CHAUDHARY CHARAN SINGH UNIVERSITY, MEERUT

DEPARTMENT OF MICROBIOLOGY

Syllabus of (M.Sc. Microbiology)

(For Fourth and Fifth Years of Higher Education (PG))

As per Guidelines of U.P. Government according to National Education policy- 2020

w.e.f. the Session 2022-2023

(For both University Campus and Colleges)

1. Applicability

These regulations shall apply to the **Master in Microbiology** programme from the session 2022-23.

2. Minimum Eligibility for admission

A three/four-year Bachelor's degree or equivalent in Science (Biology group) awarded by a University or Institute established as per law and recognised as equivalent by this University with minimum 45% percentage marks or equivalent grade, shall constitute the minimum requirement for admission to the Master in Microbiology programme.

3. Programme Objectives

The M.Sc. Microbiology programme covers all aspects of Microbiology and involves classical, modern and inter-disciplinary approaches. The proposed syllabus endeavours to provide training in microbiological skills through lectures, projects, practical exercises and seminars/presentations.

4. Programme Outcomes

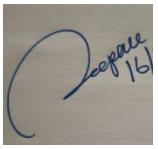
After completion of the two year Course in Microbiology, the students would have:

- Gathered substantive knowledge that prepares post graduates for careers in areas of Biochemistry, Medical Microbiology, Environmental and Food Sciences, Molecular Biology and Biotechnology.
- Developed an exploratory mind-set along with problem-solving and analytical skills, to enable a smooth progress into the area of research and teaching.
- Accumulated skills such as critical scientific thinking needed for data analysis.
- Received training in the preparation of a Dissertation from the Internship in the last Semester, designed as a vital, gainful component of practical training for the students.

5. Programme Employability

- Plan and conduct complex research projects, such as improving sterilization procedures or developing new drugs to combat infectious diseases.
- Perform laboratory experiments that are used in the diagnosis and treatment of illnesses
- Supervise the work of biological technicians and other workers and evaluate the accuracy of their results.
- Isolate and maintain cultures of bacteria or other microorganisms for study
- Identify and classify microorganisms found in specimens collected from humans, plants, animals, or the environment.
- Monitor the effect of microorganisms on plants, animals, other microorganisms, or the environment.
- Review literature and the findings of other researchers and attend conferences
- Prepare technical reports, publish research papers, and make recommendations based on their research findings.
- Present research findings to scientists, nonscientist executives, engineers, other colleagues, and the public.

Member of Board of Studies of M.Sc. Microbiology:

S. No.	Name	Designation	College/ University	Signature
1	Prof. Mridul Gupta	Dean, Faculty of Science	C.C.S. University campus, Meerut	
2	Prof. Y Vimala	Pro-VC & Head Convener -1	Department of Microbiology C.C.S. University campus, Meerut	
3	Dr. Neeraj Kumar	External Subject Expert	Department of Microbiology, Kurushetra University, Kurushetra	
4	Dr. Deepak Chand Sharma	External Subject Expert	Department of Microbiology, Dr. Shakuntala Mishra Rehabilitation University, Lucknow (UP)	
5	Dr. Charu Gupta	External Subject Expert	Department of Microbiology, Amity University, Noida	
6	Dr. Rajesh Kumar Sharma	External Subject Expert	Ret. Principle S.S.V. College Hapur	
7	Dr. Praveen Malik	External Subject Expert	Director NIAH Baghpat	
8.	Dr. kavita Chaudhary	Special Invitee Member	Government college Noida	
9.	Dr. Shalini Sharma	Special Invitee Member	Department of Microbiology M.I.E.T. College Meerut	
10.	Dr. Anjali Malik	Special Invitee Member	Department of Microbiology C.C.S. University Campus, Meerut	

Syllabus of (M.Sc. Microbiology)
(For Fourth and Fifth Years of Higher Education (PG))

As per Guidelines of U.P. Government according to National Education policy- 2020 w.e.f. the Session 2022-2023

Year	Sem.	Course Code	Paper Title	Core Compulsary/ Elective/Value added	Theory/ Pra.	Credits
Year I	Sem. I	MIC-CCSU-101	Microbial Tools and Techniques	Core Compulsory	Theory	4
		MIC-CCSU-102	Microbial Genetics	Core Compulsory	Theory	4
		MIC-CCSU-103	Microbial Diversity	Core Compulsory	Theory	4
		MIC-CCSU-104	Any one of the following I. Nutritional Therapy II. Natural Resources and Conservation	Core Elective/Value Added	Theory	4
		MIC-CCSU-105	Practical Lab	Core Compulsory	Practical	4
		MIC-CCSU-RP-I	Industrial Training/ Research Project/ Survey	Core Compulsory	Practical	4
		MIC-CCSU-OE-I	Food Quality Testing	Minor-Open Elective for other faculty	Theory	4
	Sem. 2	MIC-CCSU-201	Microbial Growth and Physiological Diversity	Core Compulsory	Theory	4
		MIC-CCSU-202	Molecular Biology and Genetic Engineering	Core Compulsory	Theory	4
		MIC-CCSU-203	Agriculture and Environmental Microbiology	Core Compulsory	Theory	4
		MIC-CCSU-204	Any one of the following I. Lab Diagnostic II. Food Microbiology	Core Elective/Value Added	Theory	4
		MIC-CCSU-205	Practical Lab	Core Compulsory	Practical	4
		MIC-CCSU-RP-II	Industrial Training/ Research Project/ Survey	Core Compulsory	Practical	4
Year II	Sem. III	MIC-CCSU-301	Immunology	Core Compulsory	Theory	4
		MIC-CCSU-302	Microbial biotechnology and industrial microbiology	Core Compulsory	Theory	4
		MIC-CCSU-303	Computer Applications, Bioinformatics, Statistics and Research Methodology	Core Compulsory	Theory	4
		MIC-CCSU-304	Any one of the following I. Food	Core Elective/Value Added	Theory	4

			II. Chemistry Food and Water borne Disease			
		MIC-CCSU-305	Practical Lab	Core Compulsory	Practical	4
		MIC-CCSU-RP-III	Industrial Training/ Research Project/ Survey	Core Compulsory	Practical	4
		MIC-CCSU-OE-II	Health and Hygiene	Minor-Open Elective for other faculty	Theory	4
	Sem. IV	**MIC-CCSU-401**	Medical Microbiology	Core Compulsory	Theory	4
		MIC-CCSU-402	Human, Animal and Plant Virology	Core Compulsory	Theory	4
		MIC-CCSU-403	Any one of the following I. Food Processing, Preservation and Packaging II. Food Safety	Core Elective	Theory	4
		MIC-CCSU-404	Any one of the following I. Epidemiology II. Pharmaceutical Microbiology	Core Elective/Value Added	Theory	4
		MIC-CCSU-405	Practical Lab	Core Compulsory	Practical	4
		MIC-CCSU-RP-IV	Industrial Training/ Research Project/ Survey	Core Compulsory	Practical	4

The types of paper, number of papers, credit for each semester and research project semester wise, as per guidelines of UP state govt. letter no. 401/sattar-3-2022, dated February 09, 2022, as a part of NEP-2020 implementation in U.P. universities, have been prepared as above.

The maximum and minimum marks for each Theory paper, Practical papers (internal & external) and projects have been finalized according to the letter number-1032/sattar-3-2022-8(35)/2020, dated 9 February, 2022. The basic structure of the programme related to types of paper, number of papers, credit etc have been finalized according to the letter of government dated July 13, 2021.

Core Compulsory Courses: These are main (major) courses of the subject which every student has to study who has taken admission in PG (First and Second Year).

