Sunrise University

Approved by Govt. of Rajasthan vide Sunrise University Act, 2011
Recognized by UGC Act, 1956 u/s 2 (f)

B. Sc. (Bachelor of Science) in Microbiology

Syllabus

FIRST SEMESTER

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
BSFD101	INTRODUCTORY BIOLOGY	40	60	100
BSFD102	CHEMISTRY	40	60	100
BSFD103	ENGLISH	40	60	100
BSFD104	INTRODUCTORY MICROBIOLOGY	40	60	100
BSFD105	INFORMATION SYSTEMS	40	60	100
PRACTICAL				
BSFD106	CHEMISTRY LAB	60	40	100
BSFD107	INTRODUCTORY MICROBIOLOGY LAB	60	40	100
Total		**420**	**480**	**700**

SECOND SEMESTER

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
BSFD201	PHYSICS	40	60	100
BSFD202	MICROBIAL ECOLOGY, DIVERSITY & CLASSIFICATION	40	60	100
BSFD203	BIOCHEMISTRY	40	60	100
BSFD204	MATHEAMTICS	40	60	100
BSFD205	MYCOLOGY	40	60	100
PRACTICAL				
BSFD206	PHYSICAL SCIENCE LAB	60	40	100
BSFD207	BIOCHEMISTRY LAB	60	40	100
Total		**320**	**380**	**700**

THIRD SEMESTER

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
BSFD301	MOLECULAR BIOLOGY	40	60	100
BSFD302	CELL BIOLOGY	40	60	100
BSFD303	MICROBIAL PHYSIOLOGY & METABOLISM	40	60	100
BSFD304	ANALYTICAL BIOCHEMISTRY	40	60	100
BSFD305	VIROLOGY	40	60	100
PRACTICAL				
BSFD306	GENERAL MICROBIOLOGY LAB	60	40	100
BSFD307	CELL AND MOLECULAR BIOLOGY LAB	60	40	100
Total		**320**	**380**	**700**

FOURTH SEMESTER

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
BSFD401	INHERITANCE BIOLOGY	40	60	100
BSFD402	IMMUNOLOGY	40	60	100
BSFD403	ENZYME TECHNOLOGY	40	60	100
BSFD404	BIOSTATISTICS	40	60	100
BSFD405	FOOD MICROBIOLOGY	40	60	100
PRACTICAL				
BSFD406	IMMUNOLOGY LAB	60	40	100
BSFD407	FOOD MICROBIOLOGY LAB	60	40	100
Total		**320**	**380**	**700**

FIFTH SEMESTER

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
BSFD501	INDUSTRIAL MICROBIOLOGY	40	60	100
BSFD502	MEDICAL BACTERIOLOGY	40	60	100
BSFD503	RECOMBINANT DNA TECHNOLOGY	40	60	100
BSFD504	ENVIRONMENT & AGRICULTURAL MICROBIOLOGY	40	60	100
BSFD505	RESEARCH METHODOLOGY	40	60	100
PRACTICAL				
BSFD506	MEDICAL BACTERIOLOGY LAB	60	40	100
BSFD507	INDUSTRIAL MICROBIOLOGY LAB	60	40	100
Total		**320**	**380**	**700**

SIXTH SEMESTER

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
BSFD601	INTRODUCTORY BIOINFORMATICS	40	60	100
BSFD602	PHARMACOLOGY	40	60	100
BSFD603	PARASITOLOGY	40	60	100
PRACTICAL				
BSFD604	PHARMACOLOGY LAB	60	40	100
BSFD605	PARASITOLOGY LAB	60	40	100
BSFD606	PROJECT		200	200
Total		**240**	**460**	**700**

SEMESTER- I

MIC103 (INTRODUCTORY BIOLOGY)

Introduction: Themes in the Study of Life, Biodiversity: Phylogeny and the Tree of Life, Bacteria and Archaea, Protists, Plant Diversity, Fungi, Animal Diversity, Beauty & Utility of Biodiversity in Sustainable Development, Unity in Diversity at Cellular, Subcellular, Molecular Levels: The Composition of Cells, Cell Metabolism, Fundamentals & Central Dogma of Molecular Biology, Scientific Inquiry: Making Observations & Testing Hypotheses.

Part 2: Fundamentals of Cell Theory, Cell Organelles- Nucleus, Endoplasmic Reticulum, Golgi Apparatus, Mitochondria, Chloroplast, Lysosome & Peroxisome.

Part 3: Cytoskeleton & ECM: Structure and Organization of Actin filaments, Microtubules and Intermediate Filaments, Cell Movement, Motor Proteins, Plasma membrane & Transport, Cell Wall, ECM, Cell-Cell Interactions.

Reference Textbook:

1. Campbell Biology – 10th Edition - Jane B. Reece et. al. - Boston: Benjamin Cummings / Pearson
2. The Cell, A Molecular Approach – 6th Edition – Geoffrey M.Cooper / Robert E. Hausman- SinauerAssociates, Inc.
3. Molecular Biology of the Cell. Alberts B.et al.,(2008) 5th edition. Garland Science.

Course Outcomes:

1. Understand the importance of Interdisciplinary Biology
2. Understand about evolution of life and how genetic information is transmitted in organism. Additionally, the students are encouraged to make a scientific Inquiry by framing and testing hypothesis.
3. Understand about cell theory and different cell organelles and their function.
4. Understand the role of cytoskeleton and its remodelling including the diseases associate with improper remodelling.

CHY103 (CHEMISTRY) credits: 4

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

Chemical equilibrium: 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, Hydrolytic4reactions & expression for hydrolytic constant.

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

Chemical kinetics: 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.

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

Electrochemistry: 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.

Reference:

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)

ENG 100 (ENGLISH) Credits :3

Course Objective:

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

Language Learning: English as Second Language, Developing the essential skills of English

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).

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.

Reference:

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. American and British poetry: a guide to the criticism, 1925-1978. Athens, Ohio: Swallow Press, 1984.
6. Contemporary poets. Ed. James Vinson. 5th ed. New York: St. Martin's Press, 1991

MIC 100 (INTRODUCTORY MICROBIOLOGY) Credits: 3

Learning Objective: A Basic course introducing the prokaryotic world with specific reference to the metabolic,physiological and morphological characteristics of microbes.

Syllabus

Basic concepts– 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 Flemming, Paul Erlich, Fannie Hesse, Elie Metchnikoff, Kary Mullis. Development of pure culture methods. Cell ultra-structure: Peptidoglycan structure and Archeal cell wall composition,and Acid fast cell wall. Antibiotics introduction and multidrug resistance crisis. Cytoplasmic matrix and components: Inclusion bodies.

Sterilisation and disinfection- Definitions, Principles. Methods of sterilization- Physical methods (Heat, Filtration), Radiation and Chemical methods. Control of sterilization and Testing of sterility. Microscopy – Principles, Light microscope, Phase Contrast, Dark field, 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.

