

CO6: Implement invaluable lessons from history to achieve excellence in life

22AVP103

MASTERY OVER MIND (MAOM)

1 0 2 2

LEARNING OBJECTIVES:

Master Over the Mind (MAOM) is an Amrita initiative to implement schemes and organise university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3). This program as part of our efforts for sustainable stress reduction gives an introduction to immediate and long-term benefits and equips every attendee to manage stressful emotions and anxiety facilitating inner peace and harmony.

With a meditation technique offered by Amrita Chancellor and world-renowned humanitarian and spiritual leader, Sri Mata Amritanandamayi Devi (Amma), this course has been planned to be offered to all students of all campuses of AMRITA, starting off with all first years, wherein one hour per week is completely dedicated for guided practical meditation session and one hour on the theory aspects of MAOM. The theory section comprises lecture hours within a structured syllabus and will include invited guest lecture series from eminent personalities from diverse fields of excellence. This course will enhance the understanding of experiential learning based on university's mission: "Education for Life along with Education for Living" and is aimed to allow learners to realize and rediscover the infinite potential of one's true Being and the fulfilment of life's goals.

SYLLABUS:

Unit 1

Causes of Stress: The problem of not being relaxed. Need for meditation -basics of stress management at home and workplace. Traditions and Culture. Principles of meditation—promote a sense of control and autonomy in the Universal Human Value System. Different stages of Meditation. Various Meditation Models. Various practices of Meditation techniques in different schools of philosophy and Indian Knowledge System.

Unit 2

Improving work and study performance. Meditation in daily life. Cultivating compassion and good mental health with an attitude of openness and acceptance. Research and Science of Meditation: Significance of practising meditation and perspectives from diverse fields like science, medicine, technology, philosophy, culture, arts, management, sports, economics,

healthcare, environment etc. The role of meditation for stress and anxiety reduction in one's life with insights based on recent cutting-edge technology. The effect of practicing meditation for the wholesome wellbeing of an individual.

Unit 3

Communications: principles of conscious communication. Relationships and empathy: meditative approach in managing and maintaining better relationships in life during the interactions in the world, role of MAOM in developing compassion, empathy and responsibility, instilling interest, and orientation to humanitarian projects as a key to harness intelligence and compassion in youth. Methodologies to evaluate effective awareness and relaxation gained from meditation. Evaluating the global transformation through meditation by instilling human values which leads to service learning and compassion driven research.

Textbooks

1. Mata Amritanandamayi Devi, "Cultivating Strength and vitality," published by Mata Amritanandamayi Math, Dec 2019
2. Swami Amritaswarupananda Puri, "The Color of Rainbow" published by MAM, Amritapuri.

REFERENCES:

1. Craig Groeschel, "Winning the War in Your Mind: Change Your Thinking, Change Your Life" Zondervan Publishers, February 2019
2. R Nagarathna et al, "New Perspectives in Stress Management" Swami Vivekananda Yoga Prakashana publications, Jan 1986
3. Swami Amritaswarupananda Puri "Awaken Children Vol 1, 5 and 7 - Dialogues with Amma on Meditation", August 2019
4. Swami Amritaswarupananda Puri "From Amma's Heart - Amma's answer to questions raised during world tours" March 2018
5. Secret of Inner Peace- Swami Ramakrishnananda Puri, Amrita Books, Jan 2018.
6. Mata Amritanandamayi Devi "Compassion: The only way to Peace: Paris Speech", MA Center, April 2016.
7. Mata Amritanandamayi Devi "Understanding and collaboration between Religions", MA Center, April 2016.
8. Mata Amritanandamayi Devi "Awakening of Universal Motherhood: Geneva Speech" M A center, April 2016.

COURSE OUTCOMES:

After completing this course, students will be able to:

- CO1: Describe what meditation is and to understand its health benefits
- CO2: Understand the science of meditation
- CO3: Understand the causes of stress and how meditation improves well-being
- CO4: Learn and practice MAOM meditation in daily life
- CO5: To analyze how meditation improves communication and relationships
- CO6: To apply the power of meditation to compassion-driven action

25 MIC 181 INTRODUCTORY MICROBIOLOGY LAB 0 0 4 2

LEARNING OBJECTIVES:

The main objective of this course is to provide basic knowledge to undergraduate students on various microbiological practices in the laboratory.

SYLLABUS:

1. Media Preparation and Inoculation: - Slant, Deep and Broth.
2. Pure Culture Techniques: - Streak Plate, Spread Plate and Pour Plate
3. Cultural Characteristics of Bacteria in Solid, Liquid and Semi Solid Media.
4. Staining Techniques: - Simple, Differential, and Structural Staining
5. Motility Determination: - Hanging Drop Method

REFERENCES:

1. Microbiology, Laboratory Manual-James Cappuccino, Natalie Sherman, 8th Edition 2008.
2. Laboratory Exercises in Microbiology-Harley Prescott, 9th Edition 2014.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand common methods of sterilization.

CO2: Illustrate microbial culture techniques

CO3: Demonstrate different staining methods.

SEMESTER 2

25MIC111 MICROBIAL ECOLOGY, DIVERSITY & CLASSIFICATION 2 1 0 3

LEARNING OBJECTIVES:

The course should enable the students to familiarize the students with physiological diversity of microorganisms and Microbial taxonomy decipher the roles and characteristics of various microorganisms; To get requisite knowledge about the habits and habitats of microorganisms; To evaluate explicitly the Nutritional requirement of microorganisms. Get insight into the various applications of microorganisms, such as bioremediation and composting.

SYLLABUS:

Unit 1

Classification: Five kingdom classification of microbes, definition of microbial diversity and mode of evolution; microbial phylogeny; structural diversity of microbes, Physiological diversity of microorganisms

Unit 2

Basic Concepts: Principles of microbial ecology, nutrient acquisition, microbial competition and antagonism, environments and microenvironments. Association of microbes with eukaryotes, Rumen micro flora, Aquatic habitats: Marine and fresh water; terrestrial habitats; key nutrient cycles: Carbon, Nitrogen and Sulphur.

Unit 3

Diversity: Prokaryotic diversity; eukaryotic microorganism; Microbial taxonomy, Phylogeny of *Archaea*; extremophiles; commercial uses of extremophiles

Unit 4

Application: Microbial diversity and its application in modern science

Unit 5

Bioremediation, Biomining: Microbial bioremediation, bioleaching, biodegradation, biomining.

REFERENCES:

1. Microbial Ecology, Lynch. JM, NJ. Poole, 1st edition, John Wiley and Sons, 1980
2. Microbial Ecology: Fundamentals and Applications, Ronald M. Atlas, Richard Bartha, 4th edition, Pearson, 1998.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recognize various microorganisms, know their habitat and nomenclature.

CO2: Describe microbial diversity in the various biomes.

CO3: Identify aquatic as well as marine habitats and how humans have impacted the environment.

CO4: Explain the applications of microorganisms in bioremediation, biodegradation etc.

CO5: Discuss microorganisms for pollution abatement and environmental applications.

25BIO 111

BIOCHEMISTRY

2 1 0 3

LEARNING OBJECTIVES:

This course deals with the concepts of chemical bonding and principal biochemical reaction mechanisms so that the students can apply in the domains of metabolism, enzyme technology, structural biology, molecular biology and bioinformatics

SYLLABUS:

Unit 1

Basic Organic Chemistry: Introduction- Important elements in biology, concept of hybridization Shape of water and ammonia molecules Acids and bases, pH, Henderson-Hasselbalch Equation, Buffers, Important functional groups in organic chemistry, non-covalent interactions, General types of reactions in Biochemistry, Electrophiles and nucleophiles in biological system,

Unit 2

Amino Acids and Proteins: Introduction, Classification Optical isomerism, chemical properties, Acid-base properties- polyionic nature, zwitter ions, pKa's, pI, Peptide bond formation and properties, Classification of proteins. Levels of protein structure (brief mention of primary, secondary, tertiary & quaternary structures, Denaturation of Proteins.

Unit 3

Carbohydrates Introduction, Sources, Classification into mono, di and polysaccharides. Classification of monosaccharides based on no. of carbon atoms.), aldoses and ketoses, Fischer projections, Haworth structures, Anomers, Epimers, Structure and functions of sugars, Disaccharides, Polysaccharides, Glycoconjugates.

Unit 4

Nucleic Acids Structures of purine and pyrimidine bases Nucleosides, nucleotides, RNA, & DNA Types of RNA Structure of DNA, Watson and Crick model, DNA denaturation, Hyperchromic shift, Aminoacyl tRNA synthetase

Unit 5

Lipids Introduction, sources, Nomenclature Classification, Properties & Functions, Fatty acids, Triacyl glycerols, Membrane lipids, Glycerophospholipids and sphingophospholipids, Steroids, Structure of steroid nucleus, biological role of Cholesterol, fat soluble vitamins, Biological Membranes

REFERENCES:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 7th Edition, Freeman, W. H. & Company, 2017.
2. Donald Voet, Judith G. Voet, Charlotte W. Pratt, Fundamentals of Biochemistry: Life at the Molecular Level, Wiley, 5th Edition. 2016
3. Lubert Stryer, Biochemistry, 9th Edition, W. H. Freeman, 2019.
4. T. W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder, Organic Chemistry, 12th Edition, Wileyplus 2016.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall the concepts of basic chemistry.

CO2: Interpret the structure and properties of biomolecules

CO3: Demonstrate the properties and functions of biomolecules.

25ENG 110 ENGLISH/CREATIVE WRITING & SOFT SKILLS 2 1 0 3

LEARNING OBJECTIVES:

To provide students with an ability to build and enrich their communication skills. To make them familiar with different types of communication. To understand the barriers to effective communication. Engage students in meaningful communication through effective tasks. Identify the basic principles of communication. Analyse the various types of communication. Make use of the essential principles of communication. Identify the prominent methods and models of Communication.

SYLLABUS:

Unit 1- Listening skills

Unit 2- Speaking skills

Unit 3- Reading Skills

Unit 4- Writing Skills

Unit 5- Activities

Class Activity – Spoken English – Introduction to English sounds/ Rhythm/ Pronunciation, Practice: Short speeches/ Conversation. **Written English** – Letters: formal and informal/ Paragraph: writing, analysis/Essays/ Definitions: short, expanded/ Graphical Representation/ Writing Memos, Circulars, Notices/ Reports: lab, process etc. **Listening** – Listening: for comprehension/ accent/ pronunciation. **Reading** – Intensive and extensive.

REFERENCES:

1. Andrew, Jones. *English for students of Science* – London Orient Longmans 6th ed.2003
2. Stanley, Daavies. *Spoken English for you* – London Emerald,1998
3. Hester, Strang. *English Basics (a companion to grammar and writing)* – CambridgeCUP,6th ed.1997.
4. John ,Douglas .*A communicative grammar of English*, III Ed. – London Pearson 2001
5. Strauss, Andrews. *Effective English for Technical Communication* – London Emerald Publishers, 2001
6. Strick Vauen *Spoken English in 4 Easy Steps* – Cambridge ESN pbl,2009

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Identify the correct stress, right accent and right intonation to ask questions, make requests or to make commands by referring dictionary.

CO2: Illustrate various speaking and writing tasks, such as roleplays, debates, group discussions apart from the use of correct spelling, punctuation and the ability to transfer information in the writing tasks.

CO3: Demonstrate through face-to-face conversations comprehension of simple words and phrases used in common everyday context

CO4: Use grammatically structured questions related to basic needs and respond appropriately

CO5: Use words that signal differences between present and past in simple statements related to common activities.

25CSA 113

INFORMATION SYSTEMS

2 1 0 3

LEARNING OBJECTIVES:

To enable the students to understand the fundamentals of IT and to provide the basic understanding of the internet. The students also would learn the essential applications which are useful for a life scientist.

SYLLABUS:

Unit 1

Computer Hardware

What are computers? Its various characteristics, applications, and limitations. Functional block diagram of computer - Components of a computer, digital signals, microprocessors, input/output devices, storage devices etc.

Unit 2

Software Systems

Introduction to software - Types of software - Operating systems - Types and various functions and types of operating system - Basic introduction to Linux, Unix operating system - Languages and their types (High level and low-level language). – Introduction to programming using C language.

Unit 3

Office Applications

Word processing, spreadsheets, and database applications. Basic operations in word processor like styles, table of contents, inserting objects, references, merging the documents etc. Spreadsheet operations like summing, averaging, graphs and visualizations. Making graphs and plots for scientific data.

Unit 4

Fundamentals of Modern Networking

History of Networking, Types of networking, how networks operate, Peer-to-Peer versus Client/Server, network types and topologies, network protocols.

Unit 5

Additional Information Systems Concepts

Introduction to supercomputing and high-performance computing – Multimedia application for biological domain – Introduction HTML and web technology.

REFERENCES:

1. Govindarulu, IBM PC and Clones, Tata McGraw-Hill Education, 2nd edition 2002.
2. Computer Fundamentals: Concepts, Systems & Applications- 8th Edition, Pradeep K. Sinha, Priti Sinha, BPB Publications; 6th edition, 2004
3. http://www.openoffice.org/documentation/conceptualguide/conceptual_guide_OOo_3_ebook.pdf

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Identify different components, signals, microprocessors, input/output devices

CO2: Understand software systems and office applications

CO3: Demonstrate networking and computing concepts.

The mathematics course deals with linear algebra, differential equations, basic calculus, statistics, etc. As an area of study, it has a broad appeal in that it has many applications in different aspects of biology.

SYLLABUS:

Unit-1

Linear Algebra:

Matrices-definition, Types of matrices, Addition and subtraction of matrices, Multiplication of matrices, Properties of matrix multiplication, Determinants and properties of determinants, Minors and co-factors, Transpose of a matrix, Symmetric and Skew-symmetric matrix, Orthogonal matrix, Adjoint of a matrix, Singular and Non-Singular matrix, Inverse of a matrix, Rank of a matrix, Cramer's rule, Eigen Values and Eigen Vectors, Cayley Hamilton Theorem.

Unit-2

Algebra:

Sequence and Series Sequence-definition, Arithmetic progression, Geometric Progression, Harmonic Progression, Infinite series, Sum to infinity.

Unit-3

Basic calculus:

Functions, Limits-definition problems Continuity-definition, properties, Continuity on an interval and continuity of polynomials, continuity of rational functions Differentiation- Slopes and Rate of change Product rule, Quotient rule Derivative of rational powers of x, Implicit differentiation Indeterminate forms and L Hospital rule Integration – Indefinite integral Integration from the view point of differential equations, Integration by substitution, Area as a limit of a sum, The definite integral

Unit-4

Differential Equation:

Differential Equations Definition, Initial and boundary value problems, Classification of First order differential equations, Linear equations, Bernoulli's equation, Exact equations Separable equations, Homogeneous equations,

Unit-5

Statistics:

Statistics, Collection, Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram, Frequency curve and frequency polygon, Ogives Mean, median, mode, Standard deviation.

