Sri Dev Suman Uttarakhand University, Badshahithaul, Tehri (Garhwal), Uttarakhand-249199

NATIONAL EDUCATION POLICY-2020

Syllabus for

Sri Dev Suman Uttarakhand University Campusand all Affiliated Colleges

STRUCTURE OF PG - MICROBIOLOGY SYLLABUS

NATIONAL EDUCATION POLICY-2020
M.Sc. Microbiology

(2022-23)

DEPARTMENT OF

MICROBIOLOGY

FACULTY OF SCIENCE

SRI DEV SUMAN UTTARAKHAND VISHWAVIDYALAYA, BADSHAHITHAUL, TEHRI GARHWAL

S. No.	Name	Designation	Signature
01	Prof. G. K. Dhingra	Dean Science & HOD Microbiology	
02	Dr Prabhat Kumar Singh	Subject Expert	
03	Prof. Pushpa Negi	PG Principal	
04	Prof. Pankaj Pant	PG Principal	
05	Prof. Kuldeep Singh Negi	PG Principal	
06	Prof. Anita Rawat	Director USERC	
07	Dr Neelam Negi	Member Expert	
08	Shalini Kotiyal	Member	

DEPARTMENT OF MICROBIOLOGY
Sridev Suman Uttarakhand University, Badshaithaul, Tehri Garhwal

Syllabus

For

Master of Science (Microbiology)

COURSE STRUCTURE & ORDINANACES
Faculty- Microbiology
1. Course duration four semesters (two years)

2. Objectives: Master of Science in Microbiology programme is designed for developing microbiologists confident and competent enough to shoulder the responsibility to take up challenges of research and education in the field of microbiology. The course is of interdisciplinary nature and has been formulated to impart training in Microbiology, Molecular Microbiology, Industrial Microbiology, Genetics and Biochemistry.

3. Eligibility for admission: Graduation in Science (Chemistry, Botany and Zoology) or Microbiology (Medical / Industrial) or Life Sciences or Medical Laboratory Technology B.Sc Biotecnology.

Marks requirement : Minimum 50% of aggregate (General Category). Minimum 45% of aggregate (SC, ST Category) or as per university/Government norms.
4. There shall be fifteen Theory Papers and 3 Laboratory Practical Examinations Comprising ot five Theory Papers and one Laboratory Practical Examinations in each of the three semesters as described in the following pages.
5. Each of the theory and laboratory examinations shall be of 100 marks divided into two parts 1.e. Internal Assessment (25 marks) and End Term examination (75-marks). Total Credits 4
6. Internal assessment shall be determined on the basis of mid term examination conducted by the respective institute after 6 weeks of start of the session.
7. In the fourth semester project work/industrial training of 3-4 months duration will be carried out in any National laboratory or Industry (entrepreneurship). Or a Research Project will assign in department under the Supervision of a competent faculty member (having Ph.D. degree.)
8. The student shall present the report of his / her research projects findings in the form of a seminar in the presence of external and internal examiners who shall evaluate the work and presentation and award marks on the basis of dissertation, presentation and viva-voce.
9. The student shall deliver at least 2 seminar of each semester on a recent topic in the subject of microbiology as assigned by the Head of the Department.

10. The minimum pass marks shall be 40% in each of theory paper, practical examination & internal assessment and 50% aggregate in all examinations in a semester.

11. The division shall be determined on the basis of aggregate marks obtained in all the papers (theory, practical, and dissertation / project work) of both previous and final year prescribed for the degree.

12. Overall division shall be determined be as follows a. First division 60% and above b. Second division 50% and above but less than 60% c. Third division 40% and above but less than 50%

Schedule of Semesters

Semester	Duration	Examination
First	July-November	December
Second	January-April	April/May
Third	July-November	December
Fourth	January-April	May/June

There will be one week preparatory leave, but inter-semester breaks between theory and practical examinations shall be for 6 days including holidays.

Practical examinations in first, second and third semesters will be held for 8 hours each carrying 100 marks.

Medium of teaching: English will be the teaching medium throughout the course. **Attendance:** 75% attendance is mandatory to appear in the sessional and the university examination

Program Objective :

PSO1. Students of the Msc Microbiology programme will learn to use scientific logic as they explore a wide range of contemporary subjects spanning various aspects of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Systems Biology, Immunology and Molecular biology, in addition to becoming aware of the applied aspects of microbiology such as Industrial Microbiology, Food and Dairy Microbiology, Environmental Microbiology and Medical Microbiology to name just a few.

PSO2- Students will appreciate the biological diversity of microbial forms and be able to describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations. They will become aware of the important role microorganisms play in maintenance of a clean and healthy environment. They will learn of the role of microorganisms in plant, animal and human health and disease

PSO3- Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field

PSO4- Students will develop proficiency in the quantitative skills necessary to analyze biological problems (e.g., arithmetic, algebra, and statistical methods as applied to biology)

PSO5- Post Graduates of Msc Microbiology programme will be informed citizens who can understand and evaluate the impact of new research discoveries in the life sciences, and will be able to pursue a wide range of careers, including biological and medical research in higher education institutions as well as careers in public and global health, scientific writing, environmental organizations, and food, pharmaceuticals and biotechnology industries.