Microbiological media, composition and types: selective and differential media Growth curve and growth kinetics. Influence of environmental factors for 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

Taxonomy– Principle and its types (Classical approach– Numerical, Chemical, Serological and Genetic). Bacterial taxonomy– Bergey's manual of Systematic Bacteriology (Eubacteria and Archaebacterium).

References:

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brownpublishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel: Microbiology Mc Graw Hill Book R. Krieg, 1986Company.
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. Prentica Hall.

Course Outcomes:

1. To expose students to the pioneers in microbiology and introducing their contributions.
2. To detail the prokaryotic cell and related organelles and their functions.
3. To introduce the concept of microscopy and to elaborate of few basic microscopy techniques.
4. To elaborate on microbial nutrition and methods of determining growth curve.
5. To introduce the basic principles of sterilization methods.

CSA100 (INFORMATION SYSTEMS) credits: 3

Learning Objective: To provide relevant skill sets on basic computer knowledge. The broad topics include training on applications like worksheets, word process, databases, fundamental concepts of operating systemsand computer network is also covered in the course.

SYLLABUS

Fundamentals of IT - introduction to the internet and the world wide web (WWW) Information technology - an overview of what it is and what are its applications. Computer system types, components, digital signals, microprocessors, input/output devices, storage devices etc. Introductionto software - operating systems, word processing, spreadsheet and database applications. Foundations of modern networks - overview of different architectures and protocols. Multimedia. IT applications in biology and biotechnology, Introduction to supercomputing, Basic operations in Spreadsheets like summing, averaging, graphs and visualizations. Making graphs and plots for scientific data, Fundamentals of programming.

Reference:

1. Norton, Peter, “Introduction to Computers, Mc-Graw-Hill, 6/e.
2. Raja Raman, Fundamentals of Computers, Prentice Hall of India.

Reference Books:

1. Govindarulu, IBM PC and Clones, Tata McGraw-Hill Education, 2002
2.

Course Outcomes:

1. Students will be having an understanding of different components, signals, microprocessors, input/output devices et.
2. The course enables the students to understand the IT applications in the area of biology
3. They will be knowing the fundamentals of programming, making graphs and plots forscientific data etc.
4. On completion of the course, students should have acquired essential knowledge to meet their computational requirements as a life sciences aspirant.

CUL101 (CULTURAL EDUCATION-1) Credits: 2

SYLLABUS

The Necessity of CE- Education for life and Livelihood, Role of spirituality in Indian culture, Science and Spirituality, Motto of Amrita University, Meaning of college prayer

Culture and Civilization- Definitions, Differences, Relation of culture and Values, Indian culture- Uniqueness and the pillars of Indian culture, Purusharthas or Goal of life Dharma, Artha,Kama,Moksha.
Symbols of Indian Culture – Forms, Meanings and Significance of symbols – Religious Symbols – Swastika – Omkara – Lingam – Lotus – Tilak – Rudraksha – Shankha, lotus

Man and Nature- Depletion of natural resourses-Root causes, Our ancestors life-Harmony with nature, Pancha yajnas and Pancha matas, Reestablish the lost harmony, role of religion. Rishis and scientist , India's Ecological heritage- Vedic view of nature, Sacred groves, Causes of destructions and solutions

Introduction to Vedas and Vedanta – Fourteen Abodes, Four Vedas, Samhitas, Brahmanas, Aranyakas, Upanishads, Six Vedangas, Four Upavedas
Vedanta and Image worship, Sadhana and self realization, Imbibe principles of Vedanta

References:

1. Cultural Education: Reading Material for students - prepared by Cultural Education Dept.,Amrita Vishwa Vidyapeetham.
2. *Eternal truth*- Mata Amritanandamayi Devi

MIC 180 (INTRODUCTORY MICROBIOLOGY LAB) **Credits: 2**

Learning Objective: The main objective of this course is to provide basic knowledge to undergraduate students on variousmicrobiological practices in the laboratory.

Basic Lab Practices in Microbiology: Sterilization, Disinfection. Culture media preparation of solid,semi solid and liquid media , incoculation in slant, deep and plate. Identificationof normal flora using swab, **Pure culture techniques**: Streak plate, Serial dilution, spread plate and pour plate procedures. Determining the cultural characteristics of microorganisms in plate and growth pattern in slant and broth. **Staining techniques**: Simple, differential and structural stains: Gram staining, Negative staining, Capsule staining, Spore staining, **Motility determination**: Hangingdrop

References:

1. Microbiology, A Laboratory Manual-James Cappuccino, Natalie Sherman.
2. Laboratory Exercises in Microbiology-Harley Prescott

Course Outcome:

1. Understand the physical and chemical method of sterilization.
2. Understand the methods of cultivation of microorganisms
3. Understand different staining methods

Semester - 2

PHY103 (PHYSICS) **CREDITS:4**

Learning Objectives: Physics course offered to under graduate 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

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 particles, collisions,Rotational motion, combined rotational and translational motions.

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 ultrasonic's.

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

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.

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 Textbooks:

Physics – David Halliday, Robert Resnick, Kenneth S Krane, Vol. 1, 5th (e), Willey Student Edition,2002.
Physics – David Halliday, Robert Resnick, Kenneth S Krane, Vol. 2, 5th (e), Willey Student Edition,2002.

Reference Books:

- College Physics – Raymond A Serway, Jerry S. Faughn, Chris Vuille, Charles A Bennett,Vol. 1, Thomson Brooks/Cole, 2006.
- College Physics – Raymond A Serway, Jerry S. Faughn, Chris Vuille, Charles A Bennett,Vol. 2, Thomson Brooks/Cole, 2006.

Course Outcome:

1. Students are able to categorize different types of motions.
2. They are able to relate work, energy and power.
3. They compare translational motion and rotational motion.
4. Solves problems on waves and oscillations.
5. They integrate the different phenomena's due to light such as reflection, refraction,interference, dispersion and diffraction.
6. The students distinguish the properties of matter such as solids, liquids and gases.
7. The students are able to compares and relates the Dielectrics and magnetism.

MIC101 (MICROBIAL ECOLOGY, DIVERSITY & CLASSIFICATION) Credits: 3

Learning Objective: The course should enable the students to -1. Familiarize the students with physiological diversity of microorganisms and Microbial taxonomy decipher the roles and characteristics of various microorganisms. 2. To get requisite knowledge about the habits and habitats of microorganisms. 3. Toevaluate explicitly the Nutritional requirement of microorganisms. 4. Get insight into the various applications of microorganisms, such as bioremediation, composting.

Syllabus

Microbial Classification And Basics of Microbial Diversity: Five kingdom classification of microbes, definition of microbial diversity and mode of evolution; microbial phylogeny; structural diversity of microbes, Physiological diversity of microorganisms; prokaryotic diversity; eukaryotic microorganism; Microbial taxonomy, Phylogeny of *Archea*; extremophiles; commercial uses of extremophiles; microbial diversity and its application in modern science

Habits And Habitat: 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.

Applications : Microbial bioremediation, bioleaching, biodegradation, biomining.

