RK.UNIVERSITY

DETAIL TEACHING SCHEME

SCHOOL OF SCIENCE	PROGRAM : M.Sc. Microbiology
ACADEMIC YEAR - 2018-2019	SEMESTER – III
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					
MB305	MEDICAL MICROBIOLOGY	4	0	3	7	N	Y	Y	
MB306	FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY	4	0	0	4	N	Y	N	
MB307	FERMENTATION AND MICROBIAL TECHNOLOGY	4	0	3	7	N	Y	Y	
MB308	BIOINFORMATICS, IPR AND BIOSTATISTICS	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	**MEDICAL MICROBIOLOGY**
Course Code	MB 305
Course Credit	Lecture : 4
	Practical : 3
	Tutorial : 0
	Total : 7

DETAILED SYLLABUS

Sr. No.		Sessions Allotted
	SECTION-I	**28**
1	**Normal microbial flora of human body:** Microbiome of human system-skin, oral cavity, respiratory tract, gastrointestinal tract and urogenital tract, Significance of normal microflora. Concept of Gnotobiology, Probiotics & prebiotics. **Host parasite interaction:** Host-Parasite relationships, virulence factors, epidemiology, control measures and prevention. Nonspecific Host Resistance, Microbial Mechanisms for Escaping Host Defenses: Evasion of Host Defenses by Viruse and Bacteria	
2	**Infection:** Types of infection, source of infection, reservoirs and vehicles of infection, predisposing factors. **The Epidemiology of Infectious Disease:** Epidemiological Terminology, Measuring Frequency, Recognition of an Infectious Disease in a Population, Recognition of an Epidemic, Virulence and the Mode of Transmission, Emerging and Reemerging Infectious Diseases and Pathogens, Control of Epidemics , Bioterrorism Preparedness.	
3	**Bacterial diseases:**	

	General characteristics, pathogenic properties, colonization, invasion Source, pathogenisis, epidemiology and diagnostic methods of Infection caused by **Gram positive bacteria:** *Stephylococcus, Streptococcus, Corynebacterium diphtheria, Bacillus anthracis, Clostridium, Vibrio cholerae*. **Gram negative bacteria:** *Neisseria* (meningitis, gonorrhoea)*, Escherichia coli, Klebsiella, Proteus, Pseudomonas, Shigella dysenteria, and Salmonella typhi*. **Acid fast bacteria and intracellular bacteria**:(*Mycobacterium tuberculosis, Mycobacteriium leprae, Rickettsia* and *Chlamydia*)	
	SECTION-II	**28**
4	**Viral diseases:** Morphology, pathogenesis, immune response, diagnosis and prevention of Pox viruses (small pox, variola, vaccinia), Herpes simplex Type I, II, Picorna viruses (enteroviruses and polio viruses), Paramyxo viruses (rubula viruses, para influenza viuses, orthomyxo viruses (measles and mumps viruses), Hepatitis viruses (Type A,B,C,D,E), Arboviruse (alpha viruses and flavi viruses), Rhabdo viruses (rabies virus), Oncogenic viruses, HIV, EVD.	
5	**Fungal diseases:** Route of entry, life cycle, immunity, diagnosis and prophylaxis of infections produced by: Dermatophytes (*Microsporum, Trichophyton* and *Epidermatophyton*), *Aspergillus, Candida, Histoplasma*. **Protozoan diseases:** Route of entry, life cycle, immunity, diagnosis and prophylaxis of infections produced by: *Plasmodium vivex, P.falciparum, P.malariae, Entamoeba histolytica, Entamoeba coli, Leishmania, Trypanosoma and Toxoplasma.* **Vector borne diseases:** Mosquitoes; *Aedes, Anopheles, Culex.* Sandflies. Ticks. Triatomine bugs, Tsetse flies, Fleas, Black flies, Aquatic snails	
6	**Antimicrobial chemotherapy:** The development of chemotherapy, general characteristics of antimicrobial drugs, determining the level of antimicrobial activity, drug resistance. Mode of action of various antibiotics, antibiotic misuse and drug resistance, antibacterial drugs, antifungal drugs, antiviral drugs, antiprotozoan drugs. **Clinical diagnosis of diseases and advancement in diagnostic techniques.**	
LIST OF LABORATORY EXPERIMENTS (3 HOUR/WEEK)		

1. To prepare various basic, selective, enrichment and enriched media used for isolation of medically important bacteria from clinical samples.

