

## Maharshi Dayanand University, Rohtak

### COURSE STRUCTURE of 3 - Years B.Sc. Biotechnology

#### SEMESTER-I - (2012-13)

Course No.	Course Name	Marks in Theo + I.A		Total marks	Period per week	Exam. Duration
BT 101	English	40	10	50	4	3 Hours
BT 102	Plant Diversity I and Bioprospecting	40	10	50	4	3 Hours
BT-103	Cell Biology	40	10	50	4	3 Hours
BT-104	Biochemistry and Metabolism	40	10	50	4	3 Hours
BT 105	Physical Chemistry	40	10	50	4	3 Hours
BT-106	Inorganic Chemistry	40	10	50	4	3 Hours
BT-107	Organic Chemistry	40	10	50	4	3 Hours
-	Practicals of BT-102 to BT104	-	-	-	10	-
-	Practicals of BT-105 to BT-107	-	-	-	10	-
Total					350	

#### SEMESTER-II - (2012-13)

Course No.	Course Name	Marks in Theo. + I.A		Total marks	Period per week	Exam. Duration
BT 201	Biostatistics	40	10	50	4	3 Hours
BT 202	Microbiology	40	10	50	4	3 Hours
BT-203	Genetics	40	10	50	4	3 Hours
BT 204	Animal Diversity & Economic Zoology	40	10	50	4	3 Hours
BT-205	Physical Chemistry	40	10	50	4	3 Hours
BT 206	Organic Chemistry	40	10	50	4	3 Hours
BT-207	Inorganic Chemistry	40	10	50	4	3 Hours
BT 208	Seminar and term paper writing on Biostatistics/Microbiology/Genetics/Animal Diversity	-	50	50		
BT-209	<b>Lab Course I:</b> Chemistry (BT-105 to 107 and BT-205 to 207)	100	-	100	10 (BT-205 to BT-207)	8 hrs (BT-105 to BT-107 and BT-205 to BT-207 )
BT-210	<b>Lab Course II :</b> Plant diversity, Cell Biology, Biochemistry and metabolism	100	-	100	-	8 hrs
BT-211	<b>Lab Course III :</b> Microbiology, Genetics, Animal Diversity , Biostatistics	100	-	100	10 (BT-201 to BT-204)	8 hrs (BT-201 to BT-204)
Total					700	

All the Practical examinations of Ist semester will be held along with II nd Semester annually. The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical).

## COURSE STRUCTURE of 3 - Years B.Sc. Biotechnology

### SEMESTER-III – (2013-14)

Course No.	Course Name	Marks in Theo. + I. A.		Total marks	Periods per week	Exam. duration
BT 301	Medical Microbiology	40	10	50	4	3 Hours
BT 302	Bioanalytical Tools	40	10	50	4	3 Hours
BT 303	Plant Physiology	40	10	50	4	3 Hours
BT 304	Plant Diversity II	40	10	50	4	3 Hours
BT-305	Physical Chemistry	40	10	50	4	3 Hours
BT-306	Organic Chemistry	40	10	50	4	3 Hours
BT-307	Inorganic Chemistry	40	10	50	4	3 Hours
	Practicals of BT-301 to 304	-	-	-	10	-
	Practicals of BT-305 to BT-307	-	-	-	10	
	Total			350		

### SEMESTER-IV- (2013-14)

Course No.	Course Name	Marks in Theo + I. A.		Total marks	Periods per Week	Exam. Duration
BT 401	Animal Diversity II	40	10	50	4	3 Hours
BT 402	Molecular Biology	40	10	50	4	3 Hours
BT-403	Animal Developmental Biology	40	10	50	4	3 Hours
BT 404	Mammalian Physiology	40	10	50	4	3 Hours
BT-405	Physical Chemistry	40	10	50	4	3 Hours
BT-406	Organic Chemistry	40	10	50	4	3 Hours
BT-407	Inorganic Chemistry	40	10	50	4	3 Hours
BT 408	Seminar and term paper writing on Molecular Biology/Animal Developmental biology / Physiology	-	50	50		
BT-409	<b>Lab Course-I: Chemistry</b> (BT-305 to BT-307 and BT 405 to BT -407)	100		100	10 (BT 405 to BT -407)	8 hrs(BT-305 to BT-307 and BT 405 to BT -407)
BT -410	<b>Lab Course II:</b> Bio--analytical tools, Plant Physiology, Plant Diversity, Medical Microbiology	100		100	-	8 hrs
BT-411	<b>Lab Course III:</b> Molecular Biology & Animal Diversity, Developmental and Mammalian Physiology	100		100	10 (BT-401 to BT-404)	8 hrs
	Total			700		

