KANNUR UNIVERSITY

DEPARTMENT OF BIOTECHNOLOGY AND MICROBIOLOGY

SCHEME AND SYLLABUS

MSc MICROBIOLOGY

2020 ADMISSION ONWARDS

Scheme and Syllabus of M.Sc. Microbiology
Programmes Under the Choice Based Credit and Semester System with effect from 2020 Admission

About the Department

The Department of Biotechnology and Microbiology of Kannur University established in the year 2000 at Palayad, Thalassery offers M.Sc., Ph.D. and Post-doctoral programs in Biotechnology and Microbiology. The Department is a **Centre of Excellence** in **Biosciences,** receiving research funds from state, national and international agencies. Our vision is to improve quality of life through research and molding future scientists and individuals who will be a work force to make a better tomorrow.

M.Sc. PROGRAMMES

M.Sc. Biotechnology – 12 Seats
M.Sc. Microbiology – 12 Seats

PROGRAMME SPECIFIC OUTCOMES (PSOS):

A post-graduate student upon completion of the programme is expected to gain the following attributes:

- To train students drawn from different disciplines at Post-Graduate level in frontier and multidisciplinary areas of Biotechnology and Microbiology so as to equip them to be future scientists, teachers and entrepreneurs.
- Competence for research and innovation in Biotechnology /Microbiology.
- Gaining technical skills for the betterment of planet Earth.
- Critical thinking ability to review scientific literature as stepping stone to research
- Gain confidence for career choice.
- Gain ability to work independently in choosing research topics as well as be part of team work with collaborative skills.
- To attain confidence in scientific conversation and writing skills and knowing ethical behaviour.

DURATION OF THE PROGRAMME

The whole programme is divided into four semesters (two years)

ELIGIBILITY FOR ADMISSION

Bachelor's degree in any of the subjects such as Biotechnology/ Microbiology/ Biochemistry/ Chemistry/ Zoology/ Botany/Plant Sciences/ Life Science or any other subject with Microbiology/ Biotechnology as one of the subjects of study at degree level with not less than 50% marks in aggregate (excluding languages). Those who are awaiting final year B.Sc. results also can apply but they have to fulfil the eligibility criteria before the admission. Eligible relaxation in the percentage of marks will be given to candidates belonging to SC and ST. Reservation policies of the University/State are followed for admission.

ADMISSION PROCEDURE

Admissions are notified in national newspapers inviting applications for the M.Sc Programmes (Biotechnology and Microbiology) of the Department.

All the eligible applicants have to appear for a written entrance test. Duration of the entrance test will be 120 minutes with 200 objective type multiple choice questions for 100 marks. Questions will be of undergraduate standard. There will be 25% negative marks for wrong answers. A rank list will be prepared based on the entrance test. The admission will be as per the rank in the list and reservation policy.
The subjects and their weightages in the Entrance Test will be as given below.

Physics	10%
Chemistry	15%
Botany and Zoology	25%
Biotechnology, Microbiology, Biophysics, Biochemistry, Molecular biology etc	50%

MSc CURRICULUM

The M.Sc curriculum of both Biotechnology and Microbiology closely follows the level and extent as conceived by the national curricula development centers of UGC/ DBT. The Choice Based Credit System

(CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising core and elective courses. The evaluation of the courses will be through grading system evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in internal and external examinations.

COURSES AND CREDITS

Definitions

(i) '**Academic Programme'** means the entire course of study including its programme structure, details of the course, evaluation methods etc. This will be carried out by teaching and evaluation process in the parent department / centre or jointly under more than one such Department/ Centre

(ii) **'Course'** means is a subject that is part of an Academic Programme

(iii) **'Programme Structure'** includes the list of courses (Core, Elective, Open Elective) that forms an Academic Programme which specifies the syllabus, credits, hours of teaching, evaluation process and examination schemes, the minimum credits required for successful completion of the programme etc. prepared in conformity to University Rules, eligibility criteria for admission

(iv) **'Core Course'** means a course that a student admitted to a particular programme must successfully complete compulsorily to receive the degree and that which cannot be substituted by any other course

(v) **'Elective Course'** means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre

(vi) '**Open Elective'** means an elective course which is available from recognized online resources like Swayam/ MOOCS or offered by other departments within the frame work of the subject.

(vii) **'Credit'** is the value assigned to a course which indicates the level of instruction; 1 hour of lecture per week equals 1 credit, 3 hours practical class per week equals 1 credit.

(viii) '**SGPA'** means Grade Point Average of the semester calculated for individual semester.

(ix) **'CGPA'** is Cumulative Grade Points Average calculated for all courses completed by the students at the end of the programme. A formula for conversion of CGPA into percentage marks will be given in the mark sheet.

A minimum of 80 credits are mandatory for the successful completion of the programme.

Students can opt for **one elective (open elective)** course relevant to Biotechnology programme from **online sources approved by the University (Swayam Platform or similar platforms) or other Departments** during second and third semester. The choice of the student must be reported to the Head of the Department and approved by the Department Council. **The minimum credits per semester is 16 and the maximum credits per semester (core and elective inclusive) cannot cross 24. All students have to opt for equal number of electives in each semester.**

If the student does not earn the required credits by not appearing for the exam or due to other reasons, the course will have to be repeated along with the concurrent semester of the next batch after the approval by the DC.

PROJECT WORK

Students have to take up a research project of 5 months duration in the fourth semester for which they are encouraged to go to national research institutes. The students may also get opportunity to undergo 1-2 weeks training in industrial / research institutions in the field of applied biology.

EVALUATION

The marks for Continuous Evaluation and End Semester Examination will be in the ratio 40:60. Allocation of marks for each component under continuous evaluation of theory courses shall be as given below.

Continuous Evaluation: Theory Paper (40 Marks)

Assignment	Test papers	Seminar	Total
8	16	16	40

Continuous Evaluation: Practical (40 Marks)

Midsemester	Record	Total

test/viva		
30	10	40

End Semester Examination Practical: (60 Marks)

The teacher conducting the practical examination will decide the components of the exam

End Semester Examination Theory: Written examination for **60 Marks**

ATTENDANCE:

The minimum attendance required for each course in a semester shall be 60% of the total number of classes conducted for the course. Only those who secure the minimum attendance requirement in the semester will be allowed to register for the End Semester Examination.

TENURE

A student has to complete the entire program within four years from the date of registration

Courses offered in the M.Sc. Microbiology Programme - Total credits 80

Semester I

Core: 6 (Theory: 4 Practical :2) Electives: 2

Credits: Core: 16 Elective: 6 Total: 22 Credits

SL. No	Course code	Title of the course	Contact hours /week			Marks			Credits
						ESE	CE	Total	
		Core course	L	T/S	P				
1	MSMBY01C01	Biochemistry	3	2		60	40	100	3
2	MSMBY01C02	General Microbiology	3	2		60	40	100	3
3	MSMBY01C03	Cell Biology	3	2		60	40	100	3
4	MSMBY01C04	Genetics	3	2		60	40	100	3
5	MSMBY01C05	Practical I Biochemistry & General Microbiology			3+3	60	40	100	2
6	MSMBY01C06	Practical II Cell Biology & Genetics			3+3	60	40	100	2
		Elective courses: 2/2							
7	MSMBY01E01	Biostatistics	3	2		60	40	100	3
8	MSMBY01E02	Instrumentation	3	2		60	40	100	3
									22

Semester II

Courses: Core: 3 (Theory: 2, Practical :1) Electives: 4

(Students have to choose 4 elective courses from 5)

Credits: Core: 8, Elective: 12, Total=20

SL. No	Course code	Title of the course	Contact hours /week			Marks			Credits
						ESE	CE	Total	
		Core courses	L	T/S	P				
9	MSMBY02C07	Systematic Bacteriology	3	2		60	40	100	3
10	MSMBY02C08	Food Microbiology	3	2		60	40	100	3
11	MSMBY02C09	Practical III Systematic Bacteriology and Food Microbiology			3+3	60	40	100	2
		Elective courses (4/5)							
12	MSMBY02E03	Microbial Physiology and Metabolism	3	2		60	40	100	3
13	MSMBY02E04	Immunology	3	2		60	40	100	3
14	MSMBY02E05	Human Physiology and Developmental Biology	3	2		60	40	100	3
15	MSMBY02E06	Molecular Biology	3	2		60	40	100	3
16	MSMBY02E07	Ethics Patency and IPR	3	2		60	40	100	3
									20

Semester III

Core (Theory: 4 Practical :2) Electives: 2

Credits: Core: 16 Elective: 6 Total: 22 Credits

Students have to choose Two Electives from Four

SL. No	Course code	Title of the course	Contact hours /week			Marks			Credits
						ESE	CE	Total	
		Core course	L	T/ S	P				
17	MSMBY03C10	Microbial Technology	3	2		60	40	100	3
18	MSMBY03C11	Environmental Microbiology	3	2		60	40	100	3
19	MSMBY03C12	Diagnostic and Clinical Microbiology	3	2		60	40	100	3
20	MSMBY03C13	Virology, Mycology, Protozoology	3	2		60	40	100	3
21	MSMBY03C14	Practical IV Microbial Technology & Environmental and Agricultural Microbiology			3+3	60	40	100	2
22	MSMBY03C15	Practical V Virology, Mycology, Protozoology & Diagnostic and Clinical Microbiology			3+3	60	40	100	2
		Elective course 2/4							
23	MSMBY03E08	Bioinformatics	3	2		60	40	100	3
24	MSMBY03E09	Marine Microbiology	3	2		60	40	100	3
25	MSMBY03E10	Recombinant DNA Technology	3	2		60	40	100	3
26	MSMBY03E11	Veterinary Microbiology	3	2		60	40	100	3
									22

Semester IV – Project

CORE :1 Credits :16

SL. No	Course code	Title of the course	Contact hours /week			Marks			Credits
						ESE	CE	Total	
		Core course	L	T/S	P				
27	MSMBY04C16	Project		5	25	60	40	100	16
									16

The continuous evaluation of the project work shall be done by the research supervisor based on the performance of the student in the lab. The end semester evaluation includes presentation and a viva voce based on the project.