2. To perform various biochemical tests (IMVIC, Oxidase, Catalase, Urea utilization test, sugar utilization, H_2S production on TSI slant) used for identification of medically important bacteria

3. To perform sugar fermentation test used for identification of medically important bacteria

4. To isolate normal micro flora of skin, mouth and throat

5. To isolate and identify bacterial species belonging to enteriobacteriaceae family using suitable biochemical test.

6. To isolate and identify Bacillus species using suitable media, staining techniques and biochemical test.

7. To perform microbiological analysis of Urine sample.

8. To perform microbiological analysis of sputum sample.

9. To isolate and identify dermatophytes based on colony morphology and microscopic characteristics

10. To determine antibiotic sensitivity of Gram negative and gram positive bacteria by disc diffusion method.

11. To determine MIC and MBC of an antibiotic for test bacteria.

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 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:

- Develop a thorough understanding of the major groups of infectious microorganisms, molecular mechanisms of pathogenesis, and drug resistance.
- This course will equip them for work in the field of medical microbiology.

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.
5. Medical Microbiology. Jawetz, Melnic and Adelberg's 5th edition, MacGraw Hill publishing company limited.
6. Virology. Renato Dulbecco and Harold S. Ginsberg, 4th edition. L.B. Lippincott company, USA.
7. Principles of Microbiology. Atlas, R. M., 3rd Edition, W. C. Brown Pub., 2001.
8. Medical Microbiology. Greenwood D, Slack R, Peutherer J, 15th edition. Churchil and Livinstone. 2007

RK UNIVERSITY	**SYLLABUS**
Course Title	**FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY**
Course Code	MB 306
Course Credit	Lecture : 4
	Practical : 0
	Tutorial : 0
	Total : 4

DETAILED SYLLABUS

Sr. No.		Sessions Allotted
	SECTION-I	**28**
1	**Microorganisms important in food:** Yeast, molds and Bacteria. Primary sources of microorganisms in foods. Factors influencing microbial growth in foods (extrinsic and intrinsic). **Principles of food preservation**: Preservation methods; Physical, Chemical and Biological. Microbial spoilage of food, chemical changes caused by microorganisms during spoilage. Spoilage of fruits vegetables, meat and poultry products.	
2	**Food-Borne Diseases**: Food borne Infection, Food borne Intoxications (endotoxins, exotoxins and enterotoxins). Detection of food-borne pathogens. Microbiology of Fermented Foods, Fermented Milks and milk products, Cheese Production, Meat and Fish, Other Fermented Foods, Microorganisms as Foods; SCP, Mushrooms and their uses. Food sanitation. Food adulterants.	
3	**Environmental Problems and Monitoring:** Pollution and its classification, Effluent standards: examination of waste water characteristics, municipal and industrial waste water, Global environmental problems: global warming, acid rain, ozone depletion, Sampling and analysis, Environmental monitoring and audit, Environmental laws and policies in India (CPCB)	