Reference:

1. Microbial Diversity, D.Colwd
2. Microbial Ecology, J.M.Lynch and N.J.Poole
3. Microbial Ecology, Atlas and Bartha.

Course Outcome: The students should be able to- 1. Clearly distinguish various microorganisms, know their habitat and also discern the nomenclature. 2. Thoroughly know the microbial diversity in the various biomes. 3. Identify Aquatic as well as Marine habitats and how humans have impacted the environment. 4. Postulate applications of microorganisms, such as in bioremediation, biodegradation etc. 5. Employ microorganisms for pollution abatement and various other environmental application.

BIO103 (BIOCHEMISTRY) Credits: 3

Learning objective: 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

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 typesof reactions in Biochemistry, Electrophiles and nucleophiles in biological system,

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.

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.

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

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

Reference Books:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 5th Edition, W.H.Freeman &Company
2. Voet & Voet, Fundamentals of Biochemistry, 3rd Edition 2004.
3. Lubert Stryer, Biochemistry, 6 th Edition, W.H.Freeman and Company, 2007.
4. Graham Solomons and Craig B. Frhyle , Organic Chemistry, Eighth Edition John Wileyand Sons, 2004.

Course Outcome:

1. To 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.
2. Identify and write the chemical structure of Amino acids and depict their ionisation behaviour, Peptide bond formation; describe the Primary, Secondary, Tertiary and Quaternary structure of proteins and their functions.
3. Analyse the structure and properties of Carbohydrates, Monosaccharide, Disaccharides and polysaccharides, Glycoconjugates.
4. Identify and analyse the classification, Structure and properties of lipids including Storage lipids, Membrane lipids, Steroids etc.
5. Identify and know the chemical structure of nucleotides including their components, describe primary, secondary structure of DNA and RNA

ENG101 (ENGLISH/CREATIVE WRITING & SOFT SKILLS) Credits: 3

Learning Objective :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.

Text-English and Soft Skills-S P Dhanavel : **(**Comprising different authors representing different stories each dealing with a soft skill)

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. English for students of Science – Orient Longmans
2. Spoken English for you – Emerald
3. English Basics (a companion to grammar and writing) – Cambridge.
4. A communicative grammar of English, III Ed. – Pearson
5. Effective English for Technical Communication – Emerald Publishers
6. Spoken English in 4 Easy Steps – ESN pbl

Course Outcome:

1. Prepare the students to seek and find employment in the corporate, media, English language teaching and content writing sectors.
2. Develop communicative competence in students.
3. 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
4. Expose the students to the employment opportunities, challenges and job roles. To enablethe students to conduct independent surveys, collect and analyze data, prepare and present reports and projects.
5. Guide the students to establish self-employment strategies.

MAT100 (MATHEMATICS) CREDITS 4

Learning Objective: Mathematics is a course offered to 2ndt semester B.Sc., (BT & MB). The course deals with linear algebra, differential equations, basic calculus, statistics etc. As an area of study, it has a broad appealin that it has many applications in different aspects of biology

Syllabus

Linear Algebra: Matrices-definition, Types of matrices, Addition and subtraction of matrices, Multiplication of matrices, Properties of matrix multiplication, 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,Sequence and Series Sequence-definition, Arithmetic progression, Geometric Progression, Harmonic Progression, Infinite series, Sum to infinity, Matrices, Determinants and properties of determinants, Minors and co-factors,

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,

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,

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

References:

Text Books:

1. Anton-Bivens-Davis " 7th Edition Calculas " WSE WILEY
2. S.C Gupta , V. K Kapoor "Fundamentals of Mathematical statistics " Sulthan Chand andSons.

Reference Books:

1. S.Lipschutz&M.Lipson "Discrete Mathematics" 2001-TMH
2. Thomas, Finney "Calculus 9th edition" Pearson publications
3. Seymour Lipschutz, Marc Lipson "Schaum's Outlines Of Probability" MCGRAWHILL2000 2nd
4. Bali Iyengar " A text book of Engineering Mathematics " Dr. B . S Grewal " EngineeringMathematics

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Course Outcome:

1: To understand the concepts.
2: To solve the problems by using properties.
3: The difference between any two consecutive terms is the same.
4: Find the general solution to a linear first order differential equation.
5: To solve the problems by using different methods. CO6: To find the area by using integration.

CUL102 (CULTURAL EDUCATION-2) Credits: 2

Learning Objective: Relevance of Srirama and Sri Krishna in the scientific age, Lessons from epic of India. Ramayana andMahabharata, Vidura neeti- Wise man, Rulers dharma, Story-King Shibi Karma- Role and theory of re incarnation, Bagavad gita –Introduction, Action without desire

Syllabus:

Awakening of Universal motherhood, Role & Position of Women in Indian Society – Great women of India, rishikas in the Vedas, women characters in the epics, decline of women's status.
Indian Society: Its Strengths and Weaknesses –family values, social values, community values etc., varnashrama, caste, dowry etc.
Overview of Patanjali's Yoga Sutras with focus on value systems mentioned in Yama and Niyama- Yoga system for Personality refinement, Heroism and patriotism in Modern India.

References:

Text Book:

Cultural Education: Reading Material for students - prepared by Cultural Education Dept., Amrita Vishwa Vidyapeetham.

Mother of Sweet Bliss – a biography of Mata Amritan and amayi Devi

PHY182 (Physical Sciences Lab) Credit: 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:

Name of the experiments

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)

Virtual Labs in Chemistry:

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

Reference:

http://amrita.vlab.co.in

Course Outcome:

1. To get the idea about how to handle the chemicals.
2. Students will get the exposure to use the equipments like weighing machine, OstwaldViscometer, polarimeter, pH meter, conductivity meter, calorimeter etc.
3. Students will get the chance to compare the theoretical values and practical values.
4. They can improve their hands-on

BIO180 (BIOCHEMISTRY LAB) Credits: 2

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

Syllabus:

List of Experiments:

1. Preparation of Laboratory Solutions and Buffers
2. Estimation of amino acids by ninhydrin method
3. Separation of aminoacids using TLC
4. Isoelectric precipitation of casein from milk
5. Qualitative analysis of carbohydrates
6. Qualitative analysis of amino acids
7. Estimation of reducing sugar using DNS method.
8. Verification of Beer-lamberts law using potassium dichromate

References:

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

Course Outcome:

Students will get practical exposure to commonly used biochemical techniques and also they becomefamiliar to use instruments like calorimeter, pHmeter etc.

Semester- 3

BIO202 (MOLECULAR BIOLOGY) CREDITS:3

Learning Objective: 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 subjectsin the field of biotechnology.

Syllabus:

Discovery of DNA as genetic material, Griffith's experiment, Hershy and Chase warring blender experiment, Chargaff's rule, Structure of DNA, RNA and Protein Basic mechanism of replication, transcription, translation, Gene regulation in prokaryotes and eukaryotes, positive regulation, negative regulation, attenuation, gene regulation in lambda phage life cycle, RNA processing and post transcriptional regulation Eukaryotic transcription factors, enhancers, silencers, insulators, chromatin structure and gene regulation, Translational regulation in prokaryote and eukaryotes, Post translational modification and protein stability

References:

Text books.