Core Elective Courses: These are full major courses of the subject/programme. There courses will selected by the studentsin 1/2/3/4 (or 7/8/9/10 in case of integrated PG) Semesters. The Botany department of university/colleges will run these courses in their department/colleges according to their resources/ specialization of teacher and students may opt them according to their choice.

Minor Electives: Some of the above courses, or any other such course developed by BoS, can be taken as Minor electives by the students of other Faculty, for multi-disciplinarily.

Value added course: Some of the above courses, or any other such course developed by BoS, can be taken as Value Added course (Minimum 2 Credits/ 30 Hours) by the students of other Faculty/ Subject, for value addition, besides the courses which are not part of the curriculum/mark sheet of the Botany students are opted by the students of the Botany can be treated as an add-on to the basic requirement for compilation of a degree programme.

Marks Distribution and Teaching hours

The marks distribution for each core and elective will be as

Maximum marks: 100 (Internal assessment 30 marks + External Assessment 70 marks). Teaching hours for each of the course will be 60 hours. Duration of Theory and Practical examination of each paper shall be 3 hours. The distribution of Internal Marks will be as follows

Internal Assessment	**Marks**
Class Interaction	5
Quiz	10 (5+5)
Seminar	7
Assignment(Charts/Flora/RuralService/TechnologyDissemination/field visits with report)	8
Total	30

For Practical the distribution of marks will be as follow

Internal Assessment	Marks
Practical Class Interaction	5
Viva voce	5
Two practical based exercises	10 (5+5)
Charts/model/ Collection	10
Total	30

For External practical examination the distribution of marks will be as follow

External Assessment	Marks
Viva Voce on Practical's	10
Report of Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models with reports	10
Table work / Experiments	40
Practical Record File	10
Total	70

Research Project:

B.Sc. IV year will be equivalent to M.Sc. 1st year. At the end of the 2nd(even) semester (B.Sc. VIII semester or MSc IInd semester) & 4th/10th semester (M.Sc.), the candidate will submit a research project, which will be evaluated by an external examiner & internal supervisor along with a presentation and viva-voce examination.

In Fourth year (B.Sc.) or MSc first year and Fifth year (MSc final) the topic of the research project will be chosen from among the core compulsory courses/core elective courses of that year.

In each semester, each student will work 4 hour/ week/ semester for 4 credit. In this way a project work will be of 8 credits (i.e. 16 credits for two years).

Research project may be interdisciplinary/ multidisciplinary. It may be an industrial training/ internship/ survey work. **Research project will be done under the guidance of the faculty member (s) preferably having PhD degree**. For this a co-supervisor may be chosen from a university, college, industry, research institute etc.

The research project will be of 100 marks. If any student publishes a research paper from his/her research project in a UGC care listed/ Scopus indexed or Thomsom rueter, then he/she will get 25 extra marks (although maximum marks will not exceed more 100). The marks obtained in research project will be coded in grades and they will be counted in the calculation of CGPA.

Credits: MSc Programme will be run semester wise and choice based credit system. MSc Ist year or B.Sc 4^{th} year will be of 52 credits whereas MSc 2^{nd} year will be of 48 credits.Each semester will be of 20 credits of courses (4 theory+1 practical, each will be of 4 credits) and thus the credits of two years (4 semesters) will be 80 credits.

A project work will be of 8 credits (i.e. 16 credits for two years). In other words it will be of 4credits/semester i.e. a total of 16 credits.

A minor elective will be of 4 credits.

Thus M.Sc Programme will be of 100 credits (52+48).

FIRST YEAR

I-SEMESTER

MIC-CCSU-101: MICROBIAL TOOLS AND TECHNIQUES
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will be able to:

- Learn the concept of sterile techniques for isolation of microbes in pure culture, and understand the principles of optical microscopy including generation of contrast.
- Gain knowledge about the instrumentation, working principle and applications of variedforms of spectroscopy needed to study bio-molecules and crystal structures.
- Understand chromatographic techniques for separation of bio-molecules.
- Understand the working principle behind electrophoresis, and study of antigen-antibody interactions, including applications for the identification of microbes.
- Learn centrifugation techniques, and forms of electron microscopy for the purification andcharacterization of microorganisms.

Unit I: Basic principles and methods of sterilization: control of microorganisms by physical and chemical methods, evaluation of antimicrobial agent effectiveness. Principle and functioning of LAF.

Unit II: Microscopy & Staining techniques: Basic principles for the examination of microbes by light, dark field, phase contrast, fluorescent and electron (transmission and scanning) microscopy, Specimen preparation and basic principles of Simple, Gram's stain, Capsule, Endospore, Flagella, Acid fast and Nuclear/Geimsa's staining.

Unit III: Basic principles and methods of media preparation: types of culture media, pH and buffers; Pure culture techniques: streak plate, dilution plate and spread plate method; maintenance of pure cultures; methods of preservation of various microbes.

Unit IV: Basic principles and applications of spectrophotometryUV-Visible spectrophotometry& Fluorimetry, Flame photometry and atomic absorption spectrophotometry; Paper and Thin layer chromatography, Types of Column Chromatography (column, gel filtration, ion-exchange and affinity chromatography); GLC, HPLC and FPLC.

Unit V: Miscellaneous techniques: Principles and applications of Electrophoresis for protein and DNA; Iso-electric focusing and 2-D gel electrophoresis;Centrifugation; Ultracentifugation; Dialysis, Ultrafiltration; Lyophilization.

Suggested Readings (Latest Editions):

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. T.A.Brown (2016). Gene cloning and DNA analysis, an introduction,Wiley Blackwell pub.
6. B.D.Singh (2015). Biotechnology, Kalyani publication.

MIC-CCSU-102: MICROBIAL GENETICS
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will be able to:

- Comprehensive, detailed understanding of the chemical basis of heredity
- Comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.
- Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.
- Understanding the role of genetic mechanisms in evolution.

Unit I: Mendelian Principles, Fine structure of a gene in prokaryote: The rII locus, complementation test, cistron, recon, muton, Diversity of Phage genomes, Life cycle of Bacteriophage (Lytic and Lysogenic), Linkage and Crossing over

Unit II: Mutation; spontaneous mutation, Induced mutagenesis- mutagens (physical mutagens; non ionizing radiation; chemical mutagens; Base analogues, alkylating agents, deaminating agents, intercalating agents & others), molecular mechanism of mutagens. Suppressor mutation; DNA repair mechanism; repair by direct reversal, excision repair, mismatch repair systems, recombinational repair & SOS repair.

Unit III: Recombination: Reciprocal and non reciprocal, mechanism of recombination; Holiday model and Fox model; Transposable element; Classes of transposable elements, nomenclature of transposable elements; insertion sequences (IS elements), Transposons (composite structure and complex transposons structure) mechanism of transposition.

Unit IV: Gene transfer mechanisms: bacterial transformation (mechanism of transformation, transfection, competence), transduction; generalized transduction, specialized transduction, conjugation; effective contact and pilli in conjugation, the 'F' factor, the conjugal transfer process, high frequency recombination (Hfr) Strains, Formation of F prime.

Unit V: Plasmids: types of plasmids (F plasmids, R plasmids, Col plasmids & Ti plasmid), control of copy no. and incompatibility; Bacteriophages, lytic phages-T_7 and T_4; lysogenic phages-λ & P1; M13 & φX 174.

Suggested reading (Latest Editions):

1. Freifelder O. Microbila. 2009. Genetics, Narosa publishing House.
2. Willey J. Sherwood L. & Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.
3. Berg J. M., Tymoczko J. L. & Stryer L. 2007. Biochemistry 6th Ed. W. H. Freeman and Company, New York. Glick B. R. Pasternak J. J. 2003. Molecular Biotechnology. ASM Press Washington D.C.
4. J D Watson (2008), Molecular biology
5. Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith (2012). Becker's Word of the cell.
6. William. D Stans Field (2012). Molecular and cell Biolgy, Mc Graw Hill pub.
7. Gerald Karp (2014). Cell Biology, Wiley Blackwell, Pub.

