CHOICE BASED CREDIT SYSTEM

Scheme of Instruction & Syllabus for

M.Sc. MICROBIOLOGY

2019-2020

JIS UNIVERSITY,

81, Nilgunj Road, Agarpara

Kolkata -700109

SEMESTER-I

Sl.No.	Course	Type	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	CC1	Theoretical	MMB-101	Biomolecules and Biophysical Techniques	3	1	0	4	4
2	CC2	Theoretical	MMB-102	Enzymology and Metabolism	3	1	0	4	4
3	CC3	Theoretical	MMB-103	General Microbiology	3	1	0	4	4
4	CC4	Practical	MMB-191	Biomolecules & Enzymology Lab	0	0	3	2	3
5	CC5	Practical	MMB-192	Instrumentation Lab	0	0	3	2	3
6	CC6	Practical	MMB-193	General Microbiology Lab	0	0	3	2	3
7	CBCS	Theoretical		CBCS-I	3	1	0	4	4
Total								**22**	**25**
NON-CGPA									
8	EXTRA CC		PMI1501	Seminar	0	0	1	1	1
9	EXTRA CC		PMI1502	SkillX	0	0	1	1	-
TOTAL								**23**	**26**

SEMESTER-II

Sl.No.	Course	Type	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	CC7	Theoretical	MMB-201	Immunology	3	1	0	4	4
2	CC8	Theoretical	MMB-202	Microbial Molecular Biology and Genetics	3	1	0	4	4
3	CC9	Theoretical	MMB-203	Microbial physiology and Metabolism	3	1	0	4	4
4	CC10	Practical	MMB-291	Immunology Lab	0	0	2	2	3
5	CC11	Practical	MMB-292	Microbial Molecular Biology and Genetics Lab	0	0	2	2	3
6	CC12	Practical	MMB-293	Microbial physiology and Metabolism Lab	0	0	2	2	3
7	CBCS	Theoretical		CBCS-II	3	1	0	4	4
Total								**22**	**25**
NON-CGPA									
8	EXTRA CC		PMI2501	Seminar	0	0	1	1	1
9	EXTRA CC		PMI2502	SkillX	0	0	1	1	-
TOTAL								**24**	**26**

SEMESTER-III

Sl.No.	Course	Type	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	CC13	Theoretical	MMB-301	Recombinant DNA Technology	3	0	1	4	6
2	CC14	Theoretical	MMB-302	Medical Microbiology	3	1	0	4	4
3	CC15	Theoretical	MMB-303	Bioinformatics	3	1	0	4	4
4	Elective 1	Theoretical	MMB-305/MMB-304	Cell Biology and Molecular Signalling/ Host Pathogen Interaction	3	1	0	4	4
5	CC16	Project	MMB-392	Project	0	0	2	2	3
Total								**18**	**21**
NON-CGPA									
8	EXTRA CC		PMI3501	Seminar	0	0	1	1	1
9	EXTRA CC		PMI3502	SkillX	0	0	1	1	-
TOTAL								**20**	**22**

SEMESTER-IV

Sl.No.	Course	Type	Paper Code	Title of the Paper	L	T	P	No. of Credits	No of Hrs./Week
1	CC17	Project Dissertation and Viva	MMB-491	Project and Viva	0	0	4	4	8
2	CC18	Theoretical	MMB-401	Virology	3	1	0	4	4
3	CC19	Theoretical	MMB-402	Environmental and Agricultural Microbiology	3	1	0	4	4
4	Elective 2	Theoretical	MMB-403A/ MMB-403B	Metabolic Engineering/ Nanobiotechnology	3	1	0	4	4
5	CC20	Industry Visit	MMB-492	Industrial Visit	0	0	2	2	-
Total								**18**	**20**
NON-CGPA									
8	EXTRA CC		PMI4501	Seminar	0	0	1	1	1
9	EXTRA CC		PMI4502	SkillX	0	0	1	1	-
TOTAL								**20**	**21**

M.Sc. in Microbiology Syllabus

CORE COURSES

CC1: Biomolecules and Biophysical Techniques 3-1-0=4

Unit I

Carbohydrates-Monosaccharides- disaccharides- oligosaccharides- sugar derivatives- amino sugar- phosphate esters- deoxysugar- sugar acidpolysaccharides- structure and biological functions of homo- and heteropolysaccharides- biosynthesis and degradation of glucose and glycogen.

