VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN MICROBIOLOGY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN MICROBIOLOGY
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	3rd	V	SEMESTER-V							
			Major-8	MCBHMJ08	T: Virology; P: Practical	4	3-0-1	15	60	75
			Major-9	MCBHMJ09	T: Environmental Microbiology; P: Practical	4	3-0-1	15	60	75
			Major-10	MCBHMJ10	T: Food and Dairy Microbiology; P: Practical	4	3-0-1	15	60	75
			Major Elective-01	MCBHDSE1	T: Microbial Biotechnology; P: Practical	4	3-0-1	15	60	75
			Minor-5 (Disc.-I)	MCBMIN05	T: Genetic Engineering and Biotechnology; P: Practical *(To be taken from other Discipline)*	4	3-0-1	15	60	75
			Semester-V Total			20				375
		VI	SEMESTER-VI							
			Major-11	MCBHMJ11	T: Industrial Microbiology; P: Practical	4	3-0-1	15	60	75
			Major-12	MCBHMJ12	T: Immunology; P: Practical	4	3-0-1	15	60	75
			Major-13	MCBHMJ13	T: Medical Microbiology; P: Practical	4	3-0-1	15	60	75
			Major Elective-02	MCBHDSE2	T: Microbes in Sustainable Agriculture and Development; P: Practical	4	3-0-1	15	60	75
			Minor-6 (Disc.-II)	MCBMIN06	T: Medical Microbiology and Immunology; P: Practical *(To be taken from other Discipline)*	4	3-0-1	15	60	75
			Semester-VI Total			20				375
			YEAR-3			40				750
			Eligible to be awarded Bachelor of Science in Microbiology *on Exit*			126	Marks (Year: I+II+III)			2325

MJ = Major, MI = Minor Course, DSE = Discipline Specific Elective Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical

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SEMESTER-V

MAJOR (MJ)

MJ-8: Virology **Credits 04 (Full Marks: 75)**

MJ-8T: Virology (Theory) **Credits 03 (45 Lectures)**

Course contents:

Unit 1: Nature and Properties of Viruses

Introduction: Discovery of viruses, Theories of viral origin, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions.

Viral taxonomy: Classification and nomenclature of different groups of viruses, LTH system and modern classification (Baltimore) of viruses.

Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses. Purification and assay of viral particles.

Unit 2: Bacteriophages

Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage

Unit 3: Viral Transmission, Salient features of viral nucleic acids and Replication

Modes of viral transmission: Persistent, non-persistent, vertical and horizontal.

Viral multiplication and replication strategies: Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna) , Assembly, maturation and release of virions

Unit 4: Animal viruses and plant Viruses

Reproduction of Animal viruses (pox viruses, Para viruses, Herpes viruses, Retro viruses) Cytopathic effects, Plant viruses (Details on TMV), Viruses of Fungi, Cyanophages.

Unit 5 : Viruses and Cancer

Introduction to oncogenic viruses
Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes

Unit 6 : Prevention & control of viral diseases

Antiviral compounds and their mode of action
Interferon and their mode of action
General principles of viral vaccination

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Unit 7 : Applications of Virology

Use of viral vectors in cloning and expression, Gene therapy and Phage display

MJ-8P: Virology (Practical) **Credits 01 (30 hrs.)**

1. Study of the structure of important animal viruses (influenza and retroviruses) using electron micrographs
2. Study of the structure of important plant viruses (tobacco ring spot) using electron micrographs
3. Study of the structure of important bacterial viruses (ϕX 174, T4, λ) using electron micrograph.
4. Cultivation of viruses and plaque assay.
5. Perform local lesion technique for assaying plant viruses. Study and symptoms of TMV viral diseases of plants.

Suggested Readings:

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
9. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

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MJ-9: Environmental Microbiology **Credits 04(Full Marks: 75)**

MJ-9T: Environmental Microbiology (Theory) **Credits 03 (45 Lectures)**

Course contents:

UNIT -1: Microorganisms and their Habitats

Soil as a habitat for microorganisms, Aquatic Environment: Microflora of fresh water and marine habitats, Atmosphere: Aero-microflora and dispersal of microbes, Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter.