	Biological waste Treatment: Principals of biological treatments, Biological treatments: Composting, Suspended growth systems, Attached growth systems, Bioreactor design: Activated Sludge Process, Tickling Filters, Fluidized bed and Packed bed reactor, Rotating Biological Contractors, Oxidation Ponds and Ditches, Lagoons, Anaerobic Reactors.	
	SECTION-II	**28**
4	**Bioremediation and Biodegradation:** Bioremediation principles and Processes: Biosorption, Bioaccumulation, Bioconversion, Biotransformation, Bioleaching, Biodegradation, Detoxification, Activation, acclimatization and Cometabolism. **Strategies and techniques of bioremediation**: in situ and ex situ, of Hydrocarbons, Pesticides and Dyes, GMO's in bioremediation and biodegradation. Phytoremediation	
5	**Biological Nitrogen fixation:** Symbiotic nitrogen fixation (Rhizobium, Frankia), Symbiotic nutrient mobilizers (Endomycorrhizae and Ectomycorrizae), Non symbiotic microbes (Azotobacter-Associative Symbiosis, Azospirillum, Cyanobacteria (Nostoc. Gloeocapsa), Azola Anabena System. Microbial inoculants and their agricultural importance. Physiology and Biochemistry of Nitrogen fixing organisms; Genetics and regulation of nif gene expression, Signalling factors and molecular interaction in establishing Rhizobia legume symbiosis. **Biofertilizers:** Phosphate Biofertilizers: Phosphate solubilizing microorganisms, Inorganic phosphate solubilization and its mechanisms, Phosphate mineralizers phytate and organic phosphate hydrolyzing bacteria, and Ecto and Endo Mycorrhizae.	
6	**Plant Growth Promoting Rhizobacteria:** PGPR in improving plant growth, Mechanism in plant growth promotion, Factors affecting rhizosphere colonization. **Plant pathology:** Plant pathogenesis- plant disease resistance, morphological, functional and protoplasmic resistance, variation in disease resistance, mode of entry of pathogens and disease symptoms, physiology of parasitism, factors affecting disease incidence and a brief account of control measures. Phytophthora diseases – brief account. General account of fungal, bacterial and viral diseases.	

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.

Course Learning Outcomes:

At the end of the course the students will have:

- Fundamental concepts and techniques in soil microbiology, soil microbial diversity.
- Basic applied concepts of nitrogen fixation, Phosphate solubilization and plant growth promotion, various environmental problems and available biotechnological solutions towards them.
- Deep knowledge of role of microorganism in recycling soil nutrients, biodegradationof complex plant polymers
- Understanding about sustaining and improving plant growth through improving nutrient availability, production of plant growth promoting substances and inhibiting pathogens.
- Knowledge of various aspects and impacts of our interactions with environment, waste treatment technologies.
- fundamental concepts and techniques in soil microbiology, soil microbial diversity, basic and applied concepts of nitrogen fixation, Phosphate solubilization and plant growth promotion
- Knowledge of various environmental problems and available biotechnological solutions towards them.

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.
5. Rao, N. S. Subba, Soil Microbiology, 4th edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2008.
6. Atlas, R.M. and Bartha, R. Microbial Ecology, 4th edition, Pearson Education, 2009.

RKUNIVERSITY	**SYLLABUS**
Course Title	**FERMENTATION AND MICROBIAL TECHNOLOGY**
Course Code	MB 307
Course Credit	Lecture : 4
	Practical : 3
	Tutorial : 0
	Total : 7

DETAILED SYLLABUS

Sr. No.		**Sessions Allotted**
	SECTION-I	**28**
1	**Basic concept of bioprocess technology and introduction.** Isolation and Screening of industrially important microbes. Strain improvement program. Preservation of industrially important microbes. Quality control of culture preservation techniques. **Fermentation Media:** Substrate for microbial fermentation, Antifoam agents and their role. Medium optimization. Aeration and Agitation. Kinetics of Batch, fed-batch and continuous fermentation process.	
2	**Bioreactor design and control:** Bioreactor design, Types of fermenter: Laboratory, pilot and large scale reactors, Plug flow reactors. Achievement and maintenance of aseptic condition. Factors to be controlled in bioreactor: physical, chemical and biological; on-line analysis of chemical factors. Computer applications in fermentation technology. **Up Stream processing:** Sterilization of media, air, fermenter, feeds. Fundamentals of scale up. Development of inoculum for industrial fermentation, Aeration-agitation system, mass transfer of oxygen-Determination of $K_L a$, factors affecting KLa. Fluid rheology	

