Deen Dayal Upadhyaya Gorakhpur University

Department of Industrial Microbiology

B.Sc. Industrial Microbiology Syllabus
THREE PLUS ONE FRAMEWORK 2024
National Education Policy-2020

B.Sc. INDUSTRIAL MICROBIOLOGY SYLLABUS 2024

DDD Gorakhpur University, Gorakhpur

CHOICE BASED CREDIT SYSTEM (CBCS)

FRAMEWORK OF THREE PLUS ONE UG PROGRAMME IN INDUSTRIAL MICROBIOLOGYMAJOR 2024

Year/ Semester	Subject 1 Major 1	Subject 2 Major 2	Subject 3 Minor	SEC Skill enhancement course/ vocational	AEC Ability Enhancement Courses/ CoCurricular	Research project / Dissertation / /internship/Field work/ Survey	Total credits	Degree and credits
1st year/ I SEM	Industrial Microbiology 6 credits(4+2)	6	6	SEC – 1 (3 CREDITS)	AEC -1 (2 CREDITS)		23	Certificate in Faculty (46 Credits)
1st year/ II SEM	Industrial Microbiology 6 credits(4+2)	6	6	SEC – 2 (3 CREDITS)	AEC -2 (2 CREDITS)		23	
2nd year/ III SEM	Industrial Microbiology 6 credits(4+2)	6	6	SEC – 3 (3 CREDITS)	AEC -3 (2 CREDITS)		23	Diploma in Faculty (96 Credits)
2nd year/ IV SEM	Industrial Microbiology 6 credits(4+2)	6	6		AEC -4 (2 CREDITS)	Any one (3 credits)	23	
3rd year/ V SEM	Industrial Microbiology 10 c,2X4+2	10					20	UG Degree (132 Credits)
3rd year/ VI SEM	Industrial Microbiology 10 c,2X4+2	10					20	
4th year/ VII SEM	Industrial Microbiology 20 c,4X4+4						20	UG Honors (172 credits)
4th year/ VIII SEM	Industrial Microbiology 20 c,4X4+4						20	
OR	For Students who secured 75% Marks in First Six Semesters							
4th year/ VII SEM	Industrial Microbiology 20 c,4X4+4						20	UG Honors with Research (172 credits)
4th year/ VIII SEM	Industrial Microbiology 20 c,2X4					Research Project (12 Credits)	20	

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SEMESTER-WISE TITLES OF THE PAPERS IN B.Sc. (Industrial Microbiology)			
YEAR	COURSE CODE	PAPER TITLE	CREDITS
CERTIFICATE COURSE			
FIRST YEAR	**Semester-I**		
	IMB 101F	Paper: Fundamentals of Industrial Microbiology	4+0
	IMB 102F	Practical sem I	0+2
	Semester-II		
	IMB 103F	Biochemistry	4+0
	IMB 104F	Practical sem II	0+2
DIPLOMA COURSE			
SECOND YEAR	**Semester-III**		
	IMB 201F	Fermentation technology	4+0
	IMB 202F	Practical sem III	0+2
	Semester-IV		
	IMB 203F	Environment and Agricultural Microbiology	4+0
	IMB 204F	Practical sem IV	0+2
BACHELOR OF SCIENCE			
THIRD YEAR	**Semester-V**		
	IMB 301F	Food Microbiology	4+0
	IMB 302F	Molecular Biology	4+0
	IMB 303F	Practical sem V	0+2
	Semester-VI		
	IMB 304F	Virology	4+0
	IMB 305F	Microbial diversity and phylogeny	4+0
	IMB 306F	Practical Sem VI	0+2
FOURTH YEAR	***MICROBIOLOGY HONOURS COURSE***		
	Semester- VII		
	IMB 401F	Immunology	4+0
	IMB 402F	Clinical Microbiology	4+0
	IMB 403F	Clinical Laboratory Technology	4+0
	IMB 404F	Dairy microbiology	4+0
	IMB 405F	Practical Sem VII	0+4
	Semester -VIII		
	IMB 406F	Applied Mycology	4+0
	IMB 407F	Medical Mycology	4+0
	IMB 408F	Bioremediation	4+0
	IMB 409F	Medical Virology	4+0
	IMB 410F	Practical sem VIII	0+4
OR ***MICROBIOLOGY HONOURS COURSE WITH RESEARCH*** (For Students who secured 75% Marks in First Six Semesters)			
Semester- VII			
	IMB 401F	Immunology	4+0
	IMB 402F	Clinical Microbiology	4+0
	IMB 403F	Clinical Laboratory Technology	4+0
	IMB 404F	Dairy microbiology	4+0
	IMB 405F	Practical Sem VII	4+0
Semester –VIII			
	IMB 411F	Bioinformatics and Computer Application	4+0
	IMB 412F	Extremophiles	4+0
	IMB 413F	Project/Dissertation	12

