SYLLABUS OF B.Sc. (HONS) MICROBIOLOGY
Department of Industrial Microbiology SHUATS

Semester I

1. **Course Title: Organic Chemistry**
   Course Code: CHEM 313 **Credits: 3(2-0-1)**

Unit I: Carbohydrates:- Introduction, Classification, Monosaccharide Stereochemistry, Fischer Projection, Structure of D-glucose, Cyclic structure of D-glucose4, Haworth projection, properties, Oligosaccharides, Structure of sucrose, Polysaccharides:- Structure of starch, cellulose and Glycogen.
Unit II:-Amino Acids:- Classification, Essential and Nonessential AminoAcids, Optical activity, synthesis. Properties, Zwitterion and Isoelectric point.
Unit III:- Proteins:- Classification, Primary, Secondary, Tertiary structure. Properties, Colloidal nature, Denaturation, Test for proteins.
Unit VI: Fats and Oil:- Composition of fats, Introduction, Nomenclature of fats, Physical and Chemical properties of fats, Rancidity, Analysis of fats chemical constant, Saponification, Specification number, Iodine Number, Acid value, Reichert Miessl value, Polenske value.
Unit V: Alkaloids:- Introduction, Classification, Structural feature of Terpene or Isoprene rule, Myrcene, Citral.
Unit VI: Nucleic Acids:- Chemistry of Nucleic acids, Structure and composition of purine and pyrimidines, Nucleosides, Nucleotides, general composition of DNA & RNA.

Practical:-

1. Identification of sugars and organic acids.
2. Test for proteins and amino acids.
3. Test for fats, fatty acids, acidity and Saponification.
4. Identification of Phenol, Acids, Carbonyl compounds, Hydrocarbons

Books Recommended:

1. Modern Organic Chemistry by M.K.Jain &S.C.Sharma.
2. Chemistry of Organic Natural Products by O.P.AgarwalVol.I
3. Advanced Practical Organic Chemistry by O.P.Agarwal.

2. **Course Title: Inorganic Chemistry**
   Course Code: CHEM 311 **Credits: 3(2-0-1)**

Unit I: Chemical Bonding:- Covalent, Ionic and Coordinate Bonds, Fajan's Rule, Hybridisation.
Unit II: Theories of Bonding:- Valence Bond Theory, Valence Shell Electron Pair Repulsion Theory and Molecular Orbital Theory.
Unit III: Radiochemistry and Nuclear Chemistry:

i) Natural and Artificial radioactivity-Transmutaion and Induced Radioactivity, Group Displacement law, Radioactive Disintegration and Concept of Half-life, Application of radiochemistry.

ii) Nuclear Composition, Mass defect, Binding Energy, Packing Fraction, Nuclear fission and fusion reaction.

Unit VI: Organometallics: Introduction, Classification, Nature of carbon metal bond, properties and their applications.

Unit V: Biochemical significance of Inorganic metals: Intr4oduction and biochemical significance of Na, K, Cl, Fe, Zn, Co.

Unit VI: Inorganic Polymers: Classification of inorganic polymers and preparation, properties of silicones and phosphate polymers.

Practical:

- Qualitative analysis of inorganic mixtures

3. Course Title: Cell Biology
Course Code: MCE-301 Credits: 3(2-0-1)

Unit 1. An introduction to cell biology: History of cell biology. Development of cell theory. Modern cell biology.

Unit 2. Diversity of cell size and shape: Structure of prokaryotic cells (bacteria, fungi, virus, cyanobacteria, mycoplasma etc.). General organization of eukaryotic cells, cell shape, cell size, cell volume and cell number.

Unit 3. Organization of cell: Cell wall, plasma membrane, their structural organization and functions. Membrane bound cell organelles - nucleus, endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and vacuoles. Non-membrane bound cell organelle- ribosome. Cytoskeleton- microtubules, intermediate filaments and microfilaments.

Unit 4. Cell growth and division: Cell cycle, kinds of cell division, amitosis, mitosis, meiosis, comparison between mitosis and meiosis, crossing over, significance of cell division.

Practical:

1) Microscopy- To study a simple and compound microscope
2) To prepare stain- Crystal violet; Safranin; Gram's Iodine.
3) To perform Grams staining.
4) Study of cell division (Onion Root Tip Experiment) - different stages of mitosis
5) Differential staining of blood cells.
6) Hanging drop method for motility of bacteria.

4. Course Title: Introductory Microbiology
Course Code: IM 349 Credits: 3(2-0-1)

- Definition, Scope and History of Microbiology
- Cellular organization of prokaryotic and eukaryotic cells
- Difference between prokaryotic and eukaryotic cells
- General characteristics and nature of Bacteria, Mycoplasma, Rickettsiae, Chlamydiae, Actinomycetes, Protozoa, Fungi, Algae & Viruses

Practical

- Familiarity with equipment to be used in Microbiology Laboratory.
- Cleaning, washing and sterilization of glass wares
- Observation of permanent slides to study the structural characteristics of common bacteria , fungi, algae & protozoa

5. Course Title: Basic Techniques in Microbiology
Course Code: IM 350 Credits: 3(2-0-1)

- Microscopy: Principles and applications of simple, compound, bright field, dark field, phase contrast, fluorescent and electron microscopy.
- Principles of staining: Nature of dyes, types of staining- simple, differential, spore and negative staining.
- Sterilization: Principles and methods.
- Types of media with specific examples for each type.
- Methods of maintenance and preservation of cultures.

Practical

- Handling and care of Microscopes
- Staining techniques
- Preparation and sterilization of different media types.

6. Course Title: Basic Mathematics I
Course Code: MAS 303 Credits: 3(3-0-0)

- Algebra: Theory of quadratic, Binomial-Theorem (for +ve index), Use of natural and common logarithms, exponential series, partial-fractions, Determinants of order 3, Theory of Matrices, addition, substraction, multiplication, transpose, elementary ideas on ad-joint and inverse. Solution of linear equations, inequalities, permutation and combination.
- Trigonometry: Trigonometrical-functions, addition and substraction formula, double and half angle formula laws of sines and cosines, solutions of triangles, height and distance, real and complex numbers, hyperbolic trigonometric functions, De-Movire's Theorem.
- Coordinate-Geometry: Distance between two points, Area of triangle, Staright-lines.

7. Course Title: Introduction to Computer Application
Course Code: CSIT 301 Credits: 3(2-0-1)

Unit - I
Introduction to Computers: Need and Role, Definition, Characteristics and Applications**. Hardware:** Basic block diagram & components**. Software:** System & Application

Unit - II
Introduction to Programming: Algorithm and flowchart, Program definition,

Program life cycle, Principles and techniques, Characteristics of a good program.

Unit - III

Introduction to MS Word and PowerPoint: Introduction to Word Processing and its features, formatting documents, paragraph formatting, page formatting, headers and footers, bullets and numbering, tables, finding and replacing text.
Working with slides, adding content, working with text, color schemes, graphics, slide effects.

Unit - IV

Introduction to Spreadsheet: Worksheet basics, data entry of numbers, text, date and time. Editing and formatting of a worksheet. Calculations using formula and functions. Working with graph and charts.
Data Base Management System: Concept of database, Database terminologies, working with MS-Access.

Unit - V

Introduction to Computer Networks and Internet: Definition of Computer Network, Types of Computer Network, Network media and Toplogy.
What is Internet? , History of Internet, Services of Internet, Websites, email.