1. Molecular biology of gene, J.D.Watson
2. Gene VIII, Benjamin Lewin
3. Molecular biology, David Freifielder

Course Outcome:

1. Learn and understand the important discoveries that are made in the field of molecularbiology.
2. CO2. Understand the detailed structure of the double helical nature of DNA as proposed byscientists like Watson and Crick.
3. To learn different levels of organizations that regulate the condensation of DNA that leads tothe compact metaphase chromosome.
4. To learn key molecular events that occur during the transcription and tranlation processes thatleads the protein synthesis from specific genes.
5. Understanding the mechanisms that regulate the regulation of gene expression in both prokaryotes and eukaryotes.
6. Learn about the molecular events that happen during the replication of DNA prior to the celldivision.

MIC 206 (MYCOLOGY) **Credits: 3**

Course Objective: Learn about the importance of fungi- in ecosystem, Pharmaceutical industry, agriculture, health sectors, food industry etc. Also learn about their classification, toxins produced by fungi, mushrooms and its health benefits, Toadstools. the symptoms, pathogenesis and identification method for the diseases causes by fungi.

Syllabus:

Introduction & Historical overview of mycology, General characteristics, Importance of fungi in Human life, Fungi –Taxonomy and Systematic Classification, Fungal Metabolism, Fungal Growth-Apical growth, Spitzencorper. Fungi- Reproduction and Life cycles of Chytridiomycota, Glomeromycota, Zygomycota, Macro fungi-Ascomycota and Basidiomycota Mushrooms and their health benefits, medical relevance, toadstools, Mycotoxins and mycetism Ecological importance Mycorrhiza, Lichens and its physiology, symbiotic association of fungi with insects, Fungi as biological insecticides, practical uses of fungi Medical mycology-superficial, cutaneous, sub cutaneous, opportunistic and infectious mycosis, etiological agents, pathophysiology, diagnosis and its therapy and therapy
Host responses to fungal infection-Immunity Antifungal agents

Reference:
Introductory mycology, Alexopoulos, et al

Reference books:
1. Fungal Biology by J W Deacon
2. Topley & Wilson's Microbiology and Microbial Infections, Volume 4: Medical Mycology --by Leslie Collier, et al;
3. Medical Mycology and Human Mycoses -- by

Course Outcome:
Understand about the importance of fungi in ecosystem, agriculture, pharmaceutical industries, food industries and in health sectors. 2. Understand the general characteristic features of fungi. 3. Understand the fungal classification and its morphological characteristics. 4. Students understand how to identify a disease caused by fungi.

MIC214 (MICROBIAL PHYSIOLOGY & METABOLISM) Credits: 4

Learning Objective: 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 and their energetics.

Syllabus:

Bioenergetics: Gibbs free energy, endergonic & exergonic reactions. Standard state free energy changes-DeltaG, DeltaG^0 and DeltaG'^{0}, Relationship between equilibrium constant and DeltaG'^{o}, Feasibility of reactions. Simple problems, ATP-Structure, properties and energy currency of the cell, Importance of Coupled reactions, High energy compounds, simple problems. Introduction to Metabolism - Catabolism, anabolism, catabolic, anabolic and amphibolic pathways

Carbohydrate Metabolism: Introduction, 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

Lipid Metabolism: Beta – oxidations of saturated fatty acids. Ketone bodies, production during starving 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.

Amino Acid/ Nucleic Acid Metabolism: 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.

Reference Books:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman &Company, 2004. (**T1**)
2. Voet & Voet, Fundamentals of Biochemistry, Upgrade Edition, Wiley, 2002.

Course Outcome:

1. To understand basics of microbial growth requirements.
2. To designate fundamentals of prokaryotic cell division.
3. To designate prokaryotic signal transduction network involving physiological processes including chemotaxis and biofilm formation
4. To learn about adaptation capabilities of bacteria to stress environments.
5. Students will be able to understand the different metabolic pathways including carbohydrate,fatty acid, amino acid metabolism etc.
6. Students will be able to analyse the energetics and regulatory aspects of different metabolicpathways.

BIO206 (ANALYTICAL BIOCHEMISTRY) **CREDITS: 3**

Learning Objective:

The main objective of this course is to provide basic knowledge to undergraduate students on variousanalytical tools to understand structure and functions of biomolecules.

Syllabus:

Methods of protein extraction, Protein quantitation: Biuret, Lowry, BCA and Bradford methods, Protein precipitation: Salting-in, Salting-out, Effect of organic solvents and polymers, Selective denaturation, Protein separation: Dialysis, Ultrafiltration, Centrifugation.

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, Fundamentals of high-performance chromatography,HPLC columns, HPLC detectors.
Electrophoresis: Native PAGE, SDS-PAGE, Isoelectric focussing, 2D-PAGE,

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

References:

1. Biochemistry: Voet and Voet
2. Protein Purification Techniques: Simon Roe
3. Protein Purification: Robert K. Scopes
4. Physical Biochemistry: David Sheehan
5. Practical Biochemistry: Keith Wilson and John Walker
6. Mass Spectrometry for Biotechnology: Gary Siuzdak

Course Outcome:

1: Introduce the primary steps in biomolecules (focus on proteins) purification which includes various methods in isolation and quantitation of proteins.
2: Learn how to separate proteins from a heterogeneous mixture.
3: Learn to apply important chromatographic techniques to purify biomolecules
4: Familiarize the working principles of electrophoresis and UV/Vis and fluorescence spectroscopic techniques and application of the knowledge to get basic structural information of proteins

MIC205 (VIROLOGY) **CREDITS: 3**

Learning Objective: 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, viroid's, and prions. The viral vectors and their applications in biotechnology are also discussed

Syllabus:

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.

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

Hot Response And Anti-Viral Agents: Immune responses to viruses, Interferon and othercytokines, Antiviral therapy.

References:

1. Basic Virology – Edward K Wanger
2. Matthew's Plant virology
3. Fundamentals of molecular virology – Acheson and Nicholas H

Course Outcome:

1. Students will be able to access the reason for studying viruses Understand how to cultivate, purify and detect the presence of viruses Understand the replicative strategies of different classes of viruses Understand the host immune response to viruses
2. Understand the pathogenicity and various antiviral drugs used to control viral infections.

MIC 281 (GENERAL MICROBIOLOGY LAB **Credits: 2**

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

Syllabus:

Culture Techniques-Spread plate, Pour plate and Decimal dilution.

Motility Determination-Soft agar deeps and Hanging drop method, Biochemical tests: IMViC test, Catalase test, Oxidase test, Triple sugar iron test, carbohydrate fermentation test ,urease test, fungal cultivation and staining .Identification of bacteria is using differential /selective media.

