B.Sc. HONOURS

MICROBIOLOGY AND INTEGRATED SYSTEMS BIOLOGY

CURRICULUM STRUCTURE

Semester 1

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

Semester 2

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

Semester 3

Sl. No.	Course Title	Course Code	L T P	Credits
1	MOLECULAR BIOLOGY	25BIO201	2 1 0	3
2	MYCOLOGY	25MIC206	2 1 0	3
3	BIOSTATISTICS	25MAT204	2 1 0	3
4	ANALYTICAL BIOCHEMISTRY	25BIO205	2 1 0	3
5	VIROLOGY	25MIC202	2 1 0	3
6	STRATEGIC LESSONS FROM MAHĀBHĀRATA	22ADM201	1 0 0	1
7	GENERAL MICROBIOLOGY LAB	25MIC281	0 0 4	2
8	CELL AND MOLECULAR BIOLOGY LAB	25BIO282	0 0 4	2
Total Credits		**20**		

Semester 4

Sl. No.	Course Title	Course Code	L T P	Credits
1	CELL BIOLOGY	25BIO214	2 1 0	3

2	INTRODUCTORY BIOINFORMATICS	25BIF201	2 1 0	3
3	IMMUNOLOGY	25BIO212	2 1 0	3
4	ENZYME TECHNOLOGY	25BIO213	2 1 0	3
5	MICROBIAL PHYSIOLOGY & METABOLISM	25MIC211	3 1 0	4
6	FOOD MICROBIOLOGY	25MIC212	2 1 0	3
7	SOFT SKILLS-I	25SSK201	0 1 0	1
8	LEADERSHIP FROM RĀMĀYANA(AVP)	22ADM211	1 0 0	1
9	IMMUNOLOGY LAB	25BIO283	0 0 4	2
10	FOOD MICROBIOLOGY LAB	25MIC282	0 0 4	2
Total Credits		**25**		

Semester 5

Sl. No.	Course Title	Course Code	L T P	Credits
1	INDUSTRIAL MICROBIOLOGY	25MIC302	2 1 0	3
2	MEDICAL BACTERIOLOGY	25MIC301	2 1 0	3
3	RECOMBINANT DNA TECHNOLOGY	25MIC313	3 0 0	3
4	ENVIRONMENT & AGRICULTURAL MICROBIOLOGY	25MIC303	2 1 0	3
5	RESEARCH METHODOLOGY	25BIO300	2 0 0	2
6	SOFT SKILLS-II	25SSK301	0 1 0	1
7	LIVE-IN-LABS/OPEN ELECTIVE	25MIC390*		3
8	MEDICAL BACTERIOLOGY LAB	25MIC382	0 0 4	2
9	GENETIC ENGINEERING LAB	25BIO382	0 0 4	2
10.	INDUSTRIAL MICROBIOLOGY LAB	25MIC383	0 0 4	2
Total Credits		**24**		

Semester 6

Sl. No	Course Title	Course Code	L T P	Credits
1	INTRODUCTORY BIOPHYSICS	25BIO215	2 0 0	2
2	PHARMACOLOGY	25BIO311	4 0 0	4
3	DEVELOPMENTAL BIOLOGY	25BIO312	2 1 0	3
4	INTRODUCTORY SYSTEMS BIOLOGY	25BIO305	2 1 0	3
5	PROGRAMMING CONCEPTS	25CSA315	2 1 0	3
6	PROGRAMMING CONCEPTS LAB	25CSA382	0 0 3	1
7	STRUCTURAL BIOLOGY	25BIO314	1 1 0	2
8	MACHINE LEARNING FOR BIOLOGICAL SCIENCES	25BIO306	2 1 0	3
Total Credits		**21**		

Semester 7

Sl. No	Course Title	Course Code	L T P	Credits
1	DATABASE CONCEPTS	25CSA401	2 1 0	3
2	PYTHON FOR BIOLOGY	25BIO404	2 1 0	3
3	MINI PROJECT	25MIC497	0 0 3	3
4	DATABASE LAB	25CSA481	0 0 3	1
5	PYTHON FOR BIOLOGY LAB	25BIO482	0 0 3	1
6	APPLIED MATHEMATICS FOR BIOLOGY	25MAT401	3 1 0	4
7	ELECTIVE			3
	Total Credits		**18**	

Semester 8

Sl. No.	Course Title	Course Code	L T P	Credits
1	PROJECT	25MIC498		12
Total Credits			**12**	

Total credits for program completion	165

SYLLABUS

SEMESTER 1

25MIC101 INTRODUCTORY BIOLOGY 2 1 0 3

LEARNING OBJECTIVE:

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, Types of Learned adaptation- Habituation, Sensitization, Imprinting, Conditioned behaviour-classic conditioning and operant conditioning, Insight learning and Spatial learning; 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 cell - 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.Students shall be able to understand the basics of evolution, diversity of life, transmission of genetic information, framing and testing hypothesis.

CO2. Students shall be able to explain basic concepts of cell theory; the structure of different cell organelles and their function.

CO3. Students shall be able to understand the formation and function of cytoskeletal elements like microfilaments, intermediate filaments and microtubules, cell movement and extracellular matrix.

25CHY105 CHEMISTRY 3 1 0 4

LEARNING OBJECTIVE:

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 in to the understanding and development of the bio-chemistry and related interdisciplinary fields.

SYLLABUS:

Unit 1

Chemical bonding

Introduction to bonding,Classification of elements in the periodic table, Periodic properties,Types of bonds & factors affecting the bond formation,bond parameters,Polarity of bonds, semipolar bonds

Unit 2

Chemical equilibrium and Solutions

Solutions, types of solutions,solvation energy, lattice energy, Equivalent & molecular mass, mole concept,solubility & factors affecting solubility, Expression for concentration of solutions,polarity of solvents, Importance of dielectric constant of solvents, Solvents other than water,classification of solvents, Dilution factor, serial dilution, Solute–solvent interactions in solutions.

Equilibrium constant, Le-Chatelier principle,Acid & bases, strength of acid & bases,pH of aqueous solutions,Acid –base titrations, indicators in titrations,Solubility product & applications, ionic product, Condition for precipitation,Hydrolytic reactions & expression for hydrolytic constant.

Unit 3

Organic Chemistry

Introduction to functional groups, chemical & physical properties, Reaction intermediates in organic chemistry, Electronic effects in organic compounds,Aromaticity with examples,SN1 & SN2 mechanism, Nucleophilic addition & substitution reactions at carbonyl group,E1 & E2 reactions in alcohols, Heterocyclic compounds, Configuration & projection formula, Optical & geometrical isomerism, Tautomerism & its applications

Unit 4

Chemical kinetics and Electrochemistry

Rate of reaction, differential rate law expressions,Order & molecularity, rate constant, integrated equations (Ist,2nd & 3rd order), nth life of a reaction, Arrhenius equations, temperature dependence of rate constant, energy profile diagrams. Reaction intermediates, Different theories on reaction rate, Electrode potential, related problems, Nernst equation & its applications, emf of the cell,related problems,Redox reactions in cells, free energy change & standard emf of the cell,Redox titrations applications with two examples

Unit 5

Coordination Chemistry

Introduction to co-ordinations compounds,Crystal field theory,Colour & magnetic properties of complexes, Chelation & applications, biologically relevent co-ordination compounds

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. Understand 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. Able to understand the crystals structure, defects and free electron theory

CO4. Be able to understand the mechanism and application of conductivity polymer is various electronic devices.