MIC-CCSU-103: MICROBIAL DIVERSITY
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will be able to:

- Know how to classify and compare the different types of microorganisms
- Know about bacterial and archaeal diversity and phylogenetic context.
- Learn the diversity of fungi and viruses.
- Understand the characteristics of pathogenic nematode and protozoa.

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Unit I: Discovery of microbial world; History, Scope and relevance of Microbiology Introduction to microbial biodiversity distribution, abundance, ecological niche of bacteria and archaea.History of the evolution of three domain of life. Modern trends in microbial taxonomy including RNA world. Current status of microbes in the living world, Bergey's Manual of determinative bacteriology, Brief developmental Current thoughts on microbial evolution including the origin of life.

Unit II: General characters of bacteria and Archaea; General characteristic of thermophiles, psychrophiles, osmophiles, acidophiles, alkaliphiles and halophile sincluding ecology, adaptation and biotechnological applications. General characteristics of Cyanobacteria- Ultrastructure and Economic importance.

Unit III: General account of fungi, classification of fungi and contribution of scientists, Cultivation, isolation and selection of some useful fungi Common genera–S*accharomyces, Rhizopus, Penicillium, Neurospora, Agaricus, Aspergillus,* Economic importance of Fungi.

Unit IV: General characters, nomenclature, classification, morphology and ultra-structure ofviruses; Capsid and their arrangement; Cultivation of viruses Bacteriophages, Cyanophages, Mycophages; General characters and structure of viroids, satellites and prions and major diseases caused by them.

Unit V: General characteristics of Protozoans and Helminth Parasites; Classification, characteristics and diversity of Protozoan and Nematodes with special reference to: *Plasmodium, Trypanosoma, Systoshoma, Taenia* and *Ascaris*

Suggested reading (Latest Editions):

1. Plant Pathology, G.N. Agrios, 5th ed, 2005, Elsevier.
2. Introductory Mycology, C.J. Alexopoulos, C.W. Mims and M. Blackwell, 4th edition, 1996, Wiley India.
3. Microbiology: An Introduction, G.J. Tortora, B.R. Funke, C.L. Case, 11th edition, 2016, Pearson India Education.
4. Plant Diseases, R.S. Singh, 10th edition, 2019, Scientific International Pvt. Ltd.
5. Phycology, Robert Lee, 4th edition, 2008, Cambridge University Press

MIC-CCSU-104 (I): CORE ELECTIVE/VALUE ADIDED: NUTRITIONAL THERAPY
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will be able to:

- Improved nutritional status, early recovery, improved immune status, and improved quality of life following critical illness.
- Understand that overall use of resources can be reduced by nutrition counseling, oral diet and oral supplements etc.

Unit I: Sources of Nutrition, Nutritional requirements of a healthy person, Therapeutic nutrition, Nutritional supplements, Artificial nutrition & types Functional foods & types, Prebiotics & Probiotics Neutraceuticals.

Unit II: Use of Therapeutic nutrition in Nausea, Vomiting, Swallowing problems & Weight loss , Allergies, Food allergies, Diagnosis and intolerance, Dietary management of food allergies, Pea nut allergy, Cow milk allergy.

Unit III: Diabetes types, complications, Therapeutic nutrition & management of diabetes; Fat and Cholesterol, Kidney (Renal) conditions, stones, Therapeutic nutrition & treatment

Unit IV: Cancer, dietary factors associated with cancer, Therapeutic nutrition and dietary management, Digestive disorders and diets, Metabolic conditions of liver & Gallbladder; Hepatitis, Cirrhosis

Unit V: Food for man: use of microbes and microbial enzymes in the improvement of nutritive quality of food, Microbiological criteria for food, Fruit juices, Food control.

Suggested reading (Latest Edition):

1. Adams M. R. & Moss M. O. Food Microbiology, Royal Society of Chemistry Publication, Cambridge.Pergamon Press.
2. Hobbs B. C. & Roberts D. Food poisoning and Food Hygiene, Edward Arnold (A division of Hodder and Stoughton London).
3. Robinson R. K. Dairy Microbiology, Elsevier Applied Sciences, London.
4. Jones, S., Quinn S., Textbook of Functional Medicine.
5. Jonathan V. Wright (latest Edition) Dr Wright's book of nutritional therapy
6. William C Frazier, Food Microbiology, McGraw Hill.

MIC-CCSU-104 (II): CORE ELECTIVE/VALUE AIDED: NATURAL RESOURCES AND CONSERVATION
4 Credits/40 Hours

Course Outcomes:

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

- Apprehend various components of land as a natural resource and land use planning.
- Know availability and distribution for water resources as applied to India.
- Analyze the components of air as resource and its pollution.
- Discuss biodiversity & its role in ecosystem functioning.
- Critically appreciate the environmental concerns of today.

Unit I: Land: Land as a resource, types of lands, conservation of land forms, deforestation, Soil health, ecological and economic importance of soil, impact of soil degradation on agriculture and food security, need for soil conservation, sustainable land use planning.

Unit II: Water: Global water resources, Indian water resources, Resources system planning. Water use sectors- domestic, industrial, agriculture. Water deficit and water surplus basins in India, equitable distribution, Inter-basin water transfers, Interlinking of rivers – Himalayan component, peninsular component, issues involved. Ground water.

Unit III: Air: Introduction, composition, sources and classification of air pollutants, National Ambient Air quality standards (NAAQS), Air quality index, effects of air pollution on human health. Ozone depletion weathering: physical, biogeochemical processes, erosion, agents of erosion.

Unit IV: Biodiversity: Introduction, Flora and Fauna, Importance of biodiversity, Economic values-medicinal plants, drugs, fisheries biogeochemical cycling. Threat to biodiversity, natural & anthropogenic disturbance, habitat loss. Conservation of biodiversity, National parks, wild life sanctuaries, zoological gardens, gene banks, pollen culture, ecological restoration, social forestry.

Unit V: Global warming: concept, indicators, factors and effects. Global climate change-indicators, health impacts, effect on biodiversity. Introduction to global efforts in conservation of biodiversity.

Suggested reading (Latest Edition):

1. Modi, P.N., "Irrigation Water Resources and Water Power Engineering". Standard Book House, New Delhi. 10th Edition, 2019.
2. Raghunath, H.M., "Groundwater",3rd Edition, New Age International Publishers, New Delhi, 2007.
3. Krishnan, M.S., "Geology of India & Burma". CBS publishers, New Delhi, 2017.
4. P.Jaya Rami Reddy, "A Textbook of Hydrology", University Science Press, New Delhi, 2011.
5. M N Rao and H V N Rao, "Air pollution", McGraw Hill Publications, 2017.

MIC-CCSU-105: Practical Lab
4 Credits/40 Hours

Practical in First Semester is based on MIC-CCSU-101 to MIC-CCSU-104

MIC-CCSU-RP –I
4 Credits

Industrial Training/ Research Project/ Survey (Practical Based)

MIC-CCSU-OE-I
FOOD QUALITY TESTING
Minor Open Elective for other faculty
4 Credits

Course Outcomes:

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

- Know about common food adulterants and their detection; know the legislator aspects of adulteration.
- Know about the basics of food microbiology, contamination and spoilage of different food items.

Unit: Milk and Milk Products- Quality Testing, Chemical and Microbiological analysis, Common disease caused by infected milk and milk products- their prevention and cure.

Unit II: Microbiological and chemical examination of low temperature stored food and beverages, frozen vegetables, pizza, soya cheese, Ice- creame, frozen yoghurt, frozen soup, soft drinks.

Unit III: Microbiological examination of seasonal fruits and vegetables and the common disease caused by infected fruits and vegetables.