REFERENCES:

1. P. R. Vittal - Business Mathematics and Statistics, Margham Publications 2014, Chennai.
2. S.C Gupta, V. K Kapoor "Fundamentals of Mathematical statistics" Sulthan Chand and Sons 12th Edition 2020.
3. S. Lipschitz & M. Lipson "Discrete Mathematics" 2001-TMH.
4. Thomas Finney "Calculus 9th Edition" Pearson publications.
5. Seymour Lipschitz, Marc Lipson "Schaum's Outlines of Probability" MCGRAWHILL 2000 2nd edition.

6. Bali Iyengar “A textbook of Engineering Mathematics” Dr. B. S Grewal “Engineering Mathematics”- 9th Edition - 2010

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe linear algebra concepts to model and solve real world situations.

CO2: Understand rank, eigen values and eigen vectors of a matrix and the importance of Cayley’s Hamilton theorem.

CO3: Explain first order differential equations by various methods and its applications.

CO4: Discuss the structure and procedure of solving higher order differential equations with constant and variable coefficients.

22ADM111

GLIMPSES OF GLORIOUS INDIA

2012

LEARNING OBJECTIVES:

To introduce students to the depths and richness of the Indian culture and knowledge traditions and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with knowledge of their country and its eternal values.

SYLLABUS:

Unit 1 -Face the Brutes

Unit 2 -Role of Women in India

Unit 3 -Acharya Chanakya

Unit 4 -God and Iswara

Unit 5 -Bhagavad Gita: From Soldier to Samsarin to Sadhaka

Unit 6 -Lessons of Yoga from Bhagavad Gita

Unit 7- Indian soft powers: A solution for many global challenges.

Unit 8 -Nature Preservation through faith

Unit 9 -Ancient Cultures what happened to them.

Unit 10-Practical Vedanta

Unit 11-To the World from India

Unit 12-Indian Approach to Science

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall key historical events, personalities, and philosophical concepts presented in the chapters of ‘Glimpses of Glorious India’.

CO2: Explain the vision and mission of IKS, the teachings of Acharya Chanakya, Ashtanga Yoga, and the concepts of God and Iswara as foundational elements of Indian culture.

CO3: Apply lessons from the Bhagavad Gita to real-life scenarios, demonstrating the relevance of its teachings.

CO4: Analyze the synthesis of yoga, spirituality, and life principles in Indian culture, as explored in the chapters on Bhagavad Gita and Lessons of Yoga, A glimpse into Yoga and Ashtanga Yoga.

CO5: Evaluate the existing Historiographical framework and expand on new horizons and the evaluation of the Indian Calendar System.

CO6: Develop projects that illustrate Indian contributions to the world, models of health and wellbeing, and the Indian approach to science.

25PHY 184

PHYSICAL SCIENCES LAB

0 0 4 2

LEARNING OBJECTIVE:

Students will get the chance to revise the fundamental concepts like viscosity of liquid, conductivity, heat transfer and specific rotation of glucose. Students will get the chance to revise the fundamental concepts like viscosity of liquid, conductivity, heat transfer and specific rotation of glucose.

SYLLABUS:

List of experiments

1. Solution preparation
2. Acid-base titration
3. Determination of Hardness in a water sample
4. Determination of alkalinity in a water sample
5. EMF measurement
6. Organic functional group identification
7. Determination of Viscosity of organic solvents
8. To study the effect of urea on the viscosity of diastase using Ostwald viscometer
9. Measurement of heat changes using calorimeter
10. Measurement of conductance of a given solution and the factors affecting it.
11. Determination of Specific rotation of glucose using polarimeter

REFERENCES:

1. Advanced practical physical chemistry Yadav J.B., Goel Publications (2008).
2. James Brierley Firth, Practical physical chemistry
3. Quantitative Analysis in Chemistry Vogel, Pearson; 5th edition (2006).

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Identify different types of hardness, alkalinity, and its estimation based on complexometric titration.

CO2: Recognize various organic functional groups.

CO3: Summarize the viscosity and specific rotation of glucose employing viscometer and polarimeter.

CO4: Operate calorimeter and conductivity meter

25BIO 181

BIOCHEMISTRY LAB

0 0 4 2

LEARNING OBJECTIVE:

This course deals with basic biochemical calculations and preparations of various reagents, qualitative and quantitative analysis of both carbohydrates and amino acids, and chromatography techniques.

SYLLABUS:

1. Preparation of Laboratory Solutions and Buffers.
2. Verification of Beer-lamberts Law using Potassium Dichromate.
3. Estimation of Amino acids by Ninhydrin Method.
4. Separation of Amino acids using TLC.
5. Isoelectric Precipitation of Casein from Milk
6. Qualitative Analysis of Carbohydrates
7. Qualitative Analysis of Amino acids
8. Estimation of Reducing Sugar using DNS Method.

REFERENCES:

1. "Experimental Biochemistry", Beedu Sashidhar rao, Vijay Deshpande, I K International Pvt. Ltd., ISBN 81-88237-41-8 1st edition,2005.
2. Laboratory Manual in Biochemistry; J.Jayaraman, New Age International Private Limited, Second edition 2011.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Explain buffer and reagent preparations

CO2: Operate basic laboratory biochemical equipment.

CO3: Perform qualitative and quantitative analysis of biomolecules.

SEMESTER 3

25BIO 201

MOLECULAR BIOLOGY

2 1 0 3

LEARNING OBJECTIVES:

Introducing and strengthening the basic molecular processes that are common to all living organisms. This course will form the pillar of knowledge which in turn help the students for better understanding of various other subjects in the field of biotechnology.

SYLLABUS:

Unit 1

Historical Account: Discovery of DNA as genetic material, Griffith's experiment, Hershy and Chase warring blender experiment, Chargaff's rule

Unit 2

Macromolecular Description: Structure of DNA, RNA and Protein. Basic mechanism of replication.

Unit 3

Flow Of Information-Central Dogma: Basic mechanism of replication, transcription, translation.

Unit 4

Regulation In Prokaryotes and Eukaryotes: Gene regulation in prokaryotes and eukaryotes, positive regulation, negative regulation, attenuation, gene regulation in lambda phage life cycle, RNA processing and post transcriptional regulation.

Unit 5

Regulatory Mechanisms: Eukaryotic transcription factors, enhancers, silencers, insulators, chromatin structure and gene regulation, Translational regulation in prokaryote and eukaryotes, Post translational modification and protein stability.

REFERENCES:

1. *Molecular Biology of the gene*, James D Watson et al, 7TH Edition, Pearson, 2007.
2. *Gene VIII*, Benjamin Lewin, 8th edition, Pearson publishers, 2003.
3. *Molecular biology*, David Freifelder, 2nd edition, Barlett and Jones, 1986.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall the important discoveries that are made in the field of molecular biology.

CO2: Understand the structure and different levels of organizations of biomolecules.

CO3: Explain the molecular events in replication, transcription and translation.

CO4: Understand the regulatory mechanisms of gene expression.

25MIC 206

MYCOLOGY

2 1 0 3

LEARNING OBJECTIVES:

This course is to understand the basic knowledge about the fungal kingdom, identification of edible and toad stools. Equip students to know importance of fungi and the systematic classification. Gives a thorough understanding of common diseases caused by different types of fungi, identification, treatment etc

SYLLABUS:

Unit 1

General characteristics of fungi: Introduction, Dimorphism, Growth- Apical Growth Fungi, Importance of fungi in Human life, Ecological interaction- Mycorrhiza, Lichens, interaction with insects, practical uses of fungi.

Unit 2

Systemic classification: Introduction, Reproduction and Life cycle of Micro and Macro fungi- Chytridiomycota, Glomeromycota, Zygomycota, Ascomycota and Basidiomycota.

Unit 3

Saccharomyces cerevisiae: Introduction on yeast, Characteristic features of *S. cerevisiae*, Important as a model organism in recombinant DNA technology and other fields of application.

Unit 4

Mushrooms: Introduction, medical relevance of mushrooms, Mycotoxins and Mushroom poisoning, Cultivation of different types of edible mushrooms.

Unit 5

Medical mycology: Culture methods fungi, Diagnosis. Mycoses- Superficial, Cutaneous, sub cutaneous, Opportunistic Systemic infection, Dimorphic systemic infection Host responses to fungal infection and Immunity, Antifungal agents

REFERENCES:

1. Fungal Biology by J W Deacon, 4th Edition, 2005.
2. Introductory mycology, Constantine J. Alexopoulos, Charles W. Mims, Meredith M. Blackwell, 4th Edition, 2007.
3. Topley & Wilson's Microbiology and Microbial Infections, Medical Mycology, Libero Ajello, Roderick J. Hay, Leslie Collier, Max Sussman, Volume 4, 9th Edition, 2001.
4. Medical Mycology and Human Mycoses, Everett Smith, Ph.D. Beneke, Alvin Lee, Ph.D. Rogers, 1st Edition, 1996.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe the morphology, physiology, classification and function of unicellular and multicellular fungi.

CO2: Recognize the importance of Mycology and its impact on environment and society.

CO3: Understand the importance of fungi in fermentation, pharmaceutical industry, enzyme production, organic acids, bio remedial compounds etc.

CO4: Summarize diseases in different fungal classification.

25MAT 204

BIOSTATISTICS

2 1 0 3

LEARNING OBJECTIVES:

Biostatistics is a course offered to 3rd semester B.Sc., (BT &MB). We have considered distributions relating to a single characteristic. How far the two variables, corresponding to two characteristics, tend to move together in same or opposite directions. The theory of probability is a study of Statistical or Random experiments. Using these figures, it might be possible to estimate the possible level of prices at some future data so that some policy measures can be suggested to tackle the problems. Average is a value which is typical or representative of a set of data.

SYLLABUS:

Unit 1:

Data Representations and Analysis

Collection, Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram, Frequency curve and frequency polygon, Ogives.

Unit 2:

Measures of Central Tendency and Dispersion

Correlation and Regression analysis: Correlations and regressions:- Relation between two variables, scatter diagram, definition of correlations, two regression lines, Karl Pearson's coefficient of correlation, Rank correlation, Tied ranks.

Unit 3:

Statistical Averages

Mean, median, mode, Standard deviation, curve fitting, principles of least squares,

Unit 4:

Probability

Probability theory: Random experiments, sample space, probability theory, conditional probability. Baye's theorem.

Unit 5:

Random variable

Random variable, (. discrete and continuous), Probability density function (discrete and continuous), Distribution function for discrete random variable. Distribution function for continuous random variable, Joint probability distribution, Conditional and marginal distribution. Mathematical expectations: Introduction, the expected value of random variable, moments, Moment generating functions, Product moments, Conditional expectations. Standard distributions - Uniform distribution. (Discrete and continuous). Exponential distribution, Gamma distribution, Beta distribution. Binomial distribution, Poisson distribution, Normal distributions. Standard normal distributions.

REFERENCES:

1. Fundamentals of Biostatistics. by Irfan A Khan- 2004.
2. An introduction to Biostatistics. by P.S.S. Sunder Rao, 5th Edition , 2012
3. J. Ravichandran, "Probability and Statistics for Engineers", Revised Edition 2012, Wiley India.
4. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe statistical methods and probability distribution relevant for molecular biology data.

CO2: Understand the application and limitations of different bioinformatics and statistical methods.

CO3: Apply descriptive techniques commonly used to summarize public health data.

CO5: Demonstrate basic analytical techniques to generate results.

CO6: Apply statistical knowledge to design and conduct research studies.

LEARNING OBJECTIVES:

The main objective of this course is to provide basic knowledge to students to understand analytical tools and apply them to decipher structure and functions of biomolecules.

SYLLABUS:**Unit 1**

Protein extraction and quantitation: Enzymatic lysis, Homogenizer, Blender, Sonication, Bead mill shaker, French press, Biuret, Lowry, BCA and Bradford Assays.

Protein precipitation and treatment: Salting-in, Salting-out, Effect of organic solvents and polymers, Dialysis, Ultrafiltration, Centrifugation.

Unit 2

Chromatography: Partition coefficient, Retention, Resolution, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, Hydrophobic interaction chromatography, Hydroxyapatite chromatography, Paper chromatography, Thin layer chromatography, Reversed-phase chromatography, Normal phase chromatography.

Unit 3

HPLC: Fundamentals of high-performance liquid chromatography, Columns, Detectors.

Unit 4

Electrophoresis: Native PAGE, SDS-PAGE, Isoelectric focusing, 2D-PAGE.

Unit 5

Spectroscopy: Fundamentals of UV/Vis Spectroscopy, Applications of UV/Vis spectroscopy, Spectrophotometer, Fundamentals of fluorescence spectroscopy, Jablonski diagram, Spectro fluorometer, Applications of spectrofluorimetry.

REFERENCES:

1. Protein Purification Techniques: A Practical Approach, Simon Roe, Oxford, 2nd Ed., 2004.
2. Protein Purification: Principle and Practice, Robert K. Scopes, Springer, 3rd Ed., 1994.
3. Physical Biochemistry: Principles and Applications, David Sheehan, John Wiley & Sons, 2nd Ed., 2000.
4. Practical Biochemistry: Principles and Techniques, Keith Wilson and John Walker, Cambridge, 5th Ed., 2004.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe biomolecular extraction and quantitation techniques.

CO2: Summarize concepts and applications of UV/visible and fluorescence spectroscopy.

CO3: Discuss biomolecular separation and purification methods.

CO4: Solve qualitative and quantitative problems related to biomolecular characterization.

LEARNING OBJECTIVES:

Introducing students to the fascinating world of viruses with special emphasis on their general properties, replication strategies, cultivation methods, diagnostic tools, transformations, immune response and antiviral drugs. Virology course is mainly focused on the study of various types of viral pathogens, advanced study of viruses with regard to the basic, biochemical, molecular, epidemiological, and clinical aspects of animal viruses primarily and bacteriophage, plant viruses, viroids, and prions. The viral vectors and their applications in biotechnology are also discussed

SYLLABUS:**Unit 1**

Historical and Conceptual Background: History- Properties of viruses -classification of viruses based on the nature of genome-Methods of study, Viral multiplication, Attachment, entry, un-coating, replication, assembly, release, Cell transformations, Cultivation of viruses- Assay techniques

Unit 2

Different Classes of Viruses: Animal Viruses-Virus-Host interactions-Viral infections, plant viruses, bacteriophages, Viroids.

Unit 3

Host Response and Antiviral Agents: Immune responses to viruses, Interferon and other cytokines, Antiviral therapy.

Unit 4

Bacteriophages: Classification, characterization, morphology, structure, one step growth curve, applications-phage therapy, phage in environment, agriculture & Food applications. Molecular biology tools: Phage display library.