Reference Books:

Raja Raman V. (2004), "Introduction to Information Technology", PHI.
Jain, V.K.; "Information Technology", S.K. Kataria
V.K. Jain & Pankaj Bhambri,"Fundamentals of Information Technology", S.K. Kataria
P.K Sinha & P.Sinha, " Foundation of Computing", BPB

8. Course Title: Applied Physics
Course Code: PHY 309 **Credits: 3(3-0-0)**

Unit-I: Optics

Interference: Coherent sources, conditions of interference, Fresnel's bi-prism experiment, interference in thin films, wedge shaped film, Newton's ring.

Diffraction: Single slit and double slit diffraction, diffraction grating, Raleigh's criterion of limit resolution, resolving power of telescope and microscope.

Polarization: Polarization of light, Brewster's law, Malus law, phenomenon of double refraction, geometry of calcite crystal, optic axis, principal section, ordinary and extraordinary rays, construction and working of Nicol prism. Plane, circularly and elliptically polarized light. There production and analysis. Retardation Plates, optical activity, specific rotation, polarimeters.

Unit-II: X-rays

Origin of X-rays, continuous and characteristic X-ray spectra, Mosley's law, absorption of X-rays, Diffraction of X-rays, Bragg's law, Bragg's spectrometer, practical applications of X-ray, X- ray Machine.

Unit-III: Laser

Spontaneous and stimulated emission of radiation, Einstein's Coefficients. Components of laser. Type of laser and their working and application. Classes of laser equipments.

Unit-IV: Electromagnetic Theory.

Gauss's law, Poisson and Laplace equation, Maxwell's equations, Basic concepts of Electromagnetic waves and its solution in free space. Para, dia, ferro, antiferro and ferri magnetic materials. Hysteresis and magnetic circuits.

Reference books:

1. Fundamentals of Optics Jetkins & White.
2. Perspectives of Modern Physics Beiser
3. Electrodynamics David Griffith.
4. Laser – Theory & Applications Thyagranjan / Ghatak
5. Fundamentals Of Physics Resnick & Halliday.
6. Engineering Physics Uma Mukherjee.
7. Text book of Engineering Physics Navneet Gupta & Kumar.

9. Course Title: Moral and Value Education
Course Code: GPT 301 Credits: 2(2-0-0)

- My country and my people, the many Indians, Being and becoming an Indian, Nationalism and Internationalism.
- Some life issues-Love, Sex and marriage ;Men and money-value of time ;Meaning of work, Human communication; Human suffering; Addiction ; Ecology; Women's issues.
- Understanding one's neighbour. Neighbourhood groups: their structure and functions, Patterns of Social interaction of group dynamics.
- Preparation of a career; Choice of vocation; Motivation for study and research; The present educational system: Curriculum and syllabus; Teaching methods; Examination and work experience.
- Definition of value education; Moral and ethics; Laws and morale based on Ten Commandments and two great commandments.
- Discovery of self; Self-awareness; Growth of intellect-Man's spiritual nature emotions, Will. Respect the rights of life, Liberty, Property, Truth reputation.
- Sin, Origin of sin, Manifestation of sin. The results of sin, The remedy of sin, Sin as an act, Sin as a state, sin as a nature.
- Conscience-as defined in Oxford Dictionary and Winston Dictionary, Types of Consciousness (Such as evil, Convicted, Purged, Pure, Weak, Good, Void of Offence).

10. Course Title: Elementary Biology
Course Code: BIOL 201 Credits: 2(2-0-0)

UNIT I Life: Living and non-living organisms. Unicellularity, multicellularity complex tissue system, Branches of biology. Structure and functions of Cell.
UNIT II Introduction to botany: Classification of plant kingdom; Brief introduction of branches of botany: morphology, anatomy, taxonomy, physiology, Palaeobotany.

UNIT III Introduction to lower botany: algae, fungi, bacteria, virus, bryophytes,Pteridophytes
UNIT IV Introduction to zoology: Classification of animal kingdom; adaptation of animals. Morphology of frog. Anatomy of frog: internal organs; different internal systems.
UNIT V Economic Zoology, Economic botany, Scope and application of biology.

Recommended Books: • NCERT. 2013. Biology. Class 11 and Class 12.NCERT Publications.
• Shukla and Upadhyaya.
2009. Economic Zoology. Rastogi Publications.
Verma.Economic Botany. 2009. Rastogi Publications.

Semester II

1. **Course Title: Basic Mathematics II**
   Course Code: MAS 304 **Credits: 3(3-0-0)**

Differential calculus: Functions, Limit, Continuity and Differentiability, Differential coefficients of standard fractions (algebraic, trigonometric, exponential, logarithmic etc.) Rules for differentiation, differentiation of composite, inverse, implicit and parametric functions. Higher order derivatives. Tangent and normal, maxima and minima.
Integral calculus: Definite integration of standard functions, integration by substitution, parts, partial fraction. Integration of rational, irrational trigonometric functions etc. Definite integrals and properties. Its application in evaluating area and volume.
Vector – Algebra: Definition and identification of vector and scalar, linear operations in vectors, linear combinations of vectors, Linear independence and dependence. Dot and vector products. Triple product.

2. **Course Title: Fundamental Statistics**
   Course Code: MAS 331 **Credits: 3(2-0-1)**

Definition & applications of Statistics, Testing of Hypothesis: Concept of Hypothesis, Degrees of freedom, Level of significance
Measures of central tendency, Measures of dispersion, standard error of mean, Coefficient of variation
Probability: Definition & applications, numerical- problems.
Simple correlation between two variables: (definition, properties & numerical).
Regression Lines: Definition & uses, Regression Coefficients, Method of least square.

Books: 1. Probability & Statistics for Engineers :R.A.Johnson.
2. Probability & Statistics for Engineers: A.J.Haten
3. Fundamental of Mathematical Statistic : Gun Gupta & Das Gupta.
4. Fundamental of Mathematical Statistics: Gupta &Kopoor.
5.

3. **Course Title: Physical Chemistry**
   Course Code: CHEM 312 **Credits: 3(2-0-1)**

Unit I : Ionic Equilibria: Concepts of acids and bases, their relative strength, pH and Buffer solution, Hydrolysis of salts, acid-base indicators Ostwalds and quinonoids theory, solubility product.
Unit II : Chemical Kinetics: Order and Molecularity, differential rate laws and integrated rate laws equation for zero order, 1^{st} , 2^{nd} and 3^{rd} order reactions (derivations included), significance of rate constant and its evaluation, time for definite fractional change of reaction, determination of order, effect of temperature on the rate os reactions, Complex reactions (consecutive, side, parallel, chain reactions), collision theory, Lindeman theory, enzyme kinetics.
Unit III : Electrochemistry: Reversible and irreversible cells, EMF of a cell and free energy, Nernst equation, equilibrium constant, standard electrode potential, types of reversible electrodes, Electrochemical series, Overvoltage, Fuel cells, applications of EMF measurements, determination of solubility product, pH, dissociation constant of acids, hydrolysis constant, solubility of sparingly soluble salts, Potentiometric titrations.
Practical:

1. Determination of rate constant and order of reaction for hydrolysis of ester by an acid.
2. To study the kinetics of dissociation of Magnesium in dilute HCl.
3. To determine the order of sap[onification of ethyl acetate with NaOH.
4. Determination of density of liquid by density bottle.
5. To find the surface tension of the given liquid.
6. To find the relation and absolute viscosity of given liquid.
7. Determination of carbonates, bicarbonates and total alkalinity in water.

Books Recommended

1. Essentials of Physical Chemistry by B.S. Bahl, ArunBahl, G.D. Tuli
2. Elements of Physical Chemistry by Puri, Sharma, Pathania
3. Physical Chemistry by Gurdeep Raj
4.

