RK.UNIVERSITY

DETAIL TEACHING SCHEME

SCHOOL OF SCIENCE	PROGRAM : M.Sc. Microbiology
ACADEMIC YEAR - 2018-2019	SEMESTER – I
DEFINITION OF ONE CREDIT : 1. **Lecture (L):** 4 hour / week / semester, **2. Practical (P)**: 3 hour / week / semester **.**	

TEACHING SCHEME

Course Code	Course Name	Teaching Hours			Credits	Audit course	CIE	PSEE	Remarks if any
		Theory	Tutorial	Practical					
MB105	GENERAL MICROBIOLOGY AND BACTERIOLOGY	4	0	3	7	N	Y	Y	
MB102	MOLECULAR BIOLOGY	4	0	3	7	N	Y	N	
MB106	ENZYMOLOGY AND MICROBIAL PHYSIOLOGY	4	0	0	4	N	Y	Y	
MB104	BIOINSTRUMENTATION AND ADVANCED BIOANALYTICAL TECHNIQUES	4	0	3	7	N	Y	Y	
	Total	**16**	**0**	**9**	**25**				
		Total Hours		**25**					

N- No	CIE – Continuous internal evaluation
Y – Yes	PSEE – Practical semester end examination including ITD, Dissertation, Industrial project, Industrial training etc..

Date:

Director,

School of Science

RK UNIVERSITY	SYLLABUS
Course Title	**MOLECULAR BIOLOGY**
Course Code	MB102
Course Credit	Lecture : 4
	Practical : 3
	Tutorial : 0
	Total : 7

DETAILED SYLLABUS

Sr. No.	NAME OF CHAPTER	Sessions Allotted
	SECTION-I	**28**
1	**Discovery of DNA as the universal genetic material:** Avery's contribution, Hershey and Chase blender experiment **Structure of DNA:** Chemistry of DNA, Forces stabilizing DNA structure, Helix parameters, Forms of DNA (A, B and Z), Watson –Crick and Hoogsteen base pairing, Physical and chemical properties of ds DNA (UV-Absorption spectra, Denaturation and Renaturation, Cot curves, density etc.).	
2	**DNA topology:** DNA supercoiling, topology of covalently closed, circular DNA, negative supercoiling in DNA, role of topoisomerase I and II, mechanism of topoisomerase I and II; quantifying the topological properties of DNA: catenation and knotting. **Mendelian Genetics:** Law of segregation, Genetic interactions and lethal genes, Law of independent assortment, Mono hybrid and di hybrid cross, Multihybrid cross, Crossing over, Multiple alleles.	
3	**Organization of DNA into chromosomes**: Packaging of DNA and organization of chromosome in bacterial cells; Packaging of DNA in eukaryotic nucleosome and	

	chromatin condensation, Variations in chromosome structure and number, C-value paradox. **DNA replication**: Replication strategy: models for replication of DNA, the cellular replisome and the enzymology of elongation: the DNA polymerases of *E. coli*, Eukaryotic DNA polymerase, DNA primase, helicases, ligases; initiation of replication, origin of replication in bacteria and eukaryotes, the replication fork, termination of replication, the regulation of replication, replication errors.	
	SECTION-II	**28**
4	**Transcription:** RNA polymerases, features of prokaryotic and eukaryotic promoters, assembly of transcription initiation complex in prokaryotes and eukaryotes and its regulation; synthesis and processing of prokaryotic and eukaryotic transcripts. Transport of RNA within eukaryotic cell, RNA editing. **The Genetic code**: General features, the 64 codons: DNA and RNA, The Wobble hypothesis, reading frame, universal genetic code, Special sequences: Initiation and Termination, The genetic dictionary.	
5	**Synthesis and processing of proteome**: Structure and role of t-RNA in protein synthesis, translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes), Posttranslational processing of proteins (protein folding, processing by proteolytic cleavage, processing by chemical modification), proteasome mediated protein degradation**.**	
6	**Regulation of gene expression in prokaryotes:** Operon concept, positive and negative regulation. Examples of lac-, ara- and trp- operon regulation; antitermination, global regulatory responses.	
LIST OF LABORATORY EXPERIMENTS (3 HOUR/WEEK)		