Proteins-primary- secondary- tertiary and quaternary structure- Ramachandran plot- super secondary structures- helix loop helix- - biosynthesis of urea.

Lipids- Classification- structure and properties- phospholipids- glycoplipidssphingolipids- cholesterol. Fatty acids- saturated and unsaturated fatty acidsbiosynthesis and degradation- Structure and biological role of prostaglandins, thromboxanes and leukotrienes.

Nucleic acids- types and structural organization- triple helix of DNA- DNA denaturation and renaturation- hypochromicity- Tm.

Unit II

Basic Techniques - Buffers; Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques; Spectroscopy Techniques - UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism; Fluorescence; MS, NMR, PMR, ESR and Plasma Emission spectroscopy Infrared Spectroscopy – Principles of IR spectroscopy, vibrational spectra of biopolymers, Fourier transform of Infra Red spectroscopy, Instrumentation, factors influencing vibrational frequency (Vibronic coupling, H-bond, electronic factors, bond angles, etc) NMR Spectroscopy – Proton magnetic resonance spectra of proteins, 13C NMR spectra of proteins, 31P NMR studies, NMR spectra of nucleic acids, Fourier transform of NMR spectroscopy, Relaxation (ID spectra) X-Ray Crystallography – Instrumentation, Fourier transformation, Application.

Unit III

Chromatography Techniques - TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity; Electrophoretic techniques - Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis

Unit IV

Centrifugation - Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge - Microcentrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

Unit V

Radioactivity - Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Brief idea of radiation dosimetry; Cerenkov radiation; Autoradiography; Measurement of stable isotopes; Falling drop method; Applications of isotopes in biochemistry; Radiotracer techniques; Distribution studies; Isotope dilution technique; Metabolic studies; Clinical application; Radioimmunoassay.

Unit VI Microscopy- Basic concept, Light, Dark-field, phase contrast, fluorescence, confocal, scanning and transmission electron microscopy, Scanning Probe microscopy (AFM, STM)

CC2: Enzymology & Metabolism 3-1-0=4

Unit I: Enzymes: General properties, Nomenclature and classification; Co-factors definition and function with special reference to the representative substances - a) Co-enzymes (NAD+, NADP+, Co-enzyme-A, TPP, Pyridoxal phosphate); b) Prosthetic groups (FAD+ - Succinic dehydrogenase); c) Metal ions: Zn2+, Mg2+, Fe2+, Fe3+, Mn2+ - required for enzyme action. Michaelis-Menten equation; Enzyme Inhibition – Competitive, Non-competitive, Regulatory enzymes-Allosteric, Feedback inhibition, Ribozyme and Abzyme.

Unit II: Carbohydrate metabolism: Aerobic respiration-Glycolysis (EMP-pathway) with energy production: entry of galactose & fructose in EMP-path; TCA-cycle with energy production: pentose-phosphate pathway, Fermentation - Glucose metabolism in anaerobic condition.

Unit III: Electron Transport Chain: ETC & ATP generation sites; ATP & ADP cycle (oxidationreduction potential and electromotive force). Photophosphorylation, oxidative phosphorylation (chemiosmotic theory)

Unit IV: Fatty acid metabolism: Oxidation of fatty (ß) acids, Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance. Biosynthesis of fatty acids. Cholesterol-Biosynthesis, regulation, transport and excretion. Metabolism of lipoproteins. Eicosanoid metabolism.

Unit V: Amino acid metabolism: Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid nitrogen - Transamination, deamination, ammonia formation and the urea cycle.Disorders of the urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to specialized products.

Unit VI: Nucleic acid metabolism: Metabolism of purines - De novo and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines.

CC3: General Microbiology 3-1-0=4

UNIT I:

History and scope of Microbiology. Identification , characterization and classification of microorganisms. Principles of bacterial taxonomy and classification: - Bergy's manual and its importance. Concepts, nomenclature and taxonomic ranks:- general properties of bacterial groups. Major characteristics used in Taxonomy-morphological, physiological and metabolic, ecological, numerical taxonomy, genetic and molecular classification systems; the kingdoms of organisms and phylogenetic trees. Distinguish characteristics between prokaryotic and eukaryotic cells. Structure and function of cell wall of bacteria, cell membranes, flagella, pili, capsule, gas vesicles, carboxysomes, magnetosomes and phycobolisomes.