Year/ Programme	Semester	Paper Code	Paper title	Credits	Theory /Practical	Total Number of Classes (in hours)
M.Sc I Year In Microbiology	Ist Semester	BMH T 701	Microbiological Tools and Technique	4	Theory	60
		BMH T 702	Microbial Diversity- Prokaryotes and Viruses	4	Theory	60
		BMH T 703	Algal and Fungal Biology	4	Theory	60
		BMH T 704	Biostatistics, Computer Applications and Bioinformatics	4	Theory	60
		BMH T 705	Practical	4	Practical	60
		BMH DS T 706	History and scope of microbiology	4	Theory	60
	IInd Semester	BMH T 801	Microbial Biochemistry	4	Theory	60
		BMH T 802	Techniques of Microbial Genetics and Molecular Biology	4	Theory	60
		BMH T 803	Microbial Environmental Technology	4	Theory	60
		BMH T 804	Recombinant DNA Technology	4	Theory	60
		BMH DS T	Food borne diseases and food preservation	4	Theory	60
		BMH T 805	Practical	4	Practical	60

M.Sc II Year In Microbiology	III Semester	PM 901	Medical Microbiology	4	Theory	60
		PM 902	- Fermentation Technology And Microbial Products	4	Theory	60
		PM 903	Pharmaceutical and Food Microbiology	4	Theory	60
		PM 904	Molecular Immunology	4	Theory	60
		PM DS 905	Applied Microbiology	4	Theory	60
		BM 906	Practical	4	Practical	60
	4^{th} Semester	PROJECT EVALUATION SEMINAR VIVA-VOCE	INDUSTRIAL TRAINING/ Dissertation PROJECT REPORT/	24	300 150 150	MM 3 Months

M.Sc. I Year **Semester – Ist**

BM –E701

BMH-701 Microbiological Tools and Technique

MM : 100
Time : 3 hrs
L Credit
4 4

Sessional : 25
ESE : 75
Pass Marks : 40

Learning objectives:

- To get the knowledge of sophisticated and common instruments used in the microbiology laboratory
- To know aseptic techniques to keep the instrument and media sterile.

Learning outcomes:

At the end of course students will be able to

- Maintain the sterility of glassware, utensils and medium by different physical and chemical procedure.
- Operate the different sophisticated instruments available in the laboratory.

Unit I:

Principle , Calibration and Application of different instruments of microbiology Lab such as microscopes, hot air oven, autoclave, laminar air flow and BOD incubator , pH Meter, Analytical Balance. Staining Technique Specimen preparation and principles of Simple, Gram's stain, Capsule, Endospore, Flagella, Acid fast and Geimsa's staining.

Unit II:

Aseptic technique: contamination, sterilization (steam sterilization, tyndallization, dry heat, chemicals, radiation sterilization, filter sterilization), sterilization of air. Evaluation of antimicrobial agent effectiveness, evaluation of efficacy of disinfectants, determination of phenol coefficient)

Unit III:

Isolation of industrially important microorganisms, Primary screening (crowded plate technique, enrichment culture technique, streak plate, Serial dilution plate and spread plate), Importance of screening. maintenance of pure cultures; methods of preservation. Maintenance and Cultivation of anaerobic bacteria.

Unit IV:

Principles and applications of Chromatography techniques: paper chromatography, thin layer chromatography, adsorption column chromatography, gas liquid chromatography, HPTLC Principle and Function of UV-Vis spectrophotometry,

Unit V

Principles and applications of Electrophoresis for protein, RNA and DNA; Centrifugation; Ultracentifugation; Lyophilization and Fumigation

Suggested Readings

1. Nelson D and Cox MM. (2010). Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York.

2. Wilson K. and Walker J. (2013). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.

3. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.

4. Upadhyaya and Nath (2015) Biophysical chemistry, Himalaya pub. House.

5. T.A.Brown (2016). Gene cloning and DNA analysis, an introduction,Wiley Blackwell pub.

6. B.D.Singh (2015). Biotechnology, Kalyani publication.

7. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3

8.Prescott's Microbiology, 10th Edition, McGraw Hill Publication

9. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2

Experiments in Microbiological Tools and Technique

1. Good laboratory practice in Microbiology and safety measures.
2. Cleaning and sterilization of glassware and equipments
3. Principles and applications of microbiology laboratory instruments (Autoclave, Laminar Air Flow, Incubator, Hot Air Oven, and Light Microscope).
4. Perform simple and Gram staining of bacteria.
5. Perform Endospore staining of bacteria.
6. Perform Capsule staining by negative staining technique of bacteria.
7. Perform Flagella staining of bacteria.
8. Perform Negative staining of bacteria.
9. Isolation of microorganisms from soil by pour plate method.
10. Isolation of microorganisms from air , water , and soil
11. Effect of radiation. on microbial growth
12. Cultivation of bacteriophages.
13. Calibration of Different instruments.
14. To prepare the Potato Dextrose Agar Medium.
15. Separation of DNA by Electrophoresis
16. Separation of Pigments By Chromatography
17. Determination of Environmental Microorganisms
18. . Isolation of Microbial colony from soil, water, air and milk.
19. To determine total viable cells in a bacterial culture by plate count method or serial dilution method.
20. . To carry out thin layer chromatography (mixture of amino acids).
21. Isolation of plasmid DNA from E. coli.
22. . TLC separation of amino acids.

BM.Sc. I Year **Semester – I**

BM –702

BMH -703 Microbial Diversity- Prokaryotes and Viruses

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the microbes diversity and their role .

To understand the basic concept of prokaryotes, their taxonomy,their differentiation from eukaryotes and biosafety regulatory framework for prokaryotes.

Learning outcomes:

At the end of course students will be able to explain the role of prokaryotes and their role in Microbiology development and what is the scope of the various branches of the subject and other beneficial roles.

- Cultivate viruses , Cyanobacteria in laboratory by different methods

Unit I:

Discovery of microbial world; Introduction to microbial biodiversity distribution, abundance, ecological niche of bacteria and archaea.

Unit II:

Microbial evolution; classification of microorganisms: Haeckel's three kingdoms, Whittaker's five kingdoms, three domains of Carl Woese, ribosomal RNA in microbial taxonomy, concept of microbial species; classification and salient features of bacteria on the basis of *Bergey's Manual of systemic Bacteriology*. General features of important groups of bacteria Protobacteria, Firmicutes , Actinobacteria, Spirochaetes, Rickettisia and Archaebacteria and cyanobacteria .

Unit III:

Extreme environments and extremophiles; Microbial diversity in different ecosystems thermophiles, halophiles, mesophiles, hyper thermophiles, acidophiles, alkalophiles, barophiles and other extremophiles) and their biotechnological applications

Unit IV:

General characters, nomenclature, classification, morphology and ultra-structure of viruses; Capsid and their arrangement; Cultivation of viruses using embryonated eggs, experimental animals and cell cultures , viroids– host range, genome and origin of viroids;); prions- spread of prions and diseases.