Year: I	Semester: I	Code: IMB -101F
Paper: **Fundamentals of Industrial Microbiology**		
Theory core	Credits: **4+0**	

Unit I

History of Industrial Microbiology

Introduction, scope and historical development of industrial microbiology (discovery era, transition period, golden age and microbiology in the 21st century), Applied branches of microbiology and industrial importance of variousmicroorganisms of industrial importance.

Unit II

Microbial Diversity

Diversity of Microbial World, Prokaryotic cell, Structure of Bacterial cell, Archaebacteria and Eubacteria, Structure and function of Plasma membrane, cell wall, capsule, endospore, flagella, nucleod, plasmid, Gram positive and Gramnegativebacteria, chromosomal & extra chromosomal genetic material and cell inclusions.

Unit III

Methods for studying microorganisms

Culture media: preparation and types of defined, differential, selective and enrichment culture, Isolation techniques: Pour plate, spread plate, streak plate. Preservation and maintenance ofculture.Methods of sterilization: physical and chemical, media types, Isolation and maintenance of pure cultures of microorganisms,and preservation techniques. Characteristics of Fungi, Algae, Protozoans, Viruses. Principles of classification of bacteria, algae, fungi, protozoa,viruses. Staining, Instrumentation

Unit IV

Microbial growth

Nutrient uptake and Transport, Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation, Iron uptake. Microbial growth, phases of growth, conditions of growth, measurement of growth, bacterial sporulation and germination, binary fission. Sterilization of culture media using autoclave and assessment for sterility. Sterilization of glassware using hot air oven. Sterilization of heat sensitive material by membrane filtration and assessment for sterility. Demonstration of the presence of microorganisms in the environment by exposing nutrient agar plate to air.Microbial growth kinetics.

Course Learning Outcomes:

Upon successful completion of the course, the student will:

1. Be acquainted with the historical account and development of microbiology as ascientific discipline.
2. Have gained knowledge on different systems of classification. They will also acquire an overview of cellularmicroorganisms.

IMB 102F Practical

Year: I	Semester: II	Code: IMB- 103F
Paper: **Biochemistry**		
Theory core	Credits: **4+0**	

Unit I

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin

Unit II

Lipids & Nucleic acids: Structure and classification of lipids- Fatty acids structure and functions;Saponification Structural lipids; Phosphoglycerides; Sphingolipids; Metabolism of lipids- Alpha and beta oxidation of lipids; Nucleic acids Structures, Double helical structure of DNA. Types of DNA: A, B, Z. Physic-chemical properties of DNA. RNA types-rRNA, mRNA, tRNA.

Unit III

Chemoheterotrophic Metabolism - Aerobic Respiration. Concept of aerobic respiration, anaerobic respiration and fermentation, Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle. Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors. Photosynthetic microbes. Oxygenic photosynthetic bacteria- PSI and PSII, Z-scheme, Non- cyclicphotophosphorylation; Anoxygenic photosynthetic bacteria- Cyclic photophosphorylation. Photosynthesis of Purple and Filamentous green bacteria, Cyanobacteria and Green sulphur bacteria. Calvin cycle

Unit IV

Proteins:Amino acids, general formula and concept of zwitterion; Protein structure: primary,secondary- peptide unit salient features, α helix, β sheet, β turn, tertiary and quaternarystructures of proteins, Protein folding.Enzymologyconcepts:Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD,metal cofactors, Classification of enzymes, Mechanism of action of enzymes: active site,transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism Definitions of terms – enzyme unit, specific activity and turnover number.