SEMESTER I (Total Credits Required: 22)

MSMBY01C01

BIOCHEMISTRY

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand structure and function of biological macromolecules.
2. Understand Chemical changes taking place in the living cells.
3. Understand transport across biological membranes.
4. Understand the role of small molecules in the biological system.

Course Outcome:

Upon completion of this course, students will be able to explain and demonstrate the structure, function and dispersal of the basic building blocks of life - the chemical components of living organisms

Course Content

Module I

Introduction: Molecular logic of living system, Biological macromolecules. Importance of Biochemistry in contemporary medicine and its perspectives.

Membranes: Structure and functions of different membranes and reasons for their composition. Membrane transport: Passive transport, co-transport, anti-port, active transport, secondary active transport, Pumps and channels and their significance, Membrane proteins.

(10 Hrs)

Module II

Carbohydrates: Definition and classification, Structure, conformation and functions of monosaccharides, disaccharides, polysaccharides. Starch, glycogen, dextrin, cellulose, amino sugars, Glycoproteins, Glycolipids, Mucopolysaccharides.

Lipids: Definition and classification, structure, function, physical and chemical properties – Fatty acids, Fats, Waxes, Phospholipids, Sphingolipids, Cerebrosides, Gangliosides, Sterols, lipoproteins. Eicosanoids - Formation of prostaglandins; prostacyclin and thromboxane from unsaturated fatty acids, Saponification number, acid number and iodine number of fats.

(14 Hrs)

Module III

Proteins: Properties of peptides and proteins, Amino acids, their properties, and their classification according to the polarity of their side chains and according to the acid-base properties. Essential and non-essential amino acids, Structure of peptides and proteins,

their primary structure, structures of higher order and their meaning for the function of peptides and proteins. Protein - protein interaction.
Nucleic acids: Definition and classification, structure, function, physical and chemical properties - Purines and pyrimidines, base pairing, Hoogsteen base pairing.

(12 Hrs)

Module IV

Vitamins and minerals: chemistry, source and functions of water soluble and fat-soluble vitamins. Role of vitamins as cofactors. Source and functions of macro elements and trace elements, Hormones & Related Molecules: Chemistry, synthesis and functions of various hormones (Plant & Animal), pigments (Plant & Animal), Pheromones and neurotransmitters

(12 Hrs)

REFERENCE

1. Lehninger: Principle of Biochemistry. Nelson L D and M M Cox.
2. Biochemistry. Jeremy M.Berg John and Tymoczko Lubert Stryer.
3. Biochemistry with Clinical Correlation. Thomas M Devlin. Wiley- Liss
4. Biochemistry. Donald Voet, Judith G Voet, Charlottew pratt. John Wiley
5. Biochemistry. Jeoffrery Zubay. Wm C Brown Pub.
6. Biochemistry. Mathews CK and KE.van Holde. Benjamin Cumming Pub.
7. Biochemistry. Vol 1&2 David Metzler.

MSMBY01C02

GENERAL MICROBIOLOGY

3 Credits (48 Hours)

Course Objectives:

1. Students will be able to isolate and identify bacteria and fungi
2. They will be able to characterize microorganisms
3. Students will acquire sufficient skills to analyses microorganisms present in various substances
4. Students will get skills to do basic microscopic analysis

Course Outcome:

On completion of the General Microbiology course students will get theoretical knowledge and laboratory skills to do basic operations in a Microbiology Laboratory.

Course Content:

Course Content:

MODULE I

Milestones in the history of Microbiology. Early discoveries and scientists. Five Kingdoms and Woese's Three Domain classifications of living system. Bacterial, fungal and viral classifications. Bergey's Manual of determinative bacteriology. Laboratory procedures for identification of bacteria. Molecular phylogeny. **(12 Hrs)**

MODULE II

Microbial morphology and colony characteristics. Microscopy: Bright field, dark field, fluorescent, phase contrast, interference, polarization and electron microscopies. Specimen preparation and staining in microscopy. Growth curve, Cultivation of bacteria, Culture media and methods, Storage and transport of microbes **(10 Hrs)**

MODULE III

Ultra-structure of bacterial cells. Difference between bacterial and fungal cells: Different staining procedures and study of bacterial and fungal morphology. Cell wall, cell membrane and transport system, chromosome and extra chromosomal genetic materials; flagella, pili, capsule, endospore. Virus, Structure and multiplication of Virus, Viral Diseases – Emerging and re-emerging viral infections. Fungal Reproduction **(10 Hrs)**

MODULE IV

Microbial nutrition and Nutritional groups of bacteria. Photo autotrophy and bacterial photosynthesis, Chemoautotrophy, Heterotrophic metabolism. Aerobic and anaerobic respiration (fermentation). Physical and chemical methods of sterilization, Methods of testing
antimicrobial substances, Drug resistance of microbes. Genetically Modified Microorganisms. **(16 Hrs)**

REFERENCE

1. Microbiology – Prescott
2. General Microbiology – Stanier
3. Fundamentals of microbiology – Frobischer
4. Principles of Microbiology – Ronald M Atlas
5. Antimicrobial Drug Resistance, Bryan, L E (eds.) Academic Press
6. Microbiology- Bernad D Davis et al, Harper International edition.
7. Microbiology Concepts and Applications Pelzar Jr. Chan. Kreic. McGraw- Hill, Inc. Microbiology.
8. Zinsser Microbiology Prentice- Hall International Inc. Manual of Methods for General Bacteriology. Gerhaldt P et al (eds.) American Society for Microbiology
9. Textbook of Microbiology 9th Edition, Ananthanarayan, Paniker, Universities Press

MSMBY01C03

CELL BIOLOGY

3 Credits (48 Hours)

Course Objectives:

1. Understand the molecular nature and functioning of the cell components and how they interact with the external environment.
2. Understand the molecular nature of replication of the cell
3. Understand the consequences arising out of error in replication including cancer and how the cell passes from one phase of replication to the next.
4. Understand how a cell responds to an external signal and the mechanisms involved.

Course Outcome:

Students will gain knowledge about the complexities of the cell.They will be able to gain advance knowledge of molecular cell mechanisms.

Course content:

MODULE I

General organization of prokaryotic and eukaryotic cells.

Differentiation of the cell surface, Constituents of the Extra-cellular matrix.

Cell junctions: tight junctions, desmosomes and gap junctions, cell coat. Cell- cell adhesion

Cytoskeleton: microtubules, microfilaments and intermediate filaments **(12 Hrs)**

MODULE II

Cell communication: general principles, signaling pathways.

Cellular Organelles and Membrane Trafficking Endoplasmic reticulum, Golgi complex, processing and trafficking of biomolecules, lysosomes, plant vacuoles, endocytosis, posttranslational modification of proteins **(14Hrs)**

MODULE III

Nucleus: Nuclear envelope, nuclear matrix. Organization of chromatin: nucleosomes, higher order folding of chromatin. Structure of centrioles, structure of mitotic spindle, synaptonemal complex. Nucleolus in ribosome synthesis.

Replication of prokaryotic, eukaryotic DNA. Enzymes and proteins of replication. DNA repair. **(10 Hrs)**

MODULE IV

Cell cycle: Phases of cell cycle. Cascade of phosphorylation and dephosphorylation associated with cell cycle progress. Kinases, cyclins and related proteins and their role in cell cycle regulation. Apoptosis and Introduction to Cancer biology. **(12 Hrs)**

REFERENCE

Molecular Cell Biology Gerald Karp 9th Edition Wiley 2020

Molecular Biology of The Cell Alberts 6th Edition 2014 Garland Science

Molecular Cell Biology Lodish 8th Edition. W.H. Freeman 2016

Genes XI Benjamin Lewin Jones and Bartlett Learning 2014

Molecular Biology of the Gene Watson 7th Edition Pearson India 2017.

Cell Biology A Laboratory Handbook 3rd Edition Elsevier Inc 2006

Cell and Molecular Biology Lab Manual David A Thompson 2009

MSMBY01C04

GENETICS

3 Credits **(48 Hours)**

Course Objectives:

1. Understand the basic principles of genetics and heredity and Mendelian laws of inheritance
2. Understand chromosome theory of inheritance, sex determination, linkage and mapping.
3. Familiarize with prokaryotic gene transfer methods.
4. Understand extra chromosomal inheritance and population genetics

Course Outcome

Completion of the course would familiarize the student with carriers of heridity and mechanisms of inheritance in eukaryotes and prokaryotes.

Course Content:

MODULE I

Mendel and his contribution to Genetics. Monohybrid crosses and principle of segregation. Dihybrid crosses and principle of independent assortment. Rediscovery of Mendel's principles**.** Multiple alleles. Modification of dominance relationships. Gene interactions. Essential and lethal genes. Environmental impact on genes **(12 hrs)**

MODULE II

Genetic linkage. Chromosomal exchange. Genetic maps. Tetrad analysis, Mitotic recombination. Chromosomal and gene mutations. Mitosis & Meiosis. Chromosome theory of inheritance. Sex determination. Analysis of sex-linked traits in humans.