UNIT -2: Microbial Interactions Biogeochemical cycle

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation, Microbe-Plant interaction: Symbiotic and non symbiotic interactions, Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction.

UNIT -3: Solid Waste Management and Bioremediation

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill), Principles and microbial degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.

UNIT -4: Liquid Waste Management and Water Potability

Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: standard qualitative procedure- presumptive test/MPN test, confirmed and completed tests for faecal coliforms.

Suggested Readings:

1. Microbial Ecology: Fundamentals & Applications. 4th edition. Atlas RM and
2. Bartha R. (2000). Benjamin/Cummings Science Publishing, USA
3. Environmental Microbiology. 2nd edition, Academic Press. Maier RM, Pepper IL
4. and Gerba CP. (2009).
5. Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York. Okafor, N (2011).

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MJ-9P: Environmental Microbiology (Practical) **Credits 01 (30 hrs.)**

Course Outline:

1. Analysis of soil – pH and water holding capacity.
2. Isolation of microbes (bacteria & fungi) from soil (28ºC & 45ºC).
3. MPN Test
4. Determination of BOD of waste water sample.
5. Isolation of *PSB* from soil.

Suggested Reading:

1) Environmental Microbiology: A Laboratory Manual - Ian L. Pepper
2) A Practical Manual of Environmental Microbiology - Upendra Thapa Shrestha

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MJ-10: Food and Dairy Microbiology Credits 04(Full Marks: 75)

MJ-10T: Food and Dairy Microbiology (Theory) Credits 03 (45 Lectures)

Course contents:

Unit 1: Foods as an ideal growth medium and Microbial Preparations:

Food types, Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, fermented dairy products: yogurt, koumiss, kefir, and cheese, other fermented foods sauerkraut, soy sauce and tampeh.

Unit 2: Microbial spoilage of various foods and diagnosis:

Sources of contamination of foods, General Principles of food Spoilage of: Spoilage of different types of foods: vegetables, fruits, meat, eggs, milk and canned Foods, HACCP, Indices of food sanitary quality and sanitizers, Cultural and rapid detection methods of food borne pathogens in foods,

Unit 3: Principles and methods of food preservation:

Principles, physical methods of food preservation: temperature (low, high, canning, drying), Irradiation, hydrostatic pressure, Emulsification, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO_2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

Unit 4: Food borne illness and Control:

Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Aflatoxin, Food infections by: *Bacillus cereus*, *Escherichia coli*, *Salmonella*, *Listeria monocytogenes* and *Campylobacter jejuni*.

MJ-10T: Food and Dairy Microbiology (Practical) Credits 01 (30 hrs.)

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Preparation of Yogurt/ Curd.
4. Isolation of *Lactobacillus* from curd.

Suggested readings:

1. Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India. Adams MR and Moss MO. (1995).
2. Basic Food Microbiology. 1st edition. CBS Publishers, Delhi, India. Banwart JM. (1987).
3. Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India. Frazier WC and Westhoff DC. (1992).
4. Laboratory Manual of Food Microbiology Paperback - Neelima Garg
5. Practical Food Microbiology – J. P. Soman

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MAJOR ELECTIVE (DSE)

Major Elective -1: Microbial Biotechnology **Credits 04(Full Marks: 75)**

MJ DSE-1T: Microbial Biotechnology (Theory) **Credits 03**

Course contents:

Unit-1: Therapeutic and Industrial Biotechnology
Recombinant microbial production processes in pharmaceutical industries -recombinant vaccines (Hepatitis B vaccine); Genetically engineered microbes for industrial application: Bacteria and yeast, Microbial polysaccharides and polyesters, Microbial production of Bio- pesticides and Bioplastics; Microbial biosensors.

Unit-2: Applications of Microbes in Biotransformation
Microbial based transformation of steroids and sterols, Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.

Unit-3: Microbial Products and their Recovery
Microbial product purification: filtration, ion exchange & affinity chromatography techniques, Down streaming process, Immobilization methods and their application.

Unit-IV: Microbes for Bio-energy and Environment
Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture.