25ENG100 ENGLISH 2 1 0 3

LEARNING OBJECTIVES:

To provide the 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.8. 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, Francoise. *Developing Reading Skills*.A Practical Guide to Reading Comprehension Exercises. CUP, 2003.
3. Hanock, 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. A*merican 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. Prepare the students to seek and find employment in the corporate, media, English language teaching and content writing sectors.

CO2. Develop communicative competence in students. Impart knowledge, ideas and concepts in the technicalities of proper pronunciation, structure, appropriate use and style of the English Language as well as the application areas of English communication.

CO3. Expose the students to the employment opportunities, challenges and job roles.

CO4. Enable the students to conduct independent surveys, collect and analyze data, prepare and present reports and projects. Guide the students to establish self-employment strategies.

25MIC102 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- CO_2 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. Wheolis 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. Understand the contributions of pioneers in Microbiology.

CO2. Designate the prokaryotic cell structure and functions.

CO3. Establish the concept of microscopy and elaborate basic microscopy techniques.

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

CO5. Designate the basic principles of sterilization methods.

25PHY106 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:

Unit1

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 the course, students shall be able to

CO1. Students are able to categorize different types of motions such as 1D, 2D and 3D motions and apply it accordingly.

CO2. They are able to relate work, energy and power and can use it in different scenarios.

CO3. They compare translational motion and rotational motion which makes the bloblem solving very easy.

CO4. Solves problems on waves and oscillations and apply it in different biological instruments.

CO5. They integrate the different phenomena due to light such as reflection, refraction, interference, dispersion and diffraction.

CO6. The students distinguish the properties of matter such as solids, liquids and gases.

CO7. The students are able to compare and relate Dielectrics and magnetism.

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 eternalvalues.

SYLLABUS:

1. **Chapter 1 - Educational Heritage of Ancient India** 2. **Chapter 2 - Life and Happiness** 3. **Chapter 3 - Impact of Colonialism and Decolonization** 4. **Chapter 4- A timeline of Early Indian Subcontinent** 5. **Chapter 5 - Indian approach towards life** 6. **Chapter 6 - Circle of Life** 7. **Chapter 7- Pinnacle of Selflessness and ultimate freedom** 8. **Chapter 8- Ocean of love; Indian Mahatmas.**
9. **Chapter 9 - Become A Strategic Thinker (Games / Indic activity)** 10. **Chapter 10 - Man's association with Nature** 11. **Chapter 11 - Celebrating life 24/7** 12. **Chapter 12 - Metaphors and Tropes** 13. **Chapter 13 - India: In the Views of foreign Scholars and Travellers.**
Self-Study/ Self-reading 14. **Chapter 14 - Personality Development Through Yoga.** 15. **Chapter 15 - Hallmark of Indian Traditions: Advaita Vedanta, Theory of oneness** 16. **Chapter 16 - Conversations on Compassion with Amma**

COURSE OUTCOMES:

. CO1: Increase student understanding of true essence of India's cultural and spiritualheritage.

CO2: Emancipating Indian histories and practices from manipulation, misunderstandings,and other ideological baggage thus, shows its contemporary relevance.

CO3: Understand the ethical and political strategic concepts to induce critical approach tovarious theories about India.

CO4: Familiarize students with the multi dimension of man's interaction with nature, fellow beings and society in general.

CO5: Appreciate the socio-political and strategic innovations based on Indian knowledgesystems. Gives an understanding of bringing Indian teaching into practical life.

22AVP103 Mastery Over Mind 1-0-2-2

COURSE OBJECTIVES:

- Mastery Over Mind (MaOM) is an Amrita initiative to implement schemes and organize university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3)
- It gives an introduction to immediate and long-term benefits of MA OM meditation and equips everyattendee to manage stressful emotions and anxiety, in turn facilitating inner peace and harmony.
- This course will enhance the understanding of experiential learning based on the 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.

COURSE OUTCOMES:

1. To be able to describe what meditation is and to understand its health benefits.
2. To understand the causes of stress and how meditation improves well-being.
3. To understand the science of meditation.
4. learn and practice MAOM meditation in daily life.
5. understand the application of meditation to improve communication and relationships.
6. To be able to understand the power of meditation in compassion- driven action.

SYLLABUS:

Unit 1: Describe Meditation and Understand its Benefits (CO1)

A: Importance of meditation. How does meditation help to overcome obstacles in life

Reading 1: Why Meditate? (Swami Shubamritananda ji)

Video Resource: Pre-recorded Video with Swami Shubhamritananda Puri

Unit 2: Causes of Stress and How Meditation Improves Well-being (CO2)

A: Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation.B: Causes of Stress. The problem of not being relaxed. Effects of stress on health. How meditation helps to relieve stress. Basics of stress management at home and the workplace.

Reading 1: Mayo Clinic Staff (2022, April 29). *Meditation: A Simple, Fast Way to Reduce Stress.*Mayo Clinic. https://www.mayoclinic.org/tests-procedures/meditation/in-depth/meditation/art- 20045858 (PDF provided)

Reading 2: 'Efficient Action.' Chapter 28 in *Amritam Gamaya* (2022). Mata AmritanandamayiMission Trust.

Video Resource: Pre-recorded Video with Dr. Ram Manohar

Video Resource: Pre-recorded Video with Prof. Udhayakumar

Unit 3: The Science of Meditation (CO3)

A: A preliminary understanding of the Science of meditation. What can modern science tell us about thistradition-based method?

B: How meditation helps humanity according to what we know from scientific research *Reading 1:* Does Meditation Aid Brain and Mental Health (Dr Shyam Diwakar) *Reading 2:* 'Science and Spirituality.' Chapter 85 in Amritam Gamaya (2022). MataAmritanandamayi Mission Trust.

Video Resource: Pre-recorded Video with Dr. Shyam Diwakar

Unit 4: Practicing MA OM Meditation in Daily Life (CO4)

Guided Meditation Sessions following scripts provided (Level One to Level Five)

Reading 1: MA OM and White Flower Meditation: A Brief Note (Swami Atmananda Puri)*Reading 2:* 'Live in the Present Moment.' Chapter 71 in *Amritam Gamaya* (2022). Mata Amritanandamayi Mission Trust.

Video Resource: Pre-recorded Video with Swami Atmananda Puri

Unit 5: Improving Communication and Relationships (CO5)

How meditation and mindfulness influence interpersonal communication. The role ofmeditationin improving relationship quality in the family, at the university and in theworkplace.

Reading 1: Seppala E (2022, June 30th) *5 Unexpected Ways Meditation Improves Relationships a Lot.* Psychology Today. https://www.psychologytoday.com/intl/blog/feeling-it/202206/5-unexpected-ways- meditation-improves-relationships-lot

Reading 2: 'Attitude.' Chapter 53 in *Amritam Gamaya* (2022). Mata AmritanandamayiMissionTrust.