(12 Hrs)

MODULE III

Cellular basis of differentiation, Gametogenesis and fertilization. Genetic basis of cell differentiation. Gene expression control. Oncogenes and tumour suppressor genes Conjugation in bacteria. Transformation in bacteria. Transduction in bacteria. Mapping of genes in bacteria. Mapping of genes in bacteriophages. **(12 Hrs)**

MODULE IV

Bacterial transposons. Eukaryotic Transposable elements Cytosomic inheritance, Inheritance through mitochondria and chloroplasts and their mapping. Genetic variation in populations and measuring. Hardy - Weinberg Equilibrium, Inbreeding. Genetic Drift. Gene flow. Natural selection. Molecular evolution. **(12Hrs)**

REFERENCE

1. Genetics by Strick Berger
2. Plant breeding by B D Singh
3. A text Book of Genetics by Veer Bala Rastogi
4. Genetics by Gardner, Simmons and Snustad
5. Genetics by Ursula Goodenough
6. Basic Genetics. Robert F. Weaver II edn. Philip W. C. B 1995.
7. An Introduction to genetic Analysis Griffith etal

MSMBY01C05
PRACTICAL I

(BIOCHEMISTRY & GENERAL MICROBIOLOGY

2 CREDITS **(96 Hours)**

Biochemistry

1. Qualitative analysis of carbohydrates.
2. Qualitative analysis of proteins.
3. Qualitative analysis of lipids.
4. Estimation of protein
5. Estimation of lipids (cholesterol, phospholipids, triacylglycerols).
6. Estimation of carbohydrates (glucose, fructose, lactose, starch).
7. Denaturation studies on proteins.
8. Estimation of lycopene from tomato
9. Estimation of Urea
10. Estimation of Uric acid
11. Determination of acid values of fat and oils
12. Determination of iodine number of fats and oil
13. Extraction and estimation of total lipids from seed
14. Extraction of total nucleic acids from plant tissue
15. Preparation of buffers of required pH.
16. Purification of proteins using dialysis.
17. Separation of amino acids using paper chromatography.

REFERENCE

1. David Plummer, An Introduction to Practical Biochemistry, McGraw Hill
2. Harold Varley, Practical Clinical Biochemistry, by Gowenlock A. H., CBS.
3. Hans Bisswanger, Practical Enzymology. Wiley VCH.
4. Robert Eisenthal, Enzyme Assays: A Practical Approach, Oxford University Press
5. Sadasivam & Manickam, Biochemical Methods, New Age International
6. DM Vasudevan & Subir Kumar Das, Practical Textbook Of Biochemistry, Jaypee Brothers

7. SK. Sawhney, Randhir Singh, Introductory Practical Biochemistry. Alpha Science International

General Microbiology

1. Microscopy- structure and organization of compound microscope
2. Sterilization Techniques
3. Staining: simple, negative, Gram's, capsular, spore, metachromatic Granule, Fungal staining
4. Preparation of media & inoculation, Isolation of organisms from various environments. Serial Dilution
5. Growth curve using breeds count, turbidimetry and CFU
6. Effect of pH, temp, oxygen and salinity on bacterial growth in liquid media.
7. Anaerobic culturing by liquid paraffin overlay and pyrogallol.
8. Starvation induced sporulation of bacteria.
9. Efficiency testing of bacteria proof filters and autoclave
10. Fungal culture and sporulation
11. Antibiotic sensitivity tests, Biochemical Tests for identification of bacteria

REFERENCE

Techniques in Microbiology: A Student Handbook 1st Edition by John M. Lammert (Author). ISBN-13: 978-0132240116

Handbook of Techniques in Microbiology: A Laboratory Guide to Microbes Paperback – 1 December 2007. by A.S. Karawa (Author), M. K. Rai (Author), H.B.T. Singh (Author) Scientific Publishers

Basic Practical Microbiology- A Manual. Society for General Microbiology (SGM). ISBN 0 95368 383 4. www.microbiologyonline.org.uk o

MSMBY01C06
Practical II

CELL BIOLOGY AND GENETICS

2 CREDITS (96 Hours)

Cell Biology

1. Cell Fractionation: chloroplast: differential centrifugation.
2. Cell Fractionation: mitochondria: differential centrifugation.
3. Isolation of DNA/RNA from liver/spleen.
4. Estimation of nucleic acid by spectrophotometric method.
5. Estimation of RNA by Orcinol test.
6. Estimation of DNA by Diphenylamine test.
7. Study of Barr Body (Buccal smear).
8. Polytene Chromosome (Drosophila).
9. Karyotyping.
10. Study of staining methods.
11. Determination of melting temperature of DNA.

REFERENCE:

1.Cell Biology A Laboratory Handbook 3rd Edition Elsevier Inc 2006
2. Cell and Molecular Biology Lab Manual David A Thompson 2009

Genetics

1.Study of mutations by Ames test.

2.Assay of antibiotics and demonstration of antibiotic resistance.

3.Bacterial transformation.

4.Transduction.

5.Conjugation

6.Isolation of plasmids.

7.Mitosis

8.Meiosis

REFERENCE

1.Cell and Molecular Biology Lab Manual David A Thompson 2009.
2. Molecular Cloning- A Laboratory Manuel Sambrook, J., Fritsch, E. F. and Maniatis, T.

1989. Second Edition. Cold Spring Harbor Laboratory Press.
3.Zinsser Microbiology Prentice- Hall International Inc. Manual of Methods for General Bacteriology. Gerhaldt P et al (eds.) American Society for Microbiology.
4.Hayes, W., 1994. Genetics of Bacteria and their viruses. 2nd Edn, CBS Publishers and Distributors, New Delhi
5.Methods in Molecular Biology Vol. 28. Protocols for Nucleic acid analysis by non - radioactive probes. Edited by Issac P. G. Human Press,

MSMBY01E01

BIOSTATISTICS

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand data types and data presentations.
2. Understand the concepts of averages and dispersion of measurement values.
3. Understand the concept of probability and probability distributions.
4. Understand the method of testing statistical hypotheses.

Course Outcome:

Students shall be able to

1. Make graphical/diagrammatic representation of given statistical data.
2. Calculate measures of central tendencies and measures of dispersion of a given set of values.
3. Explain different probability distributions.
4. Test hypothesis using normal, students-t, chi square and F distributions.

Course content:

Module I

Collection, classification and diagrammatic representation of statistical data: Variables and constants, Different types of numerical data, Collection of data, Sampling techniques, Random sampling, Stratified random sampling. Classification and tabulation of data, frequency distribution. Graphical/diagrammatic representation of data: line charts, Bar charts, Pie-chart, Histograms, frequency polygons, ogives. **(12 Hrs)**

Module II

Measures of central tendency: Arithmetic mean, Median, Mode, Geometric and Harmonic

mean. Measures of dispersion: Range, Inter-quartile range, Variance and Standard Deviation, coefficient of variation.
Correlation and Regression: Relation between two variables, scatter diagram, definition of correlations, Pearson's correlation coefficient, Spearman Rank correlation coefficient. Definition of regression: regression lines. Fitting lines using method of least squares. **(14 Hrs)**

Module III

Probability and probability distributions: Permutation and combination, types of events, Definition of probability, addition and multiplication theorems of probability. Probability distributions: Binomial, Poisson and Normal distributions. Skewness and Kurtosis: Definitions, Karl Pearsons coefficients of Skewness and Kurtosis, moments. **(10 Hrs)**

Module IV

Normal distribution and statistical inference: Central Limit Theorem, Concept of confidence interval: Estimation, confidence limit, level of significance, standard error. Statistical hypotheses, Tests of significance of means, difference between two means and proportion. Student's t-distribution and testing of hypothesis for small samples. Chi-square distribution, Chi-squared tests for independence and for goodness of fit, F-distribution and Analysis of variance. **(12 Hrs)**

References:

1. Principles of Biostatistics - Pagano M. & Kimberlee G. Duxbury Press
2. Probability and Statistical Inference - Hogg R. V. Tanis E. A., Prentice Hall, New Jersey
3. Experimental Design Data Analysis for Biologists- Quinn G. P. & Keough M. J. Cambridge University7 Press
4. Statistical Methods in Biology - 3rd edition, Bailey N.T.J., Cambridge University Press
5. Biostatistical analysis - 4th edition, Zar, J.H. Pearson Education.
6. Fundamentals of Biostatistics – P. Hanmanth Rao and K. Janardhan, I.K. International Publishing House, New Delhi.
7. Introduction to Biostatistics and Research Methods- P.S.S. Sundar Rao and J. Richard, PHI learning Pvt Ltd, New Delhi.

MSMBY01E02

INSTRUMENTATION

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand basic principles and applications of biomolecular separation techniques.

2. Understand basic principles and applications of spectrophotometric, colorimetric and radioactivity based analytical techniques.

3. Understand spectroscopic techniques for characterization of biological molecules.

4. Understand various analytical techniques based on intermolecular interactions

Course Outcome:

Students shall be able to

1. Explain working principles and applications of biomolecular separation techniques such as chromatography, electrophoresis, centrifugation and density gradient sedimentation.
2. Explain the principles and applications of colorimetry, fluorometry, flame photometry, radioimmunoassay and autoradiography.
3. Explain the principles and applications of UV, IR, ORD, CD, NMR, ESR, Microwave, Raman and Mass Spectroscopy techniques.
4. Explain the principles and applications of Surface Plasmon Resonance, Isothermal Titration Calorimetry, Differential Scanning Calorimetry, Atomic force microscopy, ELISA and ion selective electrodes.

Course Content:

Module I:

Centrifugation and density gradient sedimentation: Basic principles and applications. Chromatography: Basic principles and applications, partition coefficient and relative mobility, Types of chromatography: paper, thin layer, size exclusion, ion exchange, affinity, GLC, HPLC, HPTLC. Electrophoresis: Basic principles and application. Various types of electrophoresis, PAGE, Specialized electrophoresis techniques, Isoelectric focusing, Capillary electrophoresis. Immunoelectrophoresis, PFGE. **(14 Hrs)**

Module II:

Spectrophotometry and colourimetry: Absorption and emission spectrum, Beer-Lambert law, qualitative and quantitative spectrophotometric assays, Fluorescence and fluorometry, flame photometry, Radioimmunoassay and Autoradiography. **(10 Hrs)**

Module III:

Spectroscopic techniques: Basic principles and biological applications of UV, IR, ORD, CD, NMR, ESR, Microwave and Raman spectroscopies. Mass spectrometric techniques: various modes of ionization principles and applications. GCMS, LCMS, MALDI. **(12 Hrs)**

Module IV

Principles and applications of Surface Plasmon Resonance, Isothermal Titration Calorimetry, Differential Scanning Calorimetry, Atomic force microscopy, ELISA, Light scattering experiments. Ion selective electrodes and pH meter. **(12 Hrs)**

REFERENCE

Physical biochemistry- David Seeshan
Chromatography- Brown D.R., Ivy Publishing House, Delhi.
Encyclopedia of Separation Technology - Ruthren D. M. (Ed), JohnWiley & Sons
Experimental Biochemistry - 3 rd edition, Switzer, R.L. & Garrity, L. F. W.H.Freeman & Company
Foundations of Spectroscopy- Duckett, S. & Gilbert, B., Oxford University Press.