References:

1. Microbiology Lab Manual by James G. Cappuccino and Natalia Sherman.
2. Benson's Microbiological Applications by Alfred E. Brown
3. www.microbeonline.com

Course Outcomes:

1. To understand and perform pure culture techniques which includes Pour plate and spreadplate .
2. To understand and perform various biochemical tests to identify unknown microorganisms, practical exposure to fungus cultivation and staining.
3. To understand the use of differential, selective and special media.
4. To perform isolation of bacteriophages from waste water.

BIO281 (CELL AND MOLECULAR BIOLOGY LAB) CREDITS: 2

Learning Objective :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:

List of Experiments

1. Accurate pipetting
2. Lignin Staining : comparison between monocots and dicots
3. Cheek cell Epithelium
4. Plant cell identification: Identification of stomata and chloroplast
5. Mitosis in onion root tip
6. Polyacrylamide gel Electrophoresis
7. Agarose gel electrophoresis
8. Genomic DNA isolation by CTAB method from different sources like leaf, flowers and fruitsof plants
9. Spectrophotometry
10. SDS -PAGE (Polyacrylamide gel electrophoresis)

References:

1. Cell and Molecular Biology: Concepts and Experiments -Gerald KarpCell and
2. Molecular Biology: A lab manual -K.V. Chaitanya

Course Outcome:

1. Practical exposure to microscopy wherein the students will learn to differentiate between plant andanimal cells and identify the deposition of lignin in plants using various staining techniques.
2. The various stages of mitosis will be analysed and visualised using the actively dividing cellspresent at the root tip of Allium cepa.
3. Practical exposure to genomic DNA isolation using various plant tissues and standardising theprotocol for each of these tissues.
4. Understand the method to assess the quality of DNA using Agarose gel electrophoresis and well as spectroscopic methods.
5. Understand the basis of separation of proteins using polyacrylamide gel electrophoresis.
6. Basic introduction to animal cell culture

AVP201 / AMRITA VALUES PROGRAMME I

AVP211 AMRITA VALUES PROGRAMME II

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else inthe world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and

reception India – Message

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability
Organic farming is emerging as an important segment of human sustainability and healthy life. 'Haritamritam' is an attempt to empower the youth with basic skills in tradition of

organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

Semester 4

BIO204 (CELL BIOLOGY) **Credits: 3**

Learning Objective: Provide in depth knowledge involving the basic concepts of cell biology including cell signaling, Cell-matrix interactions with specific emphasis on the components that make up the cytoskeleton. The course also includes understanding various mechanisms that govern the growth and regulation of cancer cells including the method to culture such cells.

SYLLABUS:

Cell Structure and Function: Nucleus: Internal Structure, Traffic across the nuclear membrane, Nucleolus and rRNA Processing. Protein Sorting & Transport: Endoplasmic Reticulum, Golgi Apparatus, Vesicular Transport, Lysosome. Mitochondria: Structure, Oxidative Phosphorylation, Chloroplasts: Photosynthesis, Peroxisomes

Cell Regulation: Basics of animal communications ,Modes & Types of Cellular Signals, Receptors: GPCRs, RTKs, Cytokine Receptors & NRTKs, Enzyme linked receptors. Intracellular Signal Transduction Pathways, Cell Signalling and Cytoskeleton, Signalling Networks, Signaling in developmental pathways like Wnt, Notch and Hedgehog, Signaling in plants- Auxin, Ethylene and Phytochromes, Prokaryotic Signaling, Signaling involved in Circadian rythm in Humans, Drososphila and Cyanobacteria,

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

References:

Text books:
The Cell, A Molecular Approach – 6th Edition – Geoffrey M. Cooper, Robert E. Hausman –Sinauer Associates, Inc.
Molecular Biology of the Cell – 5th Edition – Alberts et al – Garland Science

Course Outcomes:

1. Understand how the proteins synthesised in the cytosol are transported to different organelles.
2. Understanding how cells co-operate and communicate with each other and the role of such signaling mechanisms in Cancer, Cell death and other pathological conditions.
3. Understand the regulation of cell cycle and cell death in Cancer. CO4: Understand the basictechniques used to culture animal cells.

MIC215

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

Syllabus:

GENES, CHROMOSOMES & HERIDITY
Introduction, DNA as genetic material – Cellular Reproduction – Mendelism: Basic Principles EXTENSION AND **VARIATION OF MENDELISM**
Chromosomal Basis – Variation in chromosome number & structure – Linkage, Crossing Over and Chromosome Mapping – Genetics of Bacteria and their viruses- Extra Nuclear Inheritance.
DNA, GENE EXPRESSION & GENOMICS
Molecular structure of DNA – Mutation, DNA repair & Recombination —Transposable elements – Regulation of gene expression – Cancer & Regulation of Cell Cycle
REFERENCE:

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

COURSE OUTCOME:

1. To understand the basic concept of Mendelian principles and learn its application in different genetic experiments. This would help the students to solve the majority of the genetic problems.
2. To extrapolate the deviations from the standard mendelian laws in few cases and learning themechanisms.
3. To learn the underlying genetic mechanisms that regulate sex determination and clinical casesleading into chromosome abnormalities.
4. To understand the principles of linkage, recombination and chromosome mapping to establishthe physical and genetic connection between two neighboring genes.
5. Learning how DNA repair mechanisms restore the integrity following the DNA damage. 6. Applying statistical methods to obtain probability and genetic ratios in the Mendelian crosses.

BIO207 (Immunology) **Credits: 3**

Learning Objective: This course provides understanding about development and function of the immune system during health and diseases states of the body. We emphasize the molecular and cellular aspects of the immune system and response. Course covers innate and adaptive immune response and its components, Antibody and T cell receptor structure, function, molecular development and its genetics, Major histocompatibility complex, antigen presentation, B cell and T Cell activation and signaling, effector mechanisms, biology of vaccines, hypersensitivities, autoimmunity, immunodeficiency diseases, tumor and immunology.

Syllabus:

Historical perspectives in Immunology, Host-pathogen interactions; Introduction to the Immune System, Cells and Organs of the Immune system, Innate immune responses, Cells of the innate immune system, Inflammatory response, Antigen capture and presentation to lymphocytes, Antigen recognition in the adaptive immune system, Cell mediated Immune responses, Effector mechanismsof Cell mediated Immune responses
Humoral immune responses, Effector mechanisms of Humoral Immune responses, Immunologic tolerance and autoimmunity, Immune responses against tumors and transplants, Hypersensitivity reactions and diseases, Congenital and acquired Immuno-deficiencies

References:

Text Book:
Basic Immunology: Functions and disorders of the Immune system, Abul K abbas, Andrew HLichtman and Shiv Pillai

Reference materials:

1. Immunology, Kuby, by Kindt, Goldsby, Osborne, Sixth Edition.
2. Immunobiology, The Immune system in Health and Disease, Seventh Edition by Janeway, Travers et al, Garland Publishing, 2008.
3. Research articles and reviews from scientific publications.

Course Outcome:

1. Understand immune response in our body, both innate and adaptive, to different pathogens, tissue injury and cancer.
2. Understand what happens if our immune system overreacts to foreign substances (hypersensitivities and allergies)
3. Understand what happens if our body recognize self as non-self (autoimmunity)
4. Understand the biology of different vaccines against infectious agents and cancerand solutions to produce better vaccines.