UNIT II:

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, chemical methods and their application. Concept of containment facility, sterilization at industrial level. Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development. Microscopic identification characteristics, staining methods – simple staining, differential staining, structural staining and special staining methods Microbiological media-Natural and synthetic; autotrophic, heterotrophic and phototropic media: basal, defined, complex, enrichment, selective, differential, maintenance and transport media. Preservation and Maintenance of Microbial cultures: Repeated sub culturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen preservation, drying, glycerol cultures, freeze-drying (lyophilization). Advantages and disadvantages of each method.

UNIT III:

Bacterial nutrition and growth kinetics- synchronous, stock,batch and continuous cultures. Growth measurement methods –Metabolic diversity, measurements of NAD, ATP, DNA, and Protein, CO2 liberated O2 consumed, extra cellular enzymes. Cultivation of aerobes and anaerobes, reproduction in bacteria and spore formation. Morphology, Ultra structure and chemical composition of bacteria, actinomycetes, spirochetes, rickettsiae, mycoplasma, Chlamydiae – TRIC agents and LGV Archaebacteria.

UNIT IV:

Eukaryotic microorganisms: General characteristics, reproduction and economic importance of fungi. Classification, structure, composition, reproduction and other characteristics of fungal divisions-Zygomycota, Ascomycota, Basidomycota, Deuteromycota and slime & water molds. Structure, reproduction and other characteristics of algal divisions. Distribution of algae. Characteristics of – blue green algae, dinoflagellates, thallus organization, products of algae and their economic importance. Algal SCP, emphasis on Spirulina. Characteristics of protozoa-Morphology, nutritional reuirements, reproduction. Morphology, Life cycle and Pathology of Entamoeba histolytica, Plasmodium, Free Living Pathogenic Amoeba Naglaria & Acanthamoeba.

CC4: Biomolecules & Enzymology Lab 0-0-2=3

1. Making of Buffers
2. One dimensional TLC of amino acids and Carbohydrates
3. Two dimensional TLC of amino acids and Carbohydrates
4. Isolation and precipitation of proteins from natural sources and Wavelength scan of proteins
5. Estimation of proteins by Lowry and Brandford methods
6. Thermal unfolding of proteins and calculations of thermo-dynamic parameters from temperature scanning UV spectrophotometer, Effect of solvent conditions on thermal stability of proteins.
7. pH titrations of protein, calculation of net charge and total charge at a particular pH.
8. Reduction of disulphide bonds of proteins.
9. Estimation of DNA by chemical means and wavelength scan of DNA
10. Melting studies of calf thymus DNA
11. Effect of temperature, time and substrate concentration on salivary alpha amylase activity

CC5: Instrumentation Lab 0-0-2=3

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.

4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient.

CC6: General Microbiology Lab 0-0-2=3

1. Laboratory rules, safety and regulation, First Aid and ethics.
2. Standardization of microscope, measurement of microbes and direct cell counting.
3. Culture techniques and microbe handling: adjustment of pH of the media, broth, solid, slant & slab and Plate culture technique.
4. Enrichment culture of Nitrogen fixer, Spore former, cellulose decomposer, sulphate reducing bacteria and phosphate solubilizer.
5. Plating of environmental samples on culture media, isolation of pure culture.
6. Observation of the different morphology, shape, size of bacteria, yeast, micro algae, Protozoa & Fungi, under light field microscope.
7. Staining method: Simple staining. Gram staining, Endospore staining, Acid-fast staining, Flagella staining, Capsule staining.
8. Determination of MIC of antibiotics by tube dilution method. Assay of antibiotics by agar cup method.
9. Phenol co-efficient.
10. Identification of pure prokaryote isolates following Bergey's Manual.
11. Microbial Growth measurement – turbidity, total counts, MPN technique, estimation of dry weight, Bacterial growth curve and generation time. Effect of pH and temperature on bacterial growth.
12. Plaque and Phage Induction Assay

CC7: Immunology 3-1-0=4

Unit-I: Introduction: Phylogeny of Immune system, innate and acquired immunity, Clonal nature of immune response. Organisation and structure of lymphoid organs. Nature and Biology of antigens and super antigens.