SEMESTER II
(Total Credits Required: 20)

MSMBY02C07
SYSTEMATIC BACTERIOLOGY

3 CREDITS **(48 Hours)**

Course Objectives:

- To maintain an interest in the study of systematic bacteriology.
- To state and explain the etiology, pathogenesis, laboratory diagnosis and epidemiology of major bacterial diseases of humans.
- To give an insight of current antibacterial therapy and related drug resistance.

Course Outcomes:

- Upon the completion of the paper, the students get acquainted with the ways in which bacterial pathogens are transmitted to humans, its virulence, predisposing factors and disease control.
- The students will have an adequate knowledge to make appropriate and effective - on the job professional decisions in clinical bacteriology.

Course Content:

Module I

Morphology and identification, pathogenesis, laboratory diagnosis, epidemiology, prevention and control of: The *Staphylococci* and *Streptococci*; *Neisseriae,* Spore forming Gram positive Bacilli: *Bacillus anthracis*, *Clostridium*; non spore forming Gram positive Bacilli: *Corynebacterium*; **(13Hrs)**

Module II

Morphology and identification, pathogenesis, laboratory diagnosis, epidemiology, prevention and control of Enteric Gram-negative rods: *Escherichia, Enterobacter, Klebsiella, Proteus, Shigella*; *Salmonella Pseudomonas, Vibrio, Helicobacter,*

Hemophilus, Bordetella, Brucella, Yersinia **(15 Hrs)**

Module III

Morphology and identification, pathogenesis, laboratory diagnosis, epidemiology, prevention and control of *Mycobacterium;* Spirochetes & other spiral microorganisms: *Treponema pallidum, Leptospira Borrelia etc.* **(12Hrs)**

Module IV

Morphology and identification, pathogenesis, laboratory diagnosis, prevention and control of Mycoplasmas & cell wall-defective bacteria; *Rickettsiae* and *Chlamydiae* **(8 Hrs)**

REFERRENCE

1. Medical Microbiology. Brooks GF, Butel JS, Morse SA. Mc Graw Hill.
2. Textbook of Microbiology. Ananthanarayanan R and Paniker CKJ. Orient Longman.
3. Diagnostic Microbiology. Forbes BA, Sahm DF, Weissfeld AS. Mosby Elsevier.
4. Bergey's Manual of Determinative Bacteriology. Holt JG, Krieg NR, Sneath PHA, Staley JT, Williams ST. Lippincott Williams& Wilkins.
5. District laboratory practice in tropical countries. Cheesbrough M. Cambridge University Press.
6. Manual of Clinical Microbiology. Murray PR, Jo Baron E, Pfaller MA, Tenover FC, Yolken RH. ASM Press.

MSMBY02C08
FOOD MICROBIOLOGY
3 CREDITS (48 Hours)

Course Objectives:

1. To give a general knowledge on various factors affecting microbial spoilage of food.
2. To give detailed information on various strategies that can be adopted for preservation of food.
3. To give detailed knowledge on various microbially derived food products.
4. To give detailed information on regulatory mechanisms in maintaining quality of food.

Course Outcome:

1. Students will acquire theoretical knowledge in analysis of microbial load in food and beverages
2. Students will be able to analyse food poisoning microorganisms in food and beverages
3. Students will be able formulate strategies for preservation of food and beverages.
4. Students will be able to do quality checking in food industry

Course Content:

MODULE I

Factors which influence microbial growth, survival and death in foods, spores and their significance, indicator microorganisms and microbiological criteria. Microbial spoilage of foods: Factors affecting food spoilage at different levels – intrinsic and extrinsic factors. **16Hrs)**

MODULE II

Spoilage of meat, poultry and sea foods, milk and dairy products, fruits, vegetables and grains. Preservation methods and preservatives: physical methods of preservation, chemical preservatives and natural antimicrobial compounds, biologically based preservation system. Problems associated with preservatives (**10 Hrs).**

MODULE III

Food fermentations: fermented dairy products, fermented vegetables, fermented meat, poultry and fish products, traditional fermented foods, cocoa and coffee, beer and wine. Probiotics and prebiotics **(12 Hrs).**

MODULE IV

Food borne pathogens: Food poisoning, intoxications like botulism and aflatoxins. Food hygiene and control. Single Cell Protein. HACCP. Molecular techniques in food microbiology. Food security, food safety and GM foods **(10 Hrs).**

References
1. Food microbiology – Adams MR and Moss MO
2. Food Microbiology – Frazier WC and Westhoff
3. Food Microbiology (2nd Ed) – Doyle et al.
4. Basic food microbiology – Banwart GJ
5. Dairy Microbiology – Robinson RK
6. Valorization of Food Processing By-Products, Fermented Foods and Beverages Series, (Ed) M Chandrasekaran CRC Press

MSMBY02C09
PRACTICAL III

Systematic Bacteriology and Food Microbiology

SYSTEMATIC BACTERIOLOGY

1. Grams staining, acid fast staining, endospore staining, Albert staining.
2. Phenotypic characterization of bacteria.
3. Antibiotic sensitivity test by Kirby-Bauer method.
4. *In vitro* antifungal susceptibility testing of bacteria by NCCLS: broth macro dilution and microdilution.

REFERENCE:

1. District laboratory practice in tropical countries. Cheesbrough M. Cambridge University Press.

2. Manual of Clinical Microbiology. Murray PR, Jo Baron E, Pfaller MA, Tenover FC, Yolken RH. ASM Press

3. Bailey & Scott's Diagnostic Microbiology

4. Mackie and McCartney practical Medical Microbiology.

5. Textbook of Diagnostic Microbiology (Mahon, Textbook of Diagnostic Microbiology) Publisher: Saunders;

Food Microbiology

1. Isolation identification and characterization of bacteria and fungi from food products.

2.Impact of heat, chemicals and radiation on preservation/shelf life of food

3. Detection/Estimation of indicator microorganisms

4. Production of bread

5. Production of yoghurt

6. Detection of contaminating microorganisms in food by molecular methods

Reference

1. Laboratory Manual of Food Microbiology, Neelima Garg, K L Garg & K.G. Mukerji, ISBN: 9789380578019, IK Books
2. Microbiology Practical Manual, 1st Edition Paperback – 15 September 2018 by Amita Jain (Author), Jyotsna Agarwal (Author), Vimala Venkatesh (Author). Elsevier

3. Laboratory Manual For Food Microbiology (4th ed.) - By W. C. Frazier; E. H. Marth; and R. H. Deibel. Minneapolis, Minn. 55415: Burgess Publishing Co.

MSMBY02E03
MICROBIAL PHYSIOLOGY AND METABOLISM

3 Credits (48 Hours)

Course objective

1.Understand the basic physiological charachters of microorganisms
2. Understand the basic metabolism of microorganisms

Course outcome

Students will gain knowledge about the basics of physiological and metabolic pathways of microorganisms

Module I

Nutritional groups of bacteria, photoautotrophy and bacterial photosynthesis, chemoautotrophy, photoheterotrophy, chemoheterotrophy, heterotrophic metabolism. Aerobic and anaerobic respiration (fermentation). **(6 Hrs)**

Module II

Different trophic media for bacteria, fungi and algae, defined and undefined media, basal media, differential media, maintenance media, transport media. Aerobic culturing and anaerobic culturing methods. Environmental requirements of growth.

Microbial growth, spores and sporulation. Synchronous culture and continuous culture, capsular materials, bacterial toxins. Pathogenesis and virulence. Lab methods for testing bacterial virulence. **(15 Hrs)**

Module III

Glycolysis, citric acid cycle, Glyoxylate cycle, pentose phosphate pathway of glucose oxidation, Gluconeogenesis, glycogen synthesis, biosynthesis of polysaccharides.

Biosynthesis of saturated, unsaturated, hydroxy and branched chain fatty acids, biosynthesis and degradation of phospholipids, sterol biosynthesis, conversion of cholesterol to other important molecules, formation of prostaglandins. **(12 Hrs)**

Module IV

Pathways of amino acid degradation, urea cycle, biosynthesis of amino acids- essential and non-essential.

De novo biosynthesis of purine and pyrimidine nucleotides, catabolism and interconversion of purines and pyrimidines. **(15Hrs)**

References

1. Wolfgang K. Joklik (1995). Zinssers Microbiology. Mc Graw-Hill Companies.1294pp
2. Jawertz Medical Microbiology by Lange
3. Microbiology – Prescott
4. General Microbiology – Stanier
5. Fundamentals of Microbiology – Frobischer
6. Principles of Microbiology – Ronald M Atlas
7. General Microbiology, Greenwood

MSMBY02E04
IMMUNOLOGY

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand the components and functioning of the immune system.
2. Determine the deficiencies arising out of the immune system.
3. Analyze the overreaction of the immune system.
4. Understand the methods of exploiting the specificity of the immune system for quantification, diagnosis, and immunization protocols.

Course Outcome:

1. Evaluate usefulness of immunology at the application level.
2. Apply their knowledge and design immunological experiments

3Understand the role of immune responses in the setting of infection (viral or bacterial).