BIO209 (Enzyme Technology) **Credits:3**

Learning Objective: To provide a detailed knowledge about enzymes, their chemical nature, kinetics, 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:

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.

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.

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. Kinetics Allosteric enzymes.Numerical problems in enzyme kinetics and enzyme inhibition.
Enzyme Regulation: Feedback Regulation, Allosteric Regulation, Reversible Covalent Modification and Proteolytic Activation. Enzyme processing. Enzymes in post translational modifications.
Organisation of enzymes in the cell. Enzymes in the cell, localization, compartmentation of metabolic pathways, enzymes in membranes, concentrations. Mechanisms of enzyme degradation, lysosomal and nonlysosomal pathways, examples.
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 directedmutagenesis, Designer enzymes
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 :

Textbooks :

1. Fundamentals of Enzymology : Nicholas Price & Lewis Stevens
2. Enzymes : Biochemistry, Biotechnology and Clinical Chemistry- Trevor Palmer Biochemistry text books by Stryer, Voet and Lehninger (Relevant Chapters) Proteins by Gary Walsh
3. Internet/Journal Resources

Course Outcome:

1. Introduce the term “enzyme” , history and classification
2. Learn about proteinaceous and non proteinaceous enzymes, their purification
3. Familiarise on mechanism of enzyme action-theories of enzyme action
4. Learn how to define velocity/enzyme activity/rate of a reaction and specific activity

5. Familiarise on factors affecting enzyme activity.
6. Learn about enzyme catalysis, Michelis-Menton's constant.
7. Acquire knowledge about enzyme Inhibitions
8. Learn about enzyme regulations
9. Familiarise on enzyme degradation
10. Detailing on industrial and clinical enzymes.

MAT 201 (BIOSTATISTICS) Credits: 3

Course Objective:

Biostatistics is a course offered to 3st 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

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

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

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

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 a 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.

REFERENCE:

1. Fundamentals of Biostatistics. by Irfan A Khan.
2. An introduction to Biostatistics. by PSS Sunder Rao.
3. Introduction to the Practice of Statistics by Moore and McCabe
4. Principles of Biostatistics. Marcello Pagano.
5. Course Manuals: S-PLUS Command Line Essentials, The Analysis of Microarrays

COURSE OUTCOME:

1: To understand the concepts.
2: To find r, ρ and study the nature of correlation and regression. Identify the different axiomatic approach.
3: To study and solve problems related to connectives under different situations.
4: To study the need of statistical approach Identify the different axiomatic approach.
5: To get a single value that describes the whole data and to study the variability of observation. 6: To understand the basic concepts of pmf and pdf

MIC207 (FOOD MICROBIOLOGY) Credits: 3

COURSE OBJECTIVE

Students are equipped with knowledge in techniques and experiments related to food safety andsustainability .

SYLLABUS

History and development of Food microbiology: Common Food borne Bacteria, Molds and yeasts. Role, and Significance of Microorganisms in Foods. Methods for detection of microorganisms infood: Meat diary, sea foods, vegetables. Physical, Chemical Immunological

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.HACCP : applications and microbiological criteria

Food spoilage and food borne diseases: Common food borne pathogens, Entero pathogens and diseases: Applications of food microbiology: Microorganisms in Food Fermentation.

REFERENCE:

1. Food Microbiology. 2nd Edition By Adams
2. Modern Microbiology, James M.Jay
3. Fundamental Food Microbiology, Bibek Ray.

COURSE OUTCOME:

To expose students to various methods of enumeration and identification of microorganisms in food. To introduce the concept of food preservation with special emphasis to HACCP and criteria management. To increase awareness of spoilage pathogens in food and methods to control it.To summarize on all major food borne pathogens with special importance to bacterial pathogens.

SSD201 (SOFT SKILLS –I) Credits: 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:

1. Basic understanding of the Soft skills sessions
2. Gain insights on setting objectives
3. Builds confidence to present in front of audience
4. Gains inputs to know to present self
5. Builds confidence to present in front of audience

BIO 282 (Immunology Lab) **Credits:2**

COURSE OBJECTIVE:

To expose the students to common laboratory assays, like blood grouping, agglutination reactions, ELISA (enzyme-linked immunosorbent assay), which detects the presence of antigen-antibody interactions in the body fluids.

SYLLABUS

Principles of Antigen-antibody interactions. Applications of antigen-antibody interactions in research Module 2: Blood typing by agglutination, Latex agglutination, Ouchterlony diffusion on gels for antibody titration, Diffusion experiments for testing common epitopes on antigens, ELISA

REFERENCE:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition. Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley- Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Practical Immunology, 4th Edition (2008). Frank C. Hay, Olwyn M. R. Westwood ISBN: 978-1-4051-4673-9 408 pages, Wiley-Blackwell

COURSE OUTCOME:

1. To understand and identify the morphology of cells of the immune system. 2. To understand the basic concepts of blood grouping. 3. To understand antigen-antibody interactions and detect the presence of antigens and or antibodies in a biological sample. 4. To understand antigen antibody interactions and thus quantitate the presence of antigen and or antibodies in biological samples.

MIC283 (FOOD MICROBIOLOGY LAB CREDITS: 2

COURSE OBJECTIVE:

Exposure to food enumeration, quality control and food borne pathogen detection methods.

SYLLABUS:

Water quality analysis, Dye reduction tests for milk quality determination, Breed count method for bacterial enumeration. Coliform analysis in potable water, Standard plate count determination. Food production: yoghurt and mushroom. Production and estimation of lactic acid by Lactobacillus Sp. Detection of microbial spoilage of canned foods.RODAC technique,Agar droplet method

REFERENCE:

Laboratory exercises in Microbiology: John P Harley fifth edition Fundamental Food Microbiology, Bibek Ray

COURSE OUTCOME:

To provide experimental skills on food enumeration methods. Methods to identify quality control of food products and water. Methods to detect food spoilage pathogens.

SEMESTER - 5

MIC 309 (INDUSTRIAL MICROBIOLOGY) CREDITS 3

COURSE 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

Industrial Biotechnology: Introduction and history, Isolation and screening, Primary and Secondary screening, Production strains, Production media, Inoculum preparation and inoculum Development, Introduction to Fermenter, Industrial sterilization, Scale up fermentations, Types of fermenters (12 Types), , Down stream processing of industrial products. Different types of product purification. Mode of fermenter operation, Industrial production of penicillin, production of streptomycin.

Industrial production of organic acids- introduction, production of citric acid, Industrial production of enzymes, introduction; general aspects, production of amylases& proteases, production of nucleotides & nucleotides, production of alcohols-acetone-butanol, production of ethanol, production of amino acids-introduction, production of L- glutamic acid, production of single cell proteins, production of yeast/ mushrooms, production of fermented foods, production of microbial insecticides, production of Biopolymers, Biofuels, biogas, production of Bioplastics, Biosurfactants, and Biofertilizers, General rules in patents and practices. Agitation kinetics and sterilization. Strain improvement methods: Using foreign DNA and mutation.