The practical exams of IIIrd semester will be held along with IVth Ssemster annually. The Course contents of Chemistry will be the same as that of Chemistry of B.Sc.(Medical)

## COURSE STRUCTURE of 3 - Years B.Sc. Biotechnology

### SEMESTER-V- (2014-15)

Course No.	Course Name	Marks in Theo. + I. A		Total marks	Periods per week	Exam. Duration
BT 501	Bioinformatics	40	10	50	4	3 Hours
BT 502	Recombinant DNA Technology	40	10	50	4	3 Hours
BT-503	Immunology	40	10	50	4	3 Hours
BT 504	Genomic & Proteomics	40	10	50	4	3 Hours
BT-505	Physical Chemistry	40	10	50	4	3 Hours
BT-506	Organic Chemistry	40	10	50	4	3 Hours
BT-507	Inorganic Chemistry	40	10	50	4	3 Hours
	Practicals of BT-501 to BT-504	-	-	-	10	-
	Practicals of BT-505 to BT-507	-	-	-	10	-
	Total			350		

### SEMESTER-VI- 2014-15)

Course No.	Course Name	Marks in Theo. + I. A		Total marks	Periods per Week	Time
BT 601	I.P.R. Entrepreneurship Bio-ethics & Bio safety	40	10	50	4	3 Hours
BT 602	Animal Biotechnology	40	10	50	4	3 Hours
BT-603	Bioprocess Technology	40	10	50	4	3 Hours
BT 604	Plant Biotechnology & Environmental Biotechnology	40	10	50	4	3 Hours
BT-605	Physical Chemistry	40	10	50	4	3 Hours
BT-606	Organic Chemistry	40	10	50	4	3 Hours
BT-607	Inorganic Chemistry	40	10	50	4	3 Hours
BT 608	Project report and presentation	-	50	50	-	
BT-609	<b>Lab Course- I</b> Chemistry (BT-505 to BT-507 and BT-605 to BT-607)	-	-	100	10 (BT-605 to BT-607)	8 hrs(BT-505 to BT-507 and BT-605 to BT-607)
BT-610	<b>Lab Course - II:</b> Bioinformatics, r-DNA Technology, Immunology, Genomics & Proteomics.	-	-	100	-	8 hrs
BT-611	<b>Lab Course III</b> Animal Biotech., Bioprocess technology, Plant Biotech & Env. Biotech and IPR & Entrepreneurship	-	-	100	10 (BT 601-604)	8 hrs
	Total			700		

The practical exams of V semester will be held along with VI Semester annually. The Course contents of Chemistry will be the same as that of Chemistry of B.Sc.(Medical)

## **SEMESTER – I**

### **BT-101 ENGLISH**

**MM 40+10 IA**

**Time: 3 Hours**

The syllabus for English is same as that for B.Sc. 1<sup>st</sup> Semester (Pass course).

### **BT-102 PLANT DIVERSITY I AND BIOPROSPECTING**

**MM 40+10IA**

**Time: 3 Hours**

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10 marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

#### **UNIT I**

##### **Algae:**

General character, classification and economic importance. Life histories of

algae belonging to various classes :

- x Chlorophyceae – Volvox, Oedogonium
- x Xanthophyceae – Vaucheria
- x Phaeophyceae – Ectocarpus
- x Rhodophyceae-Polysiphonia

#### **UNIT II**

##### **Fungi:**

General characters, classification & economic importance.

Life histories of Fungi-

- x Mastigomycotina- Phytophthora
- x Zygomycotina-Mucor
- x Ascomycotina- Saccharomyces
- x Basidiomycotina-Agaricus
- x Deutromycotina-Colletotrichum

#### **UNIT III**

##### **Lichens :**

Classification, general structure, reproduction and economic importance.

Plant diseases:

Casual organism, symptoms and control of following plant diseases.

- x Rust & Smut of Wheat.
- x White rust of Crucifers.
- x Late blight of Potato.
- x Red rot of Sugarcane.
- x Citrus Canker.

#### **UNIT IV**

##### **Bryophytes:**

General characters, classification & economic impotence.

Life histories of following:

- x Marchantia.
- x Funaria.

#### **PRACTICALS**

- 1) Comparative study of thallus and reproductive organs of various algae mentioned in theory
- 2) Comparative study of vegetative and reproductive parts of various fungi mentioned in theory
- 3) Study and section cutting and lectophenol mount of plant disease materials studied in theory.
- 4) Study of various types of lichens.
- 5) Study of external features & anatomy of vegetative and reproductive parts of Marchantia and Funaria.
- 6) Collection of algae, fungi, plant diseases materials and bryophytes available locally.