Unit V

: Bacteriophages- Structural organization, multiplication cycle; one step growth curve lytic and lysogenic cycle, bacteriophage typing, M13, Mu, T4, Φx174, phage λ; application of bacteriophages in health- bacteriophage therapy. cyanophages- morphology, growth cycle, mycoviruses- replication and types of mycoviruses

Suggested Readings (Latest Editions):

1. Bergey's manual systematic Bacteriology(2011) 2nd edition
2. Prakash S. Bisen (2012). Microbes-concepts and applications, Wiley-Blackwell.
3. J.D.S.Panwar (2012)-Fundamentals of Microbilogy-S.R.S Pub
4. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hil
5. Bisen, P.S. (2014). Microbes in Practices, I K international publication house pvt Ltd.
6. Sharma P.D. (2015-16). Microbilogy, 3rd edn, Rastogi publications
7. J.G.Black(2015) –Microbiology, 9th edition, Wiley publication

Experiments in Microbial Diversity- Prokaryotes and Viruses

1. Preparation of various models based on History of Microbiology.
2. Determination of growth of bacteria by spectrophotometrically.
3. Demonstration of pour plate, spread plate and streak plate methods.
4. Preparation of bacterial growth curve.
5. Isolation and characterization of thermophiles.
6. Isolation and characterization of psychrophiles.
7. Isolation and characterization of osmophiles.
8. Isolation and characterization of acidophiles.
9. Isolation and characterization of alkalophiles.
10. Isolation and characterization of halophiles.
11. Isolation and characterization of cyanobacteria.
12. Demonstration of bacteriophage typing.
13. Preparation of various models based on structure of viruses.
14. Study of virus infected plant material
15 Starch hydroloysis
16. Protein degradation-casein degradation
17. Carbohydrate fermentation (different sugars)
18. IMViC Tests: Indole, Methyl red, Vogus Prausker, Citrate utilization test.

BM.Sc. I Year **Semester – I**

BM –E703

BMH -703 **Algal and Fungal Biology**

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the microbes diversity and their role of Fungi and Algae in Ecosystem
- To understand the basic concept of prokaryotes, their taxonomy their differentiation from Prokaryotes and bio safety regulatory framework for Eukaryotes .

Learning outcomes:

At the end of course students will be able to explain the role of Fungi and Algae and their role in Microbiology development and what is the scope of the various field of the subject and other beneficial roles.

- Cultivate Fungi and Algae in laboratory by different methods

Unit 1

Algae: General account of habitat, cell structure, pigments, flagellum, reserve food. . taxonomic position of cyanobacteria. Algal growth and reproduction. Cultivation of algae in laboratory. Nittrogen fixation. Biological and economic aspects of algae, algal biotechnology. Algal blooms and eutropication.

Unit II

Mycology: Thallus morphology and modifications in fungi. Nutrition and physiology of fungi. Reproduction (asexual, sexual and parasexual) characteristics of fungi. Major taxonomic group of fungi with focus on structure, reproduction, life cycle and significance of the following: representatives: i) Gymnomycota (Cellular slime moulds), ii) Mastigomycota (*Phytophthora*), iii) Amastigomycota: a) Zygomyocotina (*Mucor/Rhizopus*), b) Ascomycotina (*Saccharomyces*), c) Basidiomycotina (*Agaricus*), d) Deutromycotina (*Fusarium*). Characteristics and importance of Deuteromycetes. Yeasts: General characteristic, structure, classification, life cycles (important forms), sexual and asexual reproduction of yeast (Saccharomyces cerevisiae)

Unit III

Nutrition and reproduction in fungi, Mycorrhiza, Lichens, Heterothallism, sex hormones in fungi. Evolutionary tendencies in lower fungi. Economic importance. Fungi in ecosystem: contribution of fungi to ecosystems, breakdown of hemicellulose, cellulose, pectins, chitin, starch and glycogen, lignin degradation; flow of nutrients-transport and translocation, secretion of colonizers on a substrate.

UNIT – IV

Fungal pathogens: occurrence, classification, morphology, characteristics features and life cycle of, *Fusarium oxysporum, Alternaria solani*, . Mycoses- superficial , cutaneous, subcutaneous opportunistic and systemic diseases

UNIT – V

Fungal metabolites of industrial importance– industrial alcoholic beverages and organic acids; Fungi as bioinoculant agents, mycotoxins- Aflatoxin ,Rubratoxin, Ochratoxin; fungal enzymes of commercial importance-amylases and cellulases, mycoprotein .

Suggested Readings (Latest Editions):

1. Chatterjee K.D. (2015). Parasitology, Calcutta publication.
2. David Greenwood (2015). Medical Microbiology, 18th edition.
3. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
4. J.G. Black(2015) –Microbiology, 9th edition, Wiley publication

5. Lee. R. E. (Latest Edition). Phycology, Cambridge University Press, Cambridge.
6. Talaro K.P. & Talaro A. (Latest Edition). Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi.
7. Sharma, P.D. (2016). Mycology and Phyotopathology, Rastogi Publications, Meerut

Experiments in Algal and Fungal Biology

1. Preparation of moist chamber for fungal isolation.
2. Isolation of fungi from soil.
3. Isolation of fungi from rhizospehere.
4. Isolation of fungi from different food sources.
5. To isolate fungi present in soil samples and calculate their relative abundance and frequency of occurrence
6. To study the fungal morphology by lactophenol cotton blue staining.
7. To study the fungal morphology by potassium hydroxide mounting.
8. Preparation of permanent fungal mounts.
9. Collection of different types of lichens.
10. Study of dimorphism in yeast.
11. Isolation of various algae from different habitat

BM.Sc. I Year **Semester – I**

BMH 704

BMH 704 Biostatistics, Computer Applications and Bioinformatics

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the statics role in biological and Research industry
- To understand the basic concept biostatics and computer.