Video Resource: Pre-recorded Video with Dr. Shobhana Madhavan

Unit 6 Meditation and Compassion-driven Action (CO6)

Understand how meditation can help to motivate compassion-driven action. *(Pre-recorded videowith Dr Shobhana Madhavan)*

Reading 1: Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocialbehavior:What do we (not) know?. *Current Opinion in Psychology*, *44*, 151-156.

Reading 2: 'Sympathy and Compassion.' Chapter 100 in *Amritam Gamaya* (2022). Mata Amritanandamyi Mission Trust.

Video Resource: Pre-recorded Video with Dr.Shobhana Madhavan

REFERENCES:

1. Chinmayananda, Swami. *The Holy Geeta*. Central Chinmaya Mission Trust, 1996.
2. Devi, Sri Mata Amritanandamayi. *Amritam Gamaya Part 1*. Translated by Rajani Menon. M ACenter, 2022
3. Easwaran, Eknath. *Conquest of Mind*. 3rd ed. Tomales: Nilgiri Press, 2010.
4. Goleman, Daniel, and Richard Davidson. *The Science of Meditation: How to Change your Brain,Mind and Body*. Penguin UK, 2017.
5. Puri, Swami Amritaswarupananda. *From Amma's Heart*. M.A. Center, 2014.
6. Sivananda, Swami. *Concentration and Meditation*. Garhwal, India: Divine Life Society, 2009.
7. Thakar, Vimala. *Why Meditation*. Delhi, India: Motilal Banarsidass, 1996.
8. Vivekananda, Swami. *Raja Yoga*. India: Sanage Publishing House, 2022.

Yatiswarananda, Swami. *Meditation and Spiritual Life*. Sri Ramakrishna Ashrama, 1979.

25MIC181 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, A 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. Students will get practical exposure to common methods of sterilization.

CO2. Skill development for cultivating various microorganisms.

CO3. Identify microorganisms by different staining methods.

SEMESTER 2

25CSA113 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, spreadsheet 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. Students will be understanding different components, signals, microprocessors, input/output devices etc.

CO2. The course enables the students to understand the IT applications in biology.

CO3. On completion of the course students will be able to use Microsoft office tools for their computational requirements as a life science professional.

CO4. They will be knowing the fundamentals of programming, making graphs and plots for scientific data etc.

CO5. On completion of the course, students should have acquired essential knowledge to meet their computational requirements as a life sciences aspirant.

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 micro environments, 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. Clearly distinguish various microorganisms, know their habitat and also discern the nomenclature.

CO2. Thoroughly know the microbial diversity in the various biomes.

CO3. Identify Aquatic as well as Marine habitats and how humans have impacted the environment.

CO4. Postulate applications of microorganisms, such as in bioremediation, biodegradation etc.

CO5. Employ microorganisms for pollution abatement and various other environmental applications.

25BIO111 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. Understand the concepts of basic chemistry including principles of chemical bonding, hybridization, shape of water and ammonia. Acids, bases, buffers, Preparation of buffers, non-covalent interactions, and general types of reactions involved in biochemistry.

CO2. Identify and write the chemical structure of Amino acids, depict their ionisation behaviour, peptide bond formation; describe the structure of proteins and their functions.

CO3. Identify and know the structure, properties and functions of carbohydrates, lipids and nucleic acids.

25ENG110 ENGLISH-CREATIVE WRITING & SOFT SKILLS 2 1 0 3

LEARNING OBJECTIVES:

To provide the 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. Prepare the students to seek and find employment in the corporate, media, English language teaching and content writing sectors.

CO2. Develop communicative competence in students.

CO3. Impart knowledge, ideas and concepts in the technicalities of proper pronunciation, structure, appropriate use and style of the English Language as well as the application areas of English communication

CO4. Expose the students to the employment opportunities, challenges and job roles. To enable the students to conduct independent surveys, collect and analyze data, prepare and present reports and projects.

CO5. Guide the students to establish self-employment strategies.

25MAT114 MATHEMATICS 3 1 0 4

LEARNING OBJECTIVES:

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: Apply linear algebra concepts to model, solve and analyze real world situations.

CO2: Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley's Hamilton theorem.

CO3: Demonstrate solutions to first order differential equation by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and newton's law cooling.

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

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:

Chapter 1	-	Face the Brutes
Chapter 2	-	Role of Women in India
Chapter 3	-	Acharya Chanakya
Chapter 4	-	God and Iswara
Chapter 5	-	Bhagavad Gita: From Soldier to Samsarin to Sadhaka
Chapter 6	-	Lessons of Yoga from Bhagavad Gita
Chapter 7	-	Indian soft powers: A solution for many global challenges.
Chapter 8	-	Nature Preservation through faith
Chapter 9	-	Ancient Cultures what happened to them.
Chapter 10	-	Practical Vedanta
Chapter 11	-	To the World from India
Chapter 12	-	Indian Approach to Science

COURSE OUTCOMES:

CO1: This part deals with two topics: The Need to Become Fearless in Life and the Role or Status of Women in India.

CO2: This part deals with three topics: Teachings and Principles of Chanakya, Difference between the terms *God and Iswara* and Contribution of *Bhagavad Gita*

CO3: This area handles two important concepts: Indian Soft powers and A portrayal of how nature was preserved through the medium of Faith.

Inner power is about never giving up on your dreams.

To manifest more of what you desire in life, you must be prepared to embrace your inner power. You must be persistent if you want to succeed. Maintain your modesty and never stop learning. Inner strength is an attitude to life.

Faiths shape and direct how we think, act, and live our lives. However, faith's power is not solely spiritual. To preserve nature, our forefathers established systems and traditions based on faith. Our culture and faith are intricately bound to nature.

CO4: Two important topics are discussed here: A Brief history of Ancient Indian Cultures and a Discussion on Practical Vedanta.

Indian culture is the legacy of the ethno-linguistically diverse country's social norms, moral principles, traditional practices, belief systems, political systems, artefacts, and technologies. Following every invasion or change of political control, new kingdoms carried their respective cultures with them, adding to the Indian culture. Vedanta is the philosophy of the Upanishads. Every soul possesses the potential to be divine. The objective is to manipulate this inner divinity by invoking both internal and external natural forces.

CO5: From this part, a student gets an insight into the contribution that India has made to the world. Moreover, foreign powers have been trying to humiliate and degrade India in front of the world for so long. However, it should be recognized that many inventions that are considered beneficial to the world today have been contributed by the great men of India.

25PHY184 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.

SYLLABUS:

1. Preparation of standard & dilute solutions.
2. To determine the solubility of an organic acid in water at room temperature.
3. Acid base titration using pH meter.
4. To study the rate of a chemical reaction-2
5. Water Analysis I- Determination of hardness of water sample using EDTA Solution.
6. Identification of functional groups.

7. Determination of Viscosity of Organic Solvents by Ostwald Viscometer
8. To study the Effect of urea on the viscosity of BSA using Ostwald Viscometer
9. Measurement of heat changes using a calorimeter
10. Measurement of conductance of a given solution & factors affecting it.
11. Measurement of emf of an electrolyte at a given temperature
12. To find the specific rotation of sugar solution using polarimeter

REFERENCES:

1. Quantitative Analysis in Chemistry Vogel, Pearson; 5th edition (2006).
2. Advanced practical physical chemistry Yadav J.B., Goel Publications (2008).
3. **Virtual Labs in Chemistry:** http://amrita.vlab.co.in

1. Calorimetry -Water equivalent & heat of neutralization.
2. Emf measurement.
3. Water Analysis –Determination of chemical parameters
4. Determination of specific conductivity of soil
5. Crystal field theory of complexes

COURSE OUTCOME:

After completing the course, students shall be able to

CO1. To get the idea about how to handle the chemicals.