Unit 5

Recent trends in Virology: Viral vaccines: development and mode of action.

REFERENCES:

1. Prescotts Microbiology ,11th edition, 2020.
2. Edward K Wanger, Basic Virology, Second edition,2003.
3. S.J. Flint, L.W. Enquist, V.R. Racaniello, A.M. Skalka, Principles of Molecular Virology Third edition, 2009.
4. Acheson and Nicholas H, Fundamentals of Molecular Virology, Second edition, 2011.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe the basics of virology

CO2: Explain the replicative strategies of different classes of viruses

CO3: Discuss the pathogenicity and mode of action of various antiviral drugs used to control viral infections.

CO4: Demonstrate the host immune response to viruses

25BIF201 INTRODUCTORY BIOINFORMATICS 2 1 0 3

LEARNING OBJECTIVE:

To introduce the field of bioinformatics via an array of publicly available tools and resources.

SYLLABUS:

Unit 1

Introduction: Bioinformatics- Bioinformatics; Components; Different fields in bioinformatics; Omics; Biological Data Acquisition; Types of DNA sequences; RNA sequencing methods; Protein sequencing and structure determination methods; Gene expression data.

Unit 2

Databases- Format and Annotation: Conventions for databases indexing and specification of search terms; Common sequence file formats; Files for multiple sequence alignment; Files for structural data; Annotated sequence databases - primary sequence databases; Subsidiary data storage unfinished genomic sequence data, organisms specific databases; Protein sequence and structure databases; List of Gateways, RNAi databases, Data – Access, Retrieval and Submission: Data Access - standard search engines; Data retrieval; Software for data building; Submission of new and revised data. NCBI resource; databases

Unit 3

Sequence alignment- Sequence Similarity Searches: Sequence homology as product of molecular evolution; Sequence similarity searches; Significance of sequence alignment; Sequence alignment; Alignment scores and gap penalties; Measurement of sequence similarity; Similarity and homology. Methods of Sequence Alignment, Graphic similarity comparison; Dot plots; Scoring mutation probability matrices; Sequence similarity searches and alignment tools Heuristic Methods of sequence alignment, FASTA, BLAST and PSI BLAST, Multiple Sequence Alignment, Significance of multiple sequence alignment; Softwares; Clustal package; Considerations while choosing a MSA software for analysis; Sensitivity and specificity of each software. Methods used to come up with the tree structure, Cladogram, Phylogram, Tools like- Phylip, MEGA. DOMAINS AND MOTIFS: Introduction to motifs and domains, Introduction to signature patterns, Identify patterns, Tools like- Prosite, Pfam, InterPro scan

Unit 4

Visualization tools and genome analysis- Pymol, VMD, Rasmol, Swisspdb viewer. Structure of genome; Anatomy of genomes of virus, prokaryotes, eukaryotes; Human genome Genome Analysis, Whole genome analysis – shotgun sequencing, clone contig; Genomic library; Isolation and microdissection of chromosomes; Hybridisation methods - northern blot, southern blot, western blot; Genome identification Feature based approach – ORF's; Primer Designing; Vector designing; APE

Unit 5

Introduction, the what and why of NGS- Concepts of Whole Exome Sequencing/Whole Genome Sequencing; Concepts of whole Transcriptome Shotgun Sequencing (WTSS) and

RNA-Seq; Introduction to Bacterial Genome Sequencing and Metagenomics; Introduction to Oxford Nanopore read sequencing; Introduction to Galaxy; Case studies

REFERENCES:

1. Vittal R.Srinivas, "BIOINFORMATICS: A MODERN APPROACH", 2005, ISBN: 978-81-203-2858-7, published by PHI Learning Private Limited, New Delhi.
2. Andreas D.Baxevanis, B.F. Francis Ouellette, "Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins", Third Edition, 2005-2006, ISBN: 978-81-265-2192-0, published by John Wiley & Sons INC., U.K.
3. Jean-Michel Claverie, Cedric Notredame, "Bioinformatics for Dummies", 2nd Edition, 2006, ISBN: 978-0-470-08985-9
4. Buermans HP, den Dunnen JT. Next generation sequencing technology: Advances and applications. *Biochim Biophys Acta*. 2014 Oct;1842(10):1932-1941. doi: 10.1016/j.bbadis.2014.06.015. Epub 2014 Jul 1. PMID: 24995601.
5. Goodwin, S., McPherson, J. & McCombie, W. Coming of age: ten years of next-generation sequencing technologies. *Nat Rev Genet* 17, 333–351 (2016). <https://doi.org/10.1038/nrg.2016.49>

COURSE OUTCOME:

After completing the course, students shall be able to

CO1: Define concepts in bioinformatics that could help to solve life science problems

CO2: Classify different biological data and relate it to the known databases and formats

CO3: Understanding the concepts of NGS and other sequencing techniques.

CO4: Demonstrate tools for sequence alignment, phylogenetics, characterization, and visualization of biomolecules

CO5: Apply basic bioinformatic tools for finding motifs, domains gene/protein homologs, designing primers, identifying mutations.

22ADM201 STRATEGIC LESSONS FROM MAHABHARATA 1 0 0 1

LEARNING OBJECTIVES:

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

SYLLABUS:

Unit 1 Mahābhārata - A Brief Summary

Unit 2 A Preamble to the Grand Itihāsa

Unit 3 The Unbroken Legacy

Unit 4 Dharmic insights of a butcher

Unit 5 The Vows we take: Pratijñā

Unit 6 Mahābhārata - The Encyclopaedia for Kingship and Polity Acumen

Unit 7 Karna: The Maestro that Went Wide of the Mark
Unit 8 Strategical Silhouette of An Extraordinary Peace Mission
Unit 9 Yajñaseni, A Woman from Fire.
Unit 10 Popular Regional Tales
Unit 11 Death & deathlessness

Self-Study / Self Reading

Unit 12 Mahabharata- An All-Encompassing Text
Unit 13 Mahabharatha- Whats and What Nots
Unit 14 Mahābhārata in Adages

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall key events and characters from the Mahabharata.

CO2: Explain the strategic decisions made by characters in the Mahabharata and their implications.

CO3: Apply strategic principles from the Mahabharata to contemporary business scenarios.

CO4: Analyse the diverse strategic approaches employed by characters in the Mahabharata.

CO5: Evaluate the enduring relevance of Mahabharata's strategic wisdom in present-day contexts.

CO6: Develop innovative strategic frameworks by synthesizing insights from the Mahabharata.

25MIC 281

GENERAL MICROBIOLOGY LAB

0 0 4 2

LEARNING OBJECTIVES:

To elaborate their knowledge in basic microbiology techniques and performing experiments to identify unknown bacteria by biochemical tests, fungal cultivation and staining, special media.

SYLLABUS:

1. Motility Determination-Soft agar deeps and Hanging drop method.
2. Biochemical tests: IMViC test, Catalase test, Oxidase test, Triple sugar iron test, Carbohydrate fermentation test, Urease test.
3. Fungal cultivation and staining.
4. Identification of bacteria is using differential /selective media

REFERENCES:

1. Microbiology Lab Manual by James G. Cappuccino and Natalia Sherman, 8th Edition 2008.
2. Benson's Microbiological Applications by Alfred E. Brown, Indian Edition 12 2011.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand biochemical tests to identify unknown bacteria

CO2: Demonstrate isolation and identification of fungi

Protein Sorting: Sorting Signals, Types of Transport, Protein Sorting to different Organelles- Nucleus, Endoplasmic Reticulum, Golgi apparatus, Mitochondria, Chloroplast, Peroxisomes, Lysosome, Vesicular Transport, Diseases associated with impaired Transport processes.

Unit 2

Cell Signaling: Basics of animal Communications, Modes & Types of Cellular Signals, Receptors: GPCRs, RTKs, Cytokine Receptors & NRTKs, Enzyme linked receptors, GPCRs in vision, smell and taste, Mechanism of actions of toxins, Nitric oxide signaling, signaling in developmental pathways like Wnt, Notch and Hedgehog, NF-KB signaling, signaling in plants- Auxin, Ethylene and Phytochromes, signaling involved in Circadian rhythm in Humans, Drosophila and Cyanobacteria.

Unit 3

Cell Division and Cell cycle: Mitosis and Meiosis. Biochemical analysis of cell cycle control systems in animal embryos and mammalian cell culture. Cell cycle check points. Role of cyclins and Cdks in cell cycle regulation.

Unit 4

Cytoskeleton: Introduction to major cytoskeletal elements in eukaryotes. Self-assembly and dynamic structure of cytoskeleton.

Unit 5

Advanced Cell Biology: Cell Death & Cancer, Cell Culture Techniques & Assays

REFERENCES:

1. The Cell, A Molecular Approach – 6th Edition – Geoffrey M. Cooper, Robert E. Hausman – Sinauer Associates, Inc. 2013.
2. Molecular Biology of the Cell – 5th Edition – Alberts et al – Garland Science. 2008.
3. Molecular Cell Biology 5th Edition by Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris Kaiser, Monty Krieger, Matthew Scott, Lawrence Zipursky and James Darnell. W.H Freeman and Company. 2003.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Identify different types of sorting signals and their mechanism and their significance in various disease states when impaired.

CO2: Explain basic concepts of cell signaling including the types of signals and receptors and signalling mechanisms, and associate the signaling pathways with various disease conditions.

CO3: Understand the regulation of cell cycle and cell death in Cancer.

CO4: Understand the basic techniques used to culture animal cells.

CO5: Demonstrate the role of cytoskeleton in maintaining cell architecture and rigidity

25MIC 211 MICROBIAL PHYSIOLOGY & METABOLISM 3 1 0 4

LEARNING OBJECTIVES:

The course provides fundamental understanding about the growth and nutrition requirements of prokaryotes and their adaptation strategies. The course helps the students to understand the different metabolic pathways, energetics, and regulation.

SYLLABUS:

Unit 1

Microbial nutrition and growth-Physical and Nutritional Requirements of Cells - batch, continuous and synchronous cultures, growth kinetics – Control of microbial growth.

Unit 2

Transport mechanisms in prokaryotes- active transport, passive diffusion, facilitated diffusion and group translocation. Mechanism of cell division in bacteria, Min CD system and FtsZ regulation

Unit 3

Prokaryotic and eukaryotic microorganisms- Comparison, Flagella, motility, and process of chemotaxis- uptake and utilization of substrates, Sporulation and germination- Two component signal transduction. **Microbial biofilms** the physiology and collective recalcitrance of microbial biofilm communities: Quorum sensing and quenching mechanisms. **Microbial stress responses:** Heat, temperature, pH.

Unit 4

Bioenergetics & Carbohydrate Metabolism: Gibbs free energy, endergonic & exergonic reactions. Standard state free energy changes- ΔG , ΔG^0 and $\Delta G'^0$, Relationship between equilibrium constant and $\Delta G'^0$, Feasibility of reactions. Simple problems, High energy compounds, Introduction to Metabolism - Catabolism, anabolism, catabolic, anabolic and amphibolic pathways

Aerobic and anaerobic pathways: Glycolysis and its regulation, Gluconeogenesis, and its regulation. TCA cycle, amphibolic & anaplerotic reactions. Electron Transport chain, Oxidative phosphorylation, & production of ATP, balance sheet of glucose oxidation, Oxidative stress., Pentose phosphate pathway (HMP shunt) Photosynthesis – ‘light’ and ‘dark’ reactions

Unit 5

Lipids, Amino Acids & Nucleic Acid Metabolism: Beta – oxidations of saturated fatty acids. Ketone bodies, production during starvation and diabetes Biosynthesis of fatty acids – Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, biosynthesis of palmitate, energetics, Regulation of fatty acid biosynthesis. Biosynthesis of cholesterol, regulation.

Biodegradation of amino acids – deamination, transamination, decarboxylation, urea cycle including its regulation. Biosynthesis of amino acids, Disorders of amino acid metabolism (phenylketonuria, alkaptonuria, biologically active amines Recycling of Purine and Pyrimidine nucleotides by salvage pathways. Lesch-Nyhan syndrome & Gout.

REFERENCES:

1. Willey, Joanne M., Linda Sherwood, Christopher J. Woolverton, Lansing M. Prescott, and Joanne M. Willey. Prescott's microbiology. 11th edition New York: McGraw-Hill, 2020.
2. Lehninger, Nelson and Cox, Principles of Biochemistry, 7th Edition, Freeman, W. H. & Company, 2017.
3. Donald Voet, Judith G. Voet, Charlotte W. Pratt, Fundamentals of Biochemistry: Life at the Molecular Level, Wiley, 5th Edition. 2016

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall basics of microbial growth requirements.

CO2: Understand physiology of nutrient acquisition, energy generation and cell division regulation in prokaryotes.

CO3: Explain prokaryotic signal transduction network involving physiological processes including chemotaxis and biofilm formation.

CO4: Understand the basics, enzymes involved and energetics of metabolism, the catabolic as well as anabolic pathways of carbohydrates, lipids and amino acids.

CO5: Apply the concepts of metabolism to analyse the feasibility, energetics, regulation, and errors in metabolism.

25BIO 212

IMMUNOLOGY

2 1 0 3

LEARNING OBJECTIVE:

In this course, students should understand basic immunological mechanisms such as cells and organs of the immune system, innate and adaptive immune response. They should be able to interpret the dysregulation of immune mechanisms during hypersensitivity states, immunodeficiency or autoimmune conditions. Students should be able to apply the understanding of immunology to develop vaccines for protection or therapeutic purpose against diseases.

SYLLABUS:

Unit 1

Introduction to the Immune System: Historical perspectives in Immunology. Cells and Organs of the Immune system, Development of immune cells, Host-pathogen interactions, overview of innate and adaptive immune system. Innate immune responses: Different barriers, phagocytosis, pattern recognition receptors, signaling, cytokines and chemokines, Inflammatory response. Functions of complement system, components of complement, complement activation, Regulation of complement system, Biological consequences of complement.

Unit 2

Humoral Immune response: Factors that influence immunogenicity, adjuvants, haptens, epitopes, Antigen capture and presentation to lymphocytes, Antigen recognition in the adaptive immune system, B cell activation and effector functions, B cell maturation and proliferation. Basic structure of antibodies, Immunoglobulin fine structure, antibody mediated effector functions, antibody classes and biological activities, monoclonal antibodies, strength of antigen-antibody interactions: affinity, avidity.

Unit 3

Cell mediated Immune Response: T cell receptor: structure, function, General properties of effector T cells, Antibody-Dependent Cell-mediated Cytotoxicity. Major Histocompatibility complex and antigen presentation: MHC restriction, Antigen presentation and T cell activation.

Unit 4

Irregularities in immune response: Hypersensitivity Reactions: Allergies, Type I, II, III, IV, Autoimmunity: organ-specific autoimmune diseases, systemic autoimmune diseases.