Learning outcomes:

At the end of course students will be able to explain the role of computer and statics in Microbiology development and what is the scope of the various field of the subject and other beneficial roles.

Unit I:

Presentation of data; Frequency distributions; Graphical representation of data by histogram,

polygon, frequency curves and pie diagram. Measures of central tendency: Mean, median and mode; Measures of dispersion: Mean deviation, standard deviation, coefficient of variation;

Unit II:

Correlation : properties, nature, coefficient of correlation, , significance of correlation Probability: Basic concepts related to probability theory, classical probability. Probability Distributions

Unit III:

Testing of significance: Students t-test for the significance of population mean, Chi square test for population variance, F-test for the equality of two population variance; Analysis of variance-One-way

Unit IV:

Introduction to Computers: Definition, Components of computer, Basics for operating systems Introduction to MS Office (MS-Word, MS-Excel, MS-Power Point); Introduction to Networking Computer application in Microbiological ,fermentation and Pharmaceutical Industry

Unit V:

Introduction to Bioinformatics: Definition and scope; Search engines: tools for web search; Introduction to biological databases (NCBI, EBI, DDBJ, Gen Bank,),Introduction to BLAST and FASTA studies.

Suggested Readings (Latest Editions):

1. Bailey, NT J (2000). Statistical Methods in Biology. English Univ. Press.
2. Campbell R.C (Latest Edition). Statistics for Biologist. Cambridge University Press, UK.
3. Sinha PK (Latest Edition). Fundamentals of computers. BPB Publication, New Delhi
4. Jonathan, P. 2008. Bioinformatics & Functional Genomics.
5. B.D.Singh(2015). Biotechnology, Kalyani Publication.
6. Sharma and Munjal(2015). A test book of Bioinformatics, Rastogi publication

Experiments in Biostatistics, Computer Applications and Bioinformatics

1. Representation of statistical data by 1. Histogram
2. Curves 3. Pie diagrams
2. Determination of averages or Central tendencies (Mean, Mode, Median) 3. Determination of measures of dispersion (Mean deviation, Standard deviation and Coefficient of variation, Quartile deviation)
4. Application of Tests of significance (Chi-Square test, student t-test, Standard error)
5. Applications of computers in biology using MS-office (MS-Word, Excel, Power point)
6. Introduction to LAN Networking
7. Introduction to Internet (E-Mail, File Transfer Protocol, Usenet, Telnet).
8. Introduction to different primary and secondary databases.

9. To access scientific data from Literature data bases (PUBMED, LITDB, Medline) 10. To access nucleic acid databases for retrieval of gene sequence.
11. To access protein databases for retrieval of amino acid sequence of target protein.
12. To perform multiple sequence alignment using BLAST.

M.Sc. I Year **Semester – I**

BMH 706

BMH DS 706 **HISTORY AND SCOPE OF MICROBIOLOGY**

MM : 100 Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4

Total Hours: 60

Learning objectives:

- To understand the statics role in biological and Research industry
- To understand the basic concept and role of microorganisms as beneficial and harmful .

Learning outcomes:

At the end of course students will be able to explain the role of Microbiology development in different field and what is the scope of the various fields of the subject and other beneficial roles.

Unit 1-

History and Development of microbiology , spontaneous generation vs biogenesis, golden age of microbiology branches of microbiology; germ theory of disease, Scope and relevance of Microbiology; Development of microbiology 20^{th} and 21^{st} century Golden era of Microbiology, , Development of various microbiological techniques, Establishment of fields of medical microbiology and immunology.

Unit 2-

Microbes in Human Health & Environment, Medical microbiology and immunology: List of important human diseases and their causative agents. Environmental microbiology: Definitions and examples of important microbial interactions,

Unit 3

Application of microorganisms: bio-pesticides, bio-fertilizers, biodegradation, bio-deterioration and bioremediation,

Unit 4

Role of microorganisms in fermentation, microbes producing important industrial products through fermentation. Biofuels, Microorganisms in food spoilage and food borne infections.

Unit 5

Concept of ecosystem: Types. Structure and function of ecosystems. Trophic levels: Primary and secondary production. Energy flow: ecological pyramids, food chains and food webs.

M.Sc. I Year **Semester – II**

BMH 801

BMH 801 Microbial Biochemistry

MM : 100

Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4

Total Hours: 60

Learning objectives:

- To understand the statics role in biochemistry in microbiology
- To understand the basic concept of macromolecules .

Learning outcomes:

At the end of course students will be able to explain the role of macromolecules in Microbiology development and what is the scope of the various fields of the subject and other beneficial roles.

Unit I

Carbohydrates : Structure and Properties and uses of monosaccharides, oligosaccharides and polysaccharides, glycoproteins, glycolipids, proteoglycans, mutarotation, annomerisation, epimerization, stability of polysaccharides

Unit II

Structure and properties of amino acids, Structure of protein (Primary, Secondary, Tertiary and Quaternary), essential and non-essential amino acids, general reactions of amino acid metabolism, urea cycle, synthesis of various molecules via amino acid metabolism intermediates, non-standard Amino Acids

Unit III

Structure and properties of fatty acids, storage and membrane lipids, phospholipids and cholesterol, Composition and synthesis of lipoproteins and their transport in the body, oxidation of fatty acids (beta & alpha), oxidation of long chain fatty acids, Synthesis of lipids, elongation

of fatty acids, desaturation of fatty acids, regulation of fatty acid synthesis, cholesterol metabolism, regulation of cholesterol metabolism.

Unit IV:

Structure, composition and properties of nucleic acids, De-Novo synthesis of purine and pyrimidine nucleotides and its regulation. Synthesis of nucleoside di- and triphosphates, deoxynucleotides and TMP and degradation of purine and pyrimidine nucleotides, salvage pathways of nucleotides synthesis...

Unit V:

Structure,and properties of vitamins, co-enzymes, biochemical action of vitamins and Fat and water soluble vitamins, Biosynthesis of vitamins, role of vitamins in the metabolism.