1. Isolation of bacterial genomic DNA, plasmid DNA and determination of its molecular weight by agarose gel electrophoresis
2. Estimation of purity and concentration of DNA by diphenylamine method
3. Total RNA isolation from bacteria and observation by gel electrophoresis
4. Estimation of RNA by Orcinol method
5. Determination of dynamics of glucose-lactose diauxic growth of *E. coli*
6. Curing of plasmids from bacterial cell
7. Isolation of auxotrophic mutants by replica plating technique
8. Demonstration of thermal cycler and discussion of different strategies for gene amplification
9. Demonstration of Amplified Ribosomal DNA Restriction Analysis (ARDA), Random Amplification of Polymorphic DNA (RAPD) and Restriction Fragment Length Polymorphism (RFLP)

Instructional Method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, Audio/Video clips etc relevant to the content.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Tutorials will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Minimum seven experiments shall be there in the laboratory related to course contents.

Course Learning Outcomes:

At the end of the course the students will be able to:

- Understand and describe structure of DNA, RNA.
- Understand the basics behind mutation and evolution.

- Explain the phenomenon Mendelian genetics

Reference books:

1. Advanced molecular Biology by R. M. Twyman
2. Molecular Biology of the Gene: J d Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine, Richard Losick
3. Genes IX: Lewin
4. Computational biology and genome informatics jason t. L. Wang ,cathy 2003 world scientific.
5. Molecular genetics of bacteria jeremy dale, simon 2004 john wiley and sons.
6. Molecular biology by David Freifelder
7. Genomes 3: T. A. Brown
8. Molecular Genetics of Bacteria: Snyder & Champness
9. Introduction to molecular biology by Peter Paolella
10. Principles of Genetics – Gardner, E. J. (1991) John Willey & Sons Publication

RK UNIVERSITY	SYLLABUS
Course Title	**BIOINSTRUMENTATION AND ADVANCED BIOANALYTICAL TECHNIQUES**
Course Code	MB104
Course Credit	Lecture : 4
	Practical : 3
	Tutorial : 0
	Total : 7

DETAILED SYLLABUS

Sr. No.	NAME OF CHAPTER	Session allotted
	SECTION-I	**28**
1	**Electrochemistry:** pH and buffers in biology. **Microscopy:** Mechanism of Image formation, resolution, magnification, working distance, numerical aperture. Principle and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, Confocal microscopy. Preparation of microbial, animal and plant samples for microscopy	
2	**Chromatography for biological application:** Classification, theories, retention mechanism, separation efficiency, Principle methodology and applications of gel filtration, ion exchange and affinity chromatography; paper and thin layer chromatography, Gas Chromatography, High Performance Liquid Chromatography, FPLC.	

3	**Advanced electrophoresis techniques**: Agarose gel electrophoresis, polyacrylamide gel electrophoresis (native and SDS-PAGE), isoelectric focusing and 2-Dimensional polyacrylamide gel electrophoresis and their uses in protein research. **Centrifugation:** Basic principle and application; Differential, density and Ultracentrifugation.	
	SECTION-II	**28**
4	**Spectroscopy in biology:** UV, Visible, IR, mass spectrometry, Raman, and structure of proteins using NMR and ESR Neutron, X-Ray diffraction for elucidation of 3D structure. Atomic absorption and plasma emission spectroscopy, Overview of Scattering Spectroscopy like Raman spectroscopy, Nephlometry and turbidimetry.	
5	**Radiochemical Technique**: Production of isotopes, Measurement of radioactivity, use of stable isotopes as trace in Biological science Autoradiography, Radio-immuno assay. **Biosensors:** Principle and applications **Biochips** (DNA chips and Protein chips).	
6	**Other techniques in protein biology** Polarimetry, Capillary Iso-electric, focusing, Electro spray Ionization mass spectrometry. LC-MS/MS, MALDI, TOF MS (Matric Assisted Laser Desorption Ionization Time of Flight Mass Spectrometry).	