Course Learning Outcomes:

Upon successful completion of the course, the student:

1. Will be able to apply the fundamental concepts of bioenergetics, pH, pKa, and the buffer system to biologicalsystems.
2. Will understand the structure of carbohydrates, lipids, proteins, and nucleicacids.
3. Will understand the fundamental principles of enzyme biochemistry, enzyme kinetics, andbe aware of the various enzyme variants present in livingcells.

IMB 104F Practical

Year: II	Semester: III	Code: IMB -201F
Paper: **Fermentation technology**		
Theory core	Credits: **4+0**	

Unit 1

Design and operation of Fermenters, Basic concepts for selection of a reactor, Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor, Scale up of Bioreactor.Types of bio-reactors and measurement of fermentation parameters. Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration. Processes involved in fermentation-I-Scale-up process and Scale down process:

Unit II

Purposes of scale-up; Stages of fermentation –laboratory scale, pilot-plant scale and production scale; Criteria of scale-up for critical parameters-aeration, agitation, broth rheology and sterilization; Scale-down. Processes involved in fermentation-IICell disruption; Filtration; Centrifugation

Unit III

Fermentation productsLarge scale fermentation of acetone, butanol and ethanol (ABE) and alcoholic Beverages -Beer and Wines; Vitamins -B12 and Riboflavin; Antibiotics-Penicillin and Streptomycin);Organicacids-Citric acid, Acetic acid and Lactic acid; Amino acid-Glutamic acid; Enzymes-Amylase, Lipases, Esterases andRestriction enzymes; Vaccines – Tetanus, Polio and Rabies.

Unit IV

Quality control & quality assurance test-QC in fermentation processes: Principles of validation for pharmaceutical industry; QA Tests of finished product-Sterility testing, Pyrogen testing, Ames test and modified Ames test,toxicity testing, Shelf life testing

Course Learning Outcomes:

Upon successful completion of the course, the student:

1. Understand role of microorganism inindustry
2. Develop understanding about fermentation processes inindustry
3. Gain fundamental knowledge of fermenter design and function
4. Gain knowledge about production of various pharmaceutical products or industriallyimportant product.

IMB 202F Practical

Year: II	Semester: IV	Code: IMB -203F
Paper: Environment and **Agricultural Microbiology**		
Theory core	Credits: **4+0**	

Unit I

Structure and function of ecosystem; Terrestrial environment: soil profile and soil microflora; Aquatic Environment: microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersion of microbes; Animal Environment: Microbes in/on human body (microbiomes) & animal (Ruminants) body; Extreme habitats: Extremophiles: Microbes thriving at high & low temperature, pH. High hydrostatic & osmotic pressures, salinity and low nutrient level;Microbial succession in decomposition of plant organicmatter.

Unit II

Carbon cycle: Microbial degradation of cellulose, hemicellulase, lignin and chitin; Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction; Phosphorous cycle: Phosphate Immobilisation and solubilisation; Sulphur cycle: Microbes involved in sulphurcycle.

Unit – III

Development of Soil Microbiology - Distribution of microorganisms in soil - quantitative and qualitative microflora of different soils - Role of microorganisms in soil fertility –Factors Influencingthe soil microflora Microorganisms in soil processes - carbon cycle - organic matter decomposition - Humus formation - Nitrogen cycle – Mineralization - Ammonification - Nitrification, Denitrification - reactions - organisms involved - Nitrogen fixation – symbiotic andnon-symbiotic- process of nitrogen fixation.

Unit –IV

Mycorrhiza - ecto and endomycorrhiza – distribution and importance – Plant growth regulators and phytotoxin production by microorganisms - use of soil microorganisms for pest and disease control - Pesticide and soil microflora - interactions. Symptoms, characters of pathogens and control measures.Bacterial diseases – Citrus canker, Blight of rice. Fungal diseases – Red rot of sugarcane, Tikka leaf spot of ground nut. Viral diseases – TMV, Vein clearing disease of Bhendi (*Abelmoschusesculentus*).