MJ DSE-1P: Microbial Biotechnology (Practical) **Credits 01 (30 hrs.)**

1. Study enzyme immobilization by sodium alginate method
2. Isolation of Pigment producing bacteria and study of pigment TLC.
3. Isolation of carbohydrate degrading bacteria from soil
4. Study of algal Single Cell Proteins.
5. Demonstration of fermentation by using yeast.

Suggested Readings:

1. Basic Biotechnology, 2nd Edition, Cambridge University Press. Ratledge, C and Kristiansen, B. (2001).9th edition, Mc Graw Hill Publishers.
2. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014),
3. Elements of Biotechnology 2nd edition, Rastogi Publications. Gupta PK (2009)
4. Microbial Biotechnology, 2nd edition, Cambridge University Press. Glazer AN and Nikaido H (2007)
5. Molecular Biotechnology 4th edition, ASM Press. Glick BR, Pasternak JJ, and Patten CL (2010)

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6. Principles of Fermentation Technology 2nd edition.,Elsevier Science. Stanbury PF, Whitaker A, Hall SJ (1995)
7. Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc. Crueger W, Crueger A (1990).
8. Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press. Demain, A. L and Davies, J. E. (1999).
9. Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201. Swartz, J. R. (2001).

OR

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MINOR (MI)

Minor (MI)-5: Genetic Engineering and Biotechnology **Credits 04(Full Marks: 75)**

Minor (MI)-5T: Genetic Engineering and Biotechnology **Credits 03**

Course contents:

Unit I: Introduction to genetic engineering

Milestones in genetic engineering and biotechnology; Restriction modification systems: Mode of action, applications of Type II restriction enzymes in genetic engineering; DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases: Use of linkers and adaptors; Transformation of bacterial DNA:: Agarose gel electrophoresis, Southern - and Northern-blotting techniques, , SDS-PAGE and Western blotting.

Unit II: Vectors

Cloning Vectors: Definition and Properties; Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors Cosmids, BACs, YACs; Expression vectors: *E.coli* lac and T7 promoter-based vectors.

Unit III: DNA Amplification and DNA sequencing

PCR: Basics of PCR, RT-PCR, Real-Time PCR Genomic and cDNA libraries: Preparation and uses, Genome sequencing; Sanger's method of DNA Sequencing: traditional and automated sequencing.

Unit IV: Application of Genetic Engineering and Biotechnology

Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated delivery, *Agrobacterium* - mediated delivery; Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, flavosavo tomato, Gene therapy, recombinant vaccine, protein engineering.

Minor (MI)-5P: Genetic Engineering and Biotechnology **Credits 01 (30 hrs.)**

1. Isolation of Plasmid DNA from *E.coli*
2. Demonstration of amplification of DNA by PCR
3. Demonstration of Southern blotting

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Suggested Readings:

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pasternik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 8th edition, McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

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SEMESTER-VI

MAJOR (MJ)

MJ-11: Industrial Microbiology **Credits 04 (Full Marks: 75)**

MJ-11T: Industrial Microbiology (Theory) **Credits 03 (45 Lecture)**

Course contents:

Unit -1: History and development of industrial microbiology
Brief history and developments in industrial microbiology; industrially important microbes and methods for their isolation; preservation and maintenance of industrial strains, strain improvement; Crude and synthetic media: molasses, corn-steep liquor, sulphite waste liquor, whey.

Unit -2: Fermentation processes, bio-reactors and fermentation parameters
Types of fermentation processes - stationary and submerged fermentations; batch and continuous fermentations; Designing of a typical bio-reactor and its components, Batch fermenter and constantly stirred tank fermenters; Fermentation control parameters - pH, temperature, foaming and aeration.

Unit -3: Down-stream processing
Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying.

Unit -4: Microbial production of industrial products and Enzyme immobilization
Microbial production: Citric acid, glutamic acid, ethanol, penicillin, Vitamin B12, Enzymes (amylase, protease), steroid; Enzyme immobilization: Definition, Methods of immobilization, advantages and applications of immobilization.