Immunodeficiency diseases: primary immunodeficiencies, AIDS and other acquired or secondary immunodeficiencies. Tumor immunology: malignant transformation of cells, oncogenes and cancer induction, tumor antigens, immune response to tumors, tumor evasion of immune system, cancer immunotherapy.

Unit 5

Biology of vaccines and immunization: Active and passive immunization, designing vaccines for active immunization, whole-organism vaccines, purified macromolecules as vaccines, recombinant-vector vaccines, DNA vaccines, multivalent subunit vaccines.

REFERENCES:

1. Basic Immunology: Functions and disorders of the Immune system, Abul K abbas, Andrew H Lichtman and Shiv Pillai, 6th edition, 2019.
2. Immunology, Kubly, by Kindt, Goldsby, Osborne, Sixth Edition. 2006.
3. Immunobiology, The Immune system in Health and Disease, Seventh Edition by Janeway, Travers et al, Garland Publishing, 2008.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand basic immunological mechanisms such as cells and organs of the immune system, innate and adaptive immune response.

CO2: Interpret the dysregulation of immune mechanisms during hypersensitivity states, immunodeficiency, or autoimmune conditions.

CO3: Apply the understanding of immunology to develop vaccines for protection or therapeutic purpose against diseases.

25BIO213

ENZYME TECHNOLOGY

2 1 0 3

LEARNING OBJECTIVES:

To provide a detailed knowledge about enzymes, their chemical nature, kinetics, catalysis, classifications, factors affecting the velocity of enzymes, theories of enzyme action, enzyme regulation, inhibitions, clinical enzymes, industrial enzymes, non-protein enzymes, coenzymes and cofactors.

SYLLABUS:

Unit 1

Introduction to Enzymes: General introduction and historic background- General Terminology, Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Enzyme units-Katal and IU. Enzyme activity- chemical nature of enzymes. Protein nature of enzymes and Non protein enzymes- Ribozymes and DNAzymes. Metalloenzymes and metal activated enzymes. Coenzymes and Cofactors- Prosthetic group, coenzymes involved in different metabolic pathways. Classification of coenzymes. Isozymes, Abzymes, Synzyme, Specificity of enzymes, Active site, Allosteric site.

Unit 2

Enzyme Catalysis and Inhibition: Lock and key, Induced fit and Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. mechanism of Serine proteases-Chymotrypsin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens).

Reversible Inhibition- Competitive, Non-Competitive, Uncompetitive, Mixed, Substrate, Allosteric and Product Inhibition. Irreversible Inhibition- Suicide inhibition. Examples and Mechanism of various Inhibitors like Penicillin, Iodoacetamide and DIPF.

Unit 3

Enzyme Kinetics: Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, K_m , V_{max} , L.B Plot, Turnover number, K_{cat} . Kinetics of Enzyme Inhibition. Kinetic Allosteric enzymes. Numerical problems in enzyme kinetics and enzyme inhibition.

Unit 4

Enzyme Regulation: Feedback Regulation, Allosteric Regulation, Reversible, Covalent Modification and Proteolytic Activation. Enzyme processing. Enzymes in post translational modifications.

Organization of enzymes in the cell. Enzymes in the cell, localization, compartmentation of metabolic pathways and enzymes in membranes. Mechanisms of enzyme degradation, lysosomal and non-lysosomal pathways, examples.

Unit 5

Industrial and Clinical uses of Enzymes (Applied Enzymology): Industrial Enzymes- Thermophilic enzymes, amylases, lipases, proteolytic enzymes in meat and leather industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes.

Clinical enzymes- Enzymes as thrombolytic agents, Anti-inflammatory agents, streptokinase, asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Amylases, Cholinesterases, Phosphatases. Immobilization of enzymes, ELIZA. Biosensors. Enzyme Engineering and site directed mutagenesis, Designer enzymes

Unit 6

Enzyme Structure activity Relationship (SAR) and Drug Discovery- Properties of Enzymes.: Lead Compound, Structure based drug design, combinatorial chemistry, High-throughput screening, Case study of DHFR etc.

REFERENCES:

1. Nicholas Price & Lewis Stevens, Fundamentals of Enzymology, 3rd Edition; 2009.
2. Trevor Palmer and P L Bonner, Enzymes:Biochemistry, Biotechnology and Clinical Chemistry, 2nd Edition, 2007.
3. Lehninger, Nelson and Cox, Principles of Biochemistry, 7th Edition, 2016.
4. Donald Voet, Judith G. Voet, Charlotte W. Pratt, Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition. 2016.
5. Gary walsh, Proteins, 2nd Edition, 2015.
6. Internet/Journal Resources

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall the basic concepts of enzymes and their classifications.

CO2: Explain enzyme kinetics, catalytic mechanisms and theories of enzyme action.

CO3: Understand enzyme inhibition and regulation.

CO4: Demonstrate the role of enzymes in industry and medicine.

25BIO216

HUMAN PHYSIOLOGY

4 0 0 4

LEARNING OBJECTIVES:

This course deals with basic concepts and knowledge of the structure and functioning of different systems in the body and to understand integrated aspect of functioning of the individual and all the systems in totality in body.

SYLLABUS:

Unit 1

Basic Cell Physiology-Cell- Introduction, Cell membrane, Movement of the substances and water through the cell membrane, Bioelectric potentials.

Unit 2

Nervous System and Neuro Muscular System- Sensory nervous system, Motor nervous system, Higher functions of the nervous system, Synapse, Reflexes, Cerebrospinal fluid, Blood brain and blood CSF barrier Muscles- Skeletal Muscles-Properties of skeletal muscles, Muscular contraction and relaxation, Neuromuscular junction, Sarco tubular system, Smooth muscle- mechanism of contraction.

Unit 3

Blood and Lymph, Circulatory System, Endocrinology and Respiratory system -Functions of Blood, Hemopoiesis, Erythropoiesis, Anemias, granulocytes and agranulocytes. Leukemia, Reticule endothelial system, Macrophage system, Hemostasis, Blood clotting defects, Blood groups - Functional anatomy of the heart, Properties of cardiac muscles, Conducting system of the heart ,Pressure changes during cardiac cycles, Capillary circulation, Arterial and venous blood pressure- Endocrine glands, hormones ,their functions, Disorders of endocrine system- Mechanism of breathing, Ventilation, Regulation of respiration, Transport of gases, Hypoxia, Artificial ventilation, Non respiratory functions of the lungs

Unit 4

Gastrointestinal System- General structure of alimentary canal, Gastric secretion, Pancreatic secretion, Gastric motility-digestive peristalsis Gastrointestinal hormones, Disorders of GIT

Unit 5

Renal Physiology- Structure of kidney, Nephrons, Juxta glomerular filtrate, Reabsorption, Secretion-mechanism of secretion, Concentrating and diluting mechanism of urine, Dialysis

REFERENCES:

1. Guyton AC and Hall JE, Textbook of Medical Physiology 12th Edition 2011.
2. Lauralee Sherwood, Human Physiology –From Cell to Systems, 7th Edition 2010.
3. Human Physiology, Fox, Stuart Ira, 8th Edition 2004.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall the organization of human body

CO2: Understand the functioning of the human body as different systems like, neuro-muscular, digestive, respiratory, urogenital, body fluids etc.

CO3: Explain the interplay between different organ systems and how organs and cells interact to maintain biological equilibria.

CO4: Demonstrate variation in normal physiology.

25MIC 212**FOOD MICROBIOLOGY****2 1 0 3****LEARNING OBJECTIVES:**

Students are equipped with knowledge in techniques and experiments related to food preservation, food safety, and sustainability.

SYLLABUS:**Unit 1**

History and development of Food Microbiology: Common Foodborne Bacteria, Molds and yeasts. The role and significance of microorganisms in foods.

Unit 2

Methods For Detection of Microorganisms in Food: Physical, Chemical Immunological and biochemical assays.

Unit 3

Food Preservation & Principles of Quality Control: Chemicals, Antibiotics, Preservatives of microbial origin: organic acids. Bacteriocins. Applications of Probiotics and prebiotics, Concept of protective cultures. Hurdle concept.

Unit 4

Food Safety and Quality- HACCP: applications and microbiological criteria. Applications of HACCP in the industry

Unit 5

Food Spoilage and Foodborne Diseases: Common foodborne pathogens, Enteric pathogens, and diseases: Applications of food microbiology: Microorganisms in Food Fermentation.

REFERENCES:

1. Adams, M. R., and M. O. Moss. Food Microbiology. 15th edition, Cambridge: Royal Society of Chemistry, 1995.
2. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). 7th edition, Modern food microbiology. (Springer eBooks.) New York: Springer.
3. Ray, B., & Bhunia, A. K. (2008). Fundamental food microbiology. 15th edition. Boca Raton: CRC Press.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Define microbial composition in food.

CO2: Explain methods to identify and enumerate microorganisms in food.

CO3: Understand the basics of synthetic and microbial preservation and concepts of protective cultures.

CO4: Understand foodborne infections and prevention methods.

25SSK 201

SOFT SKILLS -I

0 1 0 1

LEARNING OBJECTIVES:

To improve the communication and presentation skills of students.

SYLLABUS:

Introduction / Ice Breaking, Personal Visioning - Classroom Workshop, Importance of assertive communication, Introduction to presentation Skills, Assessment on presentation Skills.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand the Soft skills sessions.

CO2: Discuss insights on setting objectives.

CO3: Demonstrate confidence to present in front of audience.

22ADM211 LEADERSHIP LESSONS FROM RAMAYANA 1 0 0 1

LEARNING OBJECTIVES:

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

SYLLABUS:

Unit 1 -Introduction to the Great Itihasa

Unit 2 -Bala-Kāṇḍa: (Preparing for the renowned mission.) and Ayodhya-Kāṇḍa: (Harbinger of an Entire Tradition of Nobleness.)

Unit 3 -Aranya-Kāṇḍa: (Tale of the forest life) and Kishkindha-Kāṇḍa: (The Empire of Holy Monkeys.)

Unit 4 -Sundara-Kāṇḍa: (Heart of the Ramayana) and Yuddha-Kāṇḍa: (The most popular part of the Ramayana)

Unit 5 -Ramayana and Modern-day learning

Unit 6 -Ecological Awareness in the Ramayana

Unit 7 -Different Ramayana: (Epic that connects the world)

Unit 8 -Uttarakhand: (An attempt to explain the untold stories)

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: This part gives a brief introduction of the Great Ithihasa

CO2: This topic deals with 6 Kandas of Ramayana.

CO3: Ramayana and Modern-day learning

[This topic details the relevance of Ramayana and its learning aspects.]

Ecological Awareness in the Ramayana

[This topic demonstrates the Environment and Ecology]

CO4: This topic explains different Ramayana around the world.

CO5: This topic reveals the authenticity of Uttar Kanda and its attempt to explaining the untold stories in the first six Kanda

25BIO 283

IMMUNOLOGY LAB

0 0 4 2

LEARNING OBJECTIVES:

To expose the students to common laboratory assays, like blood grouping, agglutination reactions and antigen-antibody interactions.

SYLLABUS:

1. Blood Smear preparation
2. Blood Cell Counting using Hemocytometer
3. Blood Grouping.
4. Latex Agglutination Reaction
5. Ouchterlony Double Diffusion
6. Dot ELISA

REFERENCES:

1. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th Edition. Wiley-Blackwell Scientific Publication, Oxford.
2. Practical Immunology, 4th Edition (2008). Frank C. Hay, Olwyn M. R. Westwood ISBN: 978-1-4051-4673-9 408 pages, Wiley-Blackwell.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Identify the morphology of cells of the immune system.

CO2: Understand the basic concepts of blood grouping.

CO3: Demonstrate antigen-antibody interactions and detect the presence of antigens and/or antibodies in a biological sample.

CO4: Perform antigen antibody interactions and interpret the data for the presence of antigen and or antibodies in biological samples.

25MIC 282

FOOD MICROBIOLOGY LAB

0042

LEARNING OBJECTIVES:

The course intends to provide basic exposure to food enumeration, quality control, and detection of spoilage pathogens in food.

SYLLABUS:

1. Water quality analysis- MPN test.
2. Dye reduction tests for milk quality determination-methylene blue reductase test.
3. Breed count method for bacterial enumeration in milk.
4. Determination of viable counts in food: Standard plate count method.
5. Food production: yogurt and mushrooms.
6. Production and estimation of lactic acid by *Lactobacillus* spp.
7. Detection of microbial spoilage of canned foods.

REFERENCES:

1. Harley, John P. 2011. 15th edition. Laboratory exercises in microbiology. New York: McGraw-Hill.
2. Ray, B., & Bhunia, A. K. (2008). Fundamental food microbiology. 15th edition. Boca Raton: CRC Press.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand quality control of food products and water.

CO2: Demonstrate basic skills in food enumeration methods.

CO3: Perform methods to detect food spoilage pathogens.

SEMESTER 5

25BIF302

PYTHON FUNDAMENTALS FOR BIOLOGISTS

2103

LEARNING OBJECTIVES:

To introduce students to programming using Python, a versatile and beginner-friendly language widely used in science and data analysis, along with foundational scripting concepts in the Linux operating system.

SYLLABUS:

Unit 1: Introduction to Programming and Linux Scripting

Introduction to programming languages and paradigms,

-Problem-solving techniques and algorithm design

-Programming concepts: syntax, semantics, and flow

-Flowcharts and pseudo-code

-Introduction to compilers and interpreters

-Basic Linux commands

-Shell scripting fundamentals

Unit 2: Python Programming Basics

-Python data types and variables

-Operators and expressions

-Control structures: conditionals (if, else, elif)

-Loops (for, while)

-Lists, tuples, and dictionaries

-Handling arrays and basic matrix operations with libraries like NumPy

Unit 3: Advanced Python Concepts

-Functions: defining, calling, scope, recursion

-Introduction to classes and objects (Object-Oriented Programming)

-File input/output operations

-Logical operations and exception handling

-String manipulation and regular expressions

-Using standard and external libraries (e.g., math, os, sys, BioPython)

REFERENCE:

1. Bioinformatics Programming Using Python by Mitchell L Model
https://lib.unnes.ac.id/32049/1/Bioinformatics_Programming_Using_Python.pdf

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe programming principles and Linux scripting for basic computational tasks.

CO2: Illustrate Python programs using appropriate data types, control structures, and built-in functions.

CO3: Apply Python libraries such as NumPy for array and matrix operations in scientific computing.

CO4: Demonstrate structured code using functions, file operations, and object-oriented programming concepts in Python.

25MIC 302

INDUSTRIAL MICROBIOLOGY

2 1 0 3

LEARNING OBJECTIVE:

The objective of this course is to understand the basic skills applied in fermentation technology and use of biological resources as input to biobased processes which are economically and environmentally sustainable.