ADVANCED BIOANALYTICAL TECHNIQUES (PRACTICAL) (6 HOUR/WEEK)

1. To study microorganisms under Dark field Microscope.
2. To determine pKa value.
3. To prepare buffers of desired pH using weak/strong acid and strong/weak base.
4. To separate amino acids components by paper chromatography.
5. To identify amino acids/ plant bioactive components by Thin layer chromatography.

6. To determine retention time of biomolecule/ plant bioactive component by column chromatography.
7. To identify biomolecule/ plant bioactive component by GC/ MS (Demonstration).
8. To determine acidity/ basicity by pH titration.
9. To separate sub cellular components by differential centrifugation technique.
10. To estimate DNA by spectroscopic method by DPA method.
11. To estimate RNA by spectroscopic method by Orcinol method.
12. To determine protein molecular weight by SDS PAGE technique.
13. To separate nucleic acid by Agarose gel electrophoresis.

Instructional Method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Tutorials will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Minimum ten experiments shall be there in the laboratory related to course contents.

Course Learning Outcomes:

At the end of the course the students will be able to:

- Know all the fundamentals of various spectrometry method which are most widely use in pharmaceutical and biotechnology industries now a days.

- Know about various separation technique like chromatography and gel electrophoresis which is mainly use for the separation and purification of various biomolecules like enzyme.

Text books:

1. Christian, G. D., Analytical Chemistry, John Wiley & Sons (Asia) Pvt. Ltd., 2004.
2. Van Holde, K. E., Principles of Physical Biochemistry, Prentice Hall, 1998.
3. Boyer R, Modern Experimental Biochemistry, Pearson Education Inc, 2000.
4. Hammes, G. G., Spectroscopy for Biological Sciences, John Wiley & Sons, 2005.
5. Skoog, D. A., Holler, F. J. and Crouch, S. R., Instrumental Analysis, Brooks/Cole Cengage Learning, 2007.
6. Freifelder D., Physical Biochemistry, WH Freeman & Co., 1982.
7. Pattabhi, V. and Gautham, N. Biophysics, Kluwer Academic Publishers, 2002.
8. Cantor, C. R. and Schimmel, P. R., Biophysical Chemistry, WH Freeman & Co., 1980.
9. Cooper, A, Biophysical Chemistry, Royal Society of Chemistry, 2004.

RKUNIVERSITY	SYLLABUS	
Course Title	**GENERAL MICROBIOLOGY AND BACTERIOLOGY**	
Course Code	MB 105	
Course Credit	Lecture : 4	
	Practical : 3	
	Tutorial : 0	
	Total : 7	
DETAILED SYLLABUS		
Sr. No.		**Sessions Allotted**
	SECTION-I	**28**
1	**Introduction, history and scope of microbiology:** Introduction to microorganisms, Branches of microbiology, discovery of microorganisms, historical events in development of microbiology, Impact of microbes on earth. Scope and relevance of microbiology. **Microbial classification:** Nomenclature and modern methods of Bacterial taxonomy. Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese, classification and salient features of bacteria according to Bergey's Manual of determinative bacteriology.	
2	**Prokaryotes- ultra structure and functions of organelles:** Shape, size and arrangement of bacteria, cell wall and cell membrane of eubacteria and archaebacteria, periplasmic space, components of cytoplasmic matrix, organic and inorganic inclusion bodies, and nucleoid. Components external to bacterial cell wall**:** capsules, slime Layers, and S-layers, pilli, fimbriae. Flagella: ultrastructure, synthesis, mechanism of flagellar movement, pattern of flagella arrangement and bacterial categorization on the basis of flagella. Chemotaxis and phototaxis. Bacterial endospore: ultrastructure, types, formation and germination. **Cultivation, maintenance and preservation techniques:** Culture media: Types (complex and synthetic) and function of various components. Cultivation of microorganisms: aerobic and anaerobic culture, pure culture techniques, maintenance and preservation	