MJ-11P: Industrial Microbiology (Practical) **Credits 01 (30 hrs.)**

Course Outline:

1. Study of different parts of fermenter by photograph
2. Microbial activity study on (qualitative) analysis of: Enzymes: Amylase
3. Microbial activity study on (qualitative) analysis of: Amino acid: Tryptophan utilization
4. A visit to any educational institute/industry to see industrial fermenter and other downstream processing operations (Assignment)

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Suggested Readings

1. Industrial Microbiology. 1st edition, Macmillan India Limited. Patel A.H. (1996).
2. Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA. Okafor N. (2007).
3. Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001).
4. Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company Glaze A.N. and Nikaido H. (1995).
5. Industrial Microbiology. 1st edition. Wiley Eastern Limited. Casida LE. (1991).
6. Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi. Crueger W and Crueger A. (2000).
7. Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd. Stanbury PF, Whitaker A and Hall SJ. (2006).
8. Practical Manual on Fermentation Technology Paperback - S. Kulandaivelu
9. Basic Practical Manual on Industrial Microbiology - Basanta Kumar Rai

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MJ-12: Immunology **Credits 04 (Full Marks: 75)**

MJ-12T: Immunology (Theory) **Credits 03 (45 Lectures)**

Course contents:

Unit-1: Immune Cells and Organs of Immune system:
Beginning of Immunology as a Scientific Discipline. Concept of Innate and Adaptive immunity; Structure, Functions and Properties of: Immune Cells – Hematopoietic stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil , Basophil, Mast cell, Dendritic cell; and Primary lymphoid Organs: Bone Marrow, Thymus, Secondary lymphoid organs: Lymph Node, Spleen, GALT, MALT, CALT.

Unit 2: Antigens and Antibodies:
Characteristics of an antigen ; Haptens; Epitopes (T & B cell epitopes); Adjuvants; Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and Chimeric antibodies; Structure and Functions of MHC I & II molecules.

Unit 3: Immune Response and Immunological Disorders:
Primary and Secondary Immune Response; Generation of Humoral Immune Response; Generation of Cell Mediated Immune Response; Killing Mechanisms by CTL and NK cells, Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies, SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD.

Unit 4: Immunological Techniques:
Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, Immunoelectron microscopy.

MJ-12P: Immunology (Practical) **Credits 01 (30 hrs.)**

Practical

1. Identification of human blood groups.
2. Demonstration of agglutination reaction of unknown bacterial culture by slide agglutination technique.
3. Perform Total Leukocyte Count of the given blood sample.
4. Perform Differential Leukocyte Count of the given blood sample.
5. Separate serum from the blood sample (demonstration).

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Suggested Reading:

1. Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia. Abbas AK, Lichtman AH, Pillai S. (2007).
2. Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford. Delves P, Martin S, Burton D, Roitt IM. (2006).
3. Kuby's Immunology. 6th edition W.H. Freeman and Company, New York. Goldsby RA, Kindt TJ, Osborne BA. (2007).
4. Janeway's Immunobiology. 7th edition Garland Science Publishers, New York. Murphy K, Travers P, Walport M. (2008).
5. Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg. Peakman M, and Vergani D. (2009).
6. Immunology. 6th edition. Wiley Blackwell Publication. Richard C and Geiffrey S. (2009).
7. Practical Immunology- A Laboratory Manual – Senthilkumar Balakrishnan
8. Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg. Peakman M, and Vergani D. (2009).

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MJ-13: Medical Microbiology **Credits 04 (Full Marks: 75)**

MJ-13T: Medical Microbiology (Theory) **Credits 03 (45 Lectures)**

Course contents:

Unit I: Normal microflora of the human body and host pathogen interaction
Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract, Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity.

Unit II: Sample collection, transport and diagnosis
Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Complement fixation, PCR, DNA probes).

Unit III: Microbes and Human diseases
Diseases in detail with Symptoms, mode of transmission, prophylaxis and control: Bacterial- *Mycobacterium tuberculosis*, *Salmonella typhi*, *Vibrio cholerae*, Viral- Rabies and Dengue. Protozoan- Malaria, Fungal- Candidiasis.

Unit IV: Antimicrobial agents
Antibacterial agents: Five modes of action with one antibiotics example in each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Antiviral agents: Mechanism of action of Acyclovir, Antibiotic resistance..