Unit-II: Antibody diversity: Antibody structure and function, antigen and antibody interactions, Major histocompatibility complex, HLA. Generation of antibody diversity and complement system.

Unit-III: Cells of immune system: Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocyte, T-lymphocytes, macrophages, Dentritic cells, natural killer and lymphokine activated killer cells. Eosinophils, neutrophils and mast cells. Activation of B and T- lymphocytes. Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity.

Unit-IV: Antigen processing: Antigen processing and presentation, generation of humoral and cell mediated immune responses, cytokines and their role in immune regulation, T- cell regulation, MHC- regulation, Immunological tolerance, Hypersensitivity Reactions, Different types of anaphylaxis reactions with examples, Autoimmunity, Immunosenesence.

Unit-V: Immunological disorders: Transplantation (Immunity and graft rejections), Immunity to infectious agents (intracellular parasites, helimenths & viruses,) Tumor Immunology, AIDS and other immunodeficiences, autoimmune diseases, Hybridoma Technology and Monoclonal Antibodies.

Unit-VI: Antigen - Antibody interactions: Precipitation reactions-Radial immunodiffusion, double immunodiffusion, immunoelectrophoresis; Agglutination reactions-Hemagglutination, passive agglutination, bacterial agglutination, agglutination inhibition.

Unit-VII: Complement Systems: The complement components, function, complement activation- (i) Classical, (ii) Alternate and (iii) lectin pathways.

CC8: Molecular Biology and Genome Studies 3-1-0=4

Unit I: DNA Replication and Repair

Unit of replication, enzymes involved in replication origin and replication fork, fidelity of replication, extrachromosomal replicon, DNA damage and repair; types of damage (deamination, oxidative damage, alkylation, pyrimidine dimmers) repair path-methyl directed mismatch repair, very short patch repair, nucleotide excision repair, excision repair, recombination repair, SOS system.

Unit II : Transcription and Processing

Transcription factors and machinery, formation of initiation complex, transcription activators and repressors RNA polymerases, capping, elongation and termination, RNA processing, RNA

editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Unit III: Translation and Processing

Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, posttranslational modification of proteins, Protein transport and Chaperon Proteins.

Unit IV: Regulation of Gene Expression

Regulation of phage, viruses, eukaryotic and prokaryotic gene expression, operon concept, co-ordinated control of structural gene, stringent response, positive regulation (Arabinose operon), negative regulation (Lac operon), trp operon, regulation by attenuation.

Unit V: Genetic Exchange: Mapping and Recombination

Molecular mechanism of genetic transfer and mapping genes in – transformation, conjugation, transduction and sexduction. F plasmid, structure and function, origin of Hfr and F' strain; transducing phages, P1, T4, μ, λ. Bacterial transposones, homologous and non-homologous recombination including transposion and side specific recombination. Molecular genetic approaches in bacteria with no natural system.

Unit VI: Concept of Genomics and Proteomics

CC9: Microbial Physiology and Cell Biology 3-1-0=4

Unit I: Cell Biology and Bacterial chemolithotrops

Structure and function of cells and intracellular organelles (of both prokaryotes and eukaryotes): Regulation of Eukaryotic and Prokaryotic cell division with special emphasis on cytoskeliton and FtsZ, Cell-cell Interaction, Bacterial cell signalling systems with special reference to quoram sensing, chemotaxis, and biofilm formations.

Unit II: Bacterial Photosynthesis

Photosynthetic microorganisms, photosynthetic pigments and generation of reducing power by cyclic and non cyclic photophosphorylation, electron transport chain in photosynthetic Bacteria. Carbon dioxide fixation pathways.

Unit III Bacterial respiration: Bacterial aerobic respiration, components of electron transport chain free energy changes and electron transport, Oxidative phosphorylation and theories of ATP formation, inhibition of electron transport chain. Electron transport chain in some heterotrophic and chemolithotrophic bacteria. Bacterial anaerobes respiration: Nitrate, carbonate and sulfate as electron acceptors. Electron transport chain in some anaerobic bacteria. Catalase, super oxide dismutase, mechanism of oxygen toxicity

Unit IV Bacterial Permeation: Structure and organization of membrane (Glyco-conjugants and proteins in membrane systems), fluid mosaic model of membrane. Methods to study diffusion of solutes in bacteria, passive diffusion, facilitated diffusion, different mechanisms of active diffusion (Proton Motive Force, PTS, role of permeases in transport, different permeases in E. coli. Transport of aminoacids and inorganic ions in microorganisms and their mechanisms.