CO2. Students will get the exposure to use the equipments like weighing machine, Ostwald Viscometer, polarimeter, pH meter, conductivity meter, calorimeter etc.

CO3. Students will get the chance to compare the theoretical values and practical values.

CO4. They can improve their hands-on skills.

25BIO181 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.Students will get practical exposure to common buffer and reagent preparations.

CO2.Skill development for students on handling basic laboratory biochemical equipment's (pH meter, colorimeter, centrifuge, micropipettes).

CO3.Developing qualitative and quantitative analytical skills on biomolecules.

SEMESTER 3

25BIO201 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 Freifielder, 2nd edition, Barlett and Jones, 1986.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1. Learn and understand the important discoveries that are made in the field of molecular biology.

CO2. Understand the detailed structure of the double helical nature of DNA as proposed by scientists like Watson and Crick.

CO3. To learn different levels of organizations that regulate the condensation of DNA that leads to the compact metaphase chromosome.

CO4. To learn key molecular events that occur during the transcription and translation processes that leads the protein synthesis from specific genes.

CO5. Understanding the mechanisms that regulate the regulation of gene expression in both prokaryotes and eukaryotes.

CO6. Learn about the molecular events that happen during the replication of DNA prior to cell division.

25MIC206 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 and gain knowledge to identify and relate the fungi that they see around.

CO2. Summarise 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. Gain ability to distinguish the fungal diseases in different classification and predict the disease from the understanding of symptoms.

25MAT204 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: Know the application and limitations of different bioinformatics and statistical methods.

CO3: Perform and interpret bioinformatics and statistical analyses with real molecular biology data.

CO4: 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.

25BIO205 ANALYTICAL BIOCHEMISTRY 2 1 0 3

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 flitration 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 important biomolecular extraction, quantitation, separation and purification techniques.

CO2. Recall concepts and applications of UV/Visible and fluorescence spectroscopy.

CO3. Differentiate important techniques to analyze biomolecules.

CO4. Solve qualitative and quantitative problems related to bio molecular characterization.

25MIC202 VIROLOGY 2 1 0 3

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. Understand the reason for studying viruses.

CO2. Understand how to cultivate, purify and detect the presence of viruses.

CO3. Explain the replicative strategies of different classes of viruses.

CO4. Demonstrate the host immune response to viruses.

CO5. Discuss the pathogenicity and mode of action of various antiviral drugs used to control viral infections.

25MIC281 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. Students will get practical exposure on various biochemical tests to identify unknown bacteria.

CO2. Skill to isolate and identify fungus by cultivation and staining.

CO3. Understand the use of differential, selective and special media.

25BIO282 CELL AND MOLECULAR BIOLOGY LAB 0 0 4 2

LEARNING OBJECTIVES:

Hands-on experience to research in Cell Biology. Focuses on using microscopy to investigate various structural features of cells as well as understanding the state of the cells (resting/dividing). Lab also focuses on basic molecular biology techniques including DNA isolation and electrophoresis.

SYLLABUS:

1. Micro pipetting
2. Lignin staining: comparison between monocots and dicots

3. Plant and animal cell identification
4. Mitosis in onion root tip
5. Genomic DNA isolation by CTAB method from different sources like leaf, flowers and fruits of plants.
6. Spectrophotometry
7. Agarose gel electrophoresis
8. Polyacrylamide gel electrophoresis

REFERENCES:

1. Cell and Molecular Biology: Concepts and Experiments -Gerald Karp, 3rd edition. 2006.
2. Cell and Molecular Biology: A lab manual -K.V. Chaitanya, 2013.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1. Practical exposure to microscopy wherein the students will learn to differentiate between plant and animal cells and identify the deposition of lignin in plants using various staining techniques.

CO2. The various stages of mitosis will be analyzed and visualized using the actively dividing cells present at the root tip of Allium cepa.

CO3. Practical exposure to genomic DNA isolation using various plant tissues and standardizing the protocol for each of these tissues.

CO4. Understand the method to assess the quality of DNA using Agarose gel electrophoresis and well as spectroscopic methods.

CO5. Understand the basis of separation of proteins using polyacrylamide gel electrophoresis.

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 ofIndia in diverse fields. To equip students with a knowledge of their country and its eternalvalues.

SYLLABUS:

Chapter 1	Mahābhārata - A Brief Summary
Chapter 2	A Preamble to the Grand Itihāsa
Chapter 3	The Unbroken Legacy
Chapter 4	Dharmic insights of a butcher
Chapter 5	The Vows we take: Pratijñā

Chapter 6 Mahābhārata - The Encyclopaedia for Kingship and Polity Acumen
Chapter 7 Karna: The Maestro that Went Wide of the Mark
Chapter 8 Strategical Silhouette of An Extraordinary Peace Mission
Chapter 9 Yajñaseni, A Woman from Fire.
Chapter 10 Popular Regional Tales
Chapter 11 Death & deathlessness

Self-Study / Self Reading

1. Chapter 12 Mahabharata- An All-Encompassing Text
2. Chapter 13 Mahabharatha- Whats and What Nots
3. Chapter 14 Mahābhārata in Adages

COURSE OUTCOMES:

CO1 : Increase student understanding of 'Mahabharata 'with this lesson plan.

CO2: Appreciate the relevance of Mahabharata for modern times.

CO3: Understand the ethical and political strategic concepts to induce critical approach to Mahabharata.

CO4: Familiarize students with the inspirational female characters and regional tales from Mahabharata to gain a coherent understanding of it on Indian values and culture.

CO5: Appreciate the relevance of Mahabharata for modern times and identify its imperativeness in everyday life.

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SEMESTER 4

25BIO214 CELL BIOLOGY 2 1 0 3

LEARNING OBJECTIVES:

The course provides in depth knowledge of various concepts of cell biology that involves understanding mechanisms underlying protein sorting into the different organelles and diseases associated with impaired sorting processes, different aspects of Cell signaling, Cell Cycle and its regulation, Cancer, Apoptosis and basics of animal cell culture.

SYLLABUS:

Unit 1

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 rythm in Humans, Drososphila 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. Students will identify the different types of sorting signals and their mechanism and their significance in various disease states when impaired.

CO2. Students will explain basic concepts of cell signaling including the types of signals and receptors, signaling mechanisms and associate the signaling pathways with various disease conditions.

CO3. Students will understand the regulation of cell cycle and cell death in Cancer.

CO4. Students will describe the role of cytoskeleton in maintaining cell architecture and rigidity

CO5. Understand the basic techniques used to culture animal cells.

25BIF201 INTRODUCTORY BIOINFORMATICS 2 1 0 3

LEARNING OBJECTIVE:

To introduce to 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 the different biological data and relate it to the known databases and formats

CO3: Demonstrate tools for sequence alignment, phylogenetics, characterization, and visualization of biomolecules

CO4: Analyze, compare and apply basic bioinformatic tools for finding motifs, domains gene/protein homologs, designing primers, identifying mutations.