Unit IV: Microbiological and chemical examination of common food adulterants in wheat, flour, sugar, turmeric, grounded coriander, salt, vegetables oils, ghee, honey etc.

Unit V: Common food preservatives and their effect on human health.

Suggested reading (Latest Edition):

1. Food Microbiology – Frazier, W.C., Ed-4, Mc. Graw Hill – 2013.
2. Microbiology by John Garbult Essentials of Food Microbiology - Arnold International Student edition 1997.
3. Betty - c Hobbs & Diane Roberts – Food poisoning and food hygiene sixth edition by Arnold International Students edition – 1993.
4. Practical Food Microbiology & Technology – Mountnety Gould, Ed-3, Krieger Publishing Company, 1992.
5. Modern Food Microbiology – Jay J.H. CBS Publishers, 1990.
6. The Microbiological safety of processed foods – Growther, Marthi, Oxford and IBH Publishers Pvt. Ltd., 1988.
7. Basic food Microbiology – Banwart G.T., CBS Publishers, 1987

FIRST YEAR

II-SEMESTER

MIC-CCSU-201: MICROBIAL GROWTH AND PHYSIOLOGICAL DIVERSITY
4 Credits/40 Hours

Course Outcomes:

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

- Understand the structure of macromolecules and their basic building blocks
- Know the mechanisms of ATP generation by microbes, and importance of heterotrophic metabolism, fermentation and chemolithotrophy.
- Learn the generation of ATP in a light driven process and pathways of CO_2 fixation by phototrophic microorganisms.
- Understand how enzymes, the biological catalysts, work and factors affecting their catalytic function.
- Know about nucleic acids and their building blocks, enzyme specificity, energy-rich compounds and biological nitrogen fixation.

Unit I: Oxidative phosphorylation, Substrate-level phosphorylation, ATP synthase and ATP generation, Chemolithotrophy (oxidation of hydrogen, iron, and reduced sulphur and inorganic nitrogen compounds by bacteria), Glycolysis and TCA cycle, anaerobic respiration (Denitrification, sulphate and sulphur reduction), Fermentative diversity, Lactic acid fermentation, Alcoholic fermentation

Unit II: Nutritional groups of microbes, nutritional uptake; transport across the membranes and cell wall (diffusion, passive diffusion, active transport, group translocation and iron uptake); Physiology of growth and kinetics, Growth curve, measurement of growth (biomass, turbidity, dry weight, protein content); environmental factors affecting microbial growth.

Unit III: Types of bacterial photosynthetic pigments reaction centres and antenna pigments, photosynthetic membranes, Anoxygenic and oxygenic photosynthesis, Electron flow in purple, green and cyanobacteria, generation of reducing power and ATP Carboxysomes, pathways for CO_2 fixation (Calvin cycle, reverse citric acid cycle, hydroxypropionate pathway, Acetyl-CoA pathway)

Unit IV: Carbohydrates: Structure and properties of starch, cellulose, hemicellulose, glycogen and their derivatives; structure of lignin; General characters of fats, saturated and unsaturated fatty acids, biosynthesis of fatty acids, oxidation of fatty acids.

Unit V: Classification, structure and properties of proteins, Structure of amino acids, Classification of essential amino acids based on polarity, Classification and nomenclature of enzymes; mechanism of enzyme action, enzyme inhibition, allosteric enzymes, enzyme kinetics.

Suggested Readings (Latest Editions):

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

MIC-CCSU-202: MOLECULAR BIOLOGY AND GENETIC ENGINEERING
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will be able to:

- Understand the regulation of transcription through the various operons, and the mechanics of translation in bacteria.
- Know about enzymes, vectors and cloning strategies in genetic manipulation.
- Learn about recombinant DNA technology and methods of DNA sequencing.
- Understand the protocol for cloning of a DNA fragment in a plasmid vector, transformation of bacterial cells and screening of cDNA libraries to identify a clone of interest.
- Learn techniques in molecular biology such as PCR, RFLP and DNA microarray that are useful in diagnosis.

Unit I: Nucleic acids as genetic information carriers: DNA structure: historical aspects & current concepts, melting of DNA, types of DNA. DNA replication in prokaryotes and Eukaryotes : types of polymerases, steps: initiation, elongation (Asymmetric & dimeric nature of DNA Polymerase III & simultaneous synthesis of leadind & lagging Strands), termination. synthesis of telomeric DNA. Various modes of replication.

Unit II: Types and Structural features of RNA (mRNA, tRNA, rRNA): Transcription in prokaryotes and Eukaryotes: types of RNA polymerases (I, II & III); steps: initiation, elongation & termination. Inhibitors of RNA synthesis. Post trancriptional modification of mRNA: Basic features of the genetic code: Central dogma of life. Protein synthesis in prokaryotes and eukaryotes; steps-details of initiation, elongation & termination; Post translational modification of proteins.

Unit III: Regulation of gene expression: operon concept, negatve & positive regulation inducers and corepressors, catabolite repression. Negative regulation *E. coli*. lac operon; positive regulation- *E. coli*. ara operon; regulation by attenuation- his and trp operons, antitermination.

Unit IV- Basic steps of r-DNA technology. Restriction endonucleases. Cloning vectors: general properties, Plasmids (types of plasmids- F plasmids, R plasmids, Col plasmids & Ti plasmid). bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes. Eukaryotic cloning vectors for yeast, & animal cells. Gene libraries: genomic library, cDNA library.

Unit V- Molecular Techniques; Principles, methods & their applications in medical diagnosis - such as PCR, Southern Blotting, Northern Blotting, RFLP, RAPD, Western Blotting, DNA finger printing and DNA sequencing.

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.

MIC-CCSU-203: AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will:

- Know about the role of microbes in soil fertility
- Know about bacterial and fungal interactions with plants and animals and other microbes
- Learn the diversity of microbes in environment
- Understand the sewage treatment methods
- Learn about the pathogenic aspects of the various groups of microorganisms, their disease cycles and control measures associated with different plants

Unit I: Microorganisms as biofertilizers: *Rhizobium*, *Azospirillum*, *Azotobacter*, Cyanobacteria, commercial production of biofertilizers, biopesticides and mechanism of biological control, Commercial reality of biopesticides limitations for Indian agriculture, Integrated pest management.

Unit II: Soil microbiology: Soil as a habitat for microorganisms; Microbial diversity in surface soils, Biogeochemical cycles- C, N, S, P, Microbiology of composting, Microbial decomposition of organic matters, Microbiomics and microbial interactions, Phyllosphere, Rhizosphere, Endophytes, PGPM, Mycorrhiza.

Unit III: Microbial degradation, deterioration and bioremeadiation, Biodegradation of xenobiotics including pesticides and military chemicals (explosives and gases); Biocorrsion of metals; Microbe–metal interactions (bioleaching, biomining, biohydrometallurgy), Integrated microbial bioremediation including oil spills, Role of biosurfactants.

Unit IV: Microbes and water potability- Purification of potable water; Sanitary analysis of water (indicator microbes and methods of their detection), Standards of water quality of faecal contamination. Microbes in solid waste and sewage management, Sanitary landfills and composting.

Unit V: Solid waste management in India. Methods of sewage management; composition of sewage, small scale and modern sewage treatment methods, oxidation ponds, trickling filters, biodisc system, Measurement of water quality after sewage removal.