Course Learning Outcomes:

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

1. Capable to get information about biogeochemical cycle.
2. Able to get the knowledge about microbial interaction.
3. Capable to get idea about plant disease.

IMB 204F Practical

Year: III	Semester: V	Code: IMB -301F
Paper: **Food Microbiology**		
Theory core	Credits: **4+0**	

Unit I

Fermented food:Microbiology of dairy products (cheese, yoghurt); cereal and vegetable products(bread, sauerkraut, pickles); beverages (kanji, vinegar, wine); fermented fish and meat products.Microorganisms as food:Single cell proteins. prebiotics probiotics and synbiotics: health benefits, types ofmicroorganisms used, probiotic foods available in market. Mushroom cultivation.

Unit II

Food preservation: Basic Principles, Methods (heating, freezing, dehydration, chemical preservatives,radiation). Modern technologies in food preservation, Packaging material.Microorganisms and milk: Physical and chemical properties of milk; Milk as a substrate for microorganisms;Microbiological analysis of milk – RapidPlatform test, standard plate count, MBRT test, alkaline phosphatase enzyme test,DMC; Method of preservation of milk and milk product, pasteurization sterilizationand dehydration.

Unit III

Food borne diseases: Definition related to food borne diseases, types of diseases with example (Pandemic, Endemic and Epidemic). Infection, contamination, decontamination, disinfection, transmission (direct and indirect). Brief idea about different vector borne diseases, mode of transmission prevention and control of following diseases: Salmonella, Shigella, Typhoid, Botulism, Cholera, *E. coli* food poisoning, Staphylococcal food poisoning, Clostridium infection, Bacillary infection

Unit IV

Hygiene and sanitation Hygiene and sanitation: Contamination, control methods using physical and chemical agents, use of preservatives, pest control management, personal hygiene. Food safety management Food safety management: Concept of safety management, prerequisites- GHPs, GMP, HACCP etc. Toxic agents in food Toxic agents in food: Botulism, lathyrism, Ciguatoxins, Tetrodotoxins, Saxotoxins, conotoxins, Antivitamins, Haemagglutins, Cyanogenicglycosides, Strychnine, Solanine, atropine, Muscarine

Course Learning Outcomes:

1. Uponcompletionthestudents willlearnabouttheroleofMicro-organismin Industryoffood Microbiology.
2. Learn about chemistry and the symptoms of deterioratedfood.
3. Assimilate knowledge about Microbial Examination offood.
4. Learn about food preservationtechniques.

Year: III	Semester: V	Code: IMB- 302F
Paper: **Molecular Biology**		
Theory core	Credits: **4+0**	

Unit I

Overview of the genome organization: DNA/and RNA as genetic material, DNA double helix structure salient features, types of DNA. RNA Structure. Denaturation and renaturation, cot curves. DNA topology: linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes.DNA Replication in Prokaryotes and Eukaryotes Bidirectional and unidirectionalreplication, semi-conservative and semi-discontinuous replication. Mechanism ofDNA replication, Replication of chromosome ends.

Unit II

Transcription in Prokaryotes and EukaryotesConcept of transcription unit. General transcription process in prokaryotes andeukaryotes; Post-Transcriptional modification in eukaryotes, Aternative splicingmechanism, RNAInterference

Unit III

Translation in prokaryotes and eukaryotesRibosome structure, tRNA structure and processing, Mechanismsoftranslationin both prokaryotes and eukaryotes, Genetic code, Wobble hypothesis, Fidelity oftranslation.Regulation of gene expression in prokaryotes and eukaryotes Overview of regulationof gene expression, Regulation of gene expression by DNA methylation, histoneacetylation and histone methylation mechanisms; Transcription control mechanisms,Inducible Operon System, Repressible Operon System, Translation control mechanisms.