Suggested Readings (Latest Editions):

1. Nelson D and Cox MM. (2010). Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York.
2. Voet D and Voet JG. (2013). Principle's of Biochemistry. John Wiley and sons New York.
3. Moat AG and Foster J W (Latest Edition). Microbial Physiology. John Wiley and Sons, New York.
4. Stryer. L (2003). Biochemistry. W. H. Freeman and Co.
5. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hil
6. J.L. Jain(2015).Fundamentals of Biochemistry, S. Chand and Co.
7. U. Satyanarayan(2015). Biochemistry, Elsevier

Experiments in Microbial Biochemistry

1. To carry out qualitative analysis of Carbohydrates
2. To carry out qualitative analysis of Lipids
3. To carry out qualitative analysis of amino acids
4. To carry out qualitative analysis of Proteins
5. To perform biochemical test of starch hydrolysis.
6. To perform biochemical test of casein hydrolysis.
7. To carry out estimation of DNA by Diphenylamine method
8. To carry out estimation of RNA by Orcinol method
9. To carry out estimation of protein by Biuret method.
10. To carry out separation of amino acid by Paper Chromatography and determination of Rf value TLC of fatty acids/lipids
11. To detect presence of reducing sugar using Benedict's test.
12. Determination of absorption maxima of given sample using spectrophotometer.
13. To demonstrate carbohydrate metabolism (oxidation and fermentation of Glucose) in microorganisms

14. To demonstrate Fat hydrolysis (lipase activity) by bacteria
15. To study ability of microorganisms to hydrolyze gelatin
16. To demonstrate degradation of sulphur containing amino acids by bacteri

M.Sc. I Year **Semester – II**

BMH 802

BMH 802 Techniques of Microbial Genetics and Molecular Biology

MM : 100

Sessional : 25

Time : 3 hrs ESE : 75

L Credit Pass Marks : 40

4 4

Total Hours: 60

Learning objectives:

- To understand the Microbial technology and Molecular biology.
- To understand the basic concept genetic material;.

Learning outcomes:

At the end of course students will be able to explain the role of gene and genetic material and microbial technology and what is the scope of the various fields of the subject and other beneficial roles.

Unit I-

Nucleic acids as genetic information carriers, DNA structure, types of DNA. DNA replication in prokaryotes and eukaryotes. Structural features of RNA (mRNA, tRNA, rRNA). Transcription in prokaryotes and eukaryotes.

Unit II-

Regulation of gene expression. Basic features of the genetic code. Protein synthesis in prokaryotes and eukaryotes. Recombination: general principles. Plasmids (types of plasmids- F plasmids, R plasmids, Col plasmids and Ti plasmid). Gene transfer mechanisms: transformation, transduction, and conjugation.

Unit III-

Mutations: spontaneous mutation, Induced mutagenesis- mutagens (physical mutagens: non ionizing and ionizing radiations; chemical mutagens: Base analogues, alkylating agents, deaminating agents, intercalating agents and others), molecular mechanism of mutagenesis. DNA repair mechanism: repair by direct reversal, excision repair, recombinational repair and SOS repair.

Unit IV-

Basic steps of r-DNA technology. Restriction endonucleases. Cloning vectors: general properties, plasmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes. Eukaryotic cloning vectors for yeast, and animal cells.

Unit V-

Molecular Techniques; Principles, methods and their applications in medical diagnosis - such as PCR, Southern Blotting, Northern Blotting, Western Blotting, DNA finger printing and DNA sequencing. DNA vaccines design and advantages. Recombinant vaccines.

Suggested Readings (Latest Editions):

1. David P Clark (2010). Cell and Molecular Biolgy
2. Robert J. Brooker (2011). Genetics, Analysis and principles, Mc Graw Hill.
3. J.E. Krebs (2011). Lewin's Genes X, Jones Pub.
4. T.A.Brown (2010). Gene cloning of DNA Analysis. Wiley Blackwell.
5. J D Watson (2008), Molecular biology
6. Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith (2012). Becker's Word of the cell.
7. William. D Stans Field (2012). Molecular and cell Biolgy, Mc Graw Hill pub.
8. Gerald Karp (2014). Cell Biology, Wiley Blackwell, Pub.

Experiments in Microbial Genetics and Molecular Biology

1. Isolation of plasmid DNA from E. coli.
2. Determination of Tm of DNA and RNA.
3. Electrophoresis of isolated DNA sample.
4. Isolation of bacteria from various samples by enrichment techniques and their identification by conventional biochemical and molecular methods.
5. Restriction digestion analysis by agarose gel electrophoresis.
6. Restriction digestion analysis by polyacrylamide gel electrophoresis.
7. Isolation of plasmid from mix cultures.
8. Isolation of genomic DNA.
9. Amplification of DNA by PCR
10. RAPD analysis
11. RFLP analysis 12. Separation and analysis of proteins by SDS-PAGE

M.Sc. I Year **Semester – II**

BMH 803

BMH 803 Microbial Environmental Technologies

MM : 100

Sessional : 25

Time : 3 hrs ESE : 75

L Credit Pass Marks : 40

4 4

Total Hours: 60

Learning objectives:

- To understand the Microbial technology and Environmental Microbiology
- To understand the basic concept Disposal of and Treatment of Waste .

Learning outcomes:

At the end of course students will be able to explain the role of microbes to treatment of water and microbial technology to water testing and what is the scope of the various fields of the subject and other beneficial roles.

Unit –1

Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Concept of biosphere, communities and ecosystems. Ecosystem characteristics, structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

Unit – 2

Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment, factors influencing eutrophication. Qualitative characteristics and properties of eutrophic lakes. Measurement of degree of eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, coloured waters, red tides, and cultural eutrophication. Physico-chemical and biological measures to control eutrophication

Unit –3

Microbiology of wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary treatments. Anaerobic processes: Anaerobic digestion, anaerobic filters, and upflow anaerobic sludge. Treatment schemes for effluents of dairy, distillery, tannery, sugar and antibiotic industries Bioconversion of Solid Waste and utilization as fertilizer. Bioaccumulation of heavy metal ions from industrial effluents .