Suggested Readings (Latest Editions):

1. WilleyJ,SherwoodL.andWoolvertonC,2020,Prescott'sMicrobiology, 11thediMcGrawHil
2. J.G.Black, Microbiology, Principles and Explorations,2015,9thedition,Wilepublication.
3.R.C.DubeyandD.K.Maheshwari,ATextbookofMicrobiology,3rdedition,2013,S.Chand Co.
4.G.N. Agrios,Plant Pathology,,5thed, 2005,Elsevier

MIC-CCSU-204 (I): CORE ELECTIVE/VALUE AIDED:
LAB DIAGNOSIS
4 Credits/40 Hours

Course Outcomes:

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

- Understand the collection the clinical samples with aseptic Techniques.
- Know about the different staining techniques for different structures
- Learn about whole blood with other aspects
- Also understand the different human disease diagnosis their prevention and control

Unit I: Collection, transport and storage of clinical specimens; Prevention and control of laboratory acquired infections; Identification of Microorganisms; Different staining techniques: simple, Gram's staining, Ziehl-Neelsen method for AFB, Flurochrome staining, Giemsa's staining and special staining methods to demonstrate granules, capsule and endospores.

Unit II: Laboratory diagnosis of Diarrhoea, sore-throat, pyrexia of unknown organs, sexually transmitted disease, Urinary tract infection, Respiratory tract infection.

Unit III: Haemoglobin estimation; Blood collection: venipuncture; White blood cells (WBC), Red blood cells (RBC) and Platelet count; Staining and Differential Leucocyte Count (DLC); Erythrocyte Sedimentation Rate (ESR), Haematocrit, and Absolute values; Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC); Blood grouping.

Unit IV: Clinical pathology: physical, chemical and microbiological examination of urine, stool, CSF and blood culture; Semen analysis; Pregnancy test.

Unit V: Infection in clinical practice: Infections of the Skin and Tissues, Central nervous system, Eye and surrounding structure, Bone and Joints, Congenital and Neonatal infections, Hospital patients infections, Immunocompromised patients's infections.

Suggested Readings (Latest Edition):

1. Sangeeta Sharma (2010) Medical Laboratories management, Viva Publications.
2. Murray, P.R., Baron, E.J., Pfaller, M.A., Tenover, F.C. and Yolken, R.H. (latest Edition) Manual of
3. Clinical Microbiology, American Society for Microbiology, ASM Press.
4. Akhil Bansal (2012). Basic of body fluids analysis of undergraduate and post graduate students. Pvt
5. Ltd.
6. Fleming, D.O., Richardson, J.H., Tulis, J.J. and Vesley, D. (latest Edition) Laboratory Safety:
7. Principles and Practices, ASM Press, Washington, D.C.
8. Truant, AL (latest Edition). Manual of Commercial Methods in Clinical Microbiology, ASM Press Washington, D.C.
9. Estridge, B.H., Reynolds, A.P. and Walters, N.J. (latest Edition). Basic Medical Laboratory Techniques, Delmar, Thomson Learning.

MIC-CCSU-204 (II): CORE ELECTIVE/VALUE AIDED:
FOOD MICROBIOLOGY
4 Credits/40 Hours

Course Outcomes:

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

- Understand the significance and activities of microorganisms in food
- Know the characteristics of food borne, water borne and spoilage microorganisms, and methods for their isolation, detection and identification.
- Learn the use of standard methods and procedures for the microbiological
- analysis of food.

Unit I: Important microbes involved in spoilage of food, meat, poultry, vegetables and dairy products; factors affecting food spoilage, different types of spoilage, food preservation.

Unit II: Bio-deterioration of food items, Bacterial and mycotoxins, Important microbes secreting toxins, chemical nature of important toxins; their role in food poisoning; physiology and mechanism of action, control of toxin contamination.

Unit III: Uses of microbes in meats and poultry products, vegetables *etc*. Use of microbial enzymes in food; low calorie sweetners, Flavour modifiers; Food additives.

Unit IV: Microbiological examination of milk, standard plate count, direct microscopic count and reductase test, composition of milk, sources of contamination of milk, types of microbes in milk, pasteurization of milk, ability of milk to cause disease.

Unit V: Common food borne pathogens, diseases caused by them and their symptoms, Disease caused by bacteria, molds and yeasts, viral contamination of foods, parasites, Surveillance system for tracking of food borne disease.

Suggested Readings (Latest Editions):

1. Butt, TM, Jackson CW and Magan N. Fungi as Biocontrol agent. CABI Publishing, UK.
2. Adams Food Microbiology.
3. Prajapati Fundamentals of Dairy Microbiology.
4. John C, Ayres OM, William ES. Microbiology of Foods. W. H. Freeman and Co.
5. Andrew Proctor Alternatives to conventional food processing, RSC pub.
6. Frazer WC and Westhoff DC Food Microbiology. Mcgraw Hill, New York.

MIC-CCSU-205: Practical Lab
4 Credits/40 Hours

Practical in Second Semester is based on MIC-CCSU-201 to MIC-CCSU-204

MIC-CCSU-RP –II
4 Credits

Industrial Training/ Research Project/ Survey (Practical Based)

SECOND YEAR

III-SEMESTER

MIC-CCSU-301: IMMUNOLOGY
4 Credits/40 Hours

Course Outcomes:
At the end f the course, students will be able to

- Understand the basic knowledge of immunological processes at a cellular and molecular level.
- Compare and contrast the origin, maturation process, and general function of B and T
- Describe the roles of different types of T cells, B cells and APCs.
- Explain the importance of phagocytosis and natural killer cells in innate body defense.
- Describe surface membrane barriers and their protective functions.
- Trace the history and development of immunology.

Unit I: Introduction to the immune system: Innate immunity; anatomic, physiological, phagocytic & inflammatory barriers. Adaptive immunity; natural & artificial immunity. Cells involved in immune response: lymphoid lineage (producing B & T lymphocytes) & Myeloid lineage (phagocytes: macrophages, neutrophils & eosinophils and auxillary cells; basophils, mast cells & platelets). Organs involved in immune system: primary & secondary lymphoid organs.

Unit II: Antigens: preparation of antigens, types of antigens- haptens, superantigens & cluster of differentiation molecules (CDs), Processing and presentation of antigens.. Immunoglobulins: structure & types of immunoglobulins, genetic diversity of immunoglobulins, catalytic antibodies. B-cell biology & T-cell biology (major histocompatibility complex (MHC) molecules). HLA and H-2 systems.

Unit III: Vaccines immunizations: types of vaccines (DNA vaccines, recombinant DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines) & their characteristics. Immune Disorders: hypersensitivities, autoimmune diseases, transplantation (tissue) rejection, immunodeficiency's.

Unit IV: Complement: Classical alternative and lectin pathway of complement activation, regulation of complement system, biological consequence of complement activation. Cytokines: interferons (α, β & γ), TNF, interleukins (1-16), hematopoietins & chemokines.

Unit V: Monoclonal antibodies: hybridoma technology, applications of monoclonal antibodies. Antigen-Antibody reactions in vitro: agglutination reactions (Widal, Haemagglutination), precipitation reactions (Immunodiffusion, Immuno electrophorectic method), Immunoassays; Immunoblotting, ELISA and RIA.

Suggested Readings (Latest Editions):

1. Riott M (2003). Essentials of Immunology. Blackwell ScientificPublishers,London.
2. Claus D (2005). Immunology- Understanding of Immune System. Wiley - Liss, NewYork.
3. William P (Latest Edition). Fundamentals of Immunology.
5. Tizard Ian R (2009). Immunology. An introduction, 4th Edition.
6. Kindt, Goldsby and d Osborne (2013). Kuby Immunology. MacMillan HigherEducation.

MIC-CCSU-302: MICROBIAL BIOTECHNOLOGY AND INDUSTRIAL MICROBIOLOGY

4 Credits/40 Hours

Course Outcomes:

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

- Understand the module, students will be able to demonstrate a knowledge and understanding of: Basic fermentations processes, design of various fermentors and their types. Different separation techniques and application of fermentation in waste treatment.
- Select industrially important microbes for economical use including protein products.
- Learn the economics of the fermentation for the total cost of production
- Demonstrate a knowledge and understanding of: Concept of ethanol production from different sources and ethanol tolerance, production of industrially important alcohols. Concept of organic acids, production methods and applications.