3	**Downstream processing** An introduction to downstream processes, Methods of Cell separation and Disruption, Extraction and purification of fermentation products: solvent recovery, two-phase aqueous extraction, chromatography techniques, membrane processes; drying and crystallization, Immobilization techniques for cells and enzymes. **Fermentation Economy:** Fermentation and product recovery costs; media constitutents, labor cost, fermentation incubation period, contaminants and sterilization, yields and product recovery, product purity overhead, waste disposal, research cost, capital expenditure, patent positions.
	SECTION II
4	**General concept of Microbial biotechnology** Microbial production of ethyl alcohol: Sugar substrates; starch; cellulosic material; Microbes: yeast and bacteria; By-product, economic & energetic aspects of ethanol fermentation. **Microbial production of:** Antibiotics: Penicillin, Streptomycin. Organic acids: Citric acid, Lactic acid. Types of molasses and their applications. Industrial applications of enzymes.
5	**Microbial production of:** Enzymes: proteases, amylases. Vitamins: Vit B_{12}, $B_{2.}$ Amino acids: Glutamic acid, Lysine. Ergot Alkaloids. **Microbial Exo-Polysaccharides;** Microbial fermentation of Xanthan and Alginates **Microbial production of Flavors and Dairy Products:** Microbial Flavours: Diacetyl, Vaniline. Food and dairy products: Starter culture, Science and Technology of bread, cheese, yoghurt.
6	General introduction about Food control agencies and its regulations (FAO, FSSAI, FDA, CGMPs and HACCP). Quality management (Total quality management, SIX SIGMA, KAIGEN, CODEX, PRP)

LIST OF LABORATORY EXPERIMENTS (3 HOUR/WEEK)

1. Isolation and identification of amino acid producing microbes from soil.
2. To carry out lab scale fermentation and recovery of amino acid (Glutamic acid).
3. Separation and identification of amino acid (Glutamic acid) by qualitative and quantitative analysis.
4. To carry out Production of vinegar.
5. To carry out Production of wine
6. To carry out Production of beer

7. Screening of citric acid producers by plate assay method.
8. To carry out lab scale fermentation of citric acid.
9. To Recover citric acid from fermentation broth by $Ca(OH)_2$ precipitation method.
10. To perform Lab scale production of alcohol by *Saccharomyces cerevisiae.*
11. To recover alcohol by distillation
12. To estimate alcohol by dichromate method.
13. To Isolation and immobilize antibiotic producers from soil and identification of the isolated culture.
14. To detect adulteration in common food materials

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 ten experiments shall be there in the laboratory related to course contents.

Course Learning Outcomes:

On the completion of the course, students will be able to:

- Understand the basics concepts of microbiology and microbial biotechnology.
- Analyse strategies involved in microbial biotechnology industries.
- Monitor and manage troubles in microbial production of antibiotic, organic acid, vitamins, amino acid and industrial alcohol.

Reference books:

1. Fermentation Microbiology and Biotechnology. Mansi, E and Bryce, C.. Taylor and Francis. 2007
2. Industrial Microbiology. Casida, L, E. New Age International (P) Limited, Publishers. 1995.
3. Principles of Fermentation Technology. Stanbury P, Whitaker, A and Hall, S. Butterworth Heineman, Aditya Books (P) Ltd.1997.
4. Manual of Industrial Microbiology & Biotechnology. Demain, A and Davies, J. 2nd edition. ASM press.1999.
5. Prescott`s Microbiology. Lansing M Prescott, John P Harley, Donald A Klein, 9th Edition, MacGraw Hill Higher education.
6. General Microbiology. Stanier Roger, Ingraham John, Wheelis Mark. Painter Page. 5th Edition. Macmillan Press, London.

RK UNIVERSITY

SYLLABUS

Course Title	**BIOINFORMATICS, IPR AND BIOSTATISTICS**
Course Code	MB 308
Course Credit	Lecture : 4
	Practical : 3
	Tutorial : 0
	Total : 7

DETAILED SYLLABUS

Sr. No.		Sessions Allotted
	SECTION-I	**28**
1	**Bioinformatics:** Overview, introduction, scope and applications of bioinformatics. **Characteristics, categories and types of databases:** Literature (PubMed; LITDB), Nucleotide sequence Data bases (EMBL, DDBJ, GenBank, Unigen, PIR, SWISS-PROT and TrEMBL). Structure database (PDB, CATH, DALI, SCOP), Enzyme database.	
2	**Sequence analysis:** Pairwise alignment, local and global alignment, multiple sequence alignment, tools for sequence alignment (FAST, BLAST). Phylogenetic analysis: molecular basis of evolution, Phylogenetic trees & different methods for phylogenetic inference. **Omics:** **Genomics:** Comparative Genomics. **Proteomics:** Types of proteomics, tools for protein structure analysis (PSI BLAST, CD search, CDART), acquisition of protein structure information, databases and applications. **Metabolomics. Transcriptomics**	
3	**Introduction to Intellectual Property** Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; IPs of relevance and few Case Studies **Patent application**- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; Patenting by research students, lecturers and scientists-University/organizational rules in	