Unit V Bacterial Sporulation: Sporulating bacteria, molecular architecture of spores, induction and stages of sporulation, Influence of different factors on sporulation. Cytological and macromolecular changes during sporulation. Heat resistance and sporulation.

Unit VI Chemolithotrophy: Physiological groups of chemolithotrophs, ammonia oxidation by members of Genus Nitroso group, nitrite oxidation by Nitro group of genera. Oxidation of molecular hydrogen by Hydrogenomonas species. Ferrous and sulfur/sulfide oxidation by Thiobacillus species.

CC10: Immunology Lab 0-0-2=3

1. Simple immunodiffusion
2. Radial immuodiffusion
3. Immuno-electrophoresis
4. Spot ELISA
5. Blood group and Rh typing
6. Rocket electrophoresis
7. Ag-Ab agglutination reaction

CC11: Microbial Molecular Biology and Genetics Lab 0-0-2=3

1. Purification of chromosomal/plasmid DNA and study of DNA profile.
2. Confirmation of nucleic acid by spectral study.
3. DNA denaturation and determination of Tm and G + C contents.
4. Agarose gel electrophoresis of DNA.
5. Effect of UV radiations to study the survival pattern of E.coli /yeast. Repair mechanisms in E.coli / yeast (Dark and Photo reactivation).
6. Isolation of antibiotics resistant mutants by chemical mutagenesis.
7. Ampicillin selection method for isolation of autotrophic mutants.

8. Restriction digestion and Agarose gel electrophoresis of DNA.

CC12: Microbial Physiology and Metabolism Lab 0-0-2=3

1. Introduction/Dilution-to-Extinction
2. Growth Curves/Carbon Utilization/Isolation of Riverine Bacteria
3. Genomic DNA & Plasmid DNA Isolations
4. Biofilim Formation/ G+C Content Analysis
5. Quorum Sensing Analysis
6. Analysis of Biofilm
7. Assessment of Pigment Protection
8. Scanning Electron Microscopy Demo on Biofilm sample

CC13: Recombinant DNA Technology 3-0-1=4

Unit I: Vectors for cloning: Plasmids, phages, ssDNA phages, cosmids,YACs. Enzymes used in gene manipulation-restriction enzymes, DNA polymerases, reverse transcriptase, ligases, polynucleotide kinase, alkaline phosphatase and nucleases.

Unit II: Transfer of DNA into cells: transformation, transduction, electroporation, microinjection. Agrobacterium mediated gene transfer.

Unit III: Cloning strategies: Genomic libraries, cDNA Cloning subcloning, shot gun cloning. Cloning in E. coli, Bacilli and yeast. Yeast two hybrid system. cDNA phage display library. Recombinant clones: Detection of recombinant DNA and its Products.

Unit IV: Site-directed mutagenesis of cloned genes. DNA sequencing: Oxy, deoxy chemical methods, Pyrosequencing, Nanosequencing. PCR: Design of PCR primers, RT-PCR, RACE, AP-PCR, PAF. Antisense and ribosome technology: siRNA, miRNA, Ras, Dicer. Applications of PCR.

Unit V: Applications of genetic engineering: In medicine, agriculture, veterinary and industry. Safety aspects of recombinant DNA technology; Bioethics and Bioissues for releasing GMOs. DNA forensics. Somatic cell gene therapy.

Recombinant DNA Technology Lab

1. UV mutagenesis and percent survival
2. Photoreactivation of UV irradiated E. coli.
3. Development of auxotrophic mutants employing EMS
4. Screening of multiple antibiotic resistant mutants of E. coli
5. Plasmid curing in bacteria
6. Replica plating technique
7. Determination of purity and estimation of DNA
8. Transfection by single burst experiment
9. Blue and white colony selection employing X-gal-IPTG

CC14: Medical Microbiology 3-1-0=4

UNIT-I: Normal microbial flora of human body, host microbe interactions. Infection and infection process: port of entry, port of exit for transmission. Invasiveness and virulance factors, epidemiology, systomalogy, diagnosis, and prognosis of following diseases Typhoid, Cholera, Tetanus, Tuberculosis, Gonoriasis, AIDS, Hepatitis B, Influenza. Brief description of Mycosis with special reference to Candidiasis, Dermatomycosis; Brief description of pathogenesis of Leishmeniasis, Giardiasis, Ascariasis, and Filariasis.