CO5: Understanding the concepts of NGS and other sequencing techniques.

25BIO212 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, Kuby, 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. Students will be able to understand basic immunological mechanisms such as cells and organs of the immune system, innate and adaptive immune response.

CO2. Students will be able to interpret the dysregulation of immune mechanisms during hypersensitivity states, immunodeficiency or autoimmune conditions.

CO3. Students will be able to 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-Chymotryspin, 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, Km, Vmax, L.B Plot, Turnover number, Kcat. 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, enzymes in membranes, concentrations. 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. Understand and define the basic concepts on enzymes, their classification, metalloenzymes, holoenzymes, abzymes, Isozymes, Multienzyme complex.

CO2. Differentiate and discuss the different catalytic mechanisms with examples, transition state theory, Lock and key and induced fit theories. Zymogens, Proenzymes.

CO3. Discuss and explain enzyme kinetics, Michaelis Menton equation, LB plot, Km, Vmax, Kcat and Turnover number. Enzyme inhibitions: reversible and irreversible with example; Kinetics of inhibitions; Allosteric enzymes: regulation of enzymes.

CO4. Demonstrate and explain the role of enzymes in industry and medicine with examples**.**

25MIC211 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:

Unit1

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 $\Delta G'^o$, 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. Understand basics of microbial growth requirements.

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

CO3. Designate 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 disorders of metabolism of biomolecules.

25MIC212 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 the microbial composition in food.

CO2. Designate the 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.

25SSK201 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 OUTCOME:

After completing the course, students shall be able to

CO1. Basic understanding of the Soft skills sessions.

CO2. Gain insights on setting objectives.

CO3. Builds confidence to present in front of audience.

CO4. Gains inputs to know to present self.

CO5. Builds confidence to present in front of audience.

CO5: Appreciate the relevance of Mahabharata for modern times and identify its

imperativeness in everyday life.

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 eternalvalues.

SYLLABUS:

Chapter 1 - Introduction to the Great Itihasa

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

Chapter 3 - Araṇya-Kāṇḍa: (Tale of the forest life) And Kishkindha-Kāṇḍa: (The Empire of Holy Monkeys.)

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

Chapter 5 - Ramayana and Modern-day learning

Chapter 6 - Ecological Awareness in the Ramayana

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

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

COURSE OUTCOMES:

[O 1 – This part gives a brief introduction of the Great Ithihasa CO 2 – This topic deals with 6 Kandas
amayana.

[O 3 - Ramayana and Modern-day learning

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

cological Awareness in the Ramayana

[his topic demonstrates the Environment and Ecology]

[O 4 - This topic explains different Ramayana around the world.

[O 5 – This topic reveals the authenticity of Uttar Kanda and its attempt to explaining the untold stories
ıe first six Kanda

25BIO283 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. To identify the morphology of cells of the immune system.

CO2. To understand the basic concepts of blood grouping.

CO3. To analyze antigen-antibody interactions and detect the presence of antigens and or antibodies in a biological sample.

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

25MIC282 FOOD MICROBIOLOGY LAB 0 0 4 2

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. Designate methods to detect food spoilage pathogens.

SEMESTER 5

25MIC302 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 of industrially important microorganisms from environment, screening methods based on the type of product, and preservation of microorganisms.

CO3. Explain the need of strain improvement and methods involved in order to improve production and growth. Describe the methods for selection of the improved organisms using rational and random screening.

CO4. Describe the major parts of a bioreactor and the functions associated with it. List out the different types of fermenters.

CO5. Describe the importance of sterilization, aeration and agitation in bioreactor operation.

CO6. Explain the steps and stages of Downstream processing.

CO7. Describe the ethical waste management system in fermentation industry.

25MIC301 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 bacterias, 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. Chalmydia. Helicobacter*, *Campylobacter* and anaerobic pathogens.

REFERENCES:

1. Text book 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 and demonstrate principles of medical bacteriology and clinical correlation.

CO2. This course describe a detailed knowledge about etiological agents responsible for global infectious bacterial diseases.

CO3. The student will be able to explain general mechanisms by which an infectious agent causes disease.

25MIC313 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 basic concept of cloning, various steps involved, tools used like restriction enzymes, PCR, primer designing, vectors (Knowledge).

CO2. Interpret & discuss the principles of different molecular tools like qPCR, DNA sequencing, Blotting electrophoresis, reporter assay, DNA fingerprinting, DNA-protein and protein-protein interactions (Understand).

CO3. Illustrate the knowledge to apply for recombinant protein production, transgenic plant production for use in agriculture, medicine and research (Apply).

25MIC303 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. Thoroughly know the microbial diversity in the various biomes.

CO2. Identify terrestrial as well as marine habitats and know how humans have impacted the environment.

CO3. Decipher the use of biosensors for various environmental applications.

CO4. Postulate application of microorganisms for pollution abatement and various other industrial applications.

25BIO300 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: The students shall be able to familiarize with different aspects of research methodology.

CO2: To help the students to understand the basic concepts of hypothesis generation and experimental designing.

CO3: To make the students familiarize with analyzing, interpreting and presenting the research data.

CO4: To provide the students with basic knowledge on grant writing.

25SSK301 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 OUTCOME:

After completing the course, students shall be able to

CO1. Basic understanding of the Soft skills sessions.

CO2. Gain insights on setting objectives.

CO3. Gain insights on setting objectives.

CO4. Gain insights on setting objectives.

CO5. Gains inputs to know to present self.

CO6. Builds confidence to present in front of audience.

CO7. Builds confidence to present in front of audience .

CO8. Gains inputs to present in front of audience.

CO9. Gains inputs to present in front of audience .

CO10. Builds confidence to present in front of audience.

CO11. Builds confidence to present in front of audience.

CO12. Gains overall perspective of the course

25MIC382 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 , 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. This course describes how to make decisions about the pathogenicity of organisms associated with human infections.

CO2. Explain how to apply appropriate microbiology laboratory techniques, methodologies, instruments and equipment in accordance with current laboratory safety protocol.

CO3. Provide the opportunity to practise in microbiology laboratory techniques and to draw and report appropriate conclusions from the analysis of experimental data.

25BIO382 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: Students will discover how to isolate plasmid DNA

CO2: Students will identify a plasmid experimentally.

CO3: Students will illustrate restriction digestion followed by its mapping

CO4: Students will design PCR conditions and perform PCR.

CO5: Students will show competent cell preparation and transformation.

CO6: Students will assemble and perform SDS PAGE.

25MIC383 INDUSTRIAL MICROBIOLOGY LAB 0 0 4 2

LEARNING OBJECTIVES:

To provide hands on experience on 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 microorganism 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. Learn the technique of immobilization of cells like yeast.

CO3. Demonstrate the ability of microorganisms for nitrogen fixation and phosphate solubilization.

SEMESTER 6

25BIO215 INTRODUCTORY BIOPHYSICS 2 0 0 2

LEARNING OBJECTIVES:

This course is intended to provide concepts of thermodynamics and its applications in understanding biological phenomena give fundamental ideas about protein folding and function, familiarize molecular level changes involved in biological processes.