Unit IV

Introduction to Bioinformatics and Biological Databases Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniport, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniport, PDB, Sequence Alignments, Phylogeny and Phylogenetic trees. Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrix Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsimony, Maximum likelihood

Course Learning Outcomes:

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

1. Have an idea of organization and structure of DNA in eukaryotic cell.
2. Idea of bacterial transcription and translation.
3. Idea of regulation of gene expression in prokaryotes

IMB 303F Practical

Year: III	Semester: VI	Code: IMB -304F
Paper: **Virology**		
Theory core	Credits: **4+0**	

Unit 1

Nature and Properties of Viruses: Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses. Isolation, purification and cultivation of viruses. Viral taxonomy: Classification and nomenclature of different groups of viruses.

Unit II

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 III

Viral Transmission, Salient features of viral nucleic acids and Replication. Modes of viral transmission: Persistent, non-persistent, vertical and horizontal. Salient features of viral Nucleic acid : Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV).

Unit IV

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 with example of Polio virus and T4 phage, maturation and release of virions.

Course outcome

On completion of course, student are able to:

1. to describe the classification of virus based on their modes of nutrition, and the diverse physiological types of bacteria as determined by variable environmental factors.
2. describe the fundamental concepts and terminology of taxonomic organization and parameters used in classifying virus, and the molecular analytic approaches used to classify diverse virus.

Year: III	Semester: VI	Code: IMB -305F
Paper: **Microbial diversity and phylogeny**		
Theory core	Credits: **4+0**	

Unit I

Bacterial diversity based on nutritional and physiological factors: Classification of bacteria based on nutrition: lithotrophs, organotrophs, phototrophs, chemotrophs. Diversity based on physiological factors: solutes, pH, temperature, oxygen, pressure, radiation.

Unit II

Bacterial systematics: Definitions: Concepts of systematics, taxonomy, taxa, species, strains. Conventional and modern approaches to classification: Phenetic, phylogenetic, genotypic classification, evolutionary chronometers, rRNA oligonucleotide sequencing (ribotyping) and signature sequences, nucleic acid hybridization, genomic fingerprinting, MLSA, RFLP to study polyphasic bacterial taxonomy, FAME analysis

Unit – III

Diversity of Archaea: General characteristics with reference to genera belonging to Crenarchaeota (Sulfolobus) and Euryarchaeota: Methanogens (Methanobacterium), thermophiles (Pyrococcus), acidophiles (Picrophilus) and halophiles (Halobacterium). Key features of other groups: Thaumarchaeota, Lokiarchaeota, NanoarchaeotaDiversity of Eubacteria: Key features and significance of the following genera: Deeply Branching Bacteria: Thermotoga, Deinococcus.

Unit IV

Proteobacteria: Classes and Types. Alphaproteobacteria: Rhizobium, Ricketssia. Betaproteobacteria: Neisseria, Thiobacillus. Gammaproteobacteria: Escherichia, Yersinia. Deltaproteobacteria: Myxococcus and Bdellovibrio. Epsilonproteobacteria: Campylobacter, Helicobacter. Zetaproteobacteria: Mariprofundusferrooxydans. Non-Proteobacteria: Chlamydia, Spirochaetes. Gram Positive bacteria having genomes of low GC content: Firmicutes, *Clostridium, Bacillus*, Tenericutes Mycoplasma. Gram Positive bacteria having genomes of high GC content: Mycobacterium, Streptomyces

Course outcome

On completion of course, student are able to:

3. to describe the classification of bacteria based on their modes of nutrition, and the diverse physiological types of bacteria as determined by variable environmental factors.
4. describe the fundamental concepts and terminology of taxonomic organization and parameters used in classifying bacteria, and the molecular analytic approaches used to classify diverse bacteria.

IMB 306F Practical

Year: IV	Semester: VII	Code: IMB- 401F
Paper: **Immunology**		
Theory core	Credits: 4+0	

Unit 1

Introduction:Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology.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.Antigens:Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants

Unit II

Antibodies: Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies

Unit III

Major Histocompatibility Complex: Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)

Unit IV

Generation of Immune Response:Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to toleranceImmunological Disorders andTumor Immunity:Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.