Unit – 4

Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behaviour, biomagnification and degredative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues.

Unit – 5

Microbes and water potability. Purification of potable water; Sanitary analysis of water Standards (tolerable levels) of water quality of fecal contamination., Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

Experiments in Microbial Environmental Technology

6-09

1. To measure the D.O. of the given water samples.
2. To measure the BOD of the given water samples.
3. To measure the COD of the given water samples.
4. To determine the effect of temperature on microbial growth.
5. To determine the effect of pH on microbial growth.
6. To determine the effect of oxygen on microbial growth.
7. To study the production of lignocellulolytic enzymes (cellulases, hemicellulases and lignin degrading enzymes such as Lip, Mnp and Laccase.
8. To study the fungal degradation of lignocellulosic biomass (Crop byproducts).
9. To study the use of cellulases in saacharification of cellulosic material.
10. To study the microbiological quality of water samples from different sources.
11. To study the decolorization of distillery or textile industrial waste.
12. Determination of potability of water by MPN method

M.Sc. I Year **Semester – II**

BMH 804

BMH 804- RECOMBINANT DNA TECHNOLOGY

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit 44	Pass Marks : 40

Total Hours: 60

Learning objectives:

- To make students understand about the structure and function of biologically important molecules.
- To know the historical background of DNA structure and its role as genetic material.
- Become familiar with different tools and techniques used in genetic engineering and recombinant DNA technology.
- To understand the applications of DNA modifying enzymes, cloning strategies, vector types, and screening of recombinants
- Students will know how gene expresses and regulates in prokaryotic cells.

Learning outcomes:

At the end of course students will be able to

- Explain why DNA is the genetic material of bacteria.
- Explain the application of genetic engineering techniques in basic and applied experimental biology.
- Amplify the DNA using PCR for the diagnosis and DNA fingerprinting.
- Describe how protein synthesis occur in procaryotic cell and enzyme involved in it.

UNIT- I

Introduction to Genetic Engineering: Milestones in genetic engineering and biotechnology; Molecular Cloning- Tools and Strategies-Cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyltransferase, kinases and phosphatases, and DNA ligases Cloning Vectors: Definition and Properties Plasmid vectors: pBR, Cosmids, Expression vectors.

UNIT- II

Methods in Molecular Cloning:Transformation of DNA: chemical method, electroporation, Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viralmediated delivery, *Agrobacterium* - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern – blotting techniques, DNA Western blotting.

UNIT- III

DNA Amplification and DNA sequencing PCR: Basics of PCR, Real-Time PCR, Sanger's method of DNA Sequencing: traditional and automated sequencing.

UNIT- IV

Construction and Screening of Genomic and cDNA libraries: Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR.

UNIT - V

Applications of Recombinant DNA Technology: Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis.

Suggested Reading

1. Bruce Alberts. Molecular Biology of the Cells, W.W. Norton and Company, ISBN: 9780815344643
2. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.
3. Harvey, Lodish. Molecular Cell Biology, W.H.Freeman
4. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2

Experiments in Recombinant DNA Technology

1. Preparation of different models based on immunology.

2. Slide agglutination test.

3. Tube agglutination test / Passive agglutination. 4. To prepare soluble antigen by different methods.

4. To seperate serum and plasma from blood.

5. To precipitate immune-globulins by ammonium sulphate and to determine total protein contents.

6. To determine Blood group and Rh factor by slide agglutination test

7. To perform Radial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.

8. To perform immune-electrophoresis for separation of antigens and for detection of antigen and antibody reaction

9. To perform ELISA for assay of antibodies in serum sample against given antigen.

10. Demonstration of PCR.

11. Demonstration of Gel Electrophoresis test.

BHM –805
BMH 805- FOOD BORNE DISEASES AND FOOD PRESERVATION

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the prevalence of bacteria in food commodities.
- To understand the occurrence of food-borne diseases.
- To know the different test for the detection of food-borne infection.

Learning outcomes:

At the end of course student will be able to

- Explain the role of microorganism in food commodities.
- Explain the factor responsible for the growth of bacteria.
- Perform the different microbiological test to determine the quality of food.

UNIT – I

Food spoilage: Microbes in food, factors affecting microbial growth in foods: Extrinsic and intrinsic, microbial spoilage of foods, microbial spoilage of food – milk and milk products, fruits and vegetables, meat products, canned foods.

UNIT – II

Food preservation methods: Aseptic handling, temperature treatment, dehydration, lyophilization, osmotic pressure, radiations canning, chemical preservatives (salt and sugars, organic acids, propylene oxide, wood smoke and antibiotics), mechanism of chemical preservatives.

UNIT - III

Food-borne diseases (Bacteria and Virus): Food poisoning (food intoxication and food infections);Bacterial food poisoning (*Clostridium, Bacillus cereus* and *Staphylococcus);* Viral infections:Rotavirus, Hepatitis A & C,

UNIT – IV

Food-borne diseases (Fungus and protozoans): Fungal food poisoning (*Aspergillus* and *Penicillium*), health hazards of mycotoxins; Protozonal infections; *Entamoebahistolytica, Teniasolium, Fasciola hepatica*

UNIT - V

Methods for microbiological examination of food and quality control: Indicator organisms for assuring the suitability of food products, methods of microbiological examination, direct culture technique, enumeration methods (plate count and MPN), alternative methods (dye reduction tests), electrical methods, quality criteria, sampling schemes.

M.Sc. II Year **PM -901** **Semester – III**

PM 901 - Medical Microbiology

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- Students will understand the disease caused by the bacteria, fungi, virus and protozoa.
- To know the diagnosis and treatment of bacteria, fungi and viral pathogens.

Learning outcomes:

At the end of course students will be able to

- Understand the development and contribution of different scientist in the field of medical microbiology.
- Describe etiology, pathogenicity, epidemiology and laboratory diagnosis of disease caused by microorganism.
- To isolate and detect the pathogens from the clinical samples.
- Suggest different antimicrobial agent for the treatment of bacterial infections.