Course Content

MODULE I

History of the Immune system, Cells of the Immune system, Innate immune mechanisms**,** TLR, PRR, PAMP Phagocytosis, classical and alternative pathways of complement activation, regulation and functions of complement. Adaptive immunity: Properties of immunogens and antigens. Pathways of antigen processing and presentation**.** (**10 Hours)**

MODULE II

Primary and secondary lymphoid organs, structure and cellular organization**.** Structure of immunoglobulins. Antigen binding site of antibody. Forces involved in antigen - antibody complex formation. Receptors, co-receptors and CD antigen on B cells, Generation of receptor diversity. B cell development in activation and differentiation. **(15 Hrs)**

MODULE III

T cell development, activation and differentiation to helper, cytotoxic T cells. Signal transduction in B&T cell. Role of cytokines. Humoral and cytotoxic response, MHC complex and MHC restriction.

Introduction to Immunology of infectious diseases, Hypersensitivity and immunology of transplantation, Immuno-deficiencies, autoimmunity, immune suppression, tolerance. Tumor immunology. **(15 Hrs)**

MODULE IV

Factors governing immunogenicity, haptens and its applications, epitopes, adjuvants. Principle and applications of Antigen - antibody interactions.

Agglutination, immunodiffusion, immunoelectrophoresis, immunofluorescence, RIA and ELISA and assays for cytotoxic responses. Monoclonal Antibodies. Vaccines **(8 Hrs)**

REFERENCES

5. 1.Immunology Kuby 2019 Eighth Edition| 2019 Jenni Punt; Sharon Stranford; Patricia Jones; Judy Owen Macmillan Learning Eighth Edition
2. Immunobiology Janeway 2017 9th Edition Garland Science.
3. Essential Immunology. Roitt 2017 13th Edition. Wiley Blackwell

MSMBY02E05

HUMAN PHYSIOLOGY& DEVELOPMENTAL BIOLOGY

3 CREDITS **(48 Hours)**

Course Objectives:

Introduction about human physiology, familiarize with the homeostatic mechanism. Introduction of electrical properties associated with the neurons and conduction of nerve impulse.

Introduction of plant developmental biology taking Arabidopsis as the model organism, introduction of animal developmental biology using Drosophila as a model organism. Study of stem cell and its application

Course Outcomes:

By understanding normal physiological aspects, pathological conditions can be identified and understood. Developmental biology opens a path to understand the normal organogenesis process. The theoretical aspects along with the genetic engineering tools will be helpful in tackling the hereditary diseases.

Course Content:

MODULE- I

Introduction to human physiology, Homeostasis. Mechanism of Homeostasis
Heart: Structure and electrical activity, Neuromuscular junction: Electrical properties, and ionic fluxes. Structure of neuron and synapse, Synaptic transmission, neurotransmitter systems.
Endocrine system, General features and mechanism of action of hormones, Signaling mechanism by hormones - Insulin and Estrogen. **(15 Hrs)**

MODULE-II

Development of the Eukaryotic system*; Saccharomyces cerevisiae* as a model organism: Life cycle, cell differentiation and mechanism for determining cell type, mating, cell-cell communication.
(9 Hrs)

MODULE-III

Plant development, *Arabidopsis thaliana*- as a model organism: Brief out line on meristem, root shoot axis, growth regulators, homeotic selector gene **(9 Hrs)**

MODULE-IV

Introduction to animal developmental Biology*: Drosophila melanogaster* as model: Structure and organization of drosophila genome, Life cycle, Techniques for genetic analysis, Genetic analysis of body plan development in Drosophila.

Brief introduction to Stem Cell Biology: Embryonic, Adult and induced Pluripotent Stem Cells. Use of stem cells in understanding development and regenerative medicine. **(15 Hrs)**

REFERENCES:

1. Human Physiology, Guyton
2. Physiology, Ganong
3. Physiology, Best and Taylor
4. Developmental Biology-11th Edition ,Scott F.Gilbert ,Michael J.F.Barresi Oxford University
5. Molecular Developmental Biology T.Subramoniam
6. Analysis of Biological Development ,Kalthoff ,McGraw-Hill Science,New Delhi, India

MSMBY02E06

MOLECULAR BIOLOGY

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand the organization of genome.
2. Familiarize with cellular processes like transcription and translation
3. Study the methods to measure the level of expression of RNA and protein.
4. Understand regulation of gene expression

Course Outcome:

Familiarize the student with the mechanisms and components involved in expression of

genes in prokaryotic and eukaryotic systems.

Course Content:

MODULE I

The genome: Content, Mapping (Linkage, Restriction cleavage, Sequencing), Variations, Repetitive and Non-repetitive sequences, Organalle DNA – Mitochondrial and Chloroplast. Genome sequences and Gene numbers. Transcription in Prokaryotes -Biosynthesis of RNA, Enzymatic machinery, Promoter selection and role of RNA Polymerase and ancillary factors. **(12 Hrs)**

MODULE II

Transcription in eukaryotes: RNA polymerases, Eukaryotic promoter structure, enhancer elements and transcription factors, transcriptionally active chromatin, biosynthesis of ribosomal, transfer and messenger RNAs. Post transcriptional modifications, transfer and messenger RNAs, antibiotic inhibitors of transcription. Gene silencing. **(12 Hrs)**

MODULE III

Protein synthesis: Genetic code and gene protein relationships, nonsense and missense mutations and suppressers, ribosome structure (prokaryotic and eukaryotic) mRNA structure, polycistronic v/s monocistronic, specificity of aminoacyl tRNA synthetases, polypeptide chain elongation and termination, factors of protein synthesis (pro & eukaryotic) and their role, inhibitors of protein synthesis and their mechanism of action, translational regulation, post- translational modification, biosynthesis of secretory proteins. **(12 Hrs)**

MODULE IV

Regulation of gene expression, bacterial operons (lac, gal, ara, trp, hut, etc) and viral models (T4 and T7), stringent and relaxed control, regulation in eukaryotes, chromatin activity and gene regulation. Methods, measurements of RNA synthesis and protein synthesis, complementary sequence analysis by nucleic acid hybridization including southern blotting, isolation methods for eukaryotic mRNA, identification of translation products (flurography, western blotting). Genome sequencing - chemical. Next generation sequencing. **(12Hrs)**

REFERENCE

1. Lodish, H., Baltimore, D. Berk, A., Zipursky, S. L. Matsudaira, P. and Darnell. J. 1995 molecular Cell Biology, 3rd ed, WH.Freeman & Co.

2. Stent, G. S. and Calender, R. Molecular Genetics 1986. An Introductive Narrative, CBS Publishers and Distributors, NewDelhi.

3. Weaver, RE & Hedrick, PW. 1985 Basic Genetics, WMC.Brown Publishers.

4. Alberts, B., Bray, D. Lewis, Julian, Raffn M. Roberts, K. and J. D. Watson,J. D. 1994. Molecular Biology of the Cell, 3rd edn, Garland Publishing Inc..

5. Hayes, W., 1994. Genetics of Bacteria and their viruses. 2nd Edn, CBS Publishers and Distributors, New Delhi.

6. Genes XII Benjamin Lewin

MSMBY02E07

ETHICS, PATENCY and INTELLECTUAL PROPERTY RIGHTS

3 CREDITS (48 Hours)

Course Objectives:

To understand how precious each life forms are, the risks associated with altering the genetic makeup of an organism and their ethical aspects. Importance of maintaining the biosafety measures while handling with dangerous microorganism. Importance of maintaining the guide lines while handling the rDNA products. The essential steps to be followed to get an invention patented.

Course Outcome:

Importance of individual life forms, understanding biosafety levels, patents and patent procedures.

Course Content:

MODULE 1

Ethical aspects of interfering in natural process, Hidden dangers in altering genetic make-up**. (3Hrs)**

MODULE 2

Patent, Objectives of Patent system and general requirement of Patent law, Patent office, Patent Office Practices, Infringement problems, Harmonization of Patent laws, International treaties on IPR, International convention for the protection of new varieties-Strasbourg convention, UPOV convention. **(15Hrs)**

MODULE 3

Patentability of micro-organism- Claims, characterization and repeatability, Deposition of Culture collection, Legal protection plants and animals, Transfer of Technology, TRIPS, FDA**. (15 Hrs)**

MODULE 4

Biosafety, Definition, Objectives, Biological Containment (BC) and Physical Containment (PC), Biosafety levels, Biosafety level1, Biosafety level 2, Biosafety level 3, Biosafety level 4. The containment laboratory design and facilities.

Guidelines for rDNA research, Quality control of biologicals produced by rDNA technology. **(15Hrs)**

REFERENCE

1. Beir,F.K, Crespi, R.S and Straus J: 1982 Biotechnology and patent protection- Oxford and IBH Publishing Co. New Delhi.
2. Chowdhary, N. K and Aggarwal J. C: Dunkal's Proposals I. Implications for India and the third world.
3. Chowdhary, N. K and Aggarwal J. C: Dunkal's Proposals II. The Final Act. Significance for India and World trade.
4. Department of Biotechnology (1990) Recombinant DNA Safety guidelines. Govt. of India, New Delhi.
5. Krattinger, A.F Lesser, W and Mudge G: Implementation of Biosafety Regulatory Mechanisms under the Biodiversity Convention.
6. Narayanaswami,K: 1994 Safety and regulatory arrangements in Biotechnology in Sohal and Srivastava (eds) Environment and Biotechnology.