UNIT-II: Description and pathology of diseases caused by Aspergillus, Penicillium, Mucomycosis, Blastomycosis, Microsporosis, Rhinosporidium, Epidermophyscosis. Description and pathology of diseases caused by hemoflagellates; Leishmania donavani, L.tropica, Trypanosoma gambiense; intestinal flagellates; Trichomonas, Giardia, Entamoeba histolytica, malarial parasites, Helminthes; Ascaris lumbricoides, Hook worm, pinworm, Filarial parasites.

UNIT-III: Principles and History of chemotherapy: Classification of common therapeutant on the basis of mode of action and according to their targets; antibiotics. - Penicillin, streptomycin, sulfonamides and Polymyxins. Antifungal drugs (Nystatin), Antiviral agents. (Robovirin) and tetracycline; Mechanism of development of drug resistance in bacteria and its problems with public health.

UNIT-IV: Epidemiology and Disease Transmission: Science of Epidemiology, possible way of disease transmission, vector and vehicle borne diseases, airborne, water and food born, and wound infections; nosocomial infection, direct contact and their possible managements for public health manangments

CC15: Bioinformatics 2-0-2=4

Unit I: Basics of Computer: Basic operations, architecture of computer. Introduction of digital computers. Organization, low level and high level languages, binary number system. The soft side of the computer – Different operating systems – Windows, Linux. Introduction of programming in C. Introduction to Internet and its applications. Use of statistical packages for data analysis i.e. SPSS etc.

Unit II: Introduction to Bioinformatics: Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gene Bank, Swiss port, EMBL, NCBI, and PDB. Database searching using BLAST and FASTA.

Unit III: Multiple sequence alignment and Dynamic programming: Gene and Genome annotation – Tools used. Physical map of genomes. Molecular phylogeny - Concept methods of tree construction.

Unit IV: Protein secondary structure prediction: Protein 3D structure prediction. Molecular docking. Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery.

CC16: Review work for project 0-0-2=2

CC17: Project, Dissertation and Viva 0-0-4=4

CC18: Virology 3-1-0=4

UNIT I: History and Discovery of Viruses, Nature, origin and evolution of viruses, New emerging and reemerging, viruses, viruses in human welfare. Nomenclature, classification and structure of viruses – criteria used for naming, classification of viruses, recent ICTV classification of viruses infecting animals, humans, plants, bacteria, algae, fungi. Major characteristics of different virus families/genera/groups- Poxviridae, Hepadnaviridae, Baculoviridae, Adenoviridae, Herpesviridae, Ortho and Paramyxoviridae, Retroviridae, Reoviridae, Parvoviridae, Rhadboviridae, Picornaviridae, Flaviviridae, Potyviridae, Tobamoviridae, Bromoviridae, Bunyaviridae, Geminiviridae, Caulimoviridae. Algal, Fungal and Bacterial viruses- Phycodnaviridae, Cyanophages, Partitiviridae and Totiviridae. Subviral agents-sat viruses, Sat nucleic acids, Viroids, Prions.

UNIT II: Properties of Viruses- Biological properties of viruses – host range, transmissionvector, non-vector; Physical properties of viruses – morphology, structure, sedimentation, electrophoretic mobility, buoyant density; Biochemical characteristics – chemical composition of viruses, proteins, nucleic acids, envelope, enzymes, lipids, carbohydrates, polyamines, cations, Antigenic nature of viruses.

Isolation, cultivation, assay and maintenances of viruses – Animal, Plant and Bacterial Viruses: biassay tissue culture – organ culture, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines, embryonated eggs; experimental plant tissue cultures.

UNIT III:

Viral replication and genome expression – viral genomes- structure and complexity of viral genomes, diversity among viral genomes – DNA and RNA genomeslinear, circular, double and single stranded; positive and negative sense of RNA genomes, mono, bi tri and multipartite of genomes. Replication of viruses – an overview of viral replication cycles, replication strategies of DNA, RNA viruses and regulation of viral genome expression- Baltimore strategies.