SYLLABUS:

Unit 1

Introduction to fermentation: Types of fermentation processes, Component parts of fermentation processes, Classification of fermentation process based on physical state of media, oxygen demand and mode of operation, Media formulation. Need of Sterilization, Aeration and

Agitation. Stages of downstream processing: Cell disruption (for intracellular products), Removal of insoluble, Product isolation, Product purification, Product polishing, Formulation and Marketing

Unit 2

Isolation, screening, characterization and preservation of industrially important microorganisms: Criteria of industrial microorganisms, industrial strategy for usage of microbes, Isolation of microbes from environment, Primary and secondary screening of isolated organisms, Preservation of isolated microorganisms.

Unit 3

Strain improvement: Need for strain improvement, Optimization of microbial activity (environmental and nutritional), genetic modification of isolated organisms (methods involving and not involving foreign DNA), Selection of mutants or genetically modified or improved organisms (Random and Rational screening (regulatory, auxotrophic, permeability, morphological and revertant mutants)). Examples of production: Penicillin, Streptomycin, Citric acid

Unit 4

Design of fermenter and types of fermenter: Internal view of an industrial fermenter, Provisions and activities carried out in a fermenter, Major parts of a fermenter and their functions- Temperature control of a fermenter, Aeration and agitation-types of sparger, Stirrer Gland and Bearing, Baffles, Achievements and maintenance of aseptic conditions, Sterilization of fermenter and air supply, Feed port and sensor probes, Foam control system, Monitoring and control, Different types of valves, Steam trap. Structural difference of twelve types of fermenters from the common design and their application in industry- fermentation vessel, Waldhof fermenter, Acetator, Cavitator, Tower Fermenter, Bubble column, Vertical beer tower fermenter, Multistage system, Cylindro-Conical vessel, Deep Jet Fermenter, Cyclone column fermenter, Packed Tower Fermenter, Rotating Disc Fermenter, Animal cell culture and stirred fermenter, Air lift fermenters for animal cell culture, Microcarriers, Encapsulation and hollow fibre chamber, Packed glass bead reactors and Perfusion cultures for animal cell culture.

Unit 5

Effluent treatment: Fermentation effluents, Industrial contaminants and their impacts, BOD and COD, Effluent treatment processes (primary, secondary and advanced), Biological treatment: aerobic and anaerobic. Factors influencing bioremediation. Advantage and disadvantage of bioremediation.

REFERENCES:

1. Principles of fermentation technology, Stanbury and Whitaker, 2nd edition, 2013
2. Industrial Microbiology by L.E Casida, John Wiley and sons INC, 1st edition, 1968.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe the basics of fermentation technology and their use, and types/classes of fermentation process.

CO2: Explain strategies and criteria involved in isolation, screening and preservation of industrially important microorganisms.

CO3: Discuss the strain improvement strategies and selection of the improved organisms using rational and random screening.

CO4: Illustrate the major parts of a bioreactor and discuss the different types of fermenters.

CO5: Demonstrate the different stages of Downstream processing and waste management in fermentation industry

25MIC 301

MEDICAL BACTERIOLOGY

2 1 0 3

LEARNING OBJECTIVES:

Introduces Medical bacteriology and the taxonomic approach to major human pathogens. This course provides the conceptual basis for understanding pathogenic bacteria, particularly address the fundamental mechanisms of their pathogenicity.

SYLLABUS:

Unit 1

Infection: Sources of infection, method of transmission of infection, Factors predisposing to microbial pathogenicity, Types of infectious diseases. Normal Microbial flora of human body.

Unit 2

Gram Positive Pathogens: *Staphylococcus*, *Streptococcus*, *Corynebacterium*, *Bacillus*, and *Clostridium*.

Unit 3

Gram Negative pathogens: *Neisseria*, *E. coli*, *Klebsiella*, *Proteus*, *Salmonella*, *Shigella*, *Vibrio*, *Haemophilus*, *Pseudomonas*, *Brucella* and *Yersinia*.

Unit 4

Acid Fast Bacteria: *M.tuberculosis* and *M.lepreae*.

Unit 5

Spirochetes: *Leptospira*, *Treponema*, Other medically important bacteria: *Mycoplasma*, *Chlamydia*, *Helicobacter*, *Campylobacter* and anaerobic pathogens.

REFERENCES:

1. Textbook of Microbiology, Ananthanarayan & Jayaram Panicker 7th Edition 2006.
2. Medical Microbiology - Patrick r. Murray, Ken S. Rosenthal, Michael A. Pfaller 8th Edition 2013.
3. MIMS' Pathogenesis of infectious disease, Anthony A. Nash Robert G. Dalziel J. Ross Fitzgerald 6th edition 2015.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand the principles of medical bacteriology and clinical correlation.

CO2: Understand etiological agents responsible for global infectious bacterial diseases.

CO3: Demonstrate general mechanisms of infectious diseases.

25MIC 303 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

2 1 0 3

LEARNING OBJECTIVES:

The course would enable the students to understand in depth about how important the Environment and Ecosystems are, learn about Primary, Secondary and Tertiary wastewater treatments, recent biotechnological advances made in Environmental pollution surveillance, have an understanding about Solid Waste Management, comprehend about Agricultural Microbiology and its significance.

SYLLABUS:

Unit 1

Environment and Ecosystems, Biotic and abiotic environment. Food chains, food Eutrophication Effluent treatment: Primary, Secondary waste treatments Anaerobic wastewater treatment – process overview, Methanogenesis, Different types of reactors, Genetically Engineered Microorganisms in Biotreatment of wastes. Domestic solid waste management

Unit 2

Heavy metal removal-Biosorption, Bioleaching, Phytoremediation, Other techniques, Bio technological methods for pollution detection- General bioassay, Cell biology and molecular biology in Environmental monitoring, Biosensors, Bioterrorism and drinking water safety

Unit 3

Agricultural Microbiology - Soil general properties, Microorganisms in soil –Decomposition of organic matter in soil-Biogeochemical cycles, Nitrogen fixation, Bacterial diseases of important crops, Biofertilizers and microbial insecticides

REFERENCES:

1. Environmental Biotechnology by Alan Scragg 2nd edition 2005.
2. Environmental Biotechnology: Principles and Applications by Bruce E. Rittmann and Perry L. McCarty 2nd edition 2020.
3. Agricultural Microbiology: Subba Rao 3rd edition 2020.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recall microbial diversity in various biomes.

CO2: Understand terrestrial as well as marine habitats and human impacts on environment.

CO3: Demonstrate biosensors for various environmental applications.

CO4: Demonstrate microorganisms for pollution abatement and industrial applications.

25BIO 300

RESEARCH METHODOLOGY

2 0 0 2

LEARNING OBJECTIVE:

This course introduces students to research mainly in the field of Life sciences. The objective is to get them ready to do fruitful research during their final semester and also prepare for all India level competitions for Fellowship in Indian Academy of Science.

SYLLABUS:

Unit 1

Introduction: Fundamentals of Research Methodology, Applications in life sciences,

Unit 2

Literature Search: Use of databases, framing query with examples, Bibliometric: Citation, Impact factor, Eigen factor.

Unit 3

Hypothesis Testing: Hypothesis as a framework for scientific projects, Alternatives of hypothesis driven research and hypothesis generating research.

Unit 4

Experimental Design and Data Analysis: Different types of experimental designs, Controls, Taking measurements, Data Analysis: Between-individual variation, replication and sampling, Common statistical tests with Excel.

Unit 5

Art of Scientific Writing and Presentation: Writing research hypothesis (grant). Presenting research: oral and poster

REFERENCES:

1. Research Methods for the Biosciences. Holmes, Moody & Dine. Oxford University Press.
2. Experimental Design for the Life Sciences. Ruxton & Colegrave. Oxford University Press.
3. Experimental Design for Biologists. David J. Glass. Cold Spring Harbor Laboratory.
4. C.R. Kotari, Research Methodology Methods and Techniques, Second Revised Edition, New Age International (P) Limited, Publishers.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recognise different aspects of research methodology

CO2: Understand the basic concepts of hypothesis generation and experimental designing.

CO3: Perform analysis, interpretation and presentation of research data

CO4: Apply research methodology aspects for formulating grant proposals.

25SSK 301

SOFT SKILLS II

0 1 0 1

LEARNING OBJECTIVE:

To improve confidence, presentation skills and communication skills of the students.

SYLLABUS:

Introduction / Ice Breaking, Personal Visioning, Personal Visioning - Classroom Workshop

Personal Visioning - Classroom Workshop, Self-Introduction, Importance of assertive communication, Importance of assertive communication, Introduction to presentation Skills, Discussion on presentation Skills, Assessment on presentation Skills, Assessment on presentation Skills, Concluding Session

Small activity, Familiarization of all members of the class, "Discussing the Questions, Why do we need a vision?, SWOT Analysis, SWOT as a decision making tool", "Further focus on students go deeper and do SWOT Analysis, list of achievements, 1 year action plan in the class", "Further focus on students go deeper and do SWOT Analysis, list of achievements, 1 year action plan in the class", "Sample Self Introductions, Self Intro Videos of examples", Communication merits: Body language and pitch & tone variations, "Articulation Skills: 3Cs of Communication, Verbal / Non-verbal, Written / Voice, Body Language - Video of Obama Speech, provocative questions to students and discussing on various gestures etc...Assertive + Persuasive", "- Public Speaking: Modi, Kalam, Language, Vision, Inspiration, Heart, Don't imitate, be original, making some students to speak randomly, Impromptu speech, Fluency, Structure & content, How to practice public speaking", Assessment on presentation Skills – Public presentation skills, Assessment on presentation Skills – Public presentation skills, "Concluding session: Pep talk - Practice, Practice, practice, Feedback".

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand the Soft skills sessions.

CO2: Discuss insights on setting objectives.

CO3: Demonstrate confidence to present in front of audience.

25MIC 383

INDUSTRIAL MICROBIOLOGY LAB

0 0 4 2

LEARNING OBJECTIVES:

To provide hands-on experience ~~on~~ in isolating and evaluating the industrially potential of microorganisms from various sources. This course helps students to work with small scale fermentors and learn their basic working principles.

SYLLABUS:

1. Isolation and screening of antibiotic producers by crowded plate technique.
2. Isolation of Actinomycetes from soil, Secondary screening protocols-Giant colony technique.
3. Isolation and screening of microorganisms producing proteases.
4. Isolation and screening of microorganisms producing amylases.
5. Isolation of Nitrogen fixers from soil.
6. Isolation of phosphate solubilizers from soil.
7. Immobilization of yeast in alginate beads for ethanol production.
8. Production of citric acid.

REFERENCES:

1. James G. Cappuccino and Natalie Sherman Microbiology: A Laboratory Manual, 10th edition, 2014.
2. Arnold L Demain, Julian E Davies, Manual of Industrial Microbiology and Biotechnology, 2nd edition, 1996.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand various methods of screening industrially important microorganisms from different sources.

CO2: Perform the technique of immobilization of yeast cells.

CO3: Examine the ability of microorganisms for antibiotic production

25MIC 382

MEDICAL BACTERIOLOGY LAB

0 0 4 2

LEARNING OBJECTIVES:

Learn about handling of pathogens, common diagnostics methods like staining, culture techniques, antibiotic sensitivity, and identification of pathogens.

SYLLABUS:

1. Isolation and identification of normal skin flora.
2. Preparation of blood agar and demonstration of hemolysis.
3. Staining: Acid fast ~~staining~~, ~~staining~~, Negative staining.
4. Isolation and identification of unknown bacteria from pure culture.
5. Isolation and identification of unknown bacteria from mixed culture.
6. Antibiotic sensitivity test.
7. Demonstration of WIDAL Test

REFERENCES:

1. Microbiology-A laboratory Manual-James G. Cappucino, Natalie Sherman. 10th Edition 2014.
2. Color Atlas of Medical bacteriology-Luis M de la Maza, Marie T Pezzlo 3rd Edition 2020.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe pathogenicity of organisms associated with human infections.

CO2: Apply appropriate microbiology laboratory techniques, methodologies, instruments and equipment in accordance with current laboratory safety protocol.

CO3: Perform microbiology laboratory techniques and analyze experimental data.

SEMESTER 6

LEARNING OBJECTIVES:

Genetics is the study of heredity and genes. The aim of this course is to strengthen the Mendelian principles along with other molecular genetics topics like recombination, pedigree analysis, ~~transposons,~~ and transposons. This course will help students to venture ~~in-to~~ into ~~the~~ different areas of biomedical sciences.

SYLLABUS:**Unit 1**

Genes, chromosomes & heredity: Introduction, DNA as genetic material – Cellular Reproduction – Mendelism: Basic Principles

Unit 2

Extension and variation of mendelism: Chromosomal Basis – Variation in chromosome number & structure

Unit 3

Linkage and crossing over: Linkage, Crossing Over and Chromosome Mapping – Genetics of Bacteria and their viruses- Extra Nuclear Inheritance.

Unit 4

DNA, gene expression & genomics: Molecular structure of DNA – Mutation, DNA repair & Recombination —Transposable elements

Unit 5

Gene regulation and expression: Regulation of gene expression – Cancer & Regulation of Cell Cycle

REFERENCES:

1. Genetics – 6th Edition – Snustad & Simmons – Wiley, 2011
2. Concepts of Genetics – 10th Edition – Klug et al – Pearson, 2020

COURSE OUTCOMES:

After completing the course, students shall be able to

- CO1. To understand the basic concept of Mendelian principles and learn its application in different genetic experiments. This would help the students to solve most of the genetic problems.
- CO2. To extrapolate the deviations from the standard mendelian laws in few cases and learning the mechanisms.

CO3. To learn the underlying genetic mechanisms that regulate sex determination and clinical cases leading into chromosome abnormalities, and DNA repair mechanisms restore the integrity following DNA damage.

CO4. To understand the principles of linkage, recombination and chromosome mapping to establish the physical and genetic connection between two neighboring genes.

25BIO 311

PHARMACOLOGY

4 0 0 4

LEARNING OBJECTIVE:

To provide an understanding about the basic concept of drug discovery & designing, mechanism of action of different drugs, pharmacodynamics, pharmacokinetics, pharmacogenomics etc.

SYLLABUS:

Unit 1

Introduction to Pharmacology - Fundamental Principles of Pharmacology, Fundamentals of Cardiovascular, Endocrine, and Immunopharmacology.

Unit 2

Introduction to Drug Discovery - Contemporary Approaches to Drug Discovery, Development and Delivery, Fundamentals of Drug Evaluation and Pharmacogenomics, FDA rules and regulations for the approval of new drugs, Major companies in the pharmaceutical industry, Biopharmaceuticals, Nutraceuticals, Economics of drug development.