4. **Course Title: Microbial Taxonomy and Diversity**
   Course Code: IM 412 **Credits: 3(3-0-0)**

- General principles of microbial taxonomy
- Detailed classification and study of major groups of bacteria, fungi and viruses
- Introduction to microbial diversity, distribution, abundance and ecological niche.
- Culturable and Unculturable bacteria.
- Conventional and molecular methods of studying microbial diversity

5. **Course Title: Microbial Ecology**
   Course Code: IM 413 **Credits: 2(2-0-0)**

- Microbial habitats (Soil, aquatic, air)
- Ecological groups of microorganisms (based on O_2 requirements, Carbon sources, temperature, extremophiles, and nutritional basis.
- Microbial population and community interactions.
- Microorganisms and transformation involved in the major geochemical cycles in marine, freshwater and terrestrial ecosystem.
- Bioremediation, Biodegradation and Biodeterioration.

6. **Course Title: Introduction to Biotechnology**
   Course Code: MCE 303 **Credits: 3(3-0-0)**

Unit I. Introduction: Historical development of biotechnology. Basic concepts of biotechnology. Definition and descriptions of some important terminology in biotechnology.
Unit II. Branches of biotechnology: Study of various branches of Biotechnology including Plant, Animal, Medical, Industrial, Environmental, Marine Biotechnology, Bioinformatics, etc. Introduction to recombinant DNA technology and its applications.
Unit III. Biotechnology in India: Biotechnology and developing world- concerns and consequences. Role of biotechnology in Indian industry. Impact on agricultural sector.
Unit IV. Biotechnology and other disciplines: Biotechnology- an interdisciplinary pursuit, a three component central core, product safety. New trends in biotechnology.
Unit V. Applications and scope of biotechnology: Practice of biotechnology in medicine, industry, agriculture, live stock improvement and environment. Future perspectives.

7. **Course Title: Environmental Studies I**
   Course Code: ENVS 415 **Credits: 2(2-0-0)**

- **The multidisciplinary nature of environmental studies:** Definition, scope and importance.
- **Ecosystems**
  1. Concept of an ecosystem
  2. Structure and function of an ecosystem
  3. Producers, consumers and decomposers
  4. Energy flow in an ecosystem
  5. Ecological succession
  6. Food chains, food webs and ecological pyramids
  7. Introduction, types, characteristic feature, structure and function of the following ecosystem:
     (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem
     (d) Aquatic ecosystem

- **Social issues and the environment**
  1. From unsustainable to sustainable development

2. Urban problem related to energy
3. Water conservation, rain water harvesting, watershed management.
4. Resettlement and rehabilitation of people, its problems and concerns-Case studies
5. Environmental ethics: Issues and possible solutions
6. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies
7. Wasteland reclamation
8. Consumerism and waste products
9. Environment Protection Act
10. Air (Prevention and control of pollution)
11. Visit to local polluted site-Urban/Rural/Industrial/Agricultural
12. Study of common plants, insects and birds
13. Study of simple ecosystem-ponds, river, hill slopes etc.

8. Course Title: Fundamentals of Tissue Culture
Course Code: MCE 407 Credits: 3(2-0-1)

Plant Tissue Culture: A historical view, organization of tissue culture laboratory, aseptic techniques, media formulation, clonal propagation vs tissue culture, totipotency, growth differentiation and morphogenesis in tissue culture, various types of aseptic cultures and culture techniques.
Application of tissue culture techniques: Somoclonal and gametoclonal variation, protoplast fusion and somatic hybridization, cybridization, haploid and monoploid production, secondary transformation, production of metabolites, artificial seeds, preservation of genetic resources, cryopreservation, application of tissue culture for plant improvement.
Animal Tissue Culture: Basic techniques, organ culture, media formulation for animal cell, initiation of cell culture, evolution and maintenance of cell lines, Suspension culture and Immobilized culture.

Practicals
Good Laboratory Practices. Laboratory equipments used in Plant Tissue culture. Plant Growth Hormones. Media preparation. Preparation and Sterilization of explants. Callus induction. Meristem culture.

9. Course Title: Introductory Biochemistry
Course Code: BCBE 302 Credits: 3(2-0-1)

Introduction to Biochemistry: Definitions, biological molecules, Role of biochemistry in nutrition, Health of humans. Classes of biological molecules and their chemical nature. Cell organelles composition: cell structure, organelles-functions, cell division types.
Carbohydrates: Definition, classification, properties. Metabolism of carbohydrates-monosaccharide and polysaccharide metabolism and nutritional importance.
Lipid metabolism: Definition, classification, properties. Metabolism of lipids and nutritional significance.
Protein Metabolism: Definition, classification, properties. Metabolism of proteins and their nutritional importance.
Vitamins and Hormones: Vitamins: definition, classification, disorder-deficiency,

sources. Hormones: Classification & properties.

Practical:

Determination of Lactic acid from milk.
Identification of sucrose, starch and gelatin in milk.
Determination of protein from milk.
Determination of Fat from milk.
Determination of citric acid from fruit juice.
Determination of acid number of oils.
Determination of saponification of oils.

Semester III

1. **Course Title: Analytical Chemistry**
   Course Code: CHEM 330 **Credits: 3(2-0-1)**

Unit I: General Principles of Analytical Chemistry: Volumetric Analysis, Solutions, Preperation of primary and secondary solutions. Neutralization (Acid Base) titration, Iodometry, Permagnetometry Volumetric Determination of calcium, Galvanometric Analysis:Principles and methodology, Estimation of calcium.

Unit II: Colorimetry: Principle, Lambert's and Beer's Law, Absorption Law (Derivation required).

Unit III: Thermometric Titrations: Thermo-gravimetric Analysis-types, Instrumentation, Methodology and Applications.

Unit IV:Potentiometric Titrations: Electrode System, Ion selective Electrodes, Ion selective Membrane electrode, Advantages of Potentiometric titrations, Applications of Potentiometric titrations.

Unit V:Polarimetry & Flourimetry: Instrumentation, methodology and Applications.

Unit VI: Spectrophotometry : Principle, Instrumentation, methodology and applications.

Unit VII: Spectroscopic Techniques: Introduction of U.V, IR, NMR & Mass Spectroscopy.

2. **Course Title: Molecular Biology**
   Course Code: MCE 302 **Credits: 3(3-0-0)**

Unit 1: Introduction: Development of molecular biology. Historical perspectives. Concepts in molecular biology.

Unit 2: Structure and properties of nucleic acids: Structure of nucleotides, DNA double helix, helical conformations and DNA topology. Types of DNA and RNA- A, B, Z forms of DNA, mRNA, tRNA, rRNA, hnRNA, snRNA.

Physical and chemical properties of DNA.

Unit 3: DNA protein interaction: Molecular aspects of protein-nucleic acid binding. DNA binding motifs in proteins- Helix- turn - helix, Zinc finger motifs, Leucine zipper, HMG box, etc.

Unit 4: Gene organization: Gene structure and architecture, gene clusters, split genes, overlapping genes, pseudogenes, operon, open reading frames, transposons, oncogenes. Range of genome size. C value and gene numbers. Re-association kinetics, Repetitive DNA - satellite DNA.

3. Title: General Bacteriology
Course Code: IM 431 **Credits: 3(2-0-1)**

- Morphology and fine structure of bacterial cell.
- Cultivation of bacteria: Nutritional requirements, Nutritional types of bacteria, Physical conditions required for growth
- Pure cultures and Cultural characteristics
- Reproduction and growth of bacteria: Modes of cell division, Growth curve, Quantitative measurement of growth.