Virus – host interactions – cytopathic effects of viral infections, inclusion bodies, chromosomal aberrations; Response of host cells to viral infection –interference, immunological responses of the host,

UNIT IV:

Transmission of viruses – Vertical (Direct) transmission – contact, mechanical, transplacental, transovarial, sexual, fecal, oral, respiratory, seed and pollen. Virus related particles (Prion, Virion, Viroids) with special reference to HIV and Dengue. Horizontal (Indirect) transmission-aerosols, fomites, water, food, graft, dodder. Vector-arthropod, non-arthopods, virus and vector relationship. Multiple host infections – viral zoonosis.

Diagnosis of viral diseases – chemical symptoms, immuno diagnosis, molecular methods used in viral diagnosis, prevation and control of viruses: prevation – sanitation, vector control, vaccines and immunization control – chemoprophylaxis, chemotherapy – anti viral drugs, interferon therapy, efficacy of infection control.

CC19: Environmental and Agricultural Microbiology 3-1-0=4

UNIT-I: Basic concepts of Ecology and Environment – Biological spectrum at levels of organization & realm of ecology. Ecosystem – Concept, components, food chains, food webs and tropic levels. Energy transfer efficiencies between tropic levels. Biological factors influencing the growth and survival of microorganisms- inter reactions of microbial population and community dynamics – Growth in closed environments and in open environments. The kinetic properties of competition between microbial populations. Kinetic principles of prey-predator relationship.

UNIT-II: Aquatic Microbiology – Water ecosystems – types, fresh water (pond, lakes), marine habitats (estuaries, deep sea, hydrothermal vents); Eutrophication, food chain; potability of water, microbial assessment for water quality, water purification, physical, chemical, microbiological characteristics of sewage. Characterization of solid and liquid wastes, physical, chemical and biological (aerobic, anaerobic – primary, secondary, tertiary) treatment; Solid waste treatment; Liquid waste treatment – trickling, activated sludge, oxidation ponds. Formation of biofilm. Biomagnifications

UNIT-III: Microorganisms and pollution: Microbial production of methyl mercury, trimethyl arsine, hydrogen sulphide, acid rain water, carbon monoxide, ammonia, nitrate, nitrogen oxides, nitrosamines, Eutrophication, algal toxins.

Microorganisms and sewage treatment: COD, BOD & DO, trickling filters, activated sludge process, oxidation ponds; sludge treatment (anaerobic digestion).

UNIT-IV: Bioremediation Technology – Microbial degradation of oil spills, pesticides and detergents, Biofouling; Fate of genetically engineered microorganisms in the environment. Environmental impact assessment studies.

Deterioration of materials – paper, textiles, painted surfaces, prevention of microbial deterioration.

UNIT V: Soil Ecosystem: Soil environment types, texture, different soil factors, edaphic factors, role of rhizoplane, rhizosphere effect. Interaction of soil environment: Biotic and abiotic interactions, biotic-biotic interaction (Antibiosis, commensalism, mutualism, symbiosis, antagonism, synergistic relationship). Brief description of Mycorhizza as bioinoculant for the promosion of of crop yield. Ecology of biological Nitrogen fixation: types and usage in agriculture.

UNIT VI: Use of Soil Microbes in Agriculture: Microbial biofertilizer, types and microbes used, characteristics of inoculants production, production of inoculant biomass, formulation & packaging technology, application of microbial inoculant, PGPR (plant growth promoting bacteria of rhizosphere); Biocontrol agents (General attributes considering the selection of microbial biofertilizers, PGPR); biocontrol candidates (Nitrogen fixer, phenol, indole, phinazine, siderophore, Kitinase, IAA, ACC deaminase etc)

UNIT VII: Microbial insecticides- types, microbes used production of inoculants and application.