Unit 3

Pharmacodynamics and Pharmacokinetics- Receptor theory & kinetics, Dose-response relationships, Mechanism of drug action, Phase I and ~~phase~~Phase II of drug metabolism, Drug efficacy, Pharmacokinetics concepts, Pharmacogenomics, Principles of Toxicology.

Unit 4

Principles of Chemotherapy- Principles of antimicrobial and antineoplastic chemotherapy, Types of selective targeting by drugs, Antibacterial and antifungal drugs and mechanisms of action, Antiparasitic drugs and mechanisms of action, Antiviral drugs and mechanisms of action, Antineoplastic drugs and mechanisms of action, Combination chemotherapy (with respect to antimicrobial and antineoplastic drugs).

Unit 5

Intellectual Property Rights with respect to Pharmaceuticals.

REFERENCES:

1. Pharmaceutical Biotechnology Fundamentals and Applications by Daan J. A. Crommelin, Robert D. Sindelar, Bernd Meibohm , Springer New York.
2. Principles of Pharmacology by D. Golan, A. Tashjian, E. Armstrong, J.Galanter, A.W. Armstrong, R. Arnaout and H.Rose. , Lippincott Williams and Wilkins.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand the basics of pharmacology, various stages of drug discovery and intellectual property rights.

CO2: Summarise the basic concepts and principles behind pharmacokinetics, pharmacodynamics, and toxicology

CO3: Demonstrate the principles of antimicrobial and anti-neoplastic chemotherapy

25MIC 312

PARASITOLOGY

2 1 0 3

LEARNING OBJECTIVES:

To understand the common parasitic relationship in nature, focusing more on human parasite that cause diseases.

SYLLABUS:

Unit 1

Introduction: Parasitic association, host parasitic interaction, Effect of parasitism in the host, Sources of parasitic infections. Classification of parasites.

Unit 2

Introduction to Protozoa: Amoeba *Entamoeba histolytica*, Free living amoeba, Flagellates-*Giardia* and non-intestinal *Trichomonas*, Hemoflagellates, Sporozoa and Microspora.

Unit 3

Introduction to Metazoa: General characteristics Cestodes-Intestinal Tapeworms *Taenia solium*, *Taenia saginata* and extra intestinal tape worm

Unit 4

Introduction to Trematodes: General characteristics *Schistosoma haematobium* *S.mansoni* *S.japonicum*

Unit 5

Introduction to Nematodes: General Characteristics, Intestinal nematodes *Trichinella*, *Trichuris*, *Strongyloides* , Blood and tissue *Wuchereria bancrofti* *Brugia malayi*, *Onchocerca volvulus* *Mansonella spp*

REFERENCES:

1. Burton J Bogtish. Clint E. Carter, Thomas N. Oeltmann Human parasitology 4th edition,2012.
2. General parasitology-Thomas C Cheng, 2nd edition ,2012.
3. Markell and Voge's David T. John MSPH, William A. Petri Jr, Medical Parasitology,9th edition ,2006.
4. Foundation of parasitology-Roberts, Janovy.,9th edition 2006

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand the important groups of eukaryotic parasites in vertebrates.

CO2: Classify parasites based on the cellular organization and locomotory organs.

CO3: Discuss life cycle, infection pathways and types of damage they inflict on the host.

CO4: Demonstrate the clinical features associated with each parasite.

25MIC315

MICROBIAL PATHOGENESIS

2 1 0 3

LEARNING OBJECTIVES:

The course introduces the basic concepts and molecular aspects of Bacterial and Viral Pathogenesis. Helps students to extrapolate those concepts in explaining the pathogenesis and pathology of different bacterial and viral pathogens.

SYLLABUS:

Unit 1: Importance of bacterial pathogenesis, host immunity, antibacterials and prophylactics: Bacteria and disease.

Unit 2: Host pathogen interaction. Importance of the study of bacterial pathogenesis. First line of host defense, innate immunity, antibodies and T cells. Normal Microbiota. Bacterial strategies to overcome host defense.

Unit 3: Molecular biology of virulence. Prophylactics and antibacterials.

Unit 4: Background Information of Viral Pathogenesis: Representative Organisms: DNA Virus replication strategies, RNA virus replication strategies.

Unit 5: Influenza virus and Para influenza viruses. SARS and respiratory viruses. Measles, mumps and rubella viruses. Herpes virus. Enteroviruses. Pox viruses. Retroviruses, HIV and retroviral therapy. Oncogenic viruses. Hepatitis viruses.

REFERENCES:

1. S.J. Flint, L.W. Enquist, V.R. Racaniello, A.M. Skalka, Principles of Molecular Virology Third edition, 2009.
2. Ananthanarayan, R.; Paniker, C. K. J. *Ananthanarayan and Paniker's Textbook of Microbiology*, 12th ed.; Universities Press: Hyderabad, India, 2022.
3. Levy JA, Fraenkel-Conrat H, Owens RA. *Virology*. 3rd ed. Englewood Cliffs (NJ): Prentice Hall; 1994.
4. Salyers, A. A.; Whitt, D. D. *Bacterial Pathogenesis: A Molecular Approach*; 3rd ed.; ASM Press: Washington, DC, 2002. ISBN: 978-1555811785..
5. Groisman, E. A. *Principles of Bacterial Pathogenesis*; Academic Press: Cambridge, MA, USA, 2016. ISBN: 978-0128003787.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand the pathogenesis from the perspective of the etiological agents.

CO2: Explain bacterial and viral virulence factors.

CO3: Demonstrate host responses to bacterial and viral infections.

CO4: Analyse emerging diseases on specific bacterial and viral pathogens.

25MIC 313 RECOMBINANT DNA TECHNOLOGY 3 0 0 3

LEARNING OBJECTIVES:

The course attempts to introduce the basic concepts of recombinant DNA technology namely Boyer and Cohen's workflow of gene manipulation, restriction and ligation, plasmid and phage-based vectors, transformation techniques, site-directed mutagenesis and applications.

SYLLABUS:

Unit 1

Introduction to rDNA technology

The Basic Principles of Gene Cloning and DNA Analysis Introduction, History, the advent and importance of gene cloning and the polymerase chain reaction, Vectors for Gene Cloning, Purification of DNA from Living Cells, Manipulation of Purified DNA, Introduction of DNA into Living Cells

Unit 2

Vectors for Cloning

Cloning Vectors for E. coli, λ and other high-capacity vectors, Cloning Vectors for Eukaryotes, Genomics & cDNA Libraries

Unit 3

Applications and Techniques of Gene Cloning

Polymerase Chain Reaction & qPCR, Electrophoresis & Blotting Techniques, Site- Directed Mutagenesis, DNA Sequencing, Reporter Gene Assays, DNA-Protein Interaction Assays, Protein-Protein Interaction Assays, DNA Fingerprinting.

REFERENCES:

1. T. A. Brown, Gene Cloning and DNA Analysis: An Introduction, 6th Edition, Wiley-Blackwell.
2. Sandy B. Primrose, Richard Twyman, Principles of Gene Manipulation & Genomics – 7th Edition — Blackwell

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe the process of molecular cloning.

CO2: Describe the application of molecular tools and techniques used in gene cloning and functional genomics.

CO3: Illustrate the different recombinant protein expression and purification systems.

CO4: Demonstrate advanced molecular techniques.

25BIF314 ARTIFICIAL INTELLIGENCE FOR BIOLOGY 2 1 0 3

LEARNING OBJECTIVES:

An introductory course designed to familiarize students with the role of artificial intelligence in modern biological research. The course focuses on foundational AI concepts and their

integration with molecular biology, biomedical literature mining, and real-world applications in drug discovery and protein structure prediction.

SYLLABUS:

Unit 1

Introduction to AI and Its Role in Biology – Definitions and scope of Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL). Types of machine learning: supervised, unsupervised, and reinforcement learning. Key concepts: features, labels, models, training, and validation. Overview of biological data types: genomic sequences, expression profiles, imaging, and structural data. Applications of AI in disease prediction, biomarker discovery, and pattern recognition in biological imaging, including disease marker detection, biodiversity conservation, and ecological monitoring such as pollution tracking.

Unit 2

AI Models for Molecular Biology – Role of AI models in protein structure prediction, functional annotation, and interaction prediction. Working with structure prediction data: reading PDB files, interpreting confidence scores, and understanding model limitations. Integration of model predictions into biological hypotheses. Introduction to prominent AI tools and models including AlphaFold, AlphaFold-Multimer, ESMFold, ESM3, RoseTTAFold, diffusion-based models, and FoldSeek.

Unit 3

Natural Language Processing and LLMs in Biology – Overview of NLP in biological contexts. Introduction to biomedical text databases: PubMed, PMC, and ClinicalTrials.gov. Application of NLP models in named entity recognition (genes, proteins, diseases), relation extraction (e.g., gene-disease, drug-target), automatic summarization, question answering, and literature-based discovery. Ethical considerations: misinformation and hallucination in LLMs, citation practices for AI-generated content, and training data bias.

Unit 4

Using AI Tools in Real-World Biological Research – Working with pre-trained models: interpretation of outputs, evaluation of model reliability and bias. Application of AI in drug discovery: virtual screening, target prediction, and drug repurposing. Ethical, legal, and societal aspects of AI in biology. Guidance on selecting appropriate AI tools based on research needs, accessibility, and ease of use.

REFERENCES:

1. Ramsundar, B., et al. *Deep Learning for the Life Sciences*, 2nd Edition. O'Reilly Media, 2019.
2. *A Biologist's Guide to Artificial Intelligence*, Springer, 2024.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Recognize the scope of artificial intelligence and its applications in biology.

CO2: Understand and utilize AI models relevant to molecular biology, including protein structure prediction and function inference.

CO3: Use natural language processing tools for biomedical literature mining and information

extraction.

CO4: Apply pre-trained AI tools for use in drug discovery and biological data analysis.

CO5: Implement ethical and practical considerations while applying AI in biological research.

25BIO 382

GENETIC ENGINEERING LAB

0 0 4 2

LEARNING OBJECTIVE:

The students will learn the theoretical and practical aspects of key molecular biology experiments like Plasmid DNA isolation, Restriction digestion, PCR, Competent cell preparation, Transformation, SDS-PAGE etc. Hands on experience will be given to all the students.

SYLLABUS:

1. Isolation of Plasmid DNA by Alkaline lysis method.
2. Quantification of DNA.
3. Detection of Plasmid DNA by Agarose gel electrophoresis.
4. Restriction Digestion Analysis.
5. Competent cell preparation.
6. Transformation and Efficiency of competent cells.
7. SDS PAGE
8. Polymerase Chain Reaction.
9. Isolation of Genomic DNA.
10. Calibration of pipettes.

REFERENCES:

1. Joseph Sambrook, David William Russell "Molecular cloning". 3rd Edition, CSHL Press, 2001.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe basic principles and methodology of Recombinant DNA technology

CO2: Interprets the results obtained after performing every lab experiment

CO3: Apply the knowledge to solve qualitative and quantitative problems in Recombinant DNA technology

SEMESTER 7

25BIO 401

METABOLIC ENGINEERING

2 1 0 3

LEARNING OBJECTIVES:

Understand the foundational principles of cellular metabolism and the rationale behind engineering metabolic pathways.

Learn and apply molecular and synthetic biology tools used for modifying metabolic networks in various host systems from microbial systems to cell line systems

Analyze metabolic pathways using computational models and metabolic flux analysis techniques.

Explore industrial applications of metabolic engineering

SYLLABUS:

Module 1: Foundations of Metabolic Engineering

Basic concepts and scope of metabolic engineering, beginning with an overview of cellular metabolism and metabolic pathway organization. Key biochemical pathways and manipulation of these pathways for biosynthetic applications. Energy and redox balancing, precursor metabolite generation, and regulation of metabolic fluxes. Regulatory mechanisms such as feedback inhibition, catabolite repression, and allosteric control for pathway engineering. Computational tools used for metabolic pathway analysis, including stoichiometric models and basic metabolic flux analysis (MFA).

Module 2: Tools and Strategies in Metabolic Engineering

Methodologies used to modify and optimize metabolic networks. Gene editing techniques, including gene knockouts, knock-ins, and overexpression systems, as well as synthetic biology tools for pathway reconstruction and refactoring. The use of different host organisms such as *Escherichia coli*, *Saccharomyces cerevisiae*, *Pichia pastoris*, *CHO cell lines* and newer chassis like cyanobacteria, *Corynebacterium glutamicum*, *Aspergillus* spp. for pathway efficiency and scalability. Design of new expression systems, promoter engineering, transcription factor engineering, secretion system and signal peptide engineering, Alleviation of ER stress in recombinant protein production systems, Humanisation of Yeast expression systems for therapeutic protein production. Dynamic regulation techniques such as metabolic switches, biosensors, and CRISPR-based transcriptional control for fine-tuning pathway activity.

Module 3: Applications and Emerging Trends

Real-world applications of metabolic engineering in various industries, including pharmaceuticals, food, agriculture, and sustainable energy. Case studies for pathway engineering for the microbial production of biofuels, biodegradable plastics, plant secondary metabolites, therapeutic proteins, growth factors, monoclonal antibodies with special reference to novel and modified expression systems. New genome editing tools and techniques for metabolic engineering. Systems biology approaches for omics data integration and pathway modeling. Advanced topics such as adaptive laboratory evolution (ALE), genome-scale metabolic models (GEMs), and the application of AI and machine learning in strain design. Regulatory, ethical, and safety considerations in commercial metabolic engineering.

REFERENCES:

1. "Metabolic Engineering: Principles and Methodologies"
Gregory N. Stephanopoulos, Aristos A. Aristidou, Jens Nielsen
Publisher: Academic Press
2. Systems Biology and Biotechnology of *Escherichia coli*"
Sang Yup Lee, Jens Nielsen, Gregory Stephanopoulos
Publisher: Springer

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Explain key metabolic pathways and identify potential engineering targets for enhanced metabolite production.

CO2: Discuss genetic and synthetic biology tools such as gene knockouts, CRISPR-based regulation, and promoter engineering for pathway optimization.

CO3: Demonstrate various microbial and mammalian host systems used in metabolic engineering and justify their use based on the application.

CO4: Perform basic metabolic flux analysis and use computational tools to predict outcomes of genetic modifications.

CO5: Analyse case studies and recent advancements in metabolic engineering for the sustainable production of bio-based products and therapeutics.

25BIO404 RESEARCH ETHICS, SCIENCE COMMUNICATION AND IPR MANAGEMENT

2 1 0 3

LEARNING OBJECTIVES:

The primary objective of this course is to develop scientific communication skills, including oral presentation, academic writing, grant proposal preparation, and digital science communication. The course also aims to instill awareness of intellectual property rights (IPR) and equip students with the knowledge of documentation and administrative procedures related to IPR. Additionally, the course emphasizes the importance of ethics in research, particularly in relation to human rights and responsible scientific conduct.