Practical
- Methods of isolating pure cultures
- Identification of common bacteria on the basis of cultural and biochemical characters.
- Test for motility of bacteria
- Quantitative measurement of growth

4. Title: Introduction to Virology
Course Code: IM 432 **Credits: 3(2-0-1)**

- Introduction: Definition, History of virology
- General properties of viruses: Classification, Structure and Replication.
- Animal Viruses: Morphology, Cultivation, Pathogenesis, Laboratory diagnosis and Treatment of major animal viruses(Rinder pest, Foot & Mouth Disease, Herpes, HIV, Hepatitis); Viral Vaccines, Antiviral Agents
- Plant Viruses: Cultivation and Study of common plant viral diseases(TMV, Bunchy top of banana, Cauliflower mosaic virus, etc.) , Viroid
- Bacterial viruses: Discovery , significance, and general characteristics of bacteriophages;
  Lytic and Lysogenic life cycles.

Practical
- Symptomatology of potato virus, peanut bud necrosis, viruses on pulses, Tomato leaf curl, Mung bean yellow mosaic virus, Sunflower necrosis (Tobacco streak virus) and other viral diseases of available plants.
- Local lesion assay methods(including isolation and maintenance of plant viruses)
- Conversion factor and formulas in centrifugation
- Study of inclusion bodies of available viruses by light microscopy.

5. Title: Concepts of Genetics
Course Code: MCE 401 Credits: 3(2-0-1)

Unit l. Cell: Plant cell anc animal cell, chromosome structure, cell divisions- mitosis, meiosis, variations in chromosomes; polytene chromosome, lampbrush chromosome.
Unit 2. Structural changes in chromosomes: Deletions and duplications, translocation and inversion. Numerical changes in chromosomes.
Unit 3. History: Pre-mendelian and post-mendelian concepts of heredity, mendelian principles of heredity, dominance relationship, gene interaction.
Unit 4. Linkage and crossing over mechanisms, multiple alleles, pleitropism and pseudoalleles. Sex determination and sex linkage, sex limited and sex influenced traits.
Unit 5. Chemical basis of heredity, mode of replication of genetic material transcription and translation mechanisms of genetic material. Gene regulation and operon concept.
Unit 6. Mutations: Chemical and physical mutagenes, mode of action of mutagenes. Extranuclear inheritance, Polygene and quantitative inheritance.

6. Title: Environmental Studies II
Course Code: ENVS 416 Credits: 2(2-0-0)

- **Natural Resources**
  (a) Forest resources (b) Water resources (c) Mineral resource
  (d) Food resources (e) Energy resources (f) Land resources
  Role of an individual in conservation of natural resources
  Equitable use of resources for sustainable life style
- **Biodiversity and its conservation:**
  a. Introduction- Definition: genetic, species and ecosystem diversity
  b. Biogeographical classification of India
  c. Value of Biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
  d. Biodiversity at Global, National and Local levels.
  e. India as a mega diversity nation.
  f. Hot-spots of biodiversity
  g. Threats to biodiversity: habitat loss, poaching of wild life, man-wild life conflicts.
  h. Endangered and endemic species of India
  i. Conservation of Biodiversity: In situ and ex situ conservation of Biodiversity.
- **Environmental pollution:**
  Definition
  Causes, effect and control measures of:
  (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution
  (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards
  Solid waste management: causes, effect and control measures of urban and industrial wastes.
  Role of an individual in prevention of pollution
  Pollution case studies

Disaster management: Floods, earthquake, cyclone and landslides.

7. **Title: Bioinstrumentation**
   Course Code: MCE 406 **Credits: 3(2-0-1)**

   Unit I: Molecular biology techniques: Cell fractionation. Isolation and purification of genomic DNA. Polymerase Chain Reaction. Nucleic acid blotting. DNA sequencing techniques.
   Unit 2: Instrumentation in biotechnology: Working principles, instrumentation and applications of pH meter, centrifuge, colorimeter, spectrophotometer, autoclave, distillation unit, lyophilizer, and flame photometer.
   Unit 3: Methods for separation of macromolecules: Chromatography- column, thin layer, paper, ion exchange, gel filtration, affinity. Electrophoresis- agarose gel electrophoresis and poly acrylamide gel electrophoresis.
   Unit 4: Microscopy: Principles and applications of microscopy- simple, compound, phase contrast and electron microscopy.
   Practical:
   Measurement of hydrogen ion concentration of a given solution Separation techniques-centrifugation and electrophoresis.
   Study of working principles and operation of some important equipments used in biotechnology laboratory viz., spectrophotometer, pH meter, centrifuge, electrophoresis apparatus (AGE and PAGE), PCR machine, Distillation unit, autoclaves, etc.

8. **Title: Basic Techniques in Biochemistry & Instrumentation**
   Course Code: BCBE 406 **Credits: 3(2-0-1)**

   - Electrophoresis: Principle and applications, paper and gel electrophoresis (agarose and PAGE), Isoelectric focusing.
   - Centrifugal techniques: Principle and types, Differential centrifugation, Ultracentrifugation.
   - Restriction analysis of DNA: Competent cell preparation and transformation of DNA. DNA foot printing, DNA finger printing, Polymerase chain reaction (PCR).
   - Radioisotopic and other techniques: Detection and measurement of isotopes (GM and scintillation Counters).
   - Molecular Biology Techniques: Isolation & purification of DNA, RNA and Plasmid DNA. Isolation of m-RNA from mammalian cells, Sequencing of protein and nucleic acids, Chemical synthesis of nucleotides.
   - Chromatography: Ion exchange chromatography, affinity chromatography, HPLC, Column chromatography

9. **Title: Biochemistry I**
   Course Code: BCBE 401 **Credits: 3(2-0-1)**

   - **Chemical structure of proteins** and their properties, cellular membrane and transport phenomenon.

- **Intermediary metabolism-** concept of anabolism and catabolism, metabolism of carbohydrates, lipids and amino acids and their interrelationship.
- Biological oxidation, electron transport system, oxidative phosphorylation, free energy changes in biochemical reactions, energy changes in biochemical reactions, energy rich compounds.
- Metabolism of nucleic acids and proteins.
- Hormones: regulation of metabolism by various hormones.

Practical:

- Specific group tests for carbohydrates
- Specific group tests for amino acids.
- Specific tests for lipids.
- Determination of mil protein, fat and lactose.
- Determination of acidity in sample.

Semester IV

1. **Title: General Mycology**
   Course Code: IM 433 **Credits: 3(2-0-1)**

- History and scope of mycology
- Morphology, taxonomy, life cycle, ultra-structure, and reproduction of different groups of fungi
- Evolutionary trends in fungi.

Practical

- Exercise on detailed comparative study of morphology of various representative groups of fungi.
- Collection of cultures and live specimens
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2. **Title: Phycology**
   Course Code: IM 511 **Credits: 3(2-0-1)**

- History of Algae
- Algal Ecology
- Study of the following classes with emphasis to occurrence , thallus organization, cytology, ultrastructure and life cycle
  - *Chlorophyceae*
  - *Charophyceae*
  - *Diatoms*
  - *Xanthophyceae*
  - *Phaeophyceae*
  - *Rhodophyceae*
  - *Cyanobacteria*

- Applications of algae in Agriculture, Industry, Environment anf Food
- Commercial cultivation of algae
- Economic importance of algae

Practical:

- Identification of different algae
- Preparation of temporary and permanent slides of algae
- Study of vegetative and reproductive structures of algae
- *In vitro* isolation and Culturing techniques of algae

3. Title: Biochemistry II
Course Code: BCBE 403 Credits: 3(2-0-1)

- Protein Chemistry: Structure of proteins, methods for determining the 3D structure of a protein – X-ray diffraction, NMR, Mass spectrometry, protein homology among species, protein denaturation and folding, assisted folding, edman degradation, glycoprotein, lipoproteins, proteoglycans, phosphor proteins, chromoprotein, bacterial and viral protein (HIV, HBV, toxins, etc.)
- Biomembranes: Molecular constituents of membranes, movement of molecules through membranes, energetics of membrane transport system, biosignalling, voltage gated ion channels, transporters and group translocation with examples.
- Sensory systems: Olfaction, taste, vision, hearing and touch with their biochemical mechanisms.
- Physiochemical properties of nucleic acids: Hydrogen bonding, bond length, tautomerism and its significance in nitrogen bases, DNA denomination, and factor responsible for hypochromicity. Renaturation of DNA, annealing, walloce's rule, hybridization, ionization, enzymatic of nucleic acids, effect of acids and alkalis on nucleic acids, DNA super coiling and nucleic acid mutations.