**BT-103**

**CELL BIOLOGY**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

#### **UNIT I**

**Cell:** An introduction and classification of organisms by cell structure, cytosol, compartmentalisation of eukaryotic cells, cell fractionation.

**Cell Membrane and Permeability:** Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

## **UNIT II**

**Membrane Vacuolar system, cytoskeleton and cell motility:** Structure and function of microtubules, Microfilaments, Intermediate filaments.

**Endoplasmic reticulum:** Structure, function including role in protein segregation

**Golgi Complex:** Structure, biogenesis and functions including role in protein secretion

## **UNIT III**

**Lysosomes:** Vacuoles and microbodies : Structure and functions

**Ribosomes:** Structures and function including role in protein synthesis.

**Mitochondria:** Structure, Genomes, biogenesis

**Chloroplasts:** Structure, genomes, biogenesis

**Nucleus:** Structure, Cell cycle (Interphase & M Phases), regulation of cell cycle.

## **UNIT IV**

**Extracellular Matrix:** Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function.

**Cancer:** Carcinogenesis, agents promoting carcinogenesis, characteristics of cancer cells, molecular basis of cancer.

## **PRACTICAL**

1. Study the effect of temperature, organic solvent on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and deplasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted moong or rat or any suitable source.
5. Microscopy : Structure of Prokaryotic and Eukaryotic cell, Fixation.
6. Microtomy of various organ systems, Mitochondrial staining and enzyme localization ( Histo-chemistry).
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

## **BT-104      BIOCHEMISTRY and METABOLISM**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10 marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

### **UNIT I**

**Introduction to Biochemistry:** A historical prospective.

**Amino acids & Proteins:** Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape.

Different Level of structural organization of proteins, Purification of proteins and criteria of their purity. Denaturation and renaturation of proteins. Fibrous and globular proteins.

**Carbohydrates:** Structure and Function : Structure and properties of Monosaccharides, Oligosaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

### **UNIT II**

**Lipids:** Structure and functions – Classification, structures, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids structure and properties of different types of phospholipids, sphingomyelins, glycolipids, cerebrosides, gangliosides, Prostaglandins cholesterol – its structure and biological properties, utilization of cholesterol.

**Nucleic acids:** Structure and functions: Physical & chemical properties of Nucleic acids. Structure and properties of purines & pyrimidines Nucleosides & Nucleotides. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for its A,B, & Z – DNA, denaturation and annealing of DNA.

### **UNIT III**

**Enzymes:** Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & Theories, ribozymes, abzymes Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of cofactors in enzyme catalysis: NAD<sup>+</sup>, NADP<sup>+</sup>, FMN/FAD, coenzymes A, thiamine pyrophosphate, pyridoxal phosphate, lipoic-acid, biotin vitamin B12 tetrahydrofolate and metallic ions.

## **UNIT IV**

**Carbohydrates Metabolism:** Glycolysis : reactions, energetics and regulation, Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogenesis.

TCA cycle, ETC, Oxidative phosphorylation.

Beta – oxidation of fatty acids.

## **PRACTICALS**

1. Effect of pH, temperature on the activity of salivary amylase enzyme activity.
2. To study activity of enzyme pancreatic trypsin under optimum conditions.
3. Estimation of blood glucose - glucose oxidase method.
4. Determination of - pH optimum, Temperature optimum, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) and measurement of K.
5. Principles of Colorimetry: **(i)** Verification of Beer's law, estimation of protein and phosphate. **(ii)** Finding out Xmax. Relation between O.D. and % transmission. pH, pK, Henderson's equation. Preparation of buffer.
6. Separation of Amino acids by paper chromatography.
7. Isolation of phospholipids from liver and their separation on thin layer chromatography (TLC).
8. Isolation of enzyme Acid Phosphatase from germinating lentils (moong) using  $(\text{NH}_4)_2\text{SO}_4$  precipitation and its assay using p-nitrophenyl phosphate and calculation of specific activity.



**BT-105                      PHYSICAL CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-106                      INORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-107                      ORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

## **SEMESTER II**

**BT-201**

**BIOSTATISTICS**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

### **UNIT I**

Relations between roots and coefficients of algebraic equations, Solution of cubic equations Permutation and Combination, Binomial theorem of integer, Logarithm (definition and laws of logarithm, use of log table), Trigonometric Identities. Matrices and their elementary operations.