THIRD SEMESTER

(Total Credits Required: 22)
MSBTC03C10
MICROBIAL TECHNOLOGY
3 CREDITS **(48 Hours)**

Course Objectives:

1. To impart knowledge on the importance of Microbial Bioprocess for commercial production of metabolites and biomass.
2. To give general information about the operation of different types of bioreactors.
3. To give over all information about upstream and downstream processing.
4. To impart knowledge in detail on various applications of microbial technology

Course Outcome:

1. Students get theoretical and laboratory skills in isolation and screening of commercially important microorganisms.
2. Acquire knowledge on production of various fermented food items.
3. Students will be able to operate small fermenters.
4. Students will be able to formulate bio-process media for commercial production of microbial metabolites and biomass.
5. They will be able to do preservation of industrially important microorganisms

Course Content:

MODULE I

Introduction to fermentation processes - range and components**.** Isolation and screening and preservation of industrially important microbes. The improvement of industrial microorganisms with special reference to primary and secondary metabolite over production. Bioreactors - design and types **(7 Hrs).**

MODULE II

Bioprocess control instrumentation. Devices for Monitoring variables such as, temperature, aeration, agitation, pressure and pH. Biosensors in Bioprocess monitoring. Bioprocess media- formulation and sterilization of media, Sterilization of fermenter, Agro-Industry byproducts as bioprocess media. Development of inoculum. Upstream and Downstream processing **(18 Hrs)**

MODULE III

Kinetics of fermentation process, Transport phenomena in bioprocess-Mass transfer and Heat transfer. Scale up of bio- process**.** Cell Immobilization and its applications. Solid State Fermentation and its advantages. Tray Fermenters. Semi-Solid Fermentation.

Downstream processing of fermentation products **(15 Hrs)**

MODULE IV

Microbial production of, Amino acids, Vitamins, Polysaccharides, Antibiotics, vaccines, Enzymes, Biopesticides, Biocontrol agents, Biofertilizers. Industrial alcohol, Bioremediation, Industrial waste treatment - aerobic/anaerobic systems. **(8Hrs)**

References

1. Principles of Fermentation Technology by Peter F Stanbury, A.Whittaker, S.J, Hall
2. Fermentation Microbiology and Biotechnology by E.M.T El-Mansi, C.F.A Bryce, A.L Demain, A.R. Allman (Second Edn)
3. Bioprocess engineering principles Pauline M Doran
4. Biotechnology- The Science and the Business by V. Moses & R. E. Capes.
5. Comprehensive Biotechnology Ed. By Murray Mono Young.
6. Biological fundamentals- Biotechnology Ed. By H. J. Rehm and G. Reed.
7. Fundamentals of Biotechnology Ed. By Paul Prave et al.
8. Industrial Microbiology by Prescott and Dunns.

MSMBY02C11

Environmental and Agricultural Microbiology

3 CREDITS (48 Hours)

Course Objectives:

1. To understand the diversity of bacteria, and archea in Environment and in Agriculture.
2. To understand the microbes and their role in water sources.
3. To understand the diversity of microbes in plant microbe interactions.
4. To understand the role of microbe in waste water management

Course Outcome: Upon completion of this course, students will be able to understand and explain the role of microbe diversity and factors that are involved Aquatic, Agriculture and waste management.

Course Contents:

Module I

Microbial behavior in ecosystems: Microbial biodiversity, Microbial interaction – Animal-microbe, Plant-microbe and microbe-microbe interactions. Endophytes, Plant Microbiome, Mycorrhiza, Biological Nitrogen fixers-Symbiotic and free living nitrogen fixers- physiology and genetics of nitrogen fixers, Phosphate solubilizers,

Pollution and environment, Biosensors and Biological indicators, Waste water management and sewage treatment, BOD concepts, Solid waste management and land filling, Degradation of xenobiotics, Microbes and bioremediation. Microbial Biofilms: Physiology, Morphology and Biochemistry of microbial biofilms **(14 hrs)**

Module II

Microbiology of soil: Soil as habitat for microorganisms. Soil microflora, Decomposition of organic matter - Soil as source of industrial strains. Biodegradation of recalcitrants by soil microbes. Geocycles of C, N, S, P. iron and sulphur oxidation. N2 fixation.

Microbiology of water: Microbial communities in aquatic environments, factors affecting microbial population in natural waters, Air water interface, Microbial Corrosion, Bacteriological analysis of drinking water. Water purification and various steps involved **(12 hrs)**

Module III

Aerobiology: Microbial contamination of air and sources of contamination, Microbial indicators of air pollution, Enumeration of bacteria in air, Air sampling devices. Air sanitation. Biological weapons, their regulation and precautions Effect of Air Pollution on plants and humans.

Microorganisms in extreme environments: Environmental Determinants those Govern Extreme environments, Extremes of pH & temperature, salinity, Hydrostatic pressure, Nutrient limitation. **(10 hrs)**

Module IV

Biofertilizers, Microbial control of pests and diseases. Bt-toxin- mode of action and applications, GM crops and its importance. Production of microbial biofertilizers –cyanobacteria, Rhizobium, Azotobacter, , Azospirillum, Phosphobacteria and VAM, Biopesticides, Microbes as a health food (SCP)- Spirulina and its production methods. Probiotics - use of Lactobacilli and Bifidobacterium- therapeutic and nutritional value, Microbial enhanced oil recovery, Microbial production of fuels. Microbial leaching of ores and biomining, Biopolymers and biosurfactants.

Recycling of liquid and soild wastes – Composting – Biogas – Biodegradation. Bioremediation, Bioleaching, Xenobiotic degradation. Microbial corrosion- Biofilms degradation of petroleum products. Microbes in mineral leaching and metal concentration, Microbial enhanced oil recovery **(12 hrs)**

References:

1. Buckley R. G. Environmental Microbiology. CBS; 1st edition 2019
2. Annette Bolger. Environmental Microbiology. Oxford Book Company 2010
3. Eugene L. Madsen. Environmental Microbiology: From Genomes to Biogeochemistry. Wiley-Blackwell; 1st edition
4. Campbell RE (1983) Microbial ecology (Blackwell Scientific Publications, Oxford ; Boston) 2nd ed
5. Pandey,B.P. (2001) Plant Pathology : Pathogen and Plant Disease. S.Chand & Co
6. Sharma, P.D. (2012) Plant Pathology. Rastogi publication
7. Rangaswami, G., Bagyaraj, D.J. (2007) Agricultural Microbiology 2 nd edition .Prentice Hall

MSMBY03C13

CLINICAL AND DIAGNOSTIC MICROBIOLOGY

3 Credits (48Hrs)

Course Objectives:

1. To impart knowledge on infectious diseases and it diagnosis
2. Understand the diseases caused by microorganisms
3. Understand about the collection, transport, processing of different clinical specimens
4. To impart knowledge in current development in diagnostic microbiology
5. To give knowledge about the prevention and control of infectious diseases.

Course Outcome:

1. Students get theoretical and laboratory skills in diagnosis of infectious diseases
2. Students will acquire knowledge in collection, transport and processing of clinical specimens
3. Students will be able to diagnose the causative agent of an infectious disease.
4. Students will be able to work in clinical microbiology labs and research institutes

Module I

Normal flora of human body.

Epidemiology, Etiology, Pathogenesis, diseases, Laboratory diagnostic procedures and

prophylactic measures of the following infections
Respiratory tract infections: Upper respiratory tract- etiology, transmission, pathogenesis, epidemiology and clinical features of the following
Common cold, pharyngitis and tonsillitis, otitis and sinusitis, acute epiglottitis, oral cavity infections, laryngitis and diphtheria etc.
Lower respiratory tract- whooping cough, bronchitis, RSV infections, bacterial pneumonia, viral pneumonia, tuberculosis, cystic fibrosis, lung abscesses. Diagnosis of respiratory tract infections.
Urinary tract infections and sexually transmitted diseases
Bacterial, viral and fungal infections of urinary tract- etiology, pathogenesis, transmission, clinical features, complications and diagnosis.
Etiology, transmission, clinical features, and diagnosis of sexually transmitted diseases (syphilis, gonorrhea, chlamydial infections, HIV, bacterial vaginitis, genital herpes, papilloma virus infections, opportunistic STDs etc.) **(12 Hrs)**

Module II

Gastrointestinal tract infections: Etiology, pathogenesis, clinical features and diagnosis of diarrheal diseases (bacterial and viral), *Helicobacter pylori*, food poisoning, parasites in the GI tract
Central nervous system infections: infections caused by bacteria, virus, fungi and protozoa, viral encephalitis, brain abscesses, tetanus, botulism etc..
Infections of the skin, ear and eye : Etiology, transmission, diagnosis and prevention. **(14 Hrs)**

Module III

Pyrexia of unknown origin, Blood Infections: Etiology, transmission, diagnosis and prevention, and diagnosis.
Organization, design and structure of a diagnostic Microbiology Laboratory, Biological safety measures, specimen collection, storage, transportation. Quality control, Modern techniques employed in Clinical Microbiology laboratory. **(11 hrs)**

Module IV

Nosocomial infections: epidemiology, bacterial and viral infections, diagnosis and control programmes,
Zoonotic infection, Food, water and air borne infections.
Collection, transport, processing and storage of the following clinical specimens like
Blood, Urine, Pus, Sputum, Swabs, Stool, Body fluids, Vomits, CSF, Biopsy specimens, Scrapings (Skin,Eye,Hair,Nail) **(11 hrs)**

REFERENCES

1. Medical Lab manual – Monica.
2. Text book of Microbiology - Anantha Narayan & Jayaram Panicker
3. Clinical and Pathogenic Microbiology – Barbara.
4. Bailey & Scott’s Diagnostic Microbiology.
5. Text Book of Medical Mycology – Jagadish Chander.
6. Fundamentals in diagnostic Mycology –F.Fissure

7. Medical Microbiology – Jawetz
8. Topley and Wilson's principles of Bacteriology
9. Virology – Fields

MSMBY03C14

VIROLOGY, MYCOLOGY & PARASITOLOGY (3 CREDITS)

Course Objectives:

- To impart detail understanding in viral taxonomy, viral replication and cultivation methods.
- To describe various viral diseases of human importance, it's prevention, laboratory diagnosis and control with special emphasis on vaccines.
- To provide adequate knowledge about pathogenic molds and yeasts causing diseases to humans.
- To enable students to understand the pathogenesis, clinical presentation, laboratory diagnosis, prevention/ control of various protozoan diseases.