Environmental Biotechnology - Waste water treatment, Bioremediation, Genetically Engineered Microorganisms in Biotreatment of wastes, Biotechnological methods for pollution detection, Biosensors

REFERENCE:

1. Industrial Microbiology, A.H.Patel
2. Industrial microbiology, CasidaReference Books
3. Biotechnology-A textbook of Industrial Microbiology. II edition.Wulf Crueger and AnnelieseCrueger.
4. Industrial Microbiology by L.E Casida, John Wiley and sons INC.
5. Industrial microbiology by A.H.Patel, Macillan India Ltd.
6. Principles of fermentation technology by P.Stanbury & Allan Whitekar, Pergamon.
7. Manual of Industrial Microbiology and Biotechnology,II edition. Arnold L.Demain and JuilanE.Davies

COURSE OUTCOME:

1: An introduction to fermentation process. Learn the history of fermentation process, types of fermentation, and examples of fermentation industry.
2: Design of a fermenter. Understand basic design of a fermenter. Important parts and materials required for aseptic operation and containment practice in a fermenter.
3: Types of Fermenter. Study the difference in design and functioning of different types of fermenters. Understand the advantages and disadvantages of different types of fermenters.
4: Mode of fermenter operation. Covers the basic concepts of microbial growth kinetic and stoichiometry in different bioreactor operational modes.
5: The isolation and improvement of industrially important Microorganisms. Understands the problems in isolation, strain improvement and growth of microorganisms in industrial processes.
6: The recovery and purification of fermentation products. Learn the techniques involved in the extraction and purification of high-quality fermentation products.
7: Effluent treatment. Understand the importance of proper waste treatment plant for fermentation industry. What are the different types of wastes produced and what are the different factors that need to be considered while selecting the treatment method.

MIC 312 (Medical Bacteriology) **Credits:3**

COURSE OBJECTIVE:
To understand different bacteria which causes diseases to human

SYLLABUS:

Infection-Sources of infection, method of transmission of infection, Factors predisposing to microbial pathogenicity, Types of infectious diseases. Normal Microbial flora of human body. Gram positive pathogens like Staphylococcus, Streptococcus, Corynebacterium, Bacillus, and Clostridium. Gram negative pathogens like Neisseria, E.coli, Klebsiella, Proteus, Salmonella, Shigella, Vibrio, Haemophilus, Pseudomonas, Brucella and Yersinia. Acid fast bacteria like Mycobacterium tuberculosis and M.lepreae. Spirochetes like Leptospira, Treponema. Mycoplasma. Chalmydia. Helicobacter and Campylobacter. Other important anaerobic pathogens.

REFERENCE:

1. Medical Microbiology-David Green wood
2. Text book of microbiology,Ananthanarayan& Jayaram Panicker Jawets-Medical Microbiology-Geo F.Brooks,Janet S Butel.

Reference book:
1. Manual of Clinical microbiology-Murray,Baron
2. Baily and Scot's Diagnostic MicrobiologyForbes,Salim,Weissfeld Mim's Medial Microbiology-Georing,Dockrell.
3. Foundation and principle of bacteriology-A.J.Salle

COURSE OUTCOME

Understand about normal flora of human body, different gram positive bacteria, different gram negative pathogenic bacteria, acid fast bacteria and other important medically important bacteria includes spirochetes, camphylobacter, Helicobacter etc.

MIC316 (RECOMBINANT DNA TECHNOLOGY) **CREDITS:3**

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

SYLLABUS

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,

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

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.

REFERENCE:

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

COURSE OUTCOME:

1. To help students appreciate the overarching work flow defined by Boyer and Cohen in order to perform gene manipulation.
2. To introduce the basic principles of plasmid and phage based vectors.
3. To introduce the concepts of gene and cDNA library. 3. Make the students accustom to working principles of chromosome walking and jumping. 4. To introduce the students to gene editing techniques. 5. Discussion on applications of recombinant DNA technology.

MIC317 (ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY) CREDITS 3

COURSE OBJECTIVE:

The course should enable the students to 1. Familiarize with the environment and ecosystems 2. Decipher the treatments for both solid waste as well as waste water 3. To get requisite knowledge about the habits and habitats of microorganisms and their implications in ecology 4. To evaluate explicitly the various biogeochemical cycles 5. Get insight into the various applications of microorganisms, such as bioremediation, composting.

SYLLABUS

Industrial Microbiology, Introduction and history, Isolation and screening, Primary and Secondary screening, Production strains, Production media, Inoculum preparation and inoculum Development, Introduction to Fermenter, Industrial sterilization, Scale up fermentations, Types of fermenters, Acetator and cavitator, product recovery, Industrial production of penicillin, production of streptomycin, Industrial production of organic acids- introduction, production of citric acid, production of lactic acid, Industrial production of enzymes, introduction; general aspects, production of amylases& proteases, production of nucleotides&nucleotides, production of alcohols-acetone-butanol, production of ethanol, production of aminoacids -introduction, production of L- glutamic acid, production of vitamin B12, production of single cell proteins, production of yeast/ mushrooms, production of fermented foods, production of microbial insecticides, production of Biopolymers, Biofuels, biogas, production of Bioplastics, Biosurfactants, and Biofertilizers, General rules in patents and practices.

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

REFERENCE

1. Industrial Microbiology, A.H.Patel
2. Industrial microbiology, Casida

Books:

1. Biotechnology-A textbook of Industrial Microbiology. II edition.Wulf Crueger and AnnelieseCrueger.
2. Industrial Microbiology by L.E Casida, John Wiley and sons INC.
3. Industrial microbiology by A.H.Patel, Macillan India Ltd.
4. Principles of fermentation technology by P.Stanbury & Allan Whitekar, Pergamon.
5. Manual of Industrial Microbiology and Biotechnology,II edition. Arnold L.Demain and JuilanE.Davies.

COURSE OUTCOME:

The students should be able to

1. Thoroughly know the microbial diversity in the various biomes
2.Identify terrestrial as well as marine habitats and know how humans have impacted the environment
3. Decipher the use of biosensors for various environmental applications
4. Postulate application ofmicroorganisms for pollution abatement and various other industrial applications.

BIO317 (RESEARCH METHODOLOGY) CREDITS: 2

COURSE OBJECTIVE:

This course introduces students to research mainly in 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

Research Methodology in life sciences. Literature Search: Use of databases, framing query with examples. Bibliometric: Citation, Impact factor, Eigen factor. Hypothesis as a framework for scientific projects. Alternatives of hypothesis driven research: hypothesis generating research. Experimental Design: different experimental designs, controls, Taking measurements. Data Analysis: Between-individual variation, replication and sampling. Common statistical tests with Excel. 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.