CC20: Industrial Visit 0-0-2=2

Discipline Centric Subjects

Host Pathogen Interaction 3-1-0=4

Unit I: Concepts of Virulence: the damage-response framework, Interference of pathogens with cytokine/chemokine networks, Interference with apoptosis

Unit II: Molecular mimicry/Antigenic variation, Interference with humoral immunity Interference with cell-mediated immunity, Protective vs non-protective immunity

Unit III: Adhesion and invasion, Detrimental immune responses/autoimmune disease

Unit IV: Autophagy: possible association with bacterial pathogenesis, Strategies for intracellular survival of bacteria, Subversion/Interference with host cell signalling

Unit V: Induction of host-mediated tissue damage, Superantigens/toxic shock, Interference/subversion of host cell intracellular trafficking, Microbial protein secretion systems/Interference with host cell secretion

Cell Biology and Molecular Signalling 3-1-0=4

Unit 1: General Concepts: How Do We Develop Drugs, Diabetic Neuropathy Trials and Choice of Endpoint, Molecular Signaling and Drug Discovery

Unit II: Signaling Specific Drug Discovery, Approaches and considerations for biologic therapeutic development – targeting the FGF pathway for chemotherapy, Discovery and Rational Development of an Antagonist to the Phosphaturic Hormone FGF23, Ras/Cancer, RNAi, Structured-base Drug/Vaccine Design targeting HIV/AIDS, Targeting the Pl2k-Akt-

TOR Pathaway, Patenting Clinical Data, Opiod Receptor Heterodimerization in Analgesia and Addiction

Unit III: Therapeutics for Public Health Diseases—Diabetes, RAGE and Diabetic Complications, Aldose Reductase and Diabetes Complications, Kinetin in Familial Dysautomia: A Modifier of Gene Expression

Unit IV: Signal Transduction and Signal Management in Pharmacovigilance, Startup Biotech: a 1st person perspective on the risks and rewards of starting your own company

Metabolic Engineering 3-1-0=4

UNIT I: SUCCESSFUL EXAMPLES OF METABOLIC ENGINEERING

Product over production examples: amino acids, polyhydroxyalkanoic acids, By-product minimization of acetate in recombinant E. coli, Extension of substrate utilization range for organisms such as S. cerevisae and Z. mobilis for ethanol production, Improvement of cellular properties, Altering transport of nutrients including carbon and nitrogen and xenobiotic degradation.

UNIT II: METABOLIC FLUX ANALYSIS

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, metabolic flux analysis. MFA of exactly determined systems, over determined systems.

UNIT III: CONSTRAINT BASED GENOMIC SCALE METABOLIC MODEL

Underdetermined systems- linear programming, sensitivity analysis, Development of Genomic scale metabolic model, Flux balance analysis, Regulatory on-off Minimization and Minimization of metabolic adjustments and Opt knock tool development, Elementary mode analysis, Extreme pathways.

UNIT IV: METABOLIC FLUX ANALYSIS BY ISOTOPIC LABELLING

Methods for the experimental determination of metabolic fluxes by isotope labeling metabolic fluxes using various separation-analytical techniques. Validation of flux estimates by 13C labeling studies in mammalian cell culture.

UNIT V: METABOLIC CONTROL ANALYSIS AND NETWORK ANALYSIS

Fundamental of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients, MCA of linear pathways, branched pathways, theory of large deviations. Control of flux distribution at a single branch point, grouping of reactions, optimization of flux amplification.

Nanobiotechnology 3-1-0=4

Unit I: Properties and Characterizations: Optical (UV-Vis/Fluorescence)

X-ray diffraction, Imaging and size (Electron microscopy, light scattering, Zetapotential, Surface and composition (ECSA, EDAX, AFM/STM etc), Vibrational (FT-IR and RAMAN), SERS, Magnetic, Electrical and Electrochemical

Unit II: Applications of Nano-Materials in Biosystems: Proteins - Lipids - RNA and DNA Protein Targeting - Small Molecule/Nanomaterial - Protein Interactions Nanomaterial-Cell interactions-Manifestations of Surface Modification (Polyvalency)

Unit III: Nanomaterials and Diagnostics/Drug Delivery and Therapeutics MRI, Imaging Surface Modified Nanoparticles, MEMS/NEMS based on Nanomaterials, Peptide/DNA Coupled Nanoparticles, Lipid Nanoparticles For Drug Delivery, Inorganic Nanoparticles For Drug Delivery, Metal/Metal Oxide Nanoparticles (antibacterial/anti fungal/anti viral), Anisotropic and Magnetic Particles (Hyperthermia)

Unit IV: Nanomaterials and Toxicity Evaluation Cyto-toxicity, Geno-toxicity In vivo tests/assays etc.