MJ-13P: Medical Microbiology (Practical) **Credits 01 (30 hrs.)**

Practical:

1. Identify bacteria (any one of *E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus)*, IMViC, and catalase tests
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar.
3. Perform antibacterial sensitivity by Kirby-Bauer method
4. Determination of minimal inhibitory concentration (MIC) of an antibiotic.

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Suggested Reading:

1. Textbook of Microbiology. 8th edition, University Press Publication. Ananthanarayan R. and Paniker C.K.J. (2009)
2. Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013)
3. Mims' Medical Microbiology. 4th edition. Elsevier. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007)
4. Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher
5. Education. Willey JM, Sherwood LM, and Woolverton CJ. (2013)
6. Brock Biology of Microorganisms. 14th edition. Pearson International Edition
7. Madigan MT. Martinko JM, Dunlap PV and Clark DP. (2014).
8. Diagnostic Medical Microbiology - Abdelraouf A. Elmanama
9. Medical Microbiology Lab Manual - Nafiseh Nafissi

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MAJOR ELECTIVE (DSE)

Major Elective -2: Microbes in Sustainable Agriculture and Development Credits 04(FM: 75)

MJ DSE-2T: Microbes in Sustainable Agriculture and Development (Theory) Credits 03

Course contents:

UNIT- I: Soil Microbiology
Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil

UNIT-II: Microbial Activity in Soil
Methane – production and control, Microbial mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

UNIT-III: Microbial Control of Soil Borne Plant Pathogens
Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents Microbial plant pathogens, Insects, Weeds

UNIT-IV: Microbial Control of Soil Borne Plant Pathogens
Plant growth promoting bacteria, biofertilizers – symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non Symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae, Phosphate solubilizers, algae), PGPRs, Secondary Agriculture Biotechnology: Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters, GM crops: Bt crops, golden rice

MJ DSE-2P: Microbes in Sustainable Agriculture and Development (Practical) Credits 01

Practical

1. Isolation of *Rhizobium* sp. From root nodules
2. Inoculum preparation of *Rhizobium* and field application
3. *Azotobacter* as soil inoculants characteristics and field application
4. Field study on functioning of biogas plant
5. Isolation of cellulose degrading organisms

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Suggested Readings:

1. Plant Pathology. 5th edition. Academic press, San Diego. Agrios GN. (2006).
2. Molecular Biotechnology 4th edition, ASM Press. Glick BR, Pasternak JJ, and Patten CL (2010)
3. Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/ Cummings Science Publishing, USA. Atlas RM and Bartha R. (2000).
4. Environmental Microbiology. 2nd edition, Academic Press. Maier RM, Pepper IL and Gerba C.P. (2009).
5. Microbial Ecology. 1st edition, Wiley Blackwell, USA. Barton LL & Northup DE (2011).
6. Microbial Ecology. Blackwell Scientific Publication, Oxford, England. Campbell RE. (1983).
7. Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning. Coyne MS. (2001.).
8. Agriculture Biotechnology, Ist edition, Marcel decker Inc. Altman A (1998).
9. Hand Book of Microbial Biofertilizers, the Haworth Press, Inc. New York. Mahendra K. Rai (2005).
10. Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers. Reddy, S.M. et. al. (2002).

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MINOR (MI)

Minor (MI)-6: Medical Microbiology and Immunology **Credits 04(Full Marks: 75)**

Minor (MI)-6T: Medical Microbiology and Immunology (Theory) **Credits 03**

Course contents:

Unit-I Normal microflora of the human body and host pathogen interaction

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection.

Unit-II Common Diseases and their causative agents

Common Bacterial, Viral, and Protozoan diseases of various organ systems and their causative agents; Fungal diseases- Brief description of various types of mycoses

Unit-III Antimicrobial agents: General characteristics and mode of action

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine

Unit-IV Immune Cells and Organs

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen

Unit-V Antigens, Antibodies and Immune Response

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes), Adjuvants, Structure, Types and Functions of antibodies.
Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response

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Minor (MI)-6P: Medical Microbiology and Immunology (Practical) Credits 01

1. Identify bacteria on the basis of biochemical characteristics: IMViC, and catalase tests
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Identification of human blood groups.
6. To perform Differential Leukocyte Count of the given permanent Slide.

Suggested Readings

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
6. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.
7. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
8. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication

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