Unit I: Sources and characters of industrial microbes, their isolation, purification & maintenance. Screening of useful strains: primary screening & secondary screening. Strain improvement. Fermentation technology: Bioreactors: principles & designing, microbial growth kinetics in batch, continuous & fed-batch fermentation process**.** Fermentation media. Solid state fermentation & submerged fermentation.

Unit II: Microbial transformations with special reference to steroids & alkaloids. Primary & secondary metabolites. Commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.

Unit III: Microbiology & production of alcoholic beverages: malt beverages, wine & champagne. Commercial production of organic acids like acetic, lactic, citric, & gluconic acids. Commercial production of important amino acids (lysine & tryptophan), insulin & vitamins (vitaminB_{12} & vitamin A).

Unit IV: Immobilization of microbial enzymes and whole cells and their applications in industries. Food fermentations: bread, vinegar, fermented dairy products & their spoilage. Bioprocess Engineering: Downstream processing, various steps for large scale protein purification. Single cell proteins.

Unit V: Industrial enzymes production : Cellulases, Xylanases, Proteases, Amylases, Lipases & Pectinases and their applications. Bioconversion of waste for fuels (ethanol and methane). Mushroom cultivation.

Suggested Readings (Latest Editions):

1.Reed G (2004). Industrial Microbiology. CBS Publishers (AVI Publishing Co.) 2.Stanbury PF, Whitekar A. and Hall (2006). Principles of Fermentation Technology. Pergaman. McNeul and Harvey.
3. Creuger and Creuger (2005). Biotechnology- A textbook of Industrial Microbiology,Panima pub.
4. Casida LE (2010). Industrial Microbiology, Wiley Eastern.

MIC-CCSU-303: COMPUTER APPLICATIONS, BIOINFORMATICS, STATISTICS AND RESEARCH METHODOLOGY
4 Credits/40 Hours

Course Outcomes:
At the end of the course, students will be able to

- Demonstrate the ability to choose methods appropriate to research aims and objectives. Understand the limitations of particular research methods. Develop skills in qualitative and quantitative data analysis and presentation. Develop advanced critical thinking skills.
- Restate the principal concepts about biostatistics. collect data relating to variable/variables which will be examined and calculate descriptive statistics
- Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
- Existing software effectively to extract information from large databases and to use this information in computer modeling.
- Ability to understand the Software concepts and their applications

Unit I: Basic principles of research, objectives of research, importance, types of research: basic and applied, selection of a research topic and problem, literature survey and reference collection, formulation of hypothesis, research designs, sampling designs, plagiarism, bio-safety regulations in biological research. Report writing, research papers writing, oral and written presentation of research (Abstract/Synopsis),

Unit II: Impact Factor and Citation Index. Searching research information using J- gate and SCOPUS, Science Direct.

Unit III: Introduction to Biostatistics: Definition, Types of statistics, Applications and uses of Biostatistics, Identification and types of variable, Tabulation of data, Graphical presentation (categorical and metric data), charting of data using MSExcel; Sampling techniques; Frequency distribution; Measures of central tendency (mean, median and mode); Measures of dispersion: mean deviation and standard deviation; Correlation and regression.

Unit IV: Introduction and classification; Components of computer; generation of computers; Number system; Flow chart; Basics for operating system (MS-DOS, WINDOWS, Unix and Linux); Introduction to softwares; MS-Office (MS-WORD, Power Point, MS- Excel). Introduction to networking and internet

Unit V: Introduction to Bioinformatics, Role of Bioinformatics; Biological databases: Nucleic Acid Sequence Database, Protein Sequence Database and Protein Structure Database); obtaining BLAST Documentation and Help; Important bioinformatics websites (NCBI, EBI, SIB).

Suggested Readings:

1. Research Methodology: Methods and Techniques by C.R. Kothari, New Age International publisher
2. Research Methodology: A step by step guide for beginners by Ranjit Kumar, SAGE Publications Ltd
3. Statistical Methods, by S.P. Gupta, Sultan Chand & Sons Publications

MIC-CCSU-304 (I): CORE ELECTIVE/VALUE AIDED: FOOD CHEMISTRY
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will:

- Demonstrated ability to identify solutions to problems related to the chemical composition and functionality of food and to apply and expand upon the theoretical concepts.
- Ability to use terminology, appropriate to the field of food chemistry, correctly and contextually.

Unit I: Food chemistry, history, water structure and relations in food components, carbohydrates: monosaccharides, oligosaccharides and polysaccharides, starch and cellulose derivatives as food constituents, sugar and related products nutritional value, lipids: components, food lipids and health, antioxidants.

Unit II: proteins structure and functions, enzymes structure and functions, vitamins structure, types and functions, minerals and nutritional aspects, bioavailability of nutrients.

Unit III: Food oxidants, food pigments, natural and synthetic food colours, flavoring agents, sweeteners, emulsifiers and stabilizers, spices and herbs, food preservatives, organic foods, advantages and disadvantages of organic food, food fortification.

Unit IV: Food adulteration, types of adulteration: intentional adulteration, incidental adulteration, Food laws, food standardization and regulation agencies in India, national standards, international standards.

Unit V- Evaluation of food quality, sensory tests, types of tests, objective evaluation and instruments used for texture evaluation.

Suggested Readings (Latest Editions):

1. Voet D and Voet JG. Principle's of Biochemistry. John Wiley and sons New York.
2. Moat AG and Foster J. W. Microbial Physiology. John Wiley and Sons, New York.
3. Willey J, Sherwood L. and Woolverton C. Prescott's Microbiology, McGraw Hil
4. U. Satyanarayan. Biochemistry, Elsevier
5. Robinson Dairy Microbiology.
6. Jay JM Modern Food Microbiology. Van Nostraaand Reinhold Co., New York.
7. Andrew Proctor Alternatives to conventional food processing, RSC pub.
8. Frazer WC and Westhoff DC Food Microbiology. Mcgraw Hill, New York.
9. Srilakshmi B Food Science, New Age Publication.

MIC-CCSU-304 (II): CORE ELECTIVE/VALUE AIDED: FOOD BORNE AND WATER BORNE DISEASE

4 Credits/40 Hours

Course Outcomes:

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

- Identify potential sources of contamination in the food and water system
- Understand how food borne pathogens and chemical contamination of food can impact health
- Describe the steps involved in a food borne illness outbreak investigation, and the rationale for each
- Calculate the attack rate for a food borne and water borne illness outbreak
- Describe ways to prevent food borne and water illness.

Unit I: Classification of food borne diseases, Food poisoning, infection, and intoxication, non bacterial toxins and mycotoxins Sea food toxin, Poisioninig by chemicals.

Unit II Major food and water borne bacteria *S.aureus, Pseudomonas, Clostridium, Bacillus, Vibrio, E.coli, Salmonella, Shigella,* Major food and water borne Viruses- Polio virus, Rotavirus, SARS, Enterovirus

Unit III: Rapid methods for detecting microbial contaminants in foods, Interpretation and application of result and preventive measure

Unit IV: Irradiation replaces other food borne disease, microbiological aspect of food, transmission, symptoms, diagnosis, treatment, prevention of disease, Surveillance system for tracking food borne disease.

Unit V: Natural waters: Sources of contamination, Microbial indicators of fecal pollution and other pollution, IMViC test and Water quality test.

Suggested Readings (Latest Editions):

1. Marth, E.H. and Steele, J.L. Applied Dairy Microbiology, Marcel Dekker, Inc. New York
2. Frazer, W.C. and Westhoff, D.C.Food Microbiology, McGraw Hill, New York.
3. Willey, J., Sherwood, L. and Woolverton, C. Prescott's Microbiology, McGraw Hill, New York.
4. Murray, P.R., Pfaller, M.A., Tenover, F.C. and Yolken, R.H. Clinical Microbiology. ASM.