SYLLABUS:

Unit 1: Scientific Communication:

Introduction and significance of scientific communication, scientific paper writing, publishing process and peer review system, hypothesis framing, grant writing, oral and poster presentations, science communication via digital and social media platforms.

Unit 2: Intellectual Property Rights (IPR)

Importance and types of IPR, definition and process of patent granting, copyrights, trademarks, and design registration. Overview of pharmaceutical patenting in India, implications of the TRIPS agreement, patentable aspects of pharmaceutical products and innovations.

Unit 3: Geographical Indications and IPR Traditional Knowledge

Definition and significance of geographical indications (GI), examples of GI-protected products in India, issues of biopiracy, protection of traditional knowledge systems, AYUSH and traditional medicine, commercialization of AYUSH products and the role of IPR.

Unit 4: IPR Case Studies

Real-world examples highlighting the need for effective IP management strategies, landmark patent infringement cases in pharmaceuticals, biotechnology, diagnostics, and agriculture.

Unit 5: Research Ethics

Ethical principles in scientific research, importance of protecting human rights in research, guidelines for responsible conduct of research, issues of plagiarism, data falsification, authorship disputes.

REFERENCES:

1. Cook, Trevor (2002), A Users guide to Patents, Butterworths, London
2. Benthly L, and Sherman B, (2001), Intellectual property law, Oxford University Press
3. Wegner, Harold (1994), Patent Law in biotechnology, chemicals & pharmaceuticals, Stockton, chipperham
4. Bruce Lehman, President, International Intellectual property Institute, The Pharmaceutical Industry and the Patent system.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understand scientific communication skills

CO2: Describe the importance of different types of IP protections.

CO3: Explain Ethics moral principles that constitute the basis for ethics in research.

25BIO402 APPLIED BIOANALYTICAL METHODS 2 1 0 3

LEARNING OBJECTIVES:

1. Understand the theoretical principles underlying advanced biophysical, spectroscopic, chromatographic, and genomic techniques used in modern biological research.
2. Learn to select and apply appropriate analytical tools for studying biomolecular structure, interactions, dynamics, and cellular localization.
3. Develop competence in interpreting experimental data from tools such as fluorescence spectroscopy, NMR, mass spectrometry, flow cytometry, and NGS.
4. Explore integrated applications of these techniques in proteomics, genomics, molecular diagnostics, and live-cell analysis.

SYLLABUS:

Unit 1: Spectroscopic and Biophysical Analysis of Biomolecules

Fluorescence Spectroscopy and FRET (Förster Resonance Energy Transfer) for biomolecular interactions, Circular Dichroism (CD) Spectroscopy for secondary structure analysis, NMR Spectroscopy for structure and dynamics of biomolecules, Mass Spectrometry in protein and nucleic acid analysis, Isothermal Titration Calorimetry (ITC) and Differential Scanning Calorimetry (DSC) for interaction studies

Unit 2: Advanced Chromatographic and Proteomics Tools

Affinity Chromatography and Fast Protein Liquid Chromatography (FPLC) for tagged protein purification High Performance Liquid Chromatography (HPLC) for biomolecule separation,

2D-Gel Electrophoresis and Mass Spectrometry-based Proteomics, Thermophoresis and Surface Plasmon Resonance (SPR) for kinetic and affinity profiling

Unit 3: Advanced Imaging and Cell Analysis Techniques

Confocal Laser Scanning Microscopy for 3D cellular imaging, Flow Cytometry and Fluorescence-Activated Cell Sorting (FACS), Fluorescence In Situ Hybridization (FISH) for nucleic acid localization, Super-Resolution Microscopy (STORM, PALM), Live Cell Imaging and Label-Free Imaging Techniques

Unit 4: Nucleic Acid Analysis and Genomic Tools

Digital PCR (dPCR) and Droplet Digital PCR (ddPCR) for ultra-sensitive nucleic acid quantification, FRET-based Nucleic Acid Hybridization Assays, Next-Generation Sequencing (NGS) and RNA-Seq, CRISPR-based diagnostics (e.g., SHERLOCK, DETECTR), ChIP-Seq, ATAC-Seq, and Bisulfite Sequencing for epigenomic profiling, Microarrays and Yeast Two-Hybrid for interaction mapping

REFERENCES:

1. Principles and Techniques of Biochemistry and Molecular Biology. Editors: Keith Wilson and John Walker
Publisher: Cambridge University Press
2. Introduction to Proteomics: Tools for the New Biology. Author: Daniel C. Liebler
Publisher: Humana Press

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Apply biophysical and spectroscopic methods to investigate biomolecular structure, folding, and interactions.

CO2: Demonstrate proficiency in protein purification, proteomics, and affinity/kinetic analysis using advanced chromatographic and biophysical tools.

CO3: Use imaging and flow-based techniques for detailed cellular and molecular analysis, including real-time and high-resolution applications.

CO4: Analyze complex genomic and transcriptomic data using digital PCR, NGS, and CRISPR-based diagnostic tools to draw meaningful biological conclusions

25BIO403 ADVANCED PHARMACEUTICAL BIOSCIENCES 2103

LEARNING OBJECTIVE:

The course aims to familiarize students with the fundamental concepts of drugs, including their properties, and biologics. It seeks to introduce various methods for target identification and validation, such as phenotypic screening and chemoproteomics. Students will learn about the processes involved in assay development, lead discovery, and optimization, including techniques like computer-aided drug discovery and SAR studies, chemotherapeutic agents and their properties. Additionally, the course covers the processes involved in drug metabolism, mechanisms of action, toxicity evaluation, and the role of prodrugs in enhancing drug efficacy and safety

SYLLABUS:

Unit 1

Introduction, Definition of drug, Composition of drug, Properties of drug, Druggable genome, Biologics, Properties of Biologics, Similarities and differences with respect to Chemical Entities, Target identification and validation: Different types of targets, Methods of target identification, Phenotypic screening, Chemoproteomics, Gene association studies, Transgenics, Compound Libraries, Combi-chem, Computer Aided Drug Discovery (CADD), Fragment Based Drug Discovery (FBDD).

Unit 2

Assay development: Introduction and Importance, Primary screening, Outcomes: Hit identification and re-confirmation Secondary screening, IC₅₀ determination, Lead discovery and optimization, Pharmacophore, SAR studies, Rational drug design, Toxicity studies - Different types: acute, sub-acute chronic, Safety evaluation, Clinical studies, Features, Different types: Phase 1, 2, 3 and 4, Biologics steps in drug development, Biological drug development process, Cloning in biologics development, Hybridoma technology, Bioreactors, Batch, Fed-batch and Continuous cultures, Techniques for purification, Formulation development, Types of antibodies.

Unit 3

Cancer and Chemotherapy, Alkylating agents, Antimetabolites, Folic acid antagonists, Purine antagonists, Pyrimidine antagonists, Antibiotics, Estrogen therapy, Androgen therapy, Aromatase inhibitors, Drugs derived from natural products, Tyrosine kinase inhibitors.

Unit 4

Metabolism, Mechanism of action, Detoxification reactions, Phase I - functionalization reactions, Phase II - conjugation reactions, Structure toxicity relationships, Reactive metabolites, Factors influencing drug metabolism, Metabolic enzyme induction, Biological factors, Prodrugs, Prodrugs to improve membrane permeability, Drugs recognized by transport proteins, Prodrugs to prolong drug activity, Prodrugs masking drug toxicity and side effects, Prodrugs to improve water solubility, Prodrugs to increase chemical stability, Prodrugs activated by external influence.

REFERENCES:

1. Pharmaceutical Biotechnology
Daan J. A. Crommelin, Robert D. Sindelar, Bernd Meibohm
Springer Nature, Switzerland, Sixth Edition, 2024.
2. Principles of Pharmacology
D. Golan, A. Tashjian, E. Armstrong, J. Galanter, A.W. Armstrong, R. Arnaout, H. Rose
Lippincott Williams and Wilkins/Wolters Kluwer, Baltimore, Seventh Edition, 2011.
3. Goodman and Gilman's The Pharmacological Basis of Therapeutics
Laurence L. Brunton, John S. Lazlo, Keith L. Parker
McGraw Hill, Singapore, Eleventh Edition, 2006.
4. Foye's Principles of Medicinal Chemistry
Thomas L. Lemke, David A. Williams, Victoria F. Roche, S. William Zito
Lippincott Williams and Wilkins/Wolters Kluwer, Baltimore, Seventh Edition, 2013.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Summarise the fundamental concepts of drug discovery and development.

CO2: Demonstrate the ability to design drug screening assays, SAR studies, and rational drug design, along with understanding toxicity evaluation, pharmacophore modeling, and processes involved in biologics development, and formulation.

CO3: Implement the knowledge of cancer biology and chemotherapy to understand their application in cancer treatment.

CO4: Examine drug metabolism pathways, the rationale behind prodrug design, and factors influencing drug efficacy and safety

25BIO481 ADVANCED MOLECULAR GENETICS AND GENE EXPRESSION LAB

0 0 4 2

LEARNING OBJECTIVES:

1. Understand the principles and methods for culturing and genetically analyzing *Drosophila melanogaster* as a model organism.
2. Gain practical knowledge of genetic techniques such as sex linkage analysis, genetic mapping, and chromosome visualization.
3. Learn the fundamentals of molecular cloning, protein expression, and purification in bacterial and yeast systems.
4. Acquire hands-on skills in transformation, fluorescence analysis, and recombinant protein handling.

SYLLABUS:

1. Culturing and Handling of *Drosophila*:
 - a. Media Preparation
 - b. Cleaning and Sterilization of bottles
 - c. Handling of *Drosophila*
2. Morphology and Sexual dimorphism.
3. Salivary gland Chromosome- Dissection of Salivary glands and Preparation of Polytene chromosome.
4. Problems on:
 - a. Sex linkage
 - b. Genetic map
5. Karyotyping (Optional)
6. Heterologous expression of recombinant proteins and purification in *E. coli*
 - a. PCR amplification of target gene and cloning in inducible vectors
 - b. Chemical mediated transformation/electroporation
 - c. Purification of recombinant protein by affinity chromatography
7. Analysis of fluorescent labelled bacteria

8. Transformation of *Sacharomyces cerevisiae* by electroporation and selection of recombinants

REFERENCE:

1. **Green, M. R., & Sambrook, J. (2012).** *Molecular Cloning: A Laboratory Manual* (4th ed.). Cold Spring Harbor Laboratory Press.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Illustrate handling and maintenance of *Drosophila* cultures and differentiate between sexes based on morphological traits.

CO2: Perform salivary gland dissection and prepare polytene chromosome slides for cytogenetic analysis.

CO3: Solve classical genetics problems including sex linkage and genetic mapping using *Drosophila*.

CO4: Demonstrate cloning a target gene into an inducible vector, transform *E. coli*, and express and purify the recombinant protein using affinity chromatography.

CO5: Analyze fluorescent-labelled bacterial cells and transform *Saccharomyces cerevisiae*, selecting recombinants through appropriate screening techniques.

SEMESTER 7

ELECTIVE 1 (3 0 0 3)

25BIO431

EMBRYOLOGY

3 0 0 3

LEARNING OBJECTIVES:

This course will cover the basics of human embryo development and explain the role of hormones and other factors involved in the successful implantation of embryo. The course will describe the diagnostic and treatment options available for infertility and the process involved.

SYLLABUS:

Unit 1: Basic Human Embryology, Gametogenesis, Meiosis, Implantation and placentation, Preimplantation embryo development, Development of various organs

Unit 2: Anatomy of Male and Female reproductive system, Physiology of Ovulation, Folliculogenesis, Physiology of Menses, Hormonal control of human, Natural Cycle, Various stimulation protocols, Ovarian Hyper stimulation syndrome (OHSS), Complication of stimulation

Unit 3: Reproductive Endocrinology, Reproductive pathology, Reproductive Pharmacology, Assisted Reproductive Technology- IUI, ICSI, IVF, Recent advances in ART, IVF Procedure: Fertilization, Embryo Production & Cryopreservation Techniques

Unit 4: Ethical & legal aspects of ART, Oocyte Donation Programme, Surrogacy

and modulation of the immune system. Influence of microbiota on host metabolism, development, and disease susceptibility, including the effects of antibiotics, diet, and probiotics on microbial communities.

Unit 3: Microbial Dysbiosis and Disease: From Inflammation to Therapeutics

Microbiome dysbiosis, and its association with various diseases such as inflammatory bowel disease (IBD), obesity, diabetes, neurodegenerative disorders, and cancer. Methods for analyzing microbial communities (e.g., 16S rRNA sequencing, metagenomics) and development of microbiome-based diagnostics and therapeutics, including fecal microbiota transplantation (FMT), precision probiotics, and phage therapy. Case studies on how microbial manipulation can restore health or serve as adjuvants in immunotherapy.

REFERENCES:

1. "The Human Microbiome, Diet, and Health"; *Institute of Medicine (US) Food Forum*
Publisher: National Academies Press
2. *The Human Microbiome Handbook*; *Jason Tetro*
Publisher: Springer
3. "Mims' Pathogenesis of Infectious Disease" (6th or later edition); *Anthony Nash, Richard M. Dalziel, Cedric Mims*
Publisher: Elsevier
4. "Cellular Microbiology"; Editors: Pascale Cossart, J. Patrice Gorvel, Dominique Ladant
Publisher: ASM Press

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe mechanisms of immune evasion, intracellular survival, and signaling modulation used by key pathogens such as *Mycobacterium tuberculosis*, *Salmonella*, *Klebsiella*, *Candida*, and HIV.

CO2: Explain how the human microbiome contributes to immune homeostasis, nutrient metabolism, and resistance to pathogens.

CO3: Evaluate the pathological consequences of microbial dysbiosis and its role in diseases such as IBD, obesity, and cancer.

CO4: Apply knowledge of host-pathogen and microbiome interactions to propose strategies for therapeutic intervention, including host-directed therapies, probiotics, and microbiome transplantation.

CO5: Interpret data from microbiome analysis techniques (e.g., 16S rRNA sequencing, metagenomics) and assess their application in research or clinical settings.