SYLLABUS:

Unit 1

Thermodynamics of living systems: Conservation of energy in living systems, Entropy and Life, Gibbs and Standard free energy, Equilibrium constant, Activation energy and living cells, Coupled reactions.

Unit 2

Protein folding: Forces for protein stability, Protein denaturation and renaturation, Protein folding pathways, Levinthal's paradox, Molten globule, Folding accessory proteins, Prediction of protein structures.

Unit 3

Protein function: Structure of heme, Structure of Myoglobin and hemoglobin, Oxygen binding mechanism, Oxygen binding co-operativity, Hill equation, Hill coefficient, Allostery in hemoglobin, Bohr effect, Hemoglobin abnormalities.

Unit 4

Dynamics of biomolecules: Diffusion, Laws of diffusion, Diffusion across biological membranes, Oxygen consumption and cellular respiration, Osmosis, Osmotic pressure, Osmoregulation, Osmotic work.

Unit 5

Viscosity and Surface tension: Viscosity and biological importance, Surface tension, Factors influencing surface tension, biological importance.

REFERENCES:

1. Biochemistry, Donald Voet and Judith G. Voet, John Wiley & Sons, 4th Ed., 2011.
2. Biological Thermodynamics, Donald T. Haynie, Cambridge, 1st Ed., 2001.
3. Introductory Biophysics: Perspectives on the Living State, J. R. Claycomb and J.Q.P. Tran, Jones & Bartlett, 1st Ed., 2011.
4. Molecular and Cellular Biophysics, Meyer B. Jackson, Cambridge, 1st Ed., 2006.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1. Recall thermodynamics theory and its application to know biological processes.
CO2. Describe concepts of protein folding and function.
CO3. Describe molecular level changes involved in the process of diffusion, viscosity and surface tension.
CO4. Summarize biophysical phenomena and interpret investigative and experimental data.

25BIO311 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 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. The students shall be able to understand the basics of pharmacology, various stages of drug discovery and intellectual property rights.

CO2. To help the students to understand the basic concepts and principles behind pharmacokinetics, pharmacodynamics and toxicology.

CO3. To make the students familiarize with the principles of antimicrobial and anti-neoplastic chemotherapy.

25BIO312 DEVELOPMENTAL BIOLOGY 2 1 0 3

LEARNING OBJECTIVES:

To provide an understanding about the basic principles of development of multicellular organisms. To provide an understanding of the role of genes in development. To compare the development of different organisms and to understand the similarities in development. To highlight the application of the field in stem cell therapy, regenerative medicine, drug development etc.

SYLLABUS:

Unit 1

History & Basic concepts of development: Overview of how the modern era of developmental biology emerged through multidisciplinary approaches, stages of development-zygote, blastula, gastrula, neurula**.**

Unit 2

Cell fate & commitment: potency- concept of embryonic stem cells, differential gene expression, terminal differentiation, lineages of three germ layers, fate map**.**

Unit 3

Mechanisms of differentiation: cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development**.**

Unit 4

Specification of adult stem cells. Pattern formation: axis specification, positional identification (regional specification)**.** Morphogenetic movements, Model organisms in Developmental biology: Early Development in invertebrate /vertebrate models Drosophila, C.elegans,Xenopus, Mouse/ human: Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates

Unit 5

Late Development in invertebrate /vertebrate models: Organogenesis- development of central nervous system in vertebrates, vulval formation in C. elegans**,** Germ cell specification& migration, Importance of developmental genes. Medical implications of developmental biology - genetic errors/ teratogenesis/ stem cell therapy etc.

REFERENCES:

1. Developmental Biology, Eighth Edition" by Scott F Gilbert, 2006.
2. Principles of Development - Lewis Wolpert, 4th edition, 2011.
3. Website: virtual embryo http://people.ucalgary.ca/~browder/virtualembryo/dev_biol.html

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1. Students recognize the various processes that happen during the development of different organisms.
CO2. Students relate the role of genes during development.
CO3. Students predict the problems that can happen by mutation in genes during development.
CO4. Students compare the development of different organisms.
CO5. Students summarise the major genes and signalling processes during the development.
CO6. Students infer basis of different congenital disorders in humans.

25BIO305 INTRODUCTORY SYSTEMS BIOLOGY 2 1 0 3

Course Objective:
This course explores how artificial intelligence (AI) techniques, particularly machine learning, deep learning, and data-driven modeling are revolutionizing systems biology. Students will learn key AI methods and apply them to biological networks, multi-omics data, dynamic system modeling, and biological discovery.
Syllabus
Unit 1: Introduction to Systems Biology

Data types (Omics, networks); Dimensionality reduction methods (PCA, tSNE, UMAP); Mathematical models in biology – Introduction, types of models, levels of modeling, specificity of modeling in biology. Concepts and working principles of System Biology - Practical applications of System Biology in Life Sciences - From molecules to pathway-Pathway to networks.

Unit 2: Basic principles

Model, Modeling. Modeling of biological systems: Metabolism, Cell Signaling, Aging, Evolution, Biological Oscillations, Modeling Dynamic Systems, Explainable AI (XAI) in Biology (Model interpretability, SHAP, LIME, biological validation);

Unit 3: Generative Models for Biology (GANs)
Biological Network Inference and Graph AI (Gene Regulatory Network, GNN, ODE based modeling), Predictive biomarkers-based case study

Textbooks and References
"Machine Learning for the Life Sciences" by Andreas C. Müller & Alexander Hendorf
"Systems Biology: A Textbook" by Edda Klipp et al.
Selected journal articles (updated each year)
Online resources: Tutorials (TensorFlow, PyTorch, Scikit-learn), NIH datasets

Course outcome

CO1: Understand the concept of systems biology.
CO2: Analyze and interpret multi-omics datasets using AI methods.
CO3: Design predictive models for biological networks and cellular behavior.
CO4: Develop and present a project applying AI to a systems biology problem.

25CSA315 PROGRAMMING CONCEPTS 2 1 0 3

LEARNING OBJECTIVES:

To introduce concepts of programming with a basic and widely used programming language C and introduction to scripting concepts in Linux operating system. The major objective of this course is to provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

SYLLABUS:

Unit 1

Basic Concepts

Introduction – Programming languages – Types of Languages – Problem solving technique - Algorithms - Flow charts - Pseudocode – Compilers - Interpreters - Linux command - Shell script - Evolution of 'C' Language

Unit 2

Structure of C programs

Structure of a ‘C’ Program - ‘C’ Program development life cycle - Executing and Debugging a ‘C’ Program - Keywords and Identifiers - Operators - Constants - Variables - Data Types - Precedence of Operators - Scope and Lifetime of Variables - Control constructs: Decision Making using if statement - Types of if …else block - Switch case Block - Arithmetic Expressions - Evaluation of Expressions - GOTO statement – Loops - For loop - While loop - Do while loop - Jumping in Loop - break and continue statement.