Practical:

- Fractionation of egg proteins.
- Detection of alpha – amylase activity in saliva.
- Determination of sugar/glucose I urine (Benedict's Tritrimetric method)
- Identification of blood constitution.
- Extraction of total nucleic acid from plant tissues.
- Extraction of RNA from yeast.
- Assay of protein by Biuret's method.

4. Title: Basics of Molecular Genetics
Course Code: MCE 408 Credits: 3(2-0-1)

Unit 1. Introduction: Basic concepts in molecular genetics. Prokaryotic and Eukaryotic genome. Concept of gene and central dogma.
Unit 2. Transcription: Mechanism of transcription in prokaryotes and eukaryotes. Transcription of protein coding genes- mRNA. Post transcriptional modifications 5'capping, poly A tailing and mRNA splicing in eukaryotes.

Unit 3. Translation: Introduction to protein synthesis. The nature of genetic code. Mechanism of translation in prokaryotes and eukaryotes. Post translational modification of proteins.
Unit 4. Regulation of gene expression: Gene regulation in prokaryotes - lac and trp operons as model systems. Gene regulation in eukaryotes - Transcriptional level control, RNA processing level control, translational level control, post translational level control.
Unit 5. Gene mutation: Mutagenesis. Causes of mutation - spontaneous and induced. Types of mutagens- physical and chemical. Classification of mutations. Molecular basis of gene mutation.

5. Title: Applications in Bioinformatics
Course Code: CBBI 501 **Credits: 2(1-0-1)**

Bioinformatics and Internet: Internet Basics, FTP, www, connecting to Internet, Electronic mail, internet
resources.
The NCBI data model: Introduction, Seq-id, Sequence, collection of sequence, annotation of sequence,
describing sequence.
GenBank Sequence Database: Introduction to structure, Primary and secondary database
Sequence Alignment And Database Searching : FASTA , BLAST, Multiple Sequence Alignment
Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation, Tree building and tree
evaluation, Phylogenetic software.
Introduction to Structure , PDB , MMDB , Structure file format , visualizing structure information , Structure
viewers , structure similarity searching , Advanced structure modeling.
Comparative Genome Analysis: Introduction, application, genome analysis and annotation.

Practical:
1. Understanding Linux Operating System and Commands.
2. Introduction to NCBI.
3. Using Entrez to search Literature Databases.
4. Retrieving DNA sequence from GenBank and analyzing various formats of the data stored.
5. Retrieving Protein sequence from GenPept (NCBI) and Expasy.
6. Analyzing Protein Sequences.
7. Analyzing DNA sequence.
8. Sequence alignment using BLAST (Basic Local Alignment Search Tool).
9. Sequence alignment using FASTA.
10. Multiple sequence alignment using ClustalW.

6. Title: Basic Immunology
Course Code: BCBE 405 **Credits: 3(2-0-1)**

- **Basic terminology:** Infection, pathogen, antigen, antibody, bacterial and viral antigens, haptens, adjuvants, immunogens interferons, epitopes, paratopes, lymphokines, **Specific and non-specific immune response**: cellular basis of immunity, humoral and cell mediated immunity, biochemistry of immunoglobulins (structure, types, property and function),
- **Cells of immune system:** cells involved in adaptive immune response i.e. B and T cells, cells involved in innate immune response- macrophages, dendritic cells, phagoytes, mast cells granulocytes, etc. **Organs of immune system:** primary lymphoid and secondary lymphoid oragans, their structure and function. Major Histo Compatibility complex (MHC class I and class II), their structure and function. Chemistry of antigen-antibody interactions, precipitation and agglutination.
- Structure of T-cell receptors and their comparison with analogous antibody molecule. Natural Killer cell, Their structure and function. Superantigens and Antibody dependent cell mediated cytotoxicity (ADCC).
- **Immunodeficiency disease**s: Primary B and T cell deficiency diseases, Autoimmunity, Hypersensitivity. Principles of RIA, ELISA and immunoelectrophoresis (Rocket immunoelectrophoresis), use of monoclonal antibodies in immunodiagnosis and immunotherapy.

Practical:

- To prepare blood smear.
- Separation of serum and plasma from blood.
- Qualitative tests of important constituents of plasma and serum.
- Separation of plasma proteins (i.e. Fibrinogen, globulin, and albumin).
- Determination of E.S.R. of any blood sample.
- Preparation of antigen from blood.
- Determination of the blood group.
- Determination of the haematocrit value of the blood sample.
- Use of widal kit for rapid quantitative slide test.
- Determination of density of blood.
- Determination of bleeding and clotting time of blood.
- Preparation of haematin crystals.

7. Title: Basic Proteomics
Course Code: BCBE 402 **Credits: 2(2-0-0)**

- Introduction, birth of large scale biology, the genome transcriptome and proteome, functional genomics at the DNA and RNA levels, transcriptomics, large-scale mutagenesis, RNA interference, the need for proteomics, the scope

of proteomics, sequence and structural proteomics, **Expression** proteomics, interaction proteomics, functional proteomics , the challenges of proteomics.

- Strategies of protein separation, protein separation in proteomics-general principles, principles of two dimensional gel electrophoresis, general principles of protein separation by electrophoresis, separation according to charge but not mass-iso-electric focusing, separation according to mass but not charge-SDS-PAGE, two dimensional gel electrophoresis proteomics, principles of liquid chromatography in proteomics.
- Protein expression mapping, protein expression mapping in mammalian systems, microbial system and plat system, quantitative protein expression mapping by metabolic labeling of proteins with radioactive amino acids metabolic labeling of proteins with stable isotopes, in vitro labeling of proteins using isotopes –coded affinity tags.
- current status of and future of proteomics in health and care, plant biochemistry and animal biochemistry.

8. Title: Professional Communication & Technical Writing
Course Code: LNG 304 Credits:3(3-0-0)

- **Language:** Syntax
  a. Concord (Course, Verb Agreement)
  b. Antecedents(Noun, Pronoun Agreement)
  c. Modifiers (Proper placement)
  d. Verb and Tense
  e. Determiners
  f. Error Analysis
  g. Word enrichment (Autonyms, Synonyms, Homonymns, Homophone, Spelling, and Usage)
  h. Voice
- **Communication:**
  a. Kinds
  b. Different Speech techniques

- **Technical writing:**
  a. Importance
  b. Objectives
  c. Audience
  d. Methods
  e. Essentials(Documentation, Visuals, Language)
  f. Process
  g. Resume
  h. Curriculum vitae
  i. Interview
  j. Letters (Components, Formats, 5 kinds)
  k. Memos (Administrative and Business)
  l. Report (Format, Style, Survey and Periodical Reports)