COURSE OUTCOME:

Research Methodology in life sciences. Literature Search: Use of databases, search engines: pubmed, Google Scholar; framing query with examples. Bibliometrics: Citation, Impact factor, Eigen factor. Hypothesis as a framework for scientific projects. Alternatives of hypothesis driven research: hypothesis generating research. Experimental Design: different experimental designs, controls, Taking measurements. Data Analysis: Between-individual variation, replication and sampling. Common statistical tests. Writing research hypothesis (grant). Presenting research: oral and poster. Use of common software tools: Microsoft Office™ (Powerpoint, Excel, Word); Mendeley; ImageJ. Use of social media in research: Mendeley, ResearchGate.

SSD 301 (SOFT SKILLS II) CREDITS: 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:

1. Basic understanding of the Soft skills sessions
2. Gain insights on setting objectives
3. Gain insights on setting objectives
4. Gain insights on setting objectives
5. Gains inputs to know to present self
6. Builds confidence to present in front of audience
7. Builds confidence to present in front of audience
8. Gains inputs to present in front of audience
9. Gains inputs to present in front of audience
10. Builds confidence to present in front of audience
11. Builds confidence to present in front of audience
12. Gains overall perspective of the course

MIC384 (Medical Bacteriology Lab) credits 2

COURSE OBJECTIVE:

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

SYLLABUS

Isolation and identification of normal skin flora. Preparation of blood agar and demonstration of hemolysis. Acid fast staining. Isolation and identification of unknown bacteria from pure culture. Isolation and identification of unknown bacteria from mixed cultures. Antibiotic sensitivity tests.. Demonstration of WIDAL, Fungal cultivation and staining, negative staining.

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REFERENCE:

Microbiology-A laboratory Manual-James G.Cappucino,Natalie Sherman. Color Atlas of Medical bacteriology-Luis M de la Maza,Marie T Pezzlo.

COURSE OUTCOME:

Hands on experience in isolation of normal flora, antibiotic sensitivity test, acid fast staining, negative staining, identification of unknown organism and widal test.

BIO386 (GENETIC ENGINEERING LAB) CREDITS: 2

COURSE 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

List of Experiments:

Isolation of Plasmid DNA by Alkaline lysis method
Quantitation of DNA
Detection of Plasmid DNA by Agarose gel electrophoresis
Restriction Digestion Analysis
Competent cell preparation
Transformation and Efficiency of competent cells
SDS PAGE
Polymerase Chain Reaction
Isolation of Genomic DNA from Plants
Calibration of pipettes

REFERENCE:

Joseph Sambrook, David William Russell “Molecular cloning”. 3rd Edition, CSHL Press, 2001.

Learn. Genetics. Virtual Lab / learn.genetics.utah.edu/

VALUE Virtual Lab / vlab.amrita.edu

COURSE OUTCOME

1: Hands on training for isolation of plasmids
2: Learn how to identify a plasmid experimentally.
3: Learn how to perform a restriction digestion followed by its mapping

4: Learn how a PCR works
5: Hands on experience on competent cell preparation and transformation. 6: Hands on training for assembling and performing SDS-PAGE

MIC385 Industrial Microbiology Lab CREDITS: 2Learning 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 principle.

SYLLABUS:

Experiments Isolation and screening of antibiotic producers by crowded plate technique, Isolation of Actinomycetes from soil, Secondary screening protocols-Giant colony technique, Secondary screening protocols-Kirby-Bauer method, Isolation and screening of microorganism producing proteases, Isolation and screening of microorganism producing amylases, Isolation ofNitrogen fixers from soil, Isolation of phosphate solubilizers from soil, Immobilization of yeast in alginate beads for ethanol production, Production of citric acid .

REFERENCE:

Microbiology, A Laboratory Manual-James Cappuccino, Natalie Sherman. 2.Manual of Industrial Microbiology and Biotechnology-Arnold L Demain , Julian E Davies

Course Outcomes:

Understand various methods of screening industrially important microorganisms from different sources.
Understand the working of small scale fermenter and also determine the aeration efficiency of the fermenter Understand the technique of immobilization of cells like yeast and E.coli.

Semester- 6

MIC 399 (PROJECT) CREDITS :7

Learning Objective

The project aims to expose the students to a short-term research experience. Through the process they learn to frame hypothesis, define objectives, collect relevant literature, design and perform experiments, data analysis and paper writing.

Course Outcomes

Help frame hypothesis.
Literature survey.
Hands-on experience with regard to different instrumentations and techniques.
Data interpretation and statistical analysis.
Paper writing.

BIO319 (PHARMACOLOGY) CREDITS 4

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

SYLLABUS:

Fundamental Principles of Pharmacology, Fundamentals of Cardiovascular, Endocrine, and Immunopharmacology, Principles of Chemotherapy, Principles of Toxicology, 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, Neutraceuticals, Economics of drug development. Receptor theory & kinetics, dose-response relationships, and mechanism of drug action; Phase I and phase II of drug metabolism, drug efficacy; pharmacokinetics concepts, Pharmacogenomics and Intellectual Property Rights with respect to Pharmaceuticals.

REFERENCE:

1. Pharmaceutical Biotechnology by Daan J. A. Crommelin, et al
2. "Principles of Pharmacology by D. Golan, A. Tashjian, E. Armstrong, J.Galanter,
3. A.W.Armstrong, R. Arnaout and H.Rose. 2005, Lippincott Williams and Wilkins.
4. Goodman and Gilman's The Pharmacological Basis of Therapeutics Book by J.Hardman, LeeLimbird and A.G. Gilman.

COURSE OUTCOME:
Students learn about drug discovery, mechanism of action of different drugs and get an idea aboutpharmaceutical research

MIC311 (PARASITOLOGY) CREDITS:3

COURSE OBJECTIVE:
To understand the common parasitic relationship in nature, focusing more on human parasite thatcause diseases.

SYLLABUS:

Parasitology-Introduction, Parasitic association, host parasitic interaction, Effect of parasitism in the host, Sources of parasitic infections. Classification, Introduction of protozoa (4 hr) , Protozoa- Amoeba Flagellates-*Intestinal, Hemoflagellates,* Sporozoa and Microspora(10 Hr)- Trematodes- *Schistosoma haematobium, S.mansoni, S.japonicum* (5 Hr) Cestodes-Intestinal Tapeworms and extra intestinal tape worm (7 Hr) Nematodes-Intestinal, Blood and tissues (8 Hr)

REFERENCE:
Human parasitology-Burton J Bogtish
Reference Book:
General parasitology-Thomas C Cheng Medical parasitology-Markell and Voges Foundation of parasitology-Roberts, Janovy.

COURSE OUTCOME:
Students will have a basic understanding of the most important groups of eukaryotic parasites in vertebrates. Understand their life cycle, infection pathways and types of damage they inflict on the host.

BIF301 (INTRODUCTORY BIOINFORMATICS) CREDITS: 2

COURSE OBJECTIVE:
To introduce to the field of bioinformatics via an array of publically available tools and resources

SYLLABUS:

INTRODUCTION: 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.
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 databses; 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
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; Hash tables; 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.
VISUALISATION 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

REFERENCE:

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