MIC-CCSU-305: PRACTICAL LAB
4 Credits/40 Hours

Practical in Third Semester is based on MIC-CCSU-301 to MIC-CCSU-304

MIC-CCSU-RP –III
4 Credits

Industrial Training/ Research Project/ Survey (Practical Based)

MIC-CCSU-OE II
HEALTH AND HYGIENE
Minor Open Elective for other faculty
4 Credits

Course Outcomes:

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

- Learn about the hygienic cleaning processes.
- Understand the concepts of body, hand, foot, mouth, hair, nail, face, eye, ear and nose hygiene and cleaning.
- Know the concepts of housing hygiene and health
- Understand the Role of public and government in Health promotion

Unit I: Individual health parameters, Determinants of Health, Key health indicators, Burden of diseases, Importance and Source of Public-health Data Health status in India: Standards, Relevance to social aspects, Future challenges in public health.

Unit II: Role of Public, Private and NGO in Health sector, Expenditure in Healthcare, Government Plans and Policies in India, The Global Health Council, The International AIDS Vaccine Initiative, Malaria Vaccine Initiative, World Health Organization (WHO).

Unit III: Public health and nutrition; Personal health, Food safety quality control and hygiene: Personal and domestic Hygiene. Classification of nutritional profiles of various foods and drinks, Balanced Diet, Nutritional Problems, Demography and Family Planning.

Unit IV: Epidemology and history of epidemiological diseases in India with special reference to COVID-19, Route of Transmission of Disease, Communicable and Noncommunicable diseases.

Unit V: Common Community Diseases like – Chickenguniya, Dengue, Malaria, Cholera, T.B., HIV/AIDS, Hepatitis: Their prevention and control

Suggested Readings (Latest Edition):

1. Gordon Edlin and Eric Golanty Health & Wellness Jones &BarlettPublisher.
2. Skolnik Richard Global Health 101 Jones &Barlett Learning
3. Mary-Jane Schneider Introduction to Public Health Jones &Barlett
4. Geofferey Campbell-Platt Food Science and Technology, Willey andBlackwell Publication, UK.
5. Lightfoot NF and Maier EA Microbiological analysis of food and water,Elsevier Publication, Netherland.

SECOND YEAR

IV-SEMESTER

MIC-CCSU-401: MEDICAL MICROBIOLOGY
4 Credits/40 Hours

Course Outcomes:

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

- Provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- Covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's Normal Microflora.
- Provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- Provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
- Understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

Unit I: Historical developments in medical microbiology: Normal flora of human body, role of the resident flora; collection of clinical samples and laboratory diagnosis of important bacterial infections, pathogenic microorganisms. Brief account of air, water and soil borne diseases of microbes and their preventive and control measures.

Unit II: Bacteriology: Brief account of important human diseases caused by *Staphylococcus; Streptococcus*; N*eisseria*; *Bacillus; Corynebacterium*; *Clostridium; Mycobacterium; Salmonella; Shigella* Lab diagnosis,Prevention and their control.

Unit III: Virology: Collection of clinical sample and laboratory diagnosis of important viral diseases; Mumps; Measles; Influenza; Adenovirus; Rhinovirus; Poxvirus; Hepatitis virus; Herpesvirus; Lab diagnosis,Prevention and their control.

Unit IV: Mycology: Classification of medically relevant fungi: Collection of clinical sample and laboratory diagnosis of important human fungal diseases; Candidiasis; Dermatophytosis; Aspergillosis; Cutaneous and subcutaneous mycoses; Systemic mycoses, Lab diagnosis,Prevention and their control.

Unit V: Parasitology: Important diseases caused by intestinal and urogenital protozoa: *Entamoeba*; *Giardia*; *Trichomonas*; Blood and tissue protozoa; *Plasmodium; Trypanosoma*; *Leishmania*; Cestodes: *Taenia*; Trematodes: *Schistosoma; Paragonimus*; Nematodes: Ascaris; *Ancylostoma*; Lab diagnosis, Prevention and their control.

Suggested Readings (Latest Edition):

1. Greenwood D. 2007. Medical Microbiology 4th Ed., I.K. International.
2. Murray P.R., Pfaller M.A., Tenover F.C., & Yolken R.H. 2007. Clinical Microbiology, ASM Press.
3. Talaro K. P. & Talaro A. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi. Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill. Atlas R. M. 1997. Principles of Microbiology II Ed., McGraw Hill.
4. Nester E. W., Anderson D. G. & Nester M. T. 2006. Microbiology: A Human Perspective, McGraw Hill

MIC-CCSU-402: HUMAN, ANIMAL AND PLANT VIROLOGY
4 Credits/40 Hours

Course Outcomes:

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

- Know how viruses are classified
- Understand the architecture of viruses
- Know the methods used in studying viruses
- Discern the replication strategies of representative viruses from the seven Baltimore classes
- Comprehend the intricate interaction between viruses and host cells

Unit I Origin and development of concept of virology; Collection of clinical samples; Cultivation of Viruses, Diagnostic techniques for viral diseases. Virus identification: Immunofluorescence, Immunoperoxidase test, Neutralization, Light microscopy and Electron microscopy.

Unit II Nature of viral zoonoses: Rabies, Haemorrhagic fevers, Yellow fever, Colorado tick fever, Viral Encephalitis (Japanese encephalitis, Venezuelan equine encephalitis, Eastern and Western equine encephalitis, St. Louis encephalitis, Murray valley encephalitis).

Unit III Human diseases caused by Orthomyxoviruses (Influenza), Paramyxoviruses (Mumps, Measles, Respiratory Syncytial Virus), Picornaviruses (Enteroviruses, Rhinoviruses), Poxviruses, Herpesviruses, Human Retroviruses, Adenovirus, Hepatitis.

Unit IV: Classification, characteristics and diversity of Plant Viruses with special reference to: Cucumber mosaic virus (CMV), Tobacco mosaic virus (TMV), Papaya ring spot mosaic virus (PMV) Tomato yellow leaf curl virus (TYCLV), Bhindi yellow mosaic vein virus (BYMVV).

Unit V: Prions: Structure, replication and diseases caused by them**,** Viroids; Emerging and re-emerging viral diseases.

Suggested Readings (Latest Edition):

1. David Greenwood (2015). Medical Microbiology, 18th edition.
2. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
3. J.G. Black(2015) –Microbiology, 9th edition, Wiley publication
4. Jawetz, Melnick and Adelberg's, (Latest Edition). Medical Microbiology, Mc Graw Hill Publishers.
5. S. Ram Raddy (2012) Essential of Virology, Scientific Pub.
6. Jane . Flint (2015) Principle of Virology, ASN Press.

MIC-CCSU-403 (I)
CORE ELECTIVE
FOOD PROCESSING, PRESERVATION AND PACKAGING
4 Credits/40 Hours

Course Outcomes:

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

- To enable the students to understand food composition and its physic chemical, nutritional, microbiological and sensory aspects.
- To familiarize the students about the processing and preservation techniques of variety of foods.
- To emphasize the importance of food safety, food quality, food laws and regulations
- To expose the students to different food processes used in industries and in research field.
- To prepare the students to accept the challenges in life sciences.
- To develop skills required in various industries, research labs and in the field of agriculture, food, human health.
- To enable the students to understand packaging materials and effective packaging processes.

Unit I: Primary processing: Introduction, Classification & Method of Cleaning, Sorting, Grading, Cutting, Seeding, Chilling and freezing.

Unit II: Secondary processing : Introduction, Classification & Method of Slicing, Pulping, Paste, Frying, Chilling and freezing, Milling.