Unit 3

Arrays & Strings

Arrays - One - D Array - Two - D Array - Multidimensional Array - Dynamic Arrays – Matrices Operations – Strings - Implementing String Variables - String handling Functions

Unit 4

Functions & Pointers

Concept of Function - User defined Function - System Defined Function - Types of parameter passing in function - Pointers - Types of Pointers - Pointer Expression - Arrays of Pointers - Pointers and Functions

Unit 5

Structures, Union and File Handlers

Structure and Unions - Concepts of Structure - Implementing Structure Variable - Arrays of Structure - Structure within Structure - Introduction of Unions - Difference between Structure and Unions - File Handling using 'C' - Opening and Closing File - Input / Output operations on File - Random Access to Files - Command Line Arguments

REFERENCES:

1. Yeshwant Kanetkar, Authentic Guide To C Programming Language 17th Edition, BPB publications, 2020.
2. Greg Perry, Dean Miller. "C Programming Absolute Beginner's Guide", 3rd ed., Que Publishing, 2013.
3. Stephen G. Kochan. "Programming in C", 4th ed., Addison-Wesley Professional, 2014.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1. To understand the use of software and programming for problem solving.

CO2. To understand modular programming approach in diversified problem in biological domains.

CO3. To apply the concepts of input, output and control statements, functions, arrays, strings, structures, and file handlers to solve biological problems using C language

CO4. To apply programming logic to solve Bioinformatics problems.

25CSA382 PROGRAMMING CONCEPTS -LAB 0 0 3 1

Learning Objective:

To introduce a hands-on session on the concepts of programming using a basic and widely used programming language C and an introduction to scripting concepts in Linux operating system

Syllabus:

Unit 1

Introduction to computer programming- basic Linux command, Shell scripts, use of editors and IDE, compilation, debugging,

Unit 2

String Manipulation, File Management, Control and loops, Programs using if conditions; switch case, loops, arrays,

Unit 3

Functions, files, command-line arguments, string manipulations.

Textbooks

1. "Let us C" by Yeshwant Kanetkar, (8th Edition), BPB publications
2. "The C Programming Language", by Brian W. Kernighan, Dennis M. Ritchie. (2nd Edition), Prentice Hall PTR; (April 1, 1988) [http://books.cat-v.org/computer-science/c-programming-language/The.C.Programming.Language.2nd.Edition.pdf]

Course outcome:

CO1. Understand basic programming concepts
CO2. Write and execute programs that could be used to understand and solve biological systems.
CO3. Apply skills to manage large file-based data.

25BIO314 STRUCTURAL BIOLOGY 1 1 0 2

LEARNING OBJECTIVES:

Structural biology approaches have broadened the scope for better understanding of small molecules and macromolecules. The complete genome sequencing of an organism in days which led to generating several numbers of protein sequences and so understanding the three-dimensional structure of the protein molecules has become a necessity. The course would be helpful to students to attain good knowledge in understanding the structural aspects of biomolecules.

SYLLABUS:

Unit 1

Introduction to Structural Biology: Structure of small molecules, Databases for small molecules, 2D and 3D structures of molecules, conversion, Draw the structures of molecules, Conversion of molecules to various formats, Databases for molecules, Chemical and physical properties of molecules, Lipinski rule, what are ADMET properties.

Unit 2

Introduction to Macromolecules: Protein database, how to understand and read 3D structure files, RCSB, reading PDB files, and related calculations, Basics of macromolecular crystallography, Introduction to importance of Nuclear Magnetic Resonance (NMR) and Cryo-Electron microscopy.

Unit 3

Introduction to Protein Sequences: screen the proteins to specific organism, compare sequences of proteins, identify the 3D structure of protein, introduction to protein-protein interactions and tools, identifying the Active sites in a protein.

Unit 4

Introduction to Ligand: Protein Interactions, concepts of Molecular Docking studies, tools for Molecular Docking, how to prepare Ligand, Protein files, importance of grid and dock files,

Unit 5

Optimization: preparation of Grid parameters and docking parameters, run the commands, validating the Autodock data, 3D visualization tools and labelling the amino acid residues.

REFERENCES:

1. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co.
2. Carl Ivar Branden and John Tooze., "Introduction to Protein Structure" 2nd 2001 Edition, Taylor, and Francis.

COURSE OUTCOMES:

After completing the course, students shall be able to

CO1. Understand the importance of structural biology related to small molecules and their Physico-chemical properties.

CO2. Understand the 3D structure of Proteins and structural aspects of protein using bioinformatic tools.

CO3. Understand the sequence, screening, and actives sites information of the proteins.

CO4. Understand the concepts of ligand-protein interactions and molecular docking studies using Autodock.

25BIO306 MACHINE LEARNING FOR BIOLOGICAL SCIENCES 2 1 0 3

Learning Objective:

The course gives an idea of the different algorithms to be used to train and test systems, along with mining relevant biological data from a system.

Syllabus:

Unit 1

What is Data Mining? Motivating Challenges; The origins of data mining; Data Mining Tasks. Types of Data; Data Quality. Data Preprocessing; Measures of Similarity and Dissimilarity, Machine learning, Hypothesis, Version space, MAP, Maximum likelihood. Classification: Preliminaries; General approach to solving a classification problem; Decision tree induction; Rule-based classifier; Nearest-neighbor classifier, SVM, Artificial Neural Networks. Association Analysis: Problem Definition; Frequent Itemset generation; Rule Generation; Compact representation of frequent itemset; Alternative methods for generating frequent item-sets, Neural Networks, Cluster Analysis:

Unit 2

Overview, K-means, Agglomerative hierarchical clustering, DBSCAN, Overview of Cluster Evaluation, Further Topics in Data Mining: Multidimensional analysis and descriptive mining of complex data objects; Spatial data mining; Multimedia data mining; Text mining; Mining the WWW. Outlier analysis, data mining applications; Additional themes on Data mining; Social impact of Data mining; Trends in Data mining. Data warehouse – Difference between Operational DBs and Data warehouses – Multidimensional Data Model – Data warehouse Architecture –

Unit 3

Data warehouse Implementation – OLAP Techniques Concepts & Disadvantages, Data Mining, Introduction Data Mining – Knowledge Discovery from Databases (KDD) Process – Data Processing for Data Mining – Data Cleaning, Integration, Transformation, Reduction – Data Mining Primitives – Data Mining Query Language,

Textbooks

1. "Data Mining: Concepts and Techniques (The Morgan Kaufmann Series in Data Management Systems) -- by Jiawei Han, Micheline Kamber (2011);
2. "Insight into Data Mining – Theory and Practice" by K.P. Soman, Shyam Diwakar, V.Ajay, PHI, 2006.

Course outcome:

CO1: To understand the concept of machine learning.
CO2: Learn the different classification and clustering algorithms
CO3: Apply data mining techniques to extract information from databases

SEMESTER 7

25CSA401 DATABASE CONCEPTS 2 1 0 3

Learning objective:

To introduce concepts of the database management system and make use of this in storing and retrieving biological data

Syllabus:

Unit 1

Introduction to DBMS: Basic Concepts - Data Abstraction - Data models and data independence. Instances and Schemas. Components of a DBMS and overall structure of a DBMS- Life Cycle of a DBMS application- Database terminology. Data Modeling: Basic concepts- Types of data models- Conceptual, physical, and logical database models- E-R data model and Object-oriented data model. Components of ER Model- ER Modeling symbols. Entity and entity set- Relations and relationship sets- E-R Diagrams- Reducing E-R Diagrams into tables.