	of microbial cultures (paraffin method, glycerol stock, cryopreservation, lyophilization etc).	
3	**Staining techniques**: Simple staining; positive and negative staining. Differential staining; Gram's staining, endospore staining, capsule staining, flagella staining, acid fast staining). Micrometery, Biochemical techniques. **Microbial nutrition and nutrient uptake by cell:** micronutrients, macronutrients, nutritional types of microorganisms, requirement for nitrogen, sulphur and phosphorus, growth factors. Diffusion (passive, and facilitative), Active transport mechanisms (antiport, symport, uniport), ABC Transporter system, Group Translocation (Bacterial PTS Transport).	
	SECTION-II	**28**
4	**Eukaryotes- Ultra structure and functions of organelles:** Cytoplasmic Matrix, cellular organelles (endoplasmic reticulum, golgi apparatus, lysosomes, ribosome, mitochondria, chloroplast etc.). Microfilaments (Intermediate Filaments) and Microtubules. External cell covering: cilia , flagella (ultrastructure, synthesis , motility and arrangement). **Nucleus and cell division:** nuclear ultra-structure, nucleolus , mitosis and meiosis.	
5	**Microbial Growth:** The Growth curve, measurement of growth (cell mass, cell number, chemostat and turbidostat method). Mathematics of growth. Effect of environmental factors on microbial growth. **Control of microorganisms**: Pattern of microbial death, Conditions Influencing the effectiveness of antimicrobial agent activity. Physical and chemical agents with their mode of action. Evaluation of Antimicrobial Agent Effectiveness (phenol coefficient, dilution test)	
6	**The Archaeal diversity:** Archaeal cell wall, Archaeal cell membrane and lipid content, genetics and molecular biology, metabolism, Archaeal taxonomy. Extremophiles and their adaptation to extreme environment. **Microbial interactions and Microbial communication:** Positive and negative interaction. Quorum sensing and biofilm formation.	
LIST OF LABORATORY EXPERIMENTS (6 HOUR/WEEK)		
1. Introduction to laboratory glassware, plasticware, rules and safety measures in microbiology laboratory.		

2. To study principal, construction and working of: a) Autoclave, b) Microscope, c) Hot air oven, d) Incubator (ordinary and BOD), e) Laminar Air flow hood

3. To prepare different types of culture media plates: a) Nutrient agar; b) Potato dextrose agar; c) MacConkey agar; d) Mannitol salt agar; e) TSI agar.

4. To prepare broth, slants and stabs.

5. To perform various pure culture techniques: a) Pour plate; b) spread plate; c) streak plate.

6. To perform isolation and enumeration of microorganisms from air (plate exposure method), water and soil (serial dilution method).

7. To perform different staining methods for studying morphological and structural characteristics of bacteria and fungi: a) Gram's staining; b) Endospore staining; c) Fungal staining (Lacto-phenol cotton blue staining); d) Spore staining; e) Capsule staining; f) Flagilla staining

8. To study motility of bacteria by hanging drop method and semi solid agar method.

9. To learn culture preservation techniques (slant, stabs and glycerol stocks)

10. To study effect of salt, pH and temperature on microbial growth.

11. To determine bacterial growth by turbidity measurement and plot bacterial growth curve.

Instructional Method and Pedagogy:

- Lectures will be conducted with the aid of multimedia projector, black board, audio/video clips etc. relevant to the content.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Tutorials will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Minimum ten experiments shall be there in the laboratory related to course contents.

Course Learning Outcomes:

At the end of the course the students will be able to:

- Understand the role of microorganisms and its applications and how it related to our society
- Identify different types of microorganisms, able to control normal flora and can apply their knowledge in routine life
- Describe various staining techniques to identify microorganisms.

Reference books:

1. Prescott`s Microbiology. Lansing M Prescott, John P Harley, Donald A Klein, 9th Edition, MacGraw Hill Higher education.
2. Microbiology: an introduction. Tortora G.J., Funke BR. 9th edition. Pearson education.
3. Microbiology. Pelczar M.J. Chan ECS. 5th edition. Tata MacGraw Hill publishing company limited.
4. General Microbiology. Stanier Roger, Ingraham John, Wheelis Mark. Painter Page. 5th Edition. Macmillan Press, London.