UNIT – I

Basics of medical microbiology- Early discovery of pathogenic microorganisms, development of bacteriology as scientific discipline, contribution of early microbiologists; classification of medically important microorganisms; normal microflora of human body, role of resident flora on human health; infection- types of infection, virulence, pathogenicity; characteristics of infectious diseases - disease cycle (sources of disease, reservoirs, carriers); transmission of pathogens.

UNIT – II

Bacterial Diseases: Characteristics of a successful pathogen, virulence factors- entry, adherence, invasiveness, iron sequestering, antiphagocytic factors, bacterial toxins (exotoxins and endotoxins and their mechanism of action), host-mediated pathogenesis, antigenic variation, immune suppression; bacterial diseases- characteristic features of causal organisms, symptoms, epidemiology, prophylaxis and treatment of diseases caused by *Salmonella, Vibrio, Mycobacterium, Neisseria, Corynebacterium, Staphylococcus.*

UNIT – III

Viral diseases- Classification, epidemiology, symptoms, pathogenesis, diagnosis and treatment of diseases caused by adenovirus, poxvirus, herpesvirus, hepatitis B virus, influenza virus, paramyxovirus (mumps, measles and rubella viruses), rabdoviruses, retrovirus (HIV) and ebola virus.

UNIT – IV

Fungal diseases- Significance of fungi in human health, mycoses and mycotoxicoses, superficial mycoses (tinea nigra), subcutaneous mycoses (chromoblastomycosis, basidiobolomycosis), dermatophytoses (tinea capitis, tinea barbae, tinea corporis, tinea cruris, tinea unguium, tinea pedis), systemic mycoses (histoplasmosis, candidiasis, aspergillosis).

UNIT – V

Diagnosis and antimicrobial therapy- Methods of specimen collection, transportation and storage; laboratory diagnosis-identification of pathogens through microscopy, culture, serology, antimicrobial chemotherapy - development of chemotherapy, antimicrobial drugs and their mode

of actions, drug resistance; drug sensitivity tests- significance in patient care, various methods of drug susceptibility testing, MICs, MBCs, antibiotic assay in body fluids; vaccines- vaccination schedules, schedules; nosocomial infections-factors affecting, sources and transmission, common types of hospital infections, prevention and control;

Experiments in Medical Microbiology

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 and H2S production on TSI agar slant) used for identification of medically important bacteria.
3. To perform sugar fermentation tests for identification of medically important bacteria.
4. Demonstration normal microbial flora of skin, mouth and throat.
5. Isolation and identification of Staphylococcal species using suitable media, staining techniques and biochemical tests.
6. Isolation and identification of Streptococcal species using suitable media, staining techniques and biochemical tests.
7. Isolation and identification of enteric fever causing bacteria (Salmonella typhi) using suitable media and biochemical tests.
8. Microbiological analysis of urine specimens.
9. Microbiological analysis of stool specimens.
10. Microbiological analysis of blood specimens.
11. Microbiological analysis of sput um specimens
12. To determine antibiotic sensitivity for Gram negative and Gram positive bacteria by disc diffusion method
13. To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
14. To evaluate antimicrobial chemical agents by log reduction method.

M.Sc. II Year **PM -902** **Semester – IIII**

902 - Fermentation Technology And Microbial Products

MM : 100

Sessional : 25

Time : 3 hrs

ESE : 75

L	Credit
4	4

Pass Marks : 40

Total Hours: 60

Learning objectives:

- To understand the scope and applications of industrial microbiology.

- To understand fermentation technologies used for the production of industrially important products.
- To understand how different fermentation product are produced, purified and recovered.

Learning outcomes:

At the end of course student will be able to

- Screen and isolate industrially important microorganisms.
- Make use of fermentor to produce alcoholic beverages and other fermentation products.
- Explain the different method of disinfection used in industry and also how to maintain quality of product.

Unit I

Fermentation: an overview, isolation, screening and selection of industrially important microorganisms, Crude and synthetic media; molasses, cornsteep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates. Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch and continuous fermentations.

Unit II

Bioreactors, design and components of basic fermentor, specialized fermentors for specific Purposes. Bioprocessing – Downstream processing of industrial fermentation processes, product purification and recovery, Physico-chemical basis of bio-separation processes, techniques for purification of end products – chromatography, distillation, crystallization,filtration.

Unit III

Antibiotic fermentations – production of β lactams (penicillins amino-glycosides (streptomycin),.Recombinant and synthetic Vitamins (B12, riboflavin A) Alcoholic beverages Whisky, Beer Wine and Cidar Vinegar microbes as food - single cell protein, mushrooms, probiotics.

Unit IV

Biofertilizers, sources of nitrogen and Phosphate solubilizing microorganisms, Biofertilizer production technology-strain selection, sterilization, growth, standards and quality control, Biopesticides –production of biopesticides from bacteria, fungi and viruses and their applications against different types of pathogens. Bacillus thuringiensis (Bt) as a major biopesticide, role of Bt in pest control,

Unit V

Production of organic solvent acetone- butanol fermentation, glycerol Microbial polysaccharides (xanthan, dextran, alginate, gellan, cellulose, curdlan, microbial Enzymes – production and applications of enzymes such as invertase, pectinase, cellulase oxidase, catalase,

Experiments in - **Fermentation Technology And Microbial Products**

1. Isolation of antibiotic producing microorganisms from soil.

2. Laboratory production of alcohol from Grape Juice/Sugarcane Juice.
3. Demonstration of vinegar production in laboratory.
4. Bioassay of vitamin B_{12}.
5. Fat hydrolysis (lipase activity) by a given bacterial culture.
6. Demonstration of fermentation by yeast.
7. Determine the Vitamin B12 Assay
8. Determine the Antibiotics Sensitivity Test
9. Production of Alcohol, Vinegar and Cidar Vinegar in Lab
10. Quality control test of Biofertilizers
11. Production of Biofertilizers
12. Detect the presence of antibiotic in milk samples.
13. . Production of sauerkraut by microbial fermentations
14. . To prepare yoghurt in laboratory.
15. . Production of citric acid from whey. 14. Production of single cell protein