Course outcome

On completion of course, student are able to:

1. Learn about basic principles and types of immunity.
2. Basic principles of humoral and cell immunity.
3. Learn about complement and immunological pathway.
4. Learn about cell signalling and cell signal transduction pathway

Year: IV	Semester: VII	Code: IMB- 402F
Paper: **Clinical Microbiology**		
Theory core	Credits: **4+0**	

Unit I

History of Medical Microbiology:Contribution of pioneers in the field of Medical Microbiology, Normal Microflora ofhuman body: skin, mouth, alimentary canal and genitourinary tractFood borne infectious pathogens.Diseases caused by bacteria (*Clostridium botulinum*, Brucella,*Campylobacter jejuni*, Vibrio, *E. coli*, Salmonella); fungi (Aspergillus, Candida); Virus(Hepatitis, Rotavirus)

Unit II

Antibiotics and Chemotherapeutics. Historical development of chemotherapeutic and antibiotic substances, Major antimicrobialagents, Mode of action of chemotherapeutic and antibiotic substances.

Unit III

Antibiotic resistance, Sample collection and processing Drug resistance, Mechanism of

antibiotic resistance, Antibiotic susceptibility assay. Collection and transport ofappropriate clinical sample specimen for clinical diagnostics.Infections associated with following Gram-positive bacteria – *Bacillus anthracis. Clostridium, Pneumococcus, Corynebacterium, Streptococcal infections, Staphylococcal* infections.

Unit IV

Infections associated with following Gram-negative bacteria – Enterobacteriaceae – *Salmonella, Shigella, Klebsiella, Proteus, Yersinia and Escherichia. Vibrio, Pseudomonas, Neisseria, Haemophilus, Campylobacter, Bordetella, Brucella.*Infections associated with *Mycoplasma, Mycobacterium tuberculosis and Mycobacterium leprae. Spirochetes – Treponema, Borrelia and Leptospira.* Actinomycetes. Rickettsiae and Chlamydiae.

Course outcome

On completion of course, student are able to:

1. Have a thorough understanding of nature and properties of Viruses.
2. Know the structure of Viruses.
3. Will know the vast amount of diversity within viruses and their classification.
4. Know about the viral multiplication and replication strategies.

Year: IV	Semester: VII	Code: IMB- 403F
Paper: **Clinical Laboratory Technology**		
Theory core	Credits: **4+0**	

Unit I

Safety measures in a Laboratory. Laboratory instruments - Centrifuge - Ovens - Water Bath - Incubator – Laminar Airflow- Calorimeter-Working and applications.Rules of clinical laboratory - Maintenance of laboratory records - General precautions for avoidance of laboratory accidents. Standard protocol of biomedical waste disposal.

Unit II

Methods of clinical specimen's collection - Blood, Urine, Sputum, CSF, Pus and Feces.Staining techniques-Simple and differential- Gram's.Lacto phenol - cotton blue.

Unit III

Biochemical analysis - Urine analysis, physical, chemical, microscopic, routine test viz., sugar, albumin and phosphates, other tests - bile salt, bile pigment, urobilin ketone bodies.

Unit IV

Introduction to haematology, collection of blood sample and anticoagulants, Specimen collection and processing in haematology, haemocytometer and procedure for RBC, WBC, ESR count, haemoglobin estimation, bleeding time with normal values and interpretation.Immunological Techniques:Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, Immunoelectron microscopy.

Course outcome

On completion of course, student are able to:

1. Learn the handling of instruments and various measurements used in the laboratory.
2. Gained knowledge about laboratory techniques its significance in diagnostic evaluation.
3. Identify and differentiate the different types of bacteria and fungi in clinical samples.
4. Learn the differential diagnosis by the help of different serological techniques

Year: IV	Semester: VII	Code: IMB- 404F
Paper: **Dairy Microbiology**		
Theory core	Credits: **4+0**	

Unit I

Microorganisms and Milk Physical and chemical properties of milk. Types of microorganisms in Milk -bacteria, fungi and yeast. Sources of microbial contamination of milk -milch animal, utensils and equipment, water, milking environment, personnel and packing material. 8 hours

Unit II

Microbiological analysis of milk Rapid platform tests -organoleptic, Clot on boiling (COB), titratable acidity, alcohol test, DMC, sedimentation test and pH. Standard plate count, reductase test -MBRT, Resazurin test, Methylene blue test 4 Hours

Unit III

Methods of preservation of milk and milk products: Pasteurization, sterilization and dehydration