25BIO433 MOLECULAR FLUORESCENCE: APPLICATIONS IN CHEMICAL BIOLOGY

3 0 0 3

LEARNING OBJECTIVES:

The syllabus outlines several key learning objectives such as understanding the fundamental principles of fluorescence spectroscopy such as emission and excitation spectra, polarization anisotropy, and quenching mechanisms. Students will learn to apply these concepts to

investigate protein interactions, membrane properties, and develop fluorescence-based probes and biosensors. The course also aims to equip students with skills to analyse lifetime measurements, interpret scattering effects, and utilize various fluorescent probes, including quantum dots and fluorescent proteins, in chemical biology research

SYLLABUS:

Unit 1

Emission Spectra, Raman Peaks, Excitation Spectra, Delayed Fluorescence, Scanning Methods, Applications of Polarization/Anisotropy, Protein Oligomerization, Protein/Ligand Interactions, Proteolytic Processing, Fluorescence Polarization Immunoassay, Membrane Fluidity, Effect of Scattering, Rayleigh Scatter and Rayleigh Ghosts, Depolarization via FRET

Unit 2

Excited State Lifetimes, Time Domain, Frequency Domain, Magic Angles, Anisotropic Decay, Dynamic Polarization, Determination of Quantum Yields, Quenching, Collisional or Dynamic Quenching, Static Quenching, Popular Quenchers, Quenching and Membrane Systems

Unit 3

Fluorophores, Intrinsic Probes, Extrinsic Probes, Photostability, Labelling Proteins In Vitro, Non-covalent Probes, Covalent Probes, Photoaffinity Labelling, Membrane Probes, Nucleic Acid Probes, Biosensors, Ion Probes, pH Probes, Molecular Beacons, Voltage-Sensitive Dyes, Quantum Dots, Fluorescent Proteins

REFERENCES:

1. Principles of Fluorescence Spectroscopy; Joseph Lakowicz
Springer, New York, 3rd Edition, 2006.
2. Introduction to Fluorescence; David Jameson
Taylor & Francis, Florida, 1st Edition, 2014.
3. Essentials of Chemical Biology; Andrew Miller
John Wiley & Sons, Chichester, 1st Edition, 2008.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Explain the principles and techniques of fluorescence spectroscopy, including emission/excitation spectra, polarization, and lifetime measurements.

CO2: Demonstrate various fluorescent probes and sensors for biological applications.

CO3: Analyse molecular interactions, protein oligomerization, and membrane dynamics through fluorescence polarization, quenching, and scattering methods.

SEMESTER 8

ELECTIVE II & III (3 0 0 3)

LEARNING OBJECTIVES:

This course covers in details the molecular mechanism of cancer development with emphasis on tumor viruses, oncogenes, tumor suppressor genes, cell cycle and its control and other hallmarks of cancer. It also covers the molecular approaches to cancer diagnostics and treatment. More recent advances in cancer stem cells and cancer epigenetics are also discussed

SYLLABUS:**Unit 1: The Development and Causes of Cancer**

Overview of cancer; multistep nature of cancer development; genetic, chemical, and environmental causes; hallmarks of cancer; types and classification of tumors.

Unit 2: Tumor Viruses, Oncogenes, and Tumor Suppressor Genes

Viral oncogenesis; mechanisms of transformation by DNA and RNA tumor viruses; proto-oncogenes and oncogene activation; tumor suppressor genes (p53, Rb, APC, BRCA1/2).

Unit 3: Cell Cycle Control, Apoptosis, and Telomere Biology

Regulation of cell cycle and checkpoints; dysregulation in cancer; apoptosis pathways and their inhibition; telomeres, telomerase, and cellular immortalization.

Unit 4: Cancer Stem Cells, Angiogenesis, and Metastasis

Concept of cancer stem cells; mechanisms of angiogenesis; tumor microenvironment; metastasis cascade; EMT and invasion.

Unit 5: Cancer Epigenetics, Diagnostics, and Therapeutics

Epigenetic regulation in cancer; molecular diagnostics (biomarkers, PCR, sequencing, imaging); cancer genomics and personalized therapy; immunotherapy; prevention and risk assessment.

REFERENCES:

1. The Biology of Cancer, 2nd Edition, Robert A. Weinberg
2. Molecular Biology of the Cell. Alberts B. et al., (2022) 7th edition. Garland Science.
3. The Cell: A Molecular Approach, 8th Edition, Geoffrey M. Cooper (2018).
4. Journal papers: reviews and research articles

COURSE OUTCOMES:

After the successful completion of the course, the students shall be able to

CO1: Describe the different hallmarks of cancer,

CO2: Explain the role of oncogenes and tumor suppressors during the development of cancer

CO3: Understand the dysregulation of apoptosis and cell cycle in cancer

CO4: Identify the factors regulating angiogenesis and metastasis

CO5: Compare molecular approaches to cancer diagnostics and treatment.

CO6: Interpret data published in scientific journal articles and present cancer biology articles from reputed journals

25BIO442

PHAGE BIOLOGY

3 0 0 3

LEARNING OBJECTIVES:

To enable the students to gain Advanced knowledge in bacteriophages and their application

SYLLABUS:

Unit 1: Introduction to Phage Biology and Classification

History of phage discovery, structure and morphology, classification systems (ICTV, Baltimore), lytic and lysogenic cycles, methods of isolation and quantification.

Unit 2: Ecology and Evolution of Phages

Phage diversity and distribution, phage-host coevolution, horizontal gene transfer, transduction, lysogenic conversion, role of phages in microbial ecology and bacterial virulence.

Unit 3: Molecular Biology and Physiology of Phages

Structure-function relationship of phage proteins, genome replication, regulation of gene expression, host takeover mechanisms, bacterial defense systems (restriction-modification, CRISPR-Cas).

Unit 4: Phage Applications in Health, Agriculture, and Environment

Phage therapy (human and veterinary), biocontrol in agriculture and aquaculture, food safety, wastewater sanitation, and phage role in antimicrobial resistance (AMR).

Unit 5: Genome Engineering and Molecular Biotechnology Applications

Phage genome sequencing and annotation, CRISPR–phage interactions, phage display library, engineered phages, and synthetic biology applications.

REFERENCES:

1. Flint, S. J., Enquist, L. W., Racaniello, V. R., Skalka, A. M., Flint, S. J., Enquist, L. W., ... & Skalka, A. M. (2008). Principles of Virology, (Volume I and Volume II).
2. Kutter, E., & Sulakvelidze, A. (Eds.). (2004). Bacteriophages: biology and applications. CRC Press.
3. Calendar, R., & Abedon, S. T. (2005). The bacteriophages. Oxford University Press.
4. Clokie, M. R. & Kropinski, A.M. (2009). Bacteriophages: methods and protocols, volume 1: isolation, characterization, and interactions (Vol. 1 and 2). Humana Press Inc.
5. Lobočka, M., & Szybalski, W. T. (Eds.). (2012). Bacteriophages (Vol. 82 & 83). Academic Press

COURSE OUTCOMES:

After the successful completion of the course, the students shall be able to

- CO1: Understand the fundamental principles and techniques of phage biology.
CO2: Apply phage biology science and technology in various biotechnological applications.
CO3: Design and analyse experiments using phage biology.
CO4: Evaluate research design and analysis in phage biology literature

25BIO443

CELL SIGNALLING

3 0 0 3

LEARNING OBJECTIVES:

The course includes extensive study on different cell signaling pathways and the recent advancements in contributing to various disease conditions. The course involves discussion of recent scientific papers related to each of these signaling pathways.

SYLLABUS:

Unit 1

Basics of animal communications including the different kinds of signals.

Unit 2

Principles of Cell Signaling Systems: Classification of signaling mechanism, Techniques used to understand cell signaling in the laboratory, Growth Factor/ Receptor Tyrosine Kinases (RTKs), Receptor serine threonine kinase, Cytokine Receptors, Other enzyme-linked receptors.

Unit 3

G Protein Signaling: Significance of toxins like cholera and pertussis in understanding GPCR-mediated cell signaling, Nobel lectures in G protein and RTK signaling, Signaling involved in taste, vision and smell, Cross-talk between GPCR and RTK signaling pathways.

Unit 4

Signal Transduction Through Ion Channels, Signals with Long-Term Consequences (Cell cycle and its control, Apoptosis and Cytoskeletal remodeling).

Unit 5

Signaling in developmental pathways like Wnt, Notch and Hedgehog, Signaling in plants- Auxin, Ethylene and Phytochromes, Prokaryotic Signaling, Signaling involved in Circadian rhythm in Humans, Drosophila and Cyanobacteria.

Unit 6

Recent Advances in Signaling Research and Diseases.

REFERENCES:

1. The Biochemistry of Cell Signalling, Ernst J.M. Helmreich (2005) Indian edition, Oxford University Press.

2. Molecular Biology of the Cell. Alberts B. et al., (2008) 5th edition. Garland Science.
3. The Cell: A Molecular Approach, 4th Edition, Geoffrey M. Cooper and Robert E. Hausman
4. Journal papers: reviews and research articles

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Understanding G protein signaling in depth which involves discussions on the noble lectures in the field.

CO2: Extensive study on Receptor tyrosine kinases and their signaling with respect to disease conditions like Cancer.

CO3: Study of other signaling pathways involved during various developmental stages with detailed discussions of scientific articles pertaining to each of the signaling pathways.

CO4: Involves understanding various signalling mechanisms in plants.

CO5: Trained to design experiments and interpret data based on the discussions on each signaling pathway which would help them develop scientific critical thinking skills.

25BIO444

BIOMIMICRY

3 0 0 3

LEARNING OBJECTIVES:

The course aims to present a biological perspective in solving problems concerning man and his environment.

SYLLABUS:

Unit 1

The background- Innovation inspired by nature. The pioneers- Janine M. Benyus, Dayna Baumeister etc. how and why nature can be Model, Measure and Mentor to solve problems.

Unit 2

Biomimetic solutions to food scarcity and energy crises; manufacturing in a benign and sustainable manner.

Unit 3

Nature as a repertoire of drugs and pharmacological strategies

Unit 4

Nature as paradigm to process and store information; ecological concepts in city planning and business.

Unit 5

Individual Mini projects (conceptual) to identify a problem and derive solutions from nature

REFERENCES:

Textbooks

1. Biomimicry- Innovation Inspired by nature, Janine M. Benyus.
2. Biomimicry resource handbook from Biomimicry 3.8

Web resource

<http://biomimicry.net>

<http://biomimicry.org>

<http://www.asknature.org>

COURSE OUTCOMES:

After the successful completion of the course, the students shall be able to

CO1: Remember the historical background, the principles, seeds, terminologies of biomimetics

CO2: Understand how nature can serve as a model, measure and mentor to solve problems

CO3: Demonstrate examples of innovation inspired by nature

25BIO445

NEUROSCIENCE

3 0 0 3

LEARNING OBJECTIVES:

This course deals with the study of structure and function of nervous system and how information is transmitted from one part to the other with emphasis on physiology, development, anatomy etc.

SYLLABUS:

Unit 1

Introduction to Neuroscience, History of Neuroscience, Neuroanatomical planes, parts of Central Nervous system, Neurons and glia,

Unit 2

Neurophysiology basics, resting potential, action potential, Synaptic transmission, types of synapses, behavior of neuron, initiation and propagation of action potential, Ion Channels and properties, Learning and plasticity at the synapse,

Unit 3

Neurophysiology and Neuron Simulation Virtual Labs, Hodgkin-Huxley neuron, patch clamp physiology, electrophysiological techniques, basic protocols in neuroscience,

Unit 4

Vision, Olfaction, Hearing, Motor system, Cerebellum, Brain disorders, Neural basis of Consciousness.

REFERENCES:

1. Kandel, E.R., Schwartz, J.H., Jessell, T.M., & Siegelbaum, S.A. (2013) Principles of Neural Science. 5th Edition. McGraw-Hill Professional. ISBN: 978-0071390118.
2. Neuroscience, 3rd ed, edited by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel La Mantia, James O. McNamara, and S. Mark Williams. 2004. ISBN - 0-87893-725-0
3. Neuroscience Online, the Open-Access Neuroscience Electronic Textbook! <http://neuroscience.uth.tmc.edu/>, UT Austin

4. The Synaptic Organization of the Brain, 4th Edition, Gordon Shepherd (Editor), Oxford University Press.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1: Describe the structural and functional organization of the nervous system, including key components such as neurons, glia, and major brain regions.

CO2: Explain the biophysical principles underlying neural signaling, including resting membrane potential, action potential, and synaptic transmission.

CO3: Apply knowledge of ion channels, neural plasticity, and synaptic physiology to understand mechanisms of learning and memory.

CO4: Analyse sensory and motor pathways in the context of systems neuroscience, including vision, hearing, olfaction, motor control, and cerebellar functions.

CO5: Examine neurological disorders and relate brain function to behavior and states of consciousness using current scientific understanding.

25BIO446 REGENERATIVE BIOLOGY & STEM CELLS 3 0 0 3

LEARNING OBJECTIVE:

This is an interdisciplinary course at the interface of the cutting-edge fields: stem cell research and regenerative medicine and bioengineering. The course covers how adult stem cells are specified into different cellular fate during health and disease, different model organisms used to study adult stem cell biology, role of extracellular niche and other molecular signaling pathways regulating stem cell fate decision. Course covers induced pluripotent stem cells, stem cell treatment using engineered stem cells and disease modelling using iPSCs. Course includes a discussion component where we discuss recent research advances in the field and ethics and policies in stem cell research.

SYLLABUS:

Unit 1

Introduction to regenerative medicine: Adult stem cells, Stem cell niche, Trans differentiation and dedifferentiation, Tissue regeneration during injury, Fibrosis and Regeneration, Influence of Immune system and ECM on regeneration. Regeneration models in invertebrates/vertebrates and the cellular basis. Factors responsible for differences in regenerative capacity in animal kingdom.

Unit 2

Embryonic stem cells and Induced pluripotent stem cells: Derivation of embryonic stem Cells, Derivation of iPSCs, Properties of ES and iPSCs. Disease modelling using induced pluripotent stem cells

Unit 3

Tissue engineering (Stem cell-based therapies): Introduction to Tissue engineering triad (biomaterials, biomolecules and cells). Bone/CNS/Cardiac/Pancreatic/Liver tissue engineering strategies and stem cell therapies.

Unit 4

Molecular signalling regulating stem cell proliferation and differentiation. Notch Signalling, Wnt signalling, Hedgehog signalling, FGF, LIF- smad, Protein Kinase A

Unit 5

Ethics and Policies in stem cell research: Risks, side effects, safety, therapeutic value associated with stem cell therapies.

REFERENCES:

1. Mostly based on Research and Review articles from journals in stem cells and regenerative biology and medicine
2. *Essentials of Stem Cell Biology* by Robert Lanza and Anthony Atala
3. *The Cell Biology of Stem Cells* by Eran Meshorer and Kathrin Plath
4. *Advances in Stem Cell Therapy* by Nagwa El-Badri

COURSE OUTCOMES:

After the successful completion of the course, the students shall be able to

CO1: Explain various types of stem cells in the human body, the microenvironment and their potential in regenerative medicine.

CO2: Demonstrate the cellular and molecular mechanisms of regeneration through a comparative study involving naturally regenerating species.

CO3: Compare embryonic stem cells and induced pluripotent stem cells, stem cell treatment using engineered stem cells and disease modelling using iPSCs.

CO4: Assess new perspectives in tissue regeneration for stem cell therapy and regulations in stem cell therapy.