M.Sc. II Year **PM -903** **Semester – III**

903 - Pharmaceutical and Food Microbiology

MM : 100

Sessional : 25

Time : 3 hrs
ESE : 75

L Credit
4 4

Pass Marks : 40

Total Hours: 60

Learning objectives:

- Students will learn about the basics of pharmaceutical microbiology and important microorganism playing role in pharmaceutics.
- To understand different products of microbial origin playing key role in pharmaceutical applications.
- To understand role of secondary metabolites in pharmaceutical industry.
- To understand good practices and regulation involved in utilizing microbial product for pharmaceutical applications

Learning outcomes:

At the end of course students will be able to

- Describe how antibiotic work and resistance develop in microorganisms.
- Suggest good practices and regulation involved in utilizing microbial product for pharmaceutical applications.

- Design microbiology laboratory and explain the safety measures used in microbiology laboratory.

Determine antibiotic sensitivity, MIC, MBC and other quality parameter of microbiology laboratory.

UNIT – I

Control Measures: Non-medicinal antimicrobial agents:- Bacteriostatic and bactericidal agents, factors affecting antimicrobial activity; sanitizers, disinfectants, antiseptics, , filtration, high temperature antimicrobial action of phenols and phenolic compounds, alcohols, halogens, UV Light detergents, Discarding biohazardous waste – Methodology of Disinfection

Unit – 2

Quality Assurance and Validation- Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals. SOP , Specification and Calibration of Microbiological Instruments

Unit – 3

Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization) Chemical and biological indicators. Design and layout of sterile product manufacturing unit. (Designing of Microbiology laboratory) Safety in microbiology laboratory Culture and microscopic methods - Standard plate count Biochemical and immunological methods: Limulus lysate test for endotoxin, geldiffusion, sterility testing for pharmaceutical products. microbiological assays: assays for growth promoting substances vitamin assay (B12), Assay for growth inhibiting substances – Antibiotics, drug sensitivity testing methods and their importance; determination of MIC, Preservative Efficacy Test

Unit 4

Methods for microbiological examination of food and quality control and Standard : Indicator organisms for assuring the suitability of food products, methods of microbiological examination methods (plate count and MPN), quality criteria Food Hygiene – Food-borne Infections and Intoxications, Microbial Toxins, Indicator Organisms, Food preservation methods Radiations - UV, Gamma and microwave Temperature Chemical and naturally occurring antimicrobials

UNIT - V

Concept of food safety and standard Authority of India (FSSAI), Hazard analysis of critical control point (HACCP; Indian and International Quality Systems and Standards (BIS, ISO, Codex Alimentarius, Codex India, etc.); CEDAC; Food Adulteration

Experiments in Pharmaceutical and Food Microbiology

1. Microbial limit test of given sample

Learning outcomes:

At the end of course student will be able to

- Explain the different components of immune system and how they provide defense against infections.
- Describe how our immune system protects against foreign pathogens.
- Diagnose the viral and bacterial infection through different serological tests.
- Gain knowledge of different diseased conditions generated due abnormalities in immune system.
- Explain antigen antibody reactions.

UNIT – I

Immune system and Immunity: History of immunology, structure, composition and function of cells and organs involved in immune system; Host-parasite relationships; microbial infection; immune response – naturally acquired immunity; artificially acquired immunity;

UNIT – II

Antigens and Antibodies- Antigens- structure and properties (types, haptens, adjuvants); antigen specificity; Immunoglobulins: Structure and properties of immunoglobulin classes. Theories of antibody formation, hybridoma technology for monoclonal antibodies and designer monoclonal antibodies. Multiple mylomas and structural basis of antibody diversity. Freund's adjuvants and its significance.

UNIT - III

Antigen-Antibody reaction by precipitation, agglutination and complement fixation. Non-specific immune mechanism: - Surface defenses, tissue defenses, opsonization, inflammatory reaction, and hormone balance. Tissue metabolites with bactericidal properties (lysozyme, nuclein, histone, protamine, basic peptides of tissues – leukins, phagocytins, lecterins, haemocompounds) . Immuno-assays: Widal test, haemagglutination, precipitation, complement fixation, ELISA, , RIA, Immunofluroscens and their application. Immune deficiencies and autoimmunity.

UNIT – IV

Regulation of immune response: antigen processing and presentation, generation of humoral and cell mediated immune response, activation of B and T lymphocytes, cytokines and their role in immune regulation, T cell regulation, MHC restriction, immunological tolerance. Cell mediated cytotoxicity: Mechanism of T cells and NK mediated lysis, antibody dependent cell mediated cytotoxicity, and macrophage mediated cytotoxicity. Complement system Transplantation immunology: MHC, types of grafts, , GVH reactions, mechanism Of graft rejection, and prevention of graft rejection.

At the end of course student will be able to

- Explain the different components of Microbes involved in different product processing .
- Describe how these microbial products beneficial for welfare.

Unit 1:

Nutraceuticals- Probiotics, Prebiotics, Synbiotics, SCP, Applications.

Unit 2:

Biosensors Definition, Components, Basic Characteristics, Principles, Applications. Bioplastics Definition, Properties, types and composition Environmental impact.

Unit 3:

Applications of Microbes in Biotransformation Definition, types of microbial transformations/bioconversions, biocatalysts,

Unit 4

Immobilisation methods and Applications Introduction, preparation of immobilised enzymes, RNAi Definition, RNA silencing and applications

Unit 5.

Nanotechnology Definition of nanoparticles, types, characterization and properties. Applications - drug delivery systems, antifouling, degradation of xenobiotics .

MSc IInd Year **IV Semester**

INDUSTRIAL TRAINING/ PROJECT REPORT

PROJECT EVALUATION

SEMINAR

VIVA-VOCE

MM : 600

Project , Training,/ Dissertation Writing evaluation : 300

Credits: 24

Project Seminar : 150

Viva-voce : 150