Unit IV

Fermentation in milk: Souring, lactic acid fermentation, colour and flavour fermentation, gassy fermentation and proteolysis. 3 Hours Fermented Milk Products: Yogurt -Types & production Cheese -types and production -Cheddar Prebiotics and Probiotics

Course outcome

On completion of course, student are able to:

1. Learn about the physical and chemical properties of milk and types of microorganisms present in it.
2. Gained knowledge about laboratory techniques its significance in diagnostic evaluation.
3. Identify and differentiate the different types of bacteria and fungi in clinical samples.
4. Learn the differential diagnosis by the help of different serological techniques

IMB 405F Practical

Year: IV	Semester: VIII	Code: IMB -406F
Paper: **Applied Mycology**		
Theory core	Credits: **4+0**	

Unit I

Introduction: Introduction & Historical overview of mycology; General characteristics; Importance of fungi in Human life;Fungi –Taxonomy and Systematics

Unit II

Metabolism: Fungal Metabolism; Fungal Growth, Apical growth ;Fungi- Reproduction and Life cycles;Macro fungi-Ascomycota and Basidiomycota

Unit III

Ecological And Economical Importance of Fungi: Economic importance of fungi: medicinal, industrial, agricultural. *Saccharomyces cerevisiae*-Model organism; Mycotoxins and Mushroom poisoning ;Mushrooms and their medical relevance; Mycorrhiza; Lichens

Unit IV

Nutrition: Different modes of nutrition (pathogenic/parasitic, saprobic, symbiotic)in fungi; Culture methods for fungi; Diagnosis; Host responses to fungal infection-Immunity ;Antifungal agents**Industrial Mycology**: Fungal enzymes, extraction and purification • Industrial application of fungal enzymes – i) Protease ii) Cellulase iii) Invertase iv) Phosphatase

Course outcome

On completion of course, student are able to:

1. Learn the historical overview of mycology and general characteristics of fungi
2. Know the Life cycles and mode of reproduction in fungi
3. Ecological And Economical Importance of fungi
4. Different modes of nutrition and diagnosis of fungi

Year: IV	Semester: VIII	Code: IMB -407F
Paper: **Medical Mycology**		
Theory core	Credits: **4+0**	

Unit - I

Introduction to Medical Mycology.Morphological features and methods of reproduction of fungi.Classification of medically important fungi. Culture media and stains in Mycology.Collection,transportation,isolation, identification and identification of mycological agent from clinical specimens.

Unit - II

Superficial mycosis – Pityriasisversicolor, Tineanigra, Black and White PiedraOtomycosis-Cutaneous mycosis -Dermatophytosis.

Unit - III

Subcutaneousmycosis- Sporotrichosis, Mycetoma,Chromoblastomycosis. Systemic mycosis-Histoplasmosis, Coccidioidomycosis, Blastomycosis

Unit - IV

Opportunistic mycosis- Candidiasis, Cryptococcosis, Aspergillosis,Penicilliosis. Allergic fungal diseases - Bronchial Asthma, Maple Bark Stripper's disease - Antifungal agents- type and mode of action. Sensitivitytests,Mycotoxins(MycotoxicosisandMycetismus).

Course outcome

On completion of course, student are able to:

1. Basic understanding of fungi, their morphology and culture methods of fungi.
2. Obtain knowledge on pathogenicity and laboratory diagnosis of medically important fungi.
3. Grasp knowledge on mycotoxins and their importance.
4. Gain knowledge on antifungal agents and their testing methods

Year: IV	Semester: VIII	Code: IMB -408F
Paper: **Bioremediation**		
Theory core	Credits: **4+0**	

Unit 1

Introduction, constraints and priorities of Bioremediation; Bio-stimulation of Naturally occurring microbial activities. Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation.

Unit II

Solid phase bioremediation - land farming, prepared beds, soil piles, Phytoremediation. Composting, Bioventing & Bio-sparging, Liquid phase bioremediation- suspended bioreactors, fixed biofilm reactors.