- **Speech skills:**
  a. Stress
  b. Accent
  c. Intonation
  d. Rhythm

9. Title: Enzymology and Enzyme Technology
Course Code: BCBE 404 Credits:3(2-0-1)

- Introduction of enzymes: General properties and significance, classification and nomenclature. Terms and definition in enzymology: enzyme activity, specific activity, turnover number, active site, isoenzyme, marker enzyme Multienzyme complex, extracellular enzymes, extremozymes, abzymes, ribozymes, induced enzyme etc
- Factor affecting enzyme activity: pH, Temperature, substrate concentration etc. Isolation, purification and localization of enzyme, techniques involved in enzyme assays.
- Enzyme kinetics: steady rate kinetics, Derivation of Michaelis-Menten equation using steady state/equilibrium kinetics, plots of Lineweaver- Bruke etc. machanism of substrate and multi-substrate enzyme catalyzed reaction.
- Regulation of enzyme activity: Covalent modification, enzyme inhibition and kinetics. Allostearic enzyme: feed back inhibition, allostearic model concerted and sequential, co-operativity.
- Mechanism of enzyme action and concept of active site: Vis-a-vis lysozyme, chymotrypsin, alcohol dehydrogenase, glycerldehyde 3 phosphate dehydrogenase, proteases.
- Enzyme Technology: Commercial production of enzymes, preference of extracted enzymes over whole organism, immobilization of enzymes, example of enzyme engineering, application of enzyme(therapeutic uses, analytical uses, manipulated uses etc.), uses of enzyme in solutions, enzyme reactors, biphasic system, Bi and poly functional enzymes, solvent engineering.

Practical:

- Determination of protein
- Determination of salivary amylase
- Activity of effect of salt on salivary amylase
- Detection of effect of pH on enzyme activity
- Determination of Acid/Alkaline phosphatase
- Determination of enzyme kinetics
- Separation of protein by PAGE
- Identification of extra cellular enzymes like protease, oxidase, urease, catalaseand lipase

Semester V

1. **Title: Microbial Metabolism**
   Course Code: IM 452 **Credits: 2(2-0-0)**

- Bacterial Enzymes: Classification, Properties, Factors affecting enzyme activity, Inhibition of enzyme action, Regulation of enzymes.
- Carbohydrate metabolism:
  - Anabolism- Photosynthesis (oxygenic and anoxygenic).
  - Catabolism- EMP pathway, Pentose pathway, Kreb's cycle, Fermentatio
  - Electron transport system, ATP production
- Metabolism of proteins: Metabolic pathways of nitrogen utilization, Urea cycle, Protein synthesis.
- Catabolism of lipids.

2. **Title: Principles of Microbial Genetics**
   Course Code: IM 453 **Credits: 2(2-0-0)**

- History-Experiments of Hershey Chase and Griffith; DNA as genetic material; Discovery of DNA structure, RNA as genetic material, Genetic code.
- Organization and function of genetic material-Bacterial and Viral
- Brief account of plasmids-Structure and types.
- Replication of DNA- Rolling circle model; Replication of RNA- Reverse transcriptase.
- Concept of genes-Lac operon, Tryptophan operon; Attenuation control-Promoters- Repressors- Gene Expression and control.
- Gene transfer mechanisms- Conjugation, Transformation, Transduction.
- Mutagenesis-Mutation, Mutants, IS elements, Transposons, Repair mechanisms

3. **Title: Parasitology**
   Course Code: IM 434 **Credits: 3(2-0-1)**

- General Parasitology: Parasite, Host, Host-Parasite relationships, Sources of infection, Pathogenicity, Immunity in parasitic infection, Laboratory diagnosis.
- Study of Morphology, Important development stages, Symptoms, Pathogenecity, Epidemiology, Diagnosis, Treatment and Prevention of the following:
  a) Amoebae: *Entamoebe histolytica, Naegleria fowleri.*
  b) flagellates: *Giardia, Trichomonas,Leishmania* and *Trypanosomes*
  c) sporozoa: Malarial parasite, *Toxoplasma gondii*, *Isospora, Cryptosporidium parvum*
  d) *Balantidium coli.*
  e) Helminths: *Taenia saginata,Taenia solium,Echinococcus, Schistosomes* (blood flukes), *Ascaris, Ancyclostoma,Trichuris trichuria, Enterobius vermicularis,Wucheria brancrofti, Dracunculus* and *Trichella spiralis*.

Practical

- Collection, preservation and transportation of faecal material for laboratory examination.
- Concentration technique of stool for ova and cyst.
- Wet preparation of faecal sample for ova and cyst.
- Identification of ova and cyst in stool sample.
- Staining technique for malarial parasite.
- Laboratory diagnosis of Kala-azar.
- Laboratory diagnosis of Sleeping sickness.
- Laboratory diagnosis of microfilariae.

4. **Title: Nematology**
   Course Code: PPR 521 **Credits: 2(1-0-1)**

- History and development of Nematology
- Economic importance of nematodes in Agriculture
- General characters, morphology, taxonomy and classification of important nematodes
- Symptoms of nematode attack
- Principles of nematode management
- Nematode problems of important crops and their control
- Entomopathogenic nematodes

Practical

- Techniques for nematode extraction; counting & estimation of population; killing, fixing and preparing mounts
- Study of body systems
-

5. **Title: Biostatistics**
   Course Code: MAS 531 **Credits: 3(2-0-1)**

- An introduction to Biostatistics
- Theory of probability, Probability distribution(Binomial, Poisson and Normal distribution)
- Test of significance (Line of significance, degrees of freedom, Null and Alternative hypothesis
- X^2 test, Contingency table, t, Z, F-tests
- Simple rules of Analysis of variance

6. **Title: Computational analysis of Biomolecules**
   Course Code: CBBI 507 **Credits: 4(2-0-2)**

Introduction: Sequence similarity, homology, and alignment, Probabilities and probabilistic models

Pairwise alignment: Introduction: The scoring model, Alignment algorithms, Dynamic programming with more complex models, Heuristic alignment algorithms, Linear space alignments, Significance of scores, Deriving score parameters from alignment data

Multiple sequence alignment methods: What a multiple alignment means, Scoring a multiple alignment, Multidimensional dynamic programming, Progressive alignment methods, Multiple alignment by profile HMM training

Building Phylogenetic trees: The tree of life, Background on trees, Making a tree from pair wise distances, Parsimony, Assessing the trees: the bootstrap, Simultaneous alignment and phylogeny

RNA structure analysis: secondary structure prediction

Practical:

1. To study about the NCBI site.
2. To search literature databases using Entrez tool.
3. To retrieve a nucleotide sequence from the GenBank database and analyze various formats of the data stored.
4. To retrieve a protein sequence from the UniProtKB database and analyze various formats of the data stored.
5. To perform database searching for a protein sequence using the BLASTp program.
6. To perform database searching for a nucleotide sequence using the FASTA program.
7. To perform multiple sequence alignment protein sequences using the ClustalW2 program.
8. To predict the open reading frames (ORFs) in a nucleotide sequence using the ORF finder.
9. To perform the phylogenetic analysis of nucleotide/protein sequences using the PhyML server.
10. To perform the RNA secondary structure prediction using the GeneBee-Molecular Biology Server.

7. Title: Marketing and Management of Microbiological Products
Course Code: BAM 625 Credits: 3(3-0-0)

- Marketing in the 21st Century, Meaning, Evolution, Functions and Role, Levels and Concept.
- Customer Satisfaction and Buyer Behavior, Marketing Mix, Product Mix with reference to microbial products.
- Analyzing Consumer Markets and Buyer Behavior.
- Pricing strategies and methods of pricing.
- Identifying Market Segments and Selecting Target Markets.