Unit III: Common food processing: Introduction, Classification & Method of Cooking, Baking, Frying, Roasting, Toasting, Grilling, Blanching, and Extrusion

Unit IV: Introduction to preservation, types and methods of preservation, natural and artificial preservative agent, class I, II and III preservative agents.

Unit V: Introduction to Food Packaging: Objectives and functions of food packaging, Requirements for effective food packaging, Types of packaging Materials, General properties of packaging material

Suggested Readings (Latest Edition):

1. J. Scott Smith and Y.H. Hui., Food processing principles and applications. Blackwell publishing
2. B.S. Khatkar, Food Science and technology, Daya publishing house Delhi
3. Martin R Adams and Maurice O Moss Food Microbiology. The Royal Society of Chemistry. Cambridge UK
4. William C frazier, Dennis C Westhoff. Food microbiology. McGraw Hill Education privete Limited New Delhi

MIC-CCSU-403 (II): CORE ELECTIVE
FOOD SAFETY
4 Credits/40 Hours

Course Outcomes:

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

- Discuss how contamination of food can occur in a food service establishment.
- Describe the effect and consequences of food borne illness.
- Display sound practices to prevent the possibility of food poisoning.
- Identify measures/procedures that will reduce or eliminate accidents in food preparation and service areas.

Unit I- Introduction to food safety, hazards to safe food (chemical, biological, physical hazards), contamination and spoilage, food hygiene, food itself, safety of food, sources of contamination, food quality, food safety challenges, reducing the effect of contamination; Role of food processing industries and sector.

Unit II- History, back ground and structure of HACCP, Food chain steps, benefits and barriers in implementing HACCP, HACCP prerequisites and good hygiene practice, Environmental hygiene, design and facilities in the establishment, equipment, utilities, personal health and hygiene, pest control.

Unit III- Determination of critical control points, establishing the critical limits, Establishment of corrective action, establishment of verification procedure, establish documentation and record keeping, validation, general errors in HACCP plan, Quantitative approach in HACCP , implement of HACCP Plan, case studies of HACCP.

Unit IV- Introduction to risk analysis, risk management, Risk assessment, and Risk communication.

Unit V- Other food safety practices- Good Agriculture practices, good animal husbandry practices, good manufacturing practices, good retail practices, good transport practices, nutritional labeling, Traceability studies.

Suggested Readings (Latest Editions):

1. Adams MR and Moss MO, Food Microbiology RSC publications, UK.
2. Lightfoot NF and Maier EA (Editor), Microbiological analysis of food and water, Elsevier Publication, Netherland.
3. Ray B and Bhunia A, Fundamental food Microbiology CRCpublication, UK
4. B. Srilakshmi, Food Science New Age International Publisher, New Delhi
5. Martin R Adams and M J Robert Nout, Fermentation and Food Safety, Aspen Publication, Maryland.
6. Gilbert J., Food Packaging: Ensuring the safety and quality of Food, Publisher Taylor and Francis, Basingstake, Hants, UK

MIC-CCSU-404 (I) : CORE ELECTIVE/VALUE AIDED
EPIDEMIOLOGY
4 Credits/40 Hours

Course Outcomes:

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

- Understand the basic epidemiological methods and study designs.
- Understand and discuss population based perspective to examine disease and health-related events.
- Discuss the ethical issues in epidemiological research.
- Learn the basic concepts of screening and outbreak investigations.
- Disease surveillance
- Critically review published epidemiological studies

Unit 1: History of epidemiology, basic vocabulary and processes used in the science of epidemiology, routes of transmission of disease, non communicable and communicable infection, nosocomial infections, microorganism responsible for nosocomial infection, epidemiology of nosocomail infection.

Unit 2: Studies of infectious notifiable diseases as AIDS, anthrax, botoulism, cholera, gonorrhea, hepatitis, rabies, syphilis, tetanus, tuberculosis, typhoid, with their sign, symptoms, diagonostic test, chemotherapy and vaccines availability.

Unit 3: Health and Disease: Basic Concepts and Definition, Disease Control and Levels of Prevention, Determinants and Indicators of Health, Health situation and Trends in India. Genesis and Development of the concept, Healthcare versus Medical Care.

Unit 4: Environment and Health: Environmental degradation and human pathology, Examination of living/ working environment & its impact on human health; Industrial and Occupational Health: Industrial and Occupational hazards and accidents, Occupational diseases and their prevention. Right to a safe Biosphere.

Unit 5: Nutrition and Health: Classification and Nutritional profiles of various foods and drinks, Balanced diet, Diet survey, consumption unit, nutritional classification, Nutritional problems e.g. LBW, PEM, Xerophthalmia, IDD, etc. Nutritional factors in selected/ major diseases (Cardiovascular, Diabetes, Obesity, Cancer),

Suggested reading (Latest Edition)

1. Kenneth. J. Ryan (2010) Sherris's Medical Microbiology,Mc Graw Hill.
2. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
3. Greenwood D (2015). Medical Microbiology, 18th Edition, Elsvier.
4. Murray PR, Pfaller MA, Tenover FC and Yolken RH (2007). Clinical Microbiology. ASM Press.
5. Robert S.Burlarge (2012). Principles of Public health Microbiology.

MIC-CCSU-404 (II): CORE ELECTIVE/VALUE AIDED
PHARMACEUTICAL MICROBIOLOGY
4 Credits/40 Hours

Course Outcomes:

After completion of the Course, the student will:

- Explain microbial metabolism.
- acquire knowledge and application ability on pharmaceutical field
- identify the problems about pharmaceutical field

Unit I: General Characteristics of antimicrobial drugs, Factors influencing antimicrobial drug effectiveness, Antibiotics and synthetic antimicrobial agents: Aminoglycosides, β- lactams, tetracyclines, ansamycins, antifungal antibiotics, antitumor substances; peptide antibiotics, Chloroamphenicol, sulpha drugs.

Unit II: Mechanism of actions of antibiotics: penicillin, vancomycin (cell wall synthesis inhibition); aminoglycosides, tetracycline, chloramphenicol (protein synthesis inhibition); Rifampin, quinolones and fluoroquinolones (nucleic acid synthesis inhibition); polymyxin B (cell membrane disruption).

Unit III: Molecular principles of drug targeting, drug delivery system in gene therapy, Mode of action of non-antibiotic antimicrobial agents; Penetrating defenses- how the antimicrobial agents reach the targets, cellular permeability barrier, cellular transport system and drug diffusion.

Unit IV: Microbial contamination and spoilage of pharmaceuticals products: sterile injectibles, noninjectibles, and their sterilization; Manufacturing procedures and in process control of pharmaceuticals. Use of microbial enzymes in pharmaceuticals, biosensors.

Unit V: Good manufacturing practices (GMP) and good laboratory practices(GLP) in pharmaceutical industry, regulatory aspects of quality control, Quality assurance and quality management in pharmaceuticals ISO, WHO, and US certification.

Suggested reading (Latest Edition):

1. Reed G (latest Edition). Industrial Microbiology. CBS Publishers (AVI Publishing Co.)
2. Kalapna Merchant (Latest Edition). Pharmacological regulaltion of Genes, CRC press.
3. Bhosh, Fiechter and Blakebrough Advances in Biochemical Engineering. Springer Verlag Publications.
4. Creuger and Creuger (2005). Biotechnology- A Textbook of Industrial Microbiology, Sinaeur Associates.
5. Casida LE (2010). Industrial Microbiology, New Age International Publication.

MIC-CCSU-405: Practical Lab

4 Credits/40 Hours

Practical in fourth Semester is based on MIC-CCSU-401 to MIC-CCSU-404

MIC-CCSU-RP –IV
4 Credits

Industrial Training/ Research Project/ Survey (Practical Based)