	India and abroad, credit sharing by workers, financial incentives. Patent infringement-meaning, scope, litigation, case studies and examples **Biosafety** Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs;	
	SECTION-II	**28**
4	**Data Type, Collection and Presentation:** Definition of statistics and its scope in biological research. Types of Biological Data: Qualitative data -Nominal, Ordinal, Ranked; Quantitative Data: Discrete and Continuous. Understanding of Population and sample. Methods of data collection: (i) Experimental Data and (ii) Survey Data- Simple random sample (with and without replacement), stratified sampling and cluster sampling. Tables: Frequency distributions, Relative Frequencies. Various graphical presentation of data using MS-Excel: Bar charts, pai chart, Histograms, Frequency Polygons, One way scatter plots, Box plots, two-way scatter plots, line graphs. **Descriptive Statistics:** Measures of Central Tendency: Arithmetic mean, Median, Mode, Geometric mean (for raw data and grouped data). Measures of Dispersion: Range, Variance, Standard deviation and Coefficient of variation. Measures of Skewness and Kurtosis.	
5	**Probability and Probability Distributions:** Definition of probability, Types of probability, Random experiment, sample space, events. laws of probabilities (Statements only) Some examples from biological sciences. Probability Distributions: Binomial Distribution, Normal distribution, Distributions derived from normal distribution –t-distribution, chi-square distribution, and F-distributions and their biological applications. **Hypotheses Testing:** Null hypothesis, alternative hypothesis, acceptance and rejection of hypothesis. Type I and Type II error. Tests for goodness of fit, Significance tests for normal distribution: One sample tests for mean- z test and t-test, Two sample tests for mean (i) when variances are known (ii) when variances are unknown. Tests for equality of variances. Paired t-test for equality of means.	
6	**Analysis of Variance:** One – way and two –way ANOVA, classified data – their mathematical model.	

	Regression Analysis: simple linear regression, regression equations, regression coefficients, prediction values of Y, testing the significance of regression, confidence interval in regression, Analysis of variance. **Correlation Analysis:** Simple correlation, calculation of simple correlation from raw data, calculation of correlation from regression coefficients, Testing the presence of correlation, Applications of correlation.

LIST OF LABORATORY EXPERIMENTS (3 HOUR/WEEK)

1. To utilize NCBI search tool for searching query gene and protein sequences.
2. To perform Multiple sequence alignment of given DNA and protein sequences using online tools.
3. To predict the structure of protein using EBI swisprot tool
4. To perform phylogenetic analysis of given DNA and protein sequences.
5. To carry out designing of primers using various online tools
6. To collect data from field work (Body weight, height, blood group distribution)
7. To calculate Arithmetic mean, Median, Mode, Geometric mean (for raw data and grouped data based on biological examples) using MS-Excel.
8. To represent data in different forms using MS-Excel
9. To perform hypothesis testing on data (T test, Z test, F test).

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 8-10 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:

- Apply bioinformatic tools for analysis of biological data like nucleotide sequence, aminoacid sequence
- Establish correlation among two distinct species if nucleotide sequences or other informations are available
- Know statistical fundamentals, various statistical calculation, and their application.
- Apply statistics in biotechnology and pharmaceutical field.
- Distinguish between different IP (copy rights, patents, GIs etc) and can protect their IP.
- Search patent information, file patents.

Reference books:

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Baxevanis A.D. and Ouellette, Third Edition. John Wiley and Son Inc., 2005.

2. Bioinformatics Sequence and Genome Analysis by Mount D.W., CSHL Press, 2004.

3. Introduction to Bioinformatics by Tramontano A., Chapman & Hall/CRC, 2007.

4. Understanding Bioinformatics by Zvelebil, M. and Baum, Chapman & Hall/CRC, 2008

5. Fundamentals of biostatistics by Bernard A. Rosner

6. Methods in Biostatistics by B. K. Mahajan, Jaypee Brothers, New Delhi-110002.

7. Text book of Biostatistics I by A. K. Sharma.