RK.UNIVERSITY	SYLLABUS
Course Title	**ENZYMOLOGY AND MICROBIAL PHYSIOLOGY**
Course Code	MB106
Course Credit	Lecture : 4
	Practical : 0
	Tutorial : 0
	Total : 4

DETAILED SYLLABUS

Sr. No.		Sessions Allotted
	SECTION-I	**28**
1	**Energy and Work:** The laws of thermodynamics. Free energy and reactions. Role of ATP in metabolism. Oxidation-Reduction Reactions. Role of electron carriers and uncouplers. **Enzymes:** Historical perspective, structure and classification of enzymes. Types of enzymes, ribozymes, abzymes. General concept of enzyme reactions (standard free energy, activation energy, enzyme-substrate complex, transition state, reaction intermediates, equilibrium constant, rate-limiting steps, rate constant, turnover number).	
2	**Enzyme kinetics and Factors affecting enzyme activity:** Michaelis Menten equation, determination of K_m, V_{max} and K_{cat}. Effect of pH, temperature, substrate and concentration on enzyme activity. **Enzyme Inhibition, Regulation and its kinetics:** Reversible (competitive inhibition, uncompetitive inhibition, mixed inhibition, non competitive inhibition) and Irreversible Inhibition. Allosteric regulation. Covalent modification of enzymes. Feedback inhibition.	
3	**Carbohydrate metabolism and regulation:** Structure, types, and functions. Glycolysis, Glycogenesis, Glycogenolysis, Gluconeogenesis, Pentose Phosphate pathway, Entner-Doudoroff pathway, Tricarboxylic Acid Cycle, Oxidative Phosphorylation, substrate level phosphorylation, Electron Transport Chain, structure of ATPase and ATP generation, the Yield of ATP in Glycolysis and Aerobic Respiration, Anaerobic Respiration, Fermentation (homo and hetro lactic fermentation).	
	SECTION-II	**28**

4	**Amino acids and Protein metabolism:** Structure, types and classification. Biosynthesis and catabolism. **Lipid metabolism:** Structure, types and classification. Biosynthesis and catabolism. **Nucleotide metabolism:** Structure, types and classification. Biosynthesis and catabolism.
5	**Oxygenic Photosynthesis:** Light reaction in Eukaryotes and cyanobacteria; structure of chlorophyll, photosystem I, photosystem II, cyclic photophosphorylation, noncyclic photophosphorylation, mechanism of photosynthesis. **Anoxygenic Photosynthesis:** The Light Reaction in Green and Purple Bacteria (green sulfur bacteria (*Chlorobium*), green nonsulfur bacteria (*Chloroflexus*), purple sulfur bacteria (*Chromatium*), and purple nonsulfur bacteria (*Rhodospirillum, Rhodopseudomonas*).
6	**The Photosynthetic fixation of CO_2**: Carboxylation phase, Reduction phase, Regeneration phase. Oxidation of Inorganic Molecules; Phosphorus, sulfur, and Nitrogen. **The Assimilation of Inorganic molecules:** Phosphorus assimilation, Sulfur assimilation, Nitrogen assimilation, Nitrogen fixation (nitrification, dinitrification, nitrate and ammonia assimilation pathway). Biochemistry of nitrogen fixation; nitrogenase complex (structure and its regulation). *Nif* gene and their regulation.

Instructional Method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, audio/video clips etc. relevant to the content.
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- Surprise tests/Quizzes/Tutorials will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Minimum ten experiments shall be there in the laboratory related to course contents.

Course Learning Outcomes:

At the end of the course the students will be able to:

- Understand in detail the structure, functions and characteristics biomolecules, enzymes and enzyme kinetics.
- To understand the functioning of microbial cells, with respect to energy generation and unique metabolic and physiological processes.
- To know how the microorganisms withstand and survive under stressful environmental conditions.

Reference books:

1. Lehninger Principles of Biochemistry by David Nelson and Michael Cox , 5th Edition Freeman Company. (2005).
2. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer. East-West Press Edition (2004).
3. Microbial Physiology by Albert G. Moat, John W. Foster, Michael P. Spector. 4th Edition, Wiley-Liss, (2002)
4. Prescott`s Microbiology. Lansing M Prescott, John P Harley, Donald A Klein, 9th Edition, MacGraw Hill Higher education.
5. Microbiology: an introduction. Tortora G.J., Funke BR. 9th edition. Pearson education
6. General Microbiology. Stanier Roger, Ingraham John, Wheelis Mark. Painter Page. 5th Edition. Macmillan Press, London.