Outcomes:

- The students will understand about current and emerging human viral diseases.
- Will acquired with knowledge of various human parasites and its management.
- To provide adequate knowledge about pathogenic fungus diseases to humans and it management

Module I:

General properties of viruses and bacteriophages: morphology, classification, replication, cultivation, virus host interaction and laboratory diagnosis. **(5 Hrs)**

Module II

Properties and infections of human viruses- Herpesviruses, Poxviruses, Hepatitis viruses, Picornaviruses, , Arbo viral diseases, Rhabdoviruses, Orthomyxoviruses, Paramyxoviruses; Oncogenic viruses, HIV and other retro viruses, miscellaneous DNA and RNA viruses. Antiviral chemotherapy, Interferons, Viral vaccines **(15 Hrs)**

Module III:

Fungal diseases of humans: classification and lab diagnosis,

Study the morphology, pathogenesis and laboratory diagnosis of the causative agents of superficial and cutaneous mycoses, subcutaneous mycoses, systemic/deep mycoses and opportunistic mycoses. Pneumocystis *jiroveci*. Mycotoxicoses, Antifungal agents and its mechanism of action, antifungal susceptibility testing. **(13 Hrs)**

Module IV:

Classification of human parasites. Morphology, life cycle, pathogenesis, laboratory diagnosis of important protozoans and helminthes ;. Intestinal and hemoflagellates: tissue flagellates, cestodes, trematodes, nematodes.,laboratory diagnosis of parasitic diseases. Other sporozoans: *Cryptosporidium parvum, Toxoplasma gondii. Antiparasitic agents* **(15 Hrs)**

References

1. Textbook of Microbiology. Ananthanarayanan R and Paniker CKJ. Orient Longman.
2. Principles of Virology. Flint SJ, Enquist LW, Krug RM, Racaniello VR, Skalka AM. ASM Press.
3. Medical Mycology, Jagadish Chandir, Jaypee publishers
4. Medical Mycology. Dey NC, Grueber HLE, Dey TK. Mc Graw Hill.
5. Human Parasitology. Bogitsh BJ, Carter CE, Oeltmann TN. Elsevier.
6. Animal Parasitology. Smyth JD. Cambridge University Press.
7. Diagnostic Microbiology. Forbes BA, Sahm DF, Weissfeld AS. Mosby Elsevier.
8. Essentials of medical microbiology, Apurba Sankar Sastri,Sandya Bhat.Jaypee Publications

9. Text book of microbiology, Dr.Prof.C.P Baveja, Arya Publications
10. Panikers text book of medical parasitology, jaypee publishers

MSMBY03C14
PRACTICAL IV
Microbial Technology & Environmental Microbiology
(2 Credits) 96 Hours

MICROBIAL TECHNOLOGY

1. Strain development
2. Determination of Dissolved oxygen (DO)
3.Determination of Biological oxygen demand
4. Study of industrially important Yeast and Molds
5. The fermenter and Types
6. Production of Enzymes under Submerged Fermentation (Upstream and Downstream processing)
7. Production of Enzymes under Solid State Fermentation (Upstream and Downstream processing)
8. Production of red wine and alcohol
9. Alcohol fermentation using molasses
10. Production of Mushrooms

REFERENCE:

1. Microbial Biotechnology- A Laboratory Manual for Bacterial Systems
Authors: Das, Surajit, Dash, Hirak Ranjan. Springer
2. Laboratory Bioprocess Technology Paperback – 1 January 2013
by A.N. Shukla, Arjun publishing house.
2. Practical Fermentation Technology, Brian McNeil and Linda M Harvey. Publisher: John Wiley & Sons Inc

Environmental and Agricultural Microbiology

1. Study of various types of Micro-organisms present in soil, water and air
2. Isolation of bacteria from root nodules of different legumes
3. Enrichment of *Azotobacter* and *Rhizobium* as biofertilizers and testing its efficacy.
4. Isolation of starch degraders from soil.
5. Isolation of cellulose degraders from soil
6. Isolation of phosphate solubilizers from soil.
7. Standard qualitative analysis of water.
8. Comparison of microflora in Bt-treated/chemical pesticide-treated soils.
9. Extracellular enzyme activities of microorganisms
10. Amylase, cellulose, protease, lipase, phosphatase

REFERENCE:

1. R.M.Atlas and R. Bartha (1998) Microbial Ecology-Fundamentals and Applications. Addison Wesley Longman, Inc.
2. Buckley R G, Environmental Microbiology by, CBS
3. N.S. Subbarao, Biological Nitrogen Fixation
4. Alexander and Martin, Microbiology of Soil
5. Soil Microbiology. Mark Coyne Thompson Learning
6. Ivanov, Environmental Microbiology for Engineers, Taylor & Francis Exclusive(Cbs)
7. Spencer, Environmental Microbiology Methods and Protocols, Springer
8. Ralph Mitchell, Ji-Dong Gu, Environmental Microbiology, wiley
9. Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, Environmental Microbiology,

MSMBY03C15
PRACTICAL V

CLINICAL AND DIAGNOSTIC MICROBIOLOGY AND VIROLOGY, MYCOLOGY & PARASITOLOGY

2 CREDITS (96 hours)

CLINICAL AND DIAGNOSTIC MICROBIOLOGY

Study of normal flora of human body
Isolation, characterization and identification of pathogens from various clinical specimens
Study of antibiotic sensitivity of common pathogens
Microbiological investigations on specimens like
- Urine, feces, purulent material, CSF, blood, Sputum and Body fluids.
- Blood smear for parasites.
- Feces examination for parasites.
- Microbiological examination of specimens for fungal elements

REFERENCES

1. Microbiology in clinical Practice – Shannon.
2. Bailey & Scotts Diagnostic Microbiology
3. Medical Lab manual – Monica.
4. Koneman's colour atlas and text book of diagnostic microbiology-Winn Washington .C
5. Diagnostic Microbiology- Mahron C.R; George Munuselis
6. Essentials Of Diagnostic Microbiology- Shimeld Lish Ann
7. Parasitology – K.D.Chatterjee.
8. Text book of Parasitology – C.K.Jayaram Panicker.
9. Text book of Medical Parasitology-Subhash Chandra Parija
10. Mackie and McCartney practical Medical Microbiology

VIROLOGY, MYCOLOGY & PROTOZOOLOGY

1. Embryonated eggs for cultivation of viruses
2. ELISA, Western blotting

3. Study of pathogenic yeasts and molds
4. In vitro antifungal susceptibility testing of yeasts by NCCLS: broth macrodilution and microdilution
5. Identification of eggs and cysts of parasites from stool sample: saline wet mount, iodine wet mount, sedimentation and flotation technique
6. Observation of permanent slides of pathogenic protozoans

REFERENCE:

1. District laboratory practice in tropical countries. Cheesbrough M. Cambridge University Press.

2. Manual of Clinical Microbiology. Murray PR, Jo Baron E, Pfaller MA, Tenover FC, Yolken RH. ASM Press

3. Medical Parasitology.Jayaram Panicker, Jay pee publications.

MSMBY03E08
BIOINFORMATICS
3 Credits **(48 Hours)**

Course Objectives:

1. Get knowledge about biological databases and understand sequence alignement methods.

2. Understand methods in genomics and proteomics.

3. Understand the molecular level interactions and molecular modeling.

4. Understand the method of structure-based drug design and gain basic knowledge of systems biology.

Course Outcome:

The students shall be able to

1. Access different biological databases, retrieve protein and nucleic acid sequences and perform sequence alignment.

2. Explain different methods used in genome and proteome analysis.

3. Explain different molecular interactions, techniques of molecular modeling, protein structure prediction

4. Explain the method of structure-based drug design and basic concept of systems biology.

Course Content:

Module I

Biological databases and sequence alignments: Nucleic acid databases, Protein databases (sequence, structure, classification), genome databases, specialized databases, data format (FASTA, PDB), Data storage and retrieval. Pair-wise sequence alignment: Global and local alignment: methods, scoring matrices (PAM, BLOSUM). Database searching: FASTA and BLAST. Multiple sequence alignment: methods, tools and applications. Phylogenetic analysis: type of phylogenetic trees, methods of its construction-distance based methods and character-based methods. **(13 Hrs)**

Module II

Genomics and proteomics: genome projects, Identification of sequence patterns, motifs and profiles, gene prediction methods, Genome mapping, genome sequencing, annotation. Comparative genomics, Functional genomics- ESTs, SAGE, DNA micro arrays, pharmacogenomics. An introduction to data science.
Proteomics: 2D Gel Electrophoresis, MALDI, Tandem mass spectroscopy, peptide mass fingerprinting, Protein micro arrays, protein expression analysis, protein-protein interactions. **(13 Hrs)**

Module III

Structural bioinformatics and Molecular modelling: Structure visualization. Structure comparison, RMSD, Intra and inter-molecular interactions, Potential energy functions, Energy minimization, local and global minima, Molecular Dynamics and Monte Carlo simulations. Protein structure prediction: Secondary and tertiary structure prediction-homology modeling, ab initio prediction.**(11 Hrs)**

Module IV

In silico drug design: Drugs and drug targets. Computer aided drug design: Ligand databases. Molecular docking, virtual screening, lead compounds, pharmacophore, QSAR, ADME property prediction. An introduction to systems biology and biological networks, its applications in the drug development. **(11 Hrs)**

REFERENCES

1. Bioinformatics - Baxevanis AD & Quellette BFF, John Wiley & Sons Inc.
2. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
3. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Essential Bioinformatics-Jin Xiong, Cambridge University Press
6. Evolutionary computations in Bioinformatics – Fogel & Corne, Morgan Kafman publishers
7. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
8. Medicinal Chemistry – Patrick G, Viva Books Pvt Ltd.
9. Pharmacology & Pharmacotherapeutics – Sataskar, Bhandakan & ainapur, Popuar Prakashan Mumbai
10. Principles of Medicinal chemistry – William O & Foye BI , Waverks Pvt. Ltd
11. Protein folding – Creighton TE (ed) WH Freeman & Co.
12. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
13. Structure and Mechanism in Protein science – Fersht WH freeman & Co
14. Fundamental concepts of Bioinformatics – Krane D.E and Raymer M.L., Pearson Education
15. Bioinformatics: Databases and Algorithms- N. Gautham, Narosa Publishing House, New Delhi.