- Positioning the Market offering through the PLC.
- Product Lines and Brands.
  Distribution Channel.
- Managing Advertising and Sales Promotion

Reference Books:

a. Marketing Management – Philip Kotler
b. Marketing Management – V. S. Ramaswami and S. Namakumari

8. Title: Biosafety, Bioethics and IPR in Biotechnology
Course Code: MCE 501 Credits: 3(3-0-0)

Unit 1: The legal and socioeconomic impact of biotechnology, public education of the process of biotechnology involved in generating new forms of life for informed decision making, biosafety regulation and national and international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment, regulatory bodies in biotechnology, biosafety committee.

Unit 2: Ethical issues, moral values on experimental animals, ethical implications of biotechnological products and techniques.

Unit 3: Intellectual property rights, WTO, TRIPS, International conventions, patents and copyrights, patent claims, methods of applications of patents.

Unit 4: Legal implications, biodiversity and farmers right. Beneficial application and development of research focus to the need of the poor, identification of directions for yield effect in agriculture, aquaculture etc.

Semester VI

1. Title: Environmental Microbiology
Course Code: IM 503 Credits: 3(2-0-1)

- Air Microbiology: Sources and types of microorganisms in air; Sampling techniques for microbial population; Air pollution; Significance of air borne microorganisms in human and plant diseases.
- Aquatic Microbiology: The aquatic environment; Distribution of microorganisms in aquatic environment; Techniques for study of aquatic microorganisms; Role and importance of aquatic microbial ecosystems
- Microbiology of Domestic water: Water purification; Types of microorganisms in water; Sampling techniques for microbial population in water; important water borne disease of man.
- Microbiology of waste water: Types of waste water; Chemical and Microbiological characteristics of waste water; Chemical and Microbiological analysis of waste water; Waste water treatment processes

- Water pollution; Indicators of excreted pollutants

Practical

- Study of air borne microorganisms using different methods
- Water analysis by Standard plate count; MPN technique and Coliform tests
- Study of microbial contaminants from wastewater.
- IMViC tests
- BOD and COD estimation
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2. Title: Plant Disease and their Management
Course Code: PPR 522 **Credits: 3(2-0-1)**

Symptoms, nature and prevalence, etiology, life cycle and management of important diseases.

Practical

- Detailed study of symptoms and host parasite relationship of representative diseases.

3. Title: Industrial Microbiology
Course Code: IM 502 **Credits: 3(2-0-1)**

- Production of amino acids
- Production of vinegar
- Manufacture of various chemicals: Lactic acid, citric acid
- Industrial production of therapeutic compounds: penicillin, vitamins, vaccines
- Microbial transformation of steroids
- Production of microbial enzymes
- Microbial deterioration of materials: textile, paper, paint and painted surfaces etc.
- Production of vaccines
- Use of microorganisms in bioassays

Practical

- Demonstration of fermentor its parts and maintenance
- Screening for antibiotic production
- Screening for enzyme production
- Assay of antibiotics

4. Title: Concepts of Petroleum Microbiology
Course Code: IM 508 **Credits: 3(2-0-1)**

- Overview of microorganisms inhabiting oil reservoirs
- Beneficial effect of microorganisms in oil field environments during oil production
- Hydrocarbon degradation in marine and subterresterial ecosystems

- Microbial biotechnology and oil production

Practical

- Isolation and enumeration of petrol metabolizing microorganisms
- Identification of petrol metabolizing microorganisms
- Determination of factors influencing petrol uptake by microorganisms
- Application of biosurfactants for petrol degradation

5. Title: Marine Microbiology
Course Code: IM 509 **Credits: 3(2-0-1)**

- Microbes in marine environment – bacteria, archaea, protists, fungi, non-planktonic flagellates, dinoflagellates, ciliates, diatoms, viruses.
- Role of microbes in ocean processes – carbon cycling, photosynthesis, eutrophication.
- Marine microbes in human society
- Important bacterial and viral diseases associated with marine microorganisms – human, fish.

Practical

- Isolation and enumeration of marine microorganisms
- Identification of marine microorganisms
- Study of important fish pathogenic bacteria
- Study of important human pathogenic bacteria from fish and fish products

6. Title: Immunotoxin and Drug Designing
Course Code: BCBE 605 **Credits: 3(3-0-0)**

- History of drug discovery &Molecular biology for drug:-early and recent history of drug discovery, enzymes/receptor as drug target. molecular biology for drug discovery(recombinant proteins and monoclonal antibodies as drug). Molecular basis of disease processes. Target identification and validation.
- Organic synthesis for drug discovery:-target oriented organic synthesis and retro synthetic analysis. diversity oriented organic synthesis and evolving synthetic analysis, solid phase synthesis for drug discovery (parallel is split pool strategy) combinatorial chemistry and high through put screening(HTS).
- Combinatorial chemistry for drug discovery:-combinatorial bioctalysis for drug discovery, synthesis of Bergen in derivatives. Drug discovery in cancer research/new target based drugs in clinical trials.
- Introduction of pharmacogenomics:-microbial genomics for new antibiotics, immunotoxin drug(eg ricin, a plant toxin).drug designing for blocking enzyme activity through blocking hormones receptor through inhibition of nucleic acid synthesis against heterogenous target.

7. Title: Biotransformation and Bioconversion
Course Code: BCBE 607 Credits: 3(2-0-1)

- Introduction to biotransformation, characteristics of biotransformation reaction.
- Biotransformation techniques, biotransformation by growing cells, biotransformation by stationery cells, biotransformation by spores, biotransformation with immobilized cells,Biotransformation by purified enzymes.
- Biotransformation of various L-amino acids, biotransformation of L-lysine, biotransformation of L-glutamic acid, biotransformation of L-aspartic acids, Biotransformation of vitamins like L-ascorbic acid, alpha tocopherol, biotin, Biotransformation of steroids, Biotransformation of antibiotics ,i.e. penicillin.
- Pretreatment processes of Raw starchy materials, acid treatment, Milling operations ,dry and wet milling operations, Conversion of lignocellulsic material to sugars . Lignocellulosic biotechnology-issues of bioconversion and enzyme production.

Practical:

- Demonstration of urease, production, i.e. urea hydrolysis
- Degradetion of sulphur containing amino acid
- Demonstration of carbohydrate metabolism
- Indole production by bacterial sample
- Production of Ammonia from organic compounds
- Bioconversion of ammonia to nitrate i.e. nitrification

8. Title: Recombinant DNA Technology
Course Code: MCE 502 Credits: 3(3-0-0)

Unit 1: Biology of cloning vectors: Plasmids, lambda bacteriophage, cosmids, M13bacteriophage, phagemid, Agrobacterium tumifaciens- binary and cointegration vector strategy.

Unit 2: Enzymes used in genetic engineering: Exonucleases, endonucleases - S1 nuclease, restriction endonucleases; ligases, polymerases, reverse transcriptase, terminal deoxy nucleotidyl transferases, kinases, alkaline phosphatase.

Unit 3: Principles of recombinant DNA technology: Construction of recombinant DNA, rDNA expression, genomic and complimentary DNA (cDNA) libraries, detecting expression of foreign genes.

Unit 4: Application of r-DNA technology: Medicine, industry, agriculture, livestock improvement, environmental protection, *etc*.

9. Title: Genomics
Course Code: MCE 602 **Credits: 3(3-0-0)**

Unit 1: Introduction: Basic concepts of genomics. Structural and functional genomics. Proteomics, transcriptomics, metabolomics and phenomics.

Unit 2: Genome: Physico-chemical properties of genome, genome size and sequence components, gene structure and higher order genome organization.

Unit 3: Genome analysis: DNA sequencing, DNA Micro array, gene finding, genome databases and data mining. Structural, functional and comparative genomics.

Unit 4: Genome mapping: Basic concepts, model organisms, genome projects, genetic and linkage map, cytogenetic maps, physical maps, comparative genome mapping.