Unit 2

Relational DBMS Model: Basic concepts, Attributes and domains- Intention and extensions of relation- the concept of integrity and referential constraints- Relational Query Languages (Relational algebra and relational calculus (Tuple and domain relational calculus). Relational Database Design: Notion of normalized relations- Normalization using Functional Dependency- First Normal form- Second Normal Form- Third Normal form- BCNF.

Unit 3

SQL: Structure of a SQL query- DDL and DML, TCL- SQL queries and sub-queries- Tables, views and indexes- Aggregate functions- Set Operations, predicates and joins, Set Membership- Tuple variables- Set comparison- Database modifications using SQL, PL/SQL: Basic Concepts-SQL within PL/SQL- Cursors -Concept of stored procedures and functions-packages-Triggers.

Unit 4

Database administration: Security and access control, Backup and recovery, Performance tuning, Maintenance and monitoring. Data integration and warehousing: NoSQL databases, Big data technologies, Cloud databases

Textbooks

1. "Database Management Systems" by Raghu Ramakrishnan and Johannes Gehrke, (3rd edition), McGraw Hill Education
2. "ORACLE PL/SQL Programming" by Scott Urman (5th edition), McGraw Hill Education.
3. "Insight into Data Mining – Theory and Practice" by K.P.Soman, Shyam Diwakar, V.Ajay, PHI, 2006.

References

1. "Database Systems Concepts" by Henry F Korth, Abraham Silberschatz, and S. Sudarshan (7th edition), McGraw Hill Education.
2. "Database Management Systems" by Alexis Leon, Mathews Leon and Vikas Shukla, (3rd edition) Vikas Publications
3. "Oracle 9i The Complete Reference" by Kevin Loney, George Koch,(1st edition) Oracle Press

Course Outcome:

CO1. To implement Oracle to create and design databases
CO2. To apply PL/SQL programming in building platforms for storing and retrieving biological data

25BIO404 PYTHON FOR BIOLOGY 2 1 0 3

Learning objective:

This course introduces the concept of Python programming language along with the use of modules and packages like Bio Python to solve biological problems.

Syllabus:

Unit 1
Introduction of Python programming, Introduction to Python IDEs and other programming environments, Fundamentals of data handling, File handling, Flow control, Flow control (loops), Fine turning of flow control,

Unit 2
Functional programming, Lambda and map functions, Classes and object in Python, Introduction NumPy, Data manipulation using Nd-arrays, Structured data processing using Pandas, Structured data visualization, Introduction to database management using python,

Unit 3
HTTP requests using requests package, Data/Web scraping with Python, Saving and managing scraped Data to Databases using ORM, Managing and Maintaining Code using Version Control Systems

Textbooks

1. "Python for Bioinformatics" by Bassi, Sebastian. (2018), Chapman and Hall/CRC.

Course outcome:
Students are expected to
CO1: Understand Array and Data manipulations to store and analyze biological data
CO2: Apply functions and modules in Python to solve biological problems
CO3: Implement codes using BioPython package

25CSA481 DATABASE CONCEPTS LAB 0 0 3 1

Learning objective:

To introduce a hands-on session on database management systems and make use of this in storing and retrieving biological data

Syllabus:

Unit 1
SQL, Creating databases and tables, Database administration, Function, Procedure, Trigger

Unit 2
Classification algorithms: decision tree classification, naive Bayesian classification, Data processing in WEKA, a brief introduction to other classifiers, Clustering algorithms: methods to cluster continuous data,

Unit 3
Methods to cluster categorical data, file processing in database environment, E-R models,

Textbooks

1. "Database Management Systems" by Raghu Ramakrishnan and Johannes Gehrke, (3rd edition), McGraw Hill Education
2. "ORACLE PL/SQL Programming" by Scott Urman (5th edition), McGraw Hill Education.
3. "Database Systems Concepts" by Henry F Korth, Abraham Silberschatz, and S. Sudarshan (7th edition), McGraw Hill Education.
4. "Database Management Systems" by Alexis Leon, Mathews Leon and Vikas Shukla, (3rd edition) Vikas Publications
5. "Oracle 9i The Complete Reference" by Kevin Loney, George Koch, (1st edition) Oracle Press
6. "Data Mining: Concepts and Techniques (The Morgan Kaufmann Series in Data Management Systems) -- by Jiawei Han, Micheline Kamber (2011);

Course outcome:
Students should be able to
CO1. Implementing skills to generate databases using Oracle database management system
CO2. Preparing platforms for storing and retrieving biological data

25BIO482 PYTHON FOR BIOLOGY - LAB 0 0 3 1

Learning Objective:

This course provides hands-on training in the concept of Python programming language along with the use of modules and packages like BioPython to solve biological problems.

Syllabus:

Unit 1
Python IDEs, File handling, Flow control, Functional programming, Lambda and map functions,

Unit 2
Classes and object in Python, Numpy, Ndarrays, Pandas, Visualization,

Unit 3
Introduction to Web services with Python, Web Scraping, Database management using python, Version control System- git

Textbooks

1. "Python for Bioinformatics" by Bassi, Sebastian. (2018), Chapman and Hall/CRC.

Course outcome:
Students are expected to
CO1: Understand Array and Data manipulations to store and analyze biological data
CO2: Apply functions and modules in Python to solve biological problems

25MAT401 APPLIED MATHEMATICS FOR BIOLOGY 3 1 0 4

Learning Objective:

Syllabus:

Unit 1:

Euclidean vector space- 2 space, 3 space, n space, dot product, Norm, orthogonality, Solution of system of linear equations- Row reduction method, Four fundamental spaces of a matrix, independent vectors, Gram Schmidt Process.

Unit 2

Eigenvalues, Eigenvectors, Cayley Hamilton theorem, Orthogonal matrices, Singular value Decomposition- Singular values, singular vectors, Relationship between singular value decomposition and eigen value decomposition, Principal component analysis, Interpretation of PCA results.

Unit 3

Sampling theory: Population and sample, random sample, population parameters, Sample statistics, sampling distribution of means, sampling distribution of proportion, sample variance. Estimation: unbiased, maximum likelihood, Bayesian. Test of hypothesis and significance: Type I and type II error, Power of test, P-values, Analysis of variance.

Textbooks

- Linear Algebra and Its Applications by Gilbert Strang, 5th ed., Wellesley-Cambridge Press, 2016.
- Introduction to Linear Algebra by Gilbert Strang, 5th ed., Wellesley-Cambridge Press, 2016.
- Fundamentals of Mathematical Statistics– S. C. Gupta & V. K. Kapoor.
- Mathematical Statistics with Applications by Irwin Miller, Marylees Miller, and Karl E. Mosier, 8th ed., Pearson, 2022.

Course outcomes:

Students who complete this course will be able to

CO1: Apply the concept of a matrix to solve biological systems like sequence alignment or gene expression

CO2: Implement Calculus to calculate the rate of change of substrate or to find the area under the curve in enzyme kinetics.

CO3: Apply distance calculation to predict protein structure

MINI PROJECT

25BIO497 EXPLORING YOUR SCIENCE HONOURS WITH A PROJECT 0 0 3 3

1. The B.Sc. Honours fourth year project entails comprehensive industry orientation for 8 months.
2. The student is encouraged to get trained in best labs in India.
3. The placement cell will take care of logistics if any.