MSMBY02E09

MARINE MICROBIOLOGY

3 CREDITS (48 Hours)

Course Objectives:

1. To understand the diversity of bacteria, and archea in marine environments.
2. To understand the roles of microbes in ocean processes.
3. To understand the metabolic diversity of microbes in marine environments.
4. To understand natural products originated from microbial sources in marine environments.

Course Outcome: Upon completion of this course, students will be able to explain and demonstrate the microbial diversity and factors that are involved in marine ecosystem.

Course contents:

Module I

Marine environment – sea-benthic and littoral zone, salt pan, mangroves and estuarine microbes, microbial loop – marine microbial community – planktons, bacteria, fungi, protozoa. Methods of collection and estimation of marine microbes. Influence of physical, chemical and biological factors on marine microbes. (**12 hrs)**

Module II

Microbiology of water: Microbial communities in aquatic environments, factors affecting microbial population in natural waters, Air water interface, Microbial Corrosion, Bacteriological analysis of drinking water. Water purification and various steps involved Pathogenic marine bacteria: pathogenic human viruses in coastal waters. Public health risk. (**10 hrs)**

Module III

Microorganisms responsible for bioluminescence in marine environment. Uses of

bioluminescence. Mechanism of quorum sensing in Vibrio fischeri. Microbial indicators of marine pollution and control, biofouling, biocorrosion, biofilms, biodegradation and bioremediation of marine pollutants.Use of genetically engineered microorganisms in biodegradation. (**14 hrs)**

Module IV

Marine natural products, bioactive compounds from marine microorganisms, marine biosensor. Biosurfactants, biopolymers and novel enzymes from marine organisms. (**12 hrs)**

References

1. Colin B. Munn. Marine Microbiology, Ecology & Applications. CRC Press; 3rd edition 2019

2. Olivia kesson. Marine Microbiology: Ecology And Applications. Koros 2015

3. John Paul. Marine Microbiology: Volume 30 (Methods in Microbiology).Academic Press 2001

4. "Molecular Microbial Ecology". Ed. A.M. Osborn, C. J. Smith (2005) Taylor & Francis Group – New York NY

MSMBY03E10
RECOMBINANT DNA TECHNOLOGY
3 CREDITS (48 Hours)

Course Objectives:

To familiarize with the advanced genetic engineering techniques. Appropriate application of genetic engineering technique for the mass production of protein of interest. The technology behind transgenic microorganisms, plants and animals.

Course Outcomes:

Complete understanding of genetic engineering tools such as RFLP, AFLP, RAPD, PCR, DNA finger printing etc.

Course Content:

MODULE 1

Historical events that led to the methods of recombinant DNA technology, Gene cloning, Steps of gene cloning, enzymes involved in recombinant DNA technology- Polymerases, Klenow fragment, Nucleases, Restriction endonucleases, Ligases, Poly nucleotide kinases, Terminal deoxy nucleotidyl transferases, Alkaline phosphatases. **(10Hrs)**

MODULE 2

Vectors used in Recombinant DNA technology, Plasmids, Cosmids, Phagemids, Artificial chromosomes, Shuttle vectors, Viral vectors, Expression vectors. Linkers, Adapters, Homopolymer tailing. Transformation, Transfection, Transient transfection, Selectable marker gene to identify the transfer of genes in cells. **(14Hrs)**

MODULE 3

Preparation of Gene libraries, cDNA libraries, Expression libraries, Storage of libraries and Screening of libraries, Screening by DNA hybridization, Screening by Immunological Assay, Screening by protein activity, Screening by Genetic complementation, Hybrid Arrest Translational systems. (**10Hrs)**

MODULE 4

RFLP, AFLP, RAPD Analysis, PCR, Various types of PCR and its applications, Fluorescent in-situ hybridization, Chromosome micro dissection and micro cloning

Genetic engineering of animals and generation of transgenic animals. Knock out Technology and Knock-in technology, Anti-sense RNA technology and its Application. **(14Hrs)**

REFERENCES

1. Principles of gene manipulation- An Introduction to Genetic Engineering. Old, RW & Primrose, S.B – 1994 5th Edn. Blackwell Sci Pub.
2. Molecular Cloning- A Laboratory Manuel Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989.. Second Edition. Cold Spring Harbor Laboratory Press.
3. Recombinant DNA technology- Concepts and Biomedical Applications Steinberg, M., Guyden, J., Calhann, D, Staiano- Coico, L.,Coico, R,1993. Ellice Horwood Prentice Hall.
4. Recombinant DNA Watson, J. D., Gilman, M., Witkowski, J. and Zoller, M. 1992. Second Edition. Scientific American Books, WH Freeman & Co.

5. From Genes to Clones: Introduction to Gene - Winnacker, E. L. 1987.

MSMBY02E11

Veterinary Microbiology

3 CREDITS (48 Hours)

Course Objectives:

1.Understand the important bacteria, fungi and viruses of veterinary relevance
2.Recognize the microorganisms of veterinary importance
3.Understand the bacteria, fungi and viral pathogenesis of veterinary importance
4.Understand the control measures of veterinary diseases

Course Outcome:

After completing the course, the students will be able to recognize the most important bacteria, fungi and viruses of veterinary relevance and will be able to identify the microorganism and understand the pathogenesis

Syllabus:

Unit 1: Introduction to Veterinary Microbiology

Microbes as infectious agents of Animals and Birds. Host-pathogen relationship. Bacterial and fungal toxins- production and mode of action. **(5 H)**

Unit 2: - Veterinary Bacteriology:

Studies on Animal/Avian Bacteria belonging to various families, and prion agents and pathogenesis, epidemiology, and control –

Gram negative- aerobic rods and cocci, family Pseudomonadaceae, Legionellaceae, Neisseriaceae, and genus Brucella. Facultative anaerobic Gram-negative rods, family- Vibrionaceae, Pasteurellaceae, Enterobacteriaceae and other genera

Gram positive cocci, family Micrococaceae, endospore forming Gram positive rods and cocci, family Bacillaceae genus Bacillus, Sporolactobacillus and Clostridium. Spirochetes. Family Spirochetaceae and other families like Spirillaceae, coryneform bacteria, Dermatophillaceae, Streptomycetaceae.

Mycobacteria and Nocardia, family Actinomycetaceae. Atypical prokaryotes such as Chlamydia, Rickettsiae, Mycoplasma, Acholeplasma, Spiroplasma, Anaeroplasma and Thermoplasma.

Regular non-sporing Gram positive rods such as Listeria and Erysipelas. Anaerobic Gram negative straight, curved and helical rods, family Bacteriodaceae

and genus Bacteroides and Fusobacterium **(15 h)**

Unit 3: Veterinary Mycology

Systematic study of animal mycoses such as aspergillosis, candidiasis, cryptococcosis, epizootic lymphangitis, mycetomas, sporotrichosis, histoplasmosis, blastomycosis, coccidioidomycosis, haplomycosis, rhinosporidiosis, zygomycosis, mycotic abortion, mycotic mastitis, mycotic dermatitis, dermatophytoses, mycotoxicosis **(10H)**

Unit 4: Veterinary Virology

Studies on Animal/Avian viruses belonging to various families, and prion agents and pathogenesis, epidemiology, and control –

Capripoxvirus, avipoxvirus, cowpox virus; bovine herpes viruses, equine herpes viruses, infectious laryngotracheitis virus, Marek's disease virus, pseudorabies virus, malignant cattarrh fever virus; infectious canine hepatitis virus, egg drop syndrome virus, inclusion body hepatitis, hydropericardium virus, papillomatosis, canine parvoviruses, feline panleucopenia virus.

Newcastle disease virus, canine distemper virus, rinderpest virus, PPR virus; infectious bursal disease virus; rotavirus, blue tongue virus, African horse sickness virus; rabies virus, ephemeral fever virus, borna virus.

Infectious bronchitis virus, transmissible gastroenteritis virus; equine arteritis virus, equine encephalomyelitis viruses; swine fever virus, BVDV mucosal disease virus; foot and mouth disease virus, duck hepatitis virus; visna/maedi virus, equine infectious anemia virus, avian leucosis complex virus, Avian flu Virus, bovine leukemia virus, chicken anemia virus; prions: scrapie, bovine spongiform encephalopathy, Immune response to viruses and viral vaccines. **(15 h)**

Reference

1. Glen Sonder J & Karen W Post. Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases. Cold Spring Harbor Lab. Press.
2. Wayne Roberts, Gordon R. Carter, and M. M. Chengappa, Essentials of Veterinary Microbiology
3. Frank J. Fenner, Peter A. Bachmann, E. Paul J. Gibbs, Veterinary Virology
4. B. K. Markey, Ann Cullinane, Marie Archambault, Finola Leonard, Dores Maguire, Clinical Veterinary Microbiology
5. Yuan Chung Zee, Veterinary Microbiology
6. Prescot LM, Harley JP & Klen DA. Microbiology. W. C. Brown Publ.
7. Tortora GJ, Funke BR & Case CL. Microbiology: An Introduction. Benjamin/Cummins Publ
8. Carter J & Saunders V. Virology: Principles and Applications. 1st Ed. Wiley.

9. Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. Veterinary Virology. 3rd Ed. Academic Press.
10. Dodds WJ & Schulz R. (Eds). Veterinary Vaccines and Diagnostics. Vol. 41 (Advances in Veterinary Medicine) I st Ed. Academic Press.
11. Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. New Generation Vaccines. 3rd Ed.
12. Marcel-Dekker. Pastoret PP, Blancou J, Vannier C & Verschueren C. Veterinary Vaccinology. Elsevier
13. Veterinary Microbiology and Microbial Disease Paperback – Illustrated
14. P. J. Quinn, B. K. Markey, F. C. Leonard, P. Hartigan, S. Fanning

SEMESTER FOUR

MSMBY04C16

16 Credits (5 Months)

Research & Dissertation