Semester VII

1. Title: Fermentation Technology
Course Code: IM 601 **Credits: 3(2-0-1)**

- Fermentation equipment and its use: (i) Basic functions of a fermenter, body construction, aeration, agitation, theories of aeration, oxygen transfer kinetic, baffles. Design of fermentation vessels viz. Airlift Fermenter, tower fermenter, continuous fermenter, fed batch fermenter, waldhof type fermenter.
- Growth and product formation: concept of primary and secondary metabolites, and their control, kinetics of growth and product formation (growth rate, yield coefficient, efficiency).
- Development of microbial processes: (i) Screening (ii) Strain improvement (iii) Scale up in fermentations (iv) Inoculum preparations (v) Stock culture maintenance (vi) Contamination problems in fermentation industry
- Control of metabolic pathways-Environmental control and genetic control of metabolic pathways
- Fermentation media-Types of fermentation media, sources of carbon, nitroqen, trace elements, growth factors, precursors, buffers, antifoam aqents, sterilization of media, screening for fermentation media
- Computer applications in fermentation technology-General applications and specific applications
- Process validation and quality assurance Current Good Manufacturing Practices (CGMP), and Current Good Laboratory Practices (CGLP)

Practical

- To study about fermentors
- To isolate yeast cells from fruit juice and rice flour
- Demonstration of fermentation by using Yeast
- Demonstration of wine production
- To produce citric acid by solid state fermentation

- Production of lipase by submerged fermentation

2. **Title: Microbial Enzyme Technology**
   Course Code: IM 604 **Credits: 3(2-0-1)**

- Introduction to enzymes and its classifications
- Specificity of enzyme action
- Bacterial and Fungal enzymes, Recent developments and present position
- Production of microbial enzymes, Strain selection and development, Fermentation, Recovery and finishing
- Cell and enzyme immobilization
- Applications of microbial enzymes
    - Detergent, starch, paper, leather and textile industries
    - Synthesis of fine chemicals, medical, pharmaceutical and environmental applications
- Regulation and specifications of enzymes
- Extremozymes and their structural modifications
- Thermostable enzymes and cold active enzymes
- Alkalophillic and halophillic enzymes

Practical:

- To study the hydrolysis of starch by microorganisms
- To study the hydrolysis of gelatin by microbes
- Fermentative production and extraction of amylase by *Aspergillus niger*
- Estimation of reducing sugars by DNS method
- Production of lipase by submerged fermentation

3. **Title: Food Microbiology**
   Course Code: IM 606 **Credits: 3(2-0-1)**

- Systematic study of major group of microorganisms of importance in food microbiology.
- General Principles and methods of preservation.
- Food contaminants and spoilage of food products.
- Enzymes related to food.
- Food in relation to diseases

Practical

- Isolation and identification of microorganisms involved in food spoilage
- Study of important pathogens associated with food

4. **Title: Dairy Microbiology**
   Course Code: IM 607 **Credits: 3(2-0-1)**

- Sources and types of microorganisms in milk
- Starter cultures
- Role of microorganisms in the manufacture of milk and milk products

- Tests used for microbiological analysis of milk and milk products
- Microbial spoilage of dairy products and their control
- Milk borne diseases

Practical

- Microbiological grading of milk and milk products on the basis of SPC,DMC, MBR, Coliform test and Rapid platform tests
- Isolation and identification of microorganisms associated with spoilage of milk and milk products

5. **Title: Medical Microbiology**
   Course Code: IM 608 **Credits: 3(2-0-1)**

- Norma flora of the human body: Origin of the normal flora; Distribution and occurrence of the normal flora
- Host Microbe Interactions: Pathogenicity; Virulence and Infection
- Natural Resistance and Non-specific Defence Mechanisms
- Clinical symptoms, Epidemiology, Pathogenesis, Laboratory diagnosis, Prevention and Treatment of following bacterial infections: Streptococcal infections; Staphylococcal infections; Meningitis; Tuberculosis; Typhoid; Cholera; Bacillary Dysentery; Sexuallly transmitted diseases; Tetanus
- Clinical symptoms, Epidemiology, Pathogenesis, Laboratory diagnosis, Prevention and Treatment of following viral infections: Common cold; Influenza; Measles; Mumps; Rubella; Encephalitis; Rabies; Hepatitis; AIDS; Herpes Simplex virus
- Clinical symptoms, Epidemiology, Pathogenesis, Laboratory diagnosis, Prevention and Treatment of following fungal and protozoan infections: Fungal-Superficial, Subcutaneous and Systemic mycosis. Protozoan-Amoebiasis; Malaria. Helminths- Ascariasis.
- Hospital acquired infections

Practical

- Collection and processing of clinical specimens
- Identification of common pathogens on the basis of morphological, cultural and biochemical characteristics
- Antibiotic sensitivity pattern of selected pathogens

6. **Title: Soil Microbiology**
   Course Code: IM 610 **Credits: 3(2-0-1)**

- Classification of soil; Physical and Chemical characteristics of soil; Microbial flora of soil
- Interaction among soil microorganisms
- Biogeochemical cycles: Carbon, Nitrogen Phosphorous and Sulphur

Practical

- Isolation and identification of soil microorganisms
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7. Title: Pharmaceutical Microbiology
Course Code: IM 611 **Credits: 3(2-0-1)**

Unit II: Antibiotics and Synthetic antimicrobial agents

Unit III: Microbial aspects of pharmaceutical products

Unit IV: Regulatory aspects in pharmaceuticals

Unit V: Quality assurance and validation

Practical
Related practical will be conducted.

References:

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- Dutton CJ, Haxell MA, McArthur HAI and Wax RG (2002) Peptide Antibiotics, Marcel Dekker Inc., NY, USA
- Seth SD (2004) Textbook of Pharmacology, 2nd edn., Elsvier, New Delhi (ISBN: 81-8147-553-4)
- Bhatia R and Ichhpujani RL (1995) Quality Assurance in Microbiology, CBS Publishers, New Delhi (ISBN: 81-239-0387-1)
- R.M. Baird and S.F. Bloomfield. Microbial quality assurance in cosmetics, toiletries and non-sterile pharmaceuticals. 2nd ed., Taylor & Francis, London, 1996.
- S. Denyer and R. Baird. Guide to microbiological control in pharmaceuticals. Ellis Horwood, 11
- Chichester, 1990. 4. R.M. Baird, N.A. Hodges and S.P. Denyer. Handbook of microbiological quality control. Pharmaceuticals and medical devices. Taylor & Francis, London, 2000.
- Russell-Principles and Practice of Disinfections, Preservation and Sterilization 3/e, 1999
- Hughes and Anderson 's, Antibiotics Development and Resistance
- Pharmaceuticals Microbiology by Harrish M.Baillere, Tindal and Co., London

8. Title: Cosmetic Microbiology
Course Code: IM 613 **Credits: 3(2-0-1)**

- History of cosmetic microbiology.
- Sanitary practices in cosmetic manufacturing: Microbial environment of the manufacturing plant, Hazard analysis and Critical Control Point (HACCP) protocols in cosmetic microbiology.
- Cosmetic microbiology test methods: Antimicrobial preservation efficacy and microbial content testing, Validation of methods.

- Preservation of cosmetics: Preservation strategies, antimicrobial mechanisms of selected preservatives and bacterial response.
- Global regulatory and toxicological aspects of cosmetic preservation: Consumer safety considerations, Global regulation.

Practical:

- Microbiological Analysis of Skin care, eye care and hair care products
- Microbial Limit testing for various perfumes, deodorants *etc*.
- Screening of various cosmetics for indicator pathogens
- Antimicrobial Preservative efficacy testing of various cosmetic preparations