Unit III

Biotechnology application to hazardous waste management, Examples of biotechnological applications to hazardous waste management, cyanide detoxification, detoxification of oxalate, urea etc. Toxic organics and phenols

Unit IV

Concept of bioremediation (in-situ & ex-situ), Bioremediation of toxic metal ions-biosorption and bioaccumulation principles. Microbial leaching of ore-direct and indirect mechanisms. Mining and metal. Use of microorganisms in augmentation of petroleum recovery.

Course outcome

On completion of course, student are able to:

1. Basic understanding of mitigation of natural resources,
2. Grasp knowledge on different aspects of bioremediation and their importance.

Year: IV	Semester: VIII	Code: IMB -409F
Paper: **Medical Virology**		
Theory core	Credits: **4+0**	

Unit- I

General properties - Structural- Classification- Cultivation - Isolation and identification of viruses - Serodiagnosis and molecular diagnosis of viral infections.Antiviral Agents.

Unit- II

Pox viruses - Variola, Herpes viruses - Herpes Simplex Virus, Cytomegalo Virus, Epstein Barr Virus.

Unit- III

Adena viruses, Hepatitis viruses, Papova viruses, Papilloma, Polyoma, Parvo virus, Retro virus - HIV.

Unit- IV

Picorna viruses - Polio, Rhino virus, Orthomyxovirus - Influenza, Paramyxo virus - arainfluenza, Mumps, Measles, Rhabdo virus, Rota virus. Arbo viruses: Flavi viruses- Yellow fever viruses- Dengue virus- Chickungunya virus - Japanese encephalitis virus. Emerging viral epidemcs – Inflenza H1N1, Nipah, corona - covid 19, Zika and Ebola Viruses. Vaccines for viral diseases.

Course outcome

On completion of course, student are able to:

- Understood and Recognize characters of different types of viruses causing infections, assessment of their severity, methods of diagnosis and their prophylaxis.
- Recognize how the two different classes, DNA and RNA viruses causing viral diseases in human beings.
- Conceptualized the role of viruses as well as the mechanisms underlying the pathogenicity of them, their detection and prophylaxis.

IMB 410F Practical

Year: IV	Semester: VIII	Code: IMB -411F
Paper-IV: **Bioinformatics and Computer Application**		
Theory core	Credits: **4+0**	

Unit 1

Computer fundamentals: MS Office: PPT, Microsoft Excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media. GPS tagging, Plant Identification Apps, programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, and computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.

Unit 2

Biological databases : Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem,)

Unit 3

Data Generation and Data Retrieval : Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez).

Unit 4

Phylogenetic analysis : Introductory concepts of -Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.

Course Outcome:

After the completion of the course the students will be able to:

- Learn fundamentals of computer application and Bioinformatics
- Learn about biological databases and their use
- Learn about phylogentic analysis and its importance

Year: IV	Semester: VIII	Code: IMB -412F
Paper: Extremophiles		
Theory core	Credits: **4+0**	

Unit 1

Introduction to Extremophiles- Definition and overview of extremophiles, Types of extremophiles based on environmental extremes, Historical discovery of extremophiles, Importance of studying extremophiles in microbiology and biotechnology, Cultivation techniques for extremophiles

Unit 2

Classification of Extremophiles-Thermophiles and Hyperthermophiles, Psychrophiles, Acidophiles, Alkaliphiles, Halophiles, Barophiles/Piezophiles, Xerophiles, Radiation-Resistant Microorganisms

Unit 3

Molecular adaptations in Extremophiles- Protein stability and function in extremes, membrane adaptations,DNA repair mechanisms, Enzyme functionality and stability, Metabolic pathways adapted to extreme conditions

Unit 4

Applications of extremophiles in biotechnology- Industrial enzymes from extremophiles, Bioremediation, Bioenergy production,Novel drug discovery, Extremozymes and their applications

Course outcomes:

- CO1. Students will be introduced with the basic principles of classifying extremophiles, which will enhance the knowledge of classical to modern molecular approach of classification of extremophiles commonly used nowadays.
- CO2. To understand the adaptation mechanisms in extremophiles
- CO3. Production of different enzymes in Industry with the help of extremophilic microorganisms

IMB 413F Project/Dissertation

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24/8/24