### **UNIT II**

Functions, Limits of functions, (basic idea of limits of functions without analytic definition), derivatives of functions, differentiation, integration (general introduction, significance and application for simple algebraic and trigonometric functions). Applications of Differentiation and Integration.

### **UNIT III**

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis. Probability (classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

### **UNIT IV**

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

### **PRACTICAL**

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t,F,Z and Chi-square

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit

**UNIT I**

**Fundamentals of microbiology:** History and Evolution of Microbiology.

**Classification of microorganisms:** Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.

**Microbial Diversity:** Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg – bacteria, algae, Fungi, Protozoa and Unique features of viruses.

**UNIT II**

**Cultivation and Maintenance of microorganisms:** Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

**UNIT III**

**Microbial growth:** Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

**Microbial Metabolism:** Metabolic pathways, amphi-catabolic and biosynthetic pathways

**Bacterial Reproduction:** Transformation, Transduction and Conjugation.

Endospores and sporulation in bacteria

**UNIT IV**

**Control of Microorganisms:** By physical, chemical and Chemotherapeutic

Agents

**Water Microbiology:** Bacterial pollutants of water, coliforms and non-coliforms. Sewage composition and its disposal.

**Food Microbiology:** Important microorganism in food

**Microbiology:** Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods

**Industrial Microbiology:** Bio engineering of micro organism for Industrial purposes, Industrial uses of bacteria, Yeasts, moulds. Petroleum microbiology and Deterioration of materials.

## **PRACTICAL**

1. Microscopy & use of Microscope
2. Staining method – simple staining, grain staining, spore staining, negative staining
3. Preparation of media & sterilization, Methods of Isolation of bacteria from different sources
4. Determination of cell size by micrometry.
5. Enumeration of microorganism - total & viable count

## **BT-203**

## **GENETICS**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit

### **UNIT I**

**Introduction:** Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.

**Cell Cycle:** Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycle.

**Mendelian genetics :** Mendel's experimental design, monohybrid, di-hybrid and tryhybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back cross, Chromosome theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

### **UNIT II**

**Non allelic interactions:** Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

**Chromosome and genomic organization:** Eukaryotic nuclear genome-nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA.

Genetic organization of prokaryotic and viral genome.

Structure and characteristics of bacterial and eukaryotic chromosome-chromosome morphology, concept of euchromatin and heterochromatin,

packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

### **UNIT III**

**Chromosome and gene mutations:** Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abnormalities– Aneuploidy and Euploidy.

**Sex determination and sex linkage :** Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

### **UNIT IV**

**Genetic linkage, crossing over and chromosome mapping:** Linkage and recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four-strand stage, Multiple crossing overs Genetic mapping.

**Extra chromosomal inheritance:** Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.

**Evolution and population genetics:** Inbreeding and out breeding, Hardy Weinberg law assumption, (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

### **PRACTICALS**

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Bod -*Rhoeo* translocation.
5. Karyotyping with the help of photographs

# **BT-204 ANIMAL DIVERSITY & ECONOMIC ZOOLOGY**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

## **UNIT I**

- a) Outline of classification of Non- Chordates upto subclasses. Coelomata, Acoelomata, Symmetries, Deutrostomes, Protostomes.
- b) Protozoa: Locomotion, Reproduction, evolution of Sex, General features and life history of Paramecium and Plasmodium. Pathogenic protozoans
- c) Porifera: General characters, outline of Classification ; skeleton , Canal System

## **UNIT II**

- a) Coelenterata: General Characters, Outline of classifications Polymorphism, Various types of stinging cells; Metagenesis, coral reefs and their formation.
- b) Platyhelminthes- General Characters; Outline of classification; Pathogenic flatworms: Parasitic adaptations. Important Larval forms.
- c) Aschelminthes: General features, Outline of classification, Pathogenic roundworms and their vectors in relation to man: Parasite adaptation.

## **UNIT III**

- a) Annelida: - General features, Outline of classification, Coelom: Metameric segmentation, General features and life history of Earthworm, Vermicomposting.
- b) Arthropoda: General Features, Outline of Classification; Larval forms of crustacean, Respiration in Arthropoda; Metamorphosis in insects; Social insects; Insect vectors of diseases; Apiculture, Sericulture.

## **UNIT IV**

- a) Mollusca : general features, Outline of classification, Shell Diversity; Torsion in gastropoda, Life history of Pila.
- b) Echinodermata: General features, Outline of Classification, Life history of starfish (Asterias) Larval forms
- c) Hemichordata: Phylogeny: Affinities of Balanoglossus

## **PRACTICAL**

1. Identification and Classification of Any these of the following -  
Porifera: Scypha, Leucosolenia, Euspongia, Hylonema, