SRI VENKATESWARA UNIVERSITY::TIRUPATI
COLLEGE OF SCIENCES
CHOICE BASED CREDIT SYSTEM (CBCS) 2020 – 2021
DEPARTMENT OF MICROBIOLOGY

SEMESTER – I

Sl. No.	Components of Study	Course code	Title of the course	Credit hours/ week	No. of Credits	IA	SEEM	Total Marks
1	Core-Theory	MB-101	Introductory Microbiology	6	04	20	80	100
2	Core-Theory	MB-102	Microbial Physiology	6	04	20	80	100
3	Compulsory Foundation	MB-103	Biochemistry	6	04	20	80	100
4	Elective Foundation	MB-104	Biophysics and Biostatistics	6	04	20	80	100
5	Practical-I	MB-105	Introductory Microbiology & Microbial Physiology	6	04	-	100	100
6	Practical-II	MB-106	Biochemistry, Biophysics and Biochemical Techniques	6	04	-	100	100
Total				36	24	80	520	600
7	Audit Course** (Self-Study)		**Human and Professional Ethics - I**	0	-	100	-	-

FIRST SEMESTER

MB - 101: INTRODUCTORY MICROBIOLOGY

UNIT – I

History and Scope of Microbiology - Discovery of microorganisms and development of microbiology - Contributions of pioneers- Prokaryotic and Eukaryotic microorganisms - Origin and evolution of microorganisms. Distinguishing of different microorganisms-Scope and relevance of Microbiology - Future of Microbiology.

Microbial Structure - Microscopy – principles and applications of light microscope-Bright field- Dark-field, Phase – contrast, Fluorescent, Scanning and Transmission electron microscopes, Confocal microscopy, Scanning tunneling microscope. Preparation of microbiological samples for microscopy-simple and differential staining, special and structural staining. Negative contrast staining for virus samples. Preparation of tissues for thin sectioning (fixation, dehydration, infiltration, embedding and sectioning).

Physical and Chemical methods of sterilization and disinfection : Heat, radiation, pH, atmospheric pressure, filters, various chemical agents, safety precautions. The concept of containment facility.

UNIT – II

Microbiological media: Types of media-natural and synthetic; autotrophic, heterotrophic and prototrophic media; basal, defined, complex, enrichment, selective, differential, maintenance and transport media.

Isolation, cultivation and enumeration of microorganisms : Isolation from different natural sources. Approaches for obtaining pure cultures. Cultivation of aerobes and anaerobes. Continuous, batch, synchronous broth and stock cultures. Enumeration / measurement of growth of microorganisms.

Maintenance and preservation of microbial cultures : Repeated sub-culturing, sterile soil/sand preservation, glycerol-deep freezing, oil overlay, drying methods, freeze-drying.

UNIT-III

Microbial Taxonomy: Classification of microorganisms – introduction – Hackel's three kingdom concept – Whittaker's five kingdom concept – three domain concept of Carl Woese. Basis of microbial classification. Concepts, nomenclature and taxonomic ranks; major characteristics used in Taxonomy – morphological, physiological and metabolic, ecological, numerical taxonomy; genetic and molecular classification systems; the kingdoms of organisms and phylogenetic trees. Characteristics of prokaryotes and eukaryotic cells.

UNIT – IV

Prokaryotic microorganisms:

Brief outlines on discovery, nature, origin, evolution, morphology and structure, composition, reproduction and other characteristics of Bacteria (Eubacteria) Spirochetes, Rickettsias, Chlamydias, Pseudomonads, Acetic acid bacteria, Mycloplasmas, Cyanobacteria, Archaebacteria, Actinomycetes (Actinobacteria).

Note: Viruses are dealt in separate paper with title "Basics of Virology-MB – 302".

Eukaryotic microorganisms:

Fungi : Classification, structure, composition, reproduction and other characteristics of fungal divisions – *Zygomycota, Ascomycota, Basidiomycota* and *Deuteromycota* and slime and water molds. General characteristics and importance of fungi – *Saccharomyces, Candida, Pichia, Pencillium, Neurospora, Rhizopus, Aspergillus, Agaricus, Cryptococcus, Fusarium, Trichoderma, Claviceps.*

Algae : Classification, structure, reproduction and other characteristics of algal divisions. Characteristics of *Chlorella, Senedesmus, Gelidiella* and *Gracellaria.* Economic importance of algae, phytoplantanic microalgae.

Protozoan parasites : Classification, morphology and structure, reproduction and other characteristics of pathogenic protozoa like *Entamoeba, Plasmodium, Leishmania, Cryptosporidium, Trichomonas, Taxoplasma, Trypanosoma, Giardia.*

Suggested Books:

1. Brock Biology of Microorganisms. 1997, 8th ed. Madigan et al., Prentice-Hall International, Inc.
2. Microbiology. 1999. 3rd ed. Prescott et al. Wm. C. Brown Publ.
3. Principles of Microbiology. 1997. 2nd ed. R.A. Atlas. Wm.C. Brown. Publ.
4. Foundations in Microbiology. 1996. 2nd ed. K. Talaro and A. Talaro. Wm. C. Brown Publ.
5. Microbiology. 1996. 5th ed. Pelczar et al. Tata McGram-Hill Publ. Company Ltd.
6. General Microbiology, 1999 by S.B. Sullia, Oxford and IBH Publishers.
7. General Microbiology, 1999 by Stainer et al., Macmillan Educational Ltd.
8. Instant Notes in Microbiology. 1999. J. Nicklin et al. Viva Books Pvt. Ltd.
9. Microorganisms, Biotechnology and Disease : Students Book. 1997 by Pauline Lourie and Susanwells. Cambridge University Press.
10. Introductory Mycology. 1996. 4th ed. Alexopoulos et al., John Wiley and Sons.
11. Introductory Psychology by H.D. Kumar. 2nd ed. 1999. East West Press.

MB - 102: MICROBIAL PHYSIOLOGY

UNIT – I

Nutrition : Elemental nutrient requirements of microbes; nutritional groups of bacteria; autotrophy-photoautotrophy and bacterial photosynthesis; chemoautotrophy and autotrophic metabolism; heterotrophy – photoheterotrophy and chemoheterotrophy, heterotrophic metabolism in bacteria; nutritional mutants and their use in metabolic studies.

Uptake and Transport of nutrients in microbes – Structural organization of plasma membrane in relation to transport, types and mechanisms of transport (passive, simple, facilitated, active, chemical modification) with reference to sugars, amino acids and ions; methods for studying of transport, coupling of transport of ions and metabolites to ATP/proton gradient.

Microbial Growth: building of macromolecules from elemental nutrients, supramolecules, cell components and cells; cell cycle in microbes and generation times; batch culture phases and importance of each phase, continuous cultures, synchronous culture, factors influencing the microbial growth.
Nature and properties of spores – Physiology and biochemistry of sporulation and germination of spores.

UNIT – II

The concepts of microbial metabolism, primary and secondary metabolism and their significance.
Bioenergetics : Concepts of free energy and thermodynamic principles in biology, energy transformation, ATP cycle, standard free energy of hydrolysis of phosphate compounds, energy transducers, redox potentials, free energy changes in redox reactions.

Photosynthesis : Oxygenic and anoxygenic photosynthesis, photosynthetic pigments, basic photochemistry of PS I and PS II and photosynthetic electron transport; modes of CO_2 fixation, halobacterial photosynthesis, sulphur, nitrogen and iron assimilating bacteria. Chloroplast mediated electron transport; chemolithotrophic electron transport systems. Biolumenescence.

Carbohydrate metabolism : Pathways underlying the utilization of different sugars (EMP, ED, HMP and phosphoketolase) in microorganisms, gluconeogenesis; synthesis of peptidoglycans and glycoproteins.

UNIT – III

Aerobic respiration : TCA cycle – intracellular location and reactions of the cycle, amphibolic nature of the cycle, energetics of the cycle; the glyoxalate cycle. Mechanisms of substrate-level phosphorylation; respiratory electron transport in mitochondria and bacteria along with its components (carriers); mechanism of oxidative phosphorylation, uncouplers, inhibitors;

Anaerobic respiration : nature of fermentation, the relationship of oxygen to growth and fermentation, biochemical mechanisms of lactic acid, ethanol, butanol, citric acid and acetone fermentations, study of fermentations, relationships between fermentation and energy production; nitrate and sulphate respiration.

Lipid metabolism: Biosynthesis of triacyl glycerols, phospholipids and glycolipids; oxidation of saturated and unsaturated fatty acids; microbial metabolism of aromatic and aliphatic hydrocarbons.

UNIT – IV

Protein metabolism: Assimilation of inorganic nitrogen and sulphur, biochemistry of nitrogen fixation; hydrolysis of proteins-exo-and endo-proteinases, outlines of biosynthesis and catabolism of amino acids in microbes (deamination, decarboxylation and transamination reactions). Urea cycle.

Nucleotide metabolism : biosynthesis of bases, nucleosides and nucleotides including deoxyribonucleotides, regulation of nucleotide synthesis; break down of nucleic acids – exo-and endo-nucleases (RNases and DNases) and phosphodiesterases, salvage pathways; catabolism of purines and pyrimidines.

Secondary metabolism : Utilization of secondary metabolites for production of vitamins, toxins (aflotoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

Microbial toxins and extra cellular enzymes : Exo-and endotoxins: physiology of toxin production; mode of action of toxins and extra cellular enzymes and their importance in pathogen virulence and pathogenesis.

Suggested Books:

1. Microbial Physiology and Metabolism. 1995, by D.R. Caldwell. Wm.C. Brown Publ.
2. Microbial Physiology. 1999, 3rd ed. by A.G. Moat & J.W. Foster. Wiley-Liss.
3. Principles of Biochemistry. Lehinger. 2000.
4. Foundations in Microbiology. 1996. by K. Talaro & A. Talaro, Wm. C. Brown Publ.
5. Microbiology. 2000. By Prescott et al. Wm. C. Brown Publ.
6. Molecular Cell Biology. 2000 – by Lodish et al.
7. General Microbiology, 1999 by Stainer et al., Macmillan Educational Ltd.

MB – 103: BIOCHEMISTRY

UNIT – I

Basic concepts of Chemistry of life : The major elements of life and their primary characteristics; atomic bonds and molecules – bonding properties of carbon, covalent and non-covalent bonds, Vander waals forces; polarity, hydrophilic and hydrophobic interactions; asymmetry of carbon compounds and cis-trans isomerism; electron transfer and oxidation/reduction; functional groups of organic compounds; hydrogen ion concentration of biological systems; Brownsted – Lowry acids and bases; ionization and titration of acids; dissociable biological compounds and physiological buffer systems.

Carbohydrates : Classification of carbohydrates; outline structure and properties of important mono-, di-, and oligosaccharides and their identification and analysis; structure, occurrence and biological importance of structural polysaccharides (cellulose, chitin, agar, alginic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, bacterial cell wall polysaccharides).

UNIT – II

Lipids: Building blocks of lipids. Classification of lipids. Fatty acids-physico-chemical properties, separation, distribution in nature characterization and saponification and iodine number. Nomenclature, outline structures, properties and functions of glycerides, neutral lipids (waxes, fats, oils, phospholipids, sphingolipids and glycolipids. Steroids – plant sterol, ergosterol, stigmasterol, cholesterol. Lipoproteins-classification, composition and importance. Salient features of bacterial lipids.

Amino acids : Classification, structure, physico-chemical properties, acid-base behaviour of amino acids.
Peptides : Characteristics of peptide bond, peptides of non-protein origin, properties and functions of peptides, determination of amino acid composition and sequence in peptides, chemical synthesis of peptides, peptides profiling.

UNIT – III

Proteins : Classification, properties and biological functions of proteins; structural organization of proteins – primary, secondary, tertiary and quaternary; Ramachandran's plot; proteins denaturation and renaturation (ribonuclease); structure-function relationships of certain proteins – myoglobin, hemoglobin, collagen; chaperones.

Catalytic proteins(enzymes) : Classification, nomenclature, composition and structure, enzymes as biocatalysts, outlines of purification and assay of enzymes, kinetics of enzyme catalyzed reactions, factors influencing enzyme catalyzed reactions, regulation of enzyme activity – activators and inhibitors and mechanism of action of enzymes (chymotrypsin). Regulatory enzymes – allosteric enzymes. Isoenzymes, conzymes, ribozymes, abzymes.

UNIT – IV

Nucleic acids : Types and their composition, structures of purines, pyrimidines, modified bases, nucleosides, nucleotides and polynucleotides; properties of bases and functions of nucleotides; types and structural polymorphism of DNA and RNA; denaturation and renaturation of nucleic acids, factors influencing hybridization, cot values.
Hormones and Growth regulators : Classification, outline structures and functions of major animal and plant hormones.
Vitamins : Discovery and outline chemistry of fat soluble (A,D,E and K) and water soluble (riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine folic acids and ascorbic acid) vitamins and their role in body functions.
Porphyrins and other pigments : Classification, structures and biological functions of porphyrins, brief account of haemoglobin and chlorphylls, cytochromes, xanthophylls and carotenoids of microorganisms.

Suggested Books :

1. Principles of Biochemistry, Lehninger, 3rd edition, 2000 by Nelson and Cox (Worth).
2. Biochemistry, Stryer 5th edition, W.H. Freeman, 2001.
3. Microbial Physiology and Metabolism. 1995, by D.R. Caldwell. Wm.C. Brown Publ.
4. Microbial Physiology. 1999, 3rd ed. By A.G. Moat & J.W. Foster. Wiley-Liss.
5. Foundations in Microbiology. 1996. By K. Talaro & A. Talaro, Wm. C. Brown Publ.

MB – 104: BIOPHYSICS & BIOSTATISTICS TECHNIQUES

UNIT – I

Electrochemcial techniques (Principles and applications): Redox reactions; pH and Clarke oxygen electrodes; biosensors.

Cell sorting and Flow cytometry (Principles and applications):

Radioisotope techniques - Nature and types of radioactivity, half-life of isotopes; detection and measurement of radioactivity-GM counter, liquid scintillation counter, gama-ray counter, Cerenkov counting and autoradiography; quenching and quench correction; laboratory safety measures in handling isotopes; biological uses of radioisotopes.

Spectroscopy : Electromagnetic spectrum of light; simple theory of light absorption by biomolecules; Beer's – Lambert law; transmittance; extinction co-efficient; light sources; monochromators; types of detectors; working principle and applications of visible, UV-visible, IR, Raman, ESR, mass, plasma emission, atomic absorption, and NMR spectrophotometry; fluorimetry and flame photometry; ORD and CD; X-ray diffraction and X-ray crystallography.

Amino acid and nucleotide sequencers: Basic principle, functioning and applications of amino acid and nucleotide sequencers.

UNIT – II

Centrifugation: Simple theory of preparative and analytical centrifuges and rotors; sedimentation analysis; differential, rate-zonal and equilibrium density gradient centrifugations. Applications – isolation of cells, subcellular organelles, viruses and macromolecules.

Electrophoresis (Principles and applications) : Types of electrophoresis – paper, gel (starch, acrylamide and agarose) disc, vertical, horizontal submarine, gradient, 2-dimentional, pulse-field and capillary; isoelectrofocussing; isolation and analysis of gel separated molecules – recovery of molecules from paper/gels; Southern, Northern and Western blottings.

Chromatography: Principle/simple theory and applications of partition, adsorption, ion-exchange, gel permeation and affinity chromatography based techniques – paper, thin-layer, column, GLC, HPLC, FPLC.

UNIT – III

Introduction: Definition of statistics: population and universe, the sample and population, statistical inference; parameter and statistics.

Interval Data: Mean, mode, median and standard deviation. Concept of probability – classical and frequency definitions; axiones of probability; addition and multiplication theorems (statements only); conditional probability-Baye's theorem (statement only); simple applications. Binomial, Poisson and Normal distributions (definitions and uses only).

Uncertainties in estimation of mean, comparison of means and variances – t, F, and Z tests.

Proportion data: examples of proportion data; (MPN, sterility testing of medicines, animal toxicity, therapeutic trial of drugs and vaccines, animal toxicity, infection and immunization studies) statistical treatment to proportion data. Chi-square test, goodness of fit.

Count data: examples of count data (bacterial cell count, radioactivity count, colony and plaque counts) statistical treatment to count data: Poisson distribution, standard error, confidence limits of counts.

Analysis of variance: Analysis of variance: Introduction, procedure and tests for one-way and two-way classified data. Multiple comparisons. Analysis of CRD, RBD and LSD. Factorial experiments- main effects and interaction in a 2^2 design, Duncan's Multiple Range Test.

Correlation and regression, formulae and application. Fitting straight line through a series of points. Fitting of exponential curves. Standard curve and interpolation of unknown Y-values. Multiple linear regression, logistic regression.

Statistical basis of biological assays: Response-Dose metameter. Delusion Assays, Direct and indirect assays. Quantal Responses, Probit, logit, LD_{50}, ED_{50}, PD_{50} – Standard line interpolation assay, parallel assay (4 point, 6 point assays), slope ratio assay.

Design of Experiments – Multiple comparison tests, Dunken's, Tukey's, Scheffic's, Dunnelt's etc.

Probit Analysis

Multiple Regression, Logistic regression

Discriminate Analysis

Clinical trails – Phase I, Phase II etc.

Clinical trails (meaning and importance only).

Suggested Books :

1. Practical biochemistry : Principles and Techniques 1995, 4th ed. by K. Wilson and J. Walker, Cambridge University Press.
2. Modern Experimental Biochemistry. 1993. 2nd ed. by R.F. Boyer. The Benjamin Cummings Publ. Company.
3. Physical Biochemistry : Applications to Biochemistry and Molecular Biology, 1982, 2nd ed. by David Freifelder. W.H. Freeman and company.
4. Introduction to Practical Biochemistry. 2000. by S.K. Sawhney and Randhir Singh (eds). Narosa Publ. House.
5. Biochemical Methods for Agricultural Sciences. 1992 by S. Sadasivam and A. Manikam. Wiley Eastern Ltd.

PRACTICAL:

MB – 105 : INTRODUCTORY MICROBIOLOGY & MICROBIAL PHYSIOLOGY

1. Microbiological laboratory safety measures
2. Sterilization methods - Wet method, Dry method, Filters. Evaluation of alcohol effectiveness, Phenol coefficient method
3. Preparation of different media for cultivation of bacteria & fungi
4. Plating techniques – streak plate, spread plate methods
5. Enumeration of Bacteria by serial dilution, viable count
6. Measurement of pH
7. Micrometry for cell size determination
8. Cell counting by Haemocytometer
9. Beer's Law
10. Determination of λ max for coloured solutions
11. Determination of DNA & RNA by UV spectrophotometry
12. Determination of nucleic acid Bases by UV spectrometry
13. Paper chromatography for separation of amino acids / pigments
14. TLC for separation of lipids / amino acids
15. Dialysis
16. Separation of proteins by SDS-PAGE
17. Separation of DNA by Agarose gel electrophoresis
18. Isolation of chloroplasts by sucrose density gradient centrifugation
19. Determination of concentration of green/yellow pigments by spectrophotometry

PRACTICAL:
MB – 106: BIOCHEMISTRY & BIOSTATISTCS TECHNIQUES

1. Qualitative tests for identification of Carbohydrates, amino acids, nucleic acids
2. Quantitative tests for Protein, glucose, glycine, bilirubin, cholesterol, Inorganic phosphorous
3. Determination of activity of – Peroxidase and Polyphenol oxidase in plant tissues.
4. Purification and study of Acid Phosphatase from potato tubers: Extraction of enzyme; effect of substrate concentration; enzyme concentration; temperature; pH on enzyme activity.
5. Determination of Bacterial growth curve
6. Determination of effect of temperature on bacterial growth
7. Determination of effect of pH on bacterial growth
8. Determination of effect of salt on bacterial growth
9. Determination of growth of fungi
10. Determination of concentration of cyanobacterial pigments
11. Determination of concentration of oligodynamic action
12. Determination of activity of microbial hydrolytic enzymes like amylases, lipases and proteases.
13. Demonstration of aerobic and anaerobic respiration in microbes.
14. Demonstration of Microbial fermentation
15. Demonstration of microbial toxins
16. Calculating Mean, Mode Median
17. Problems related to T test & F test & Z test
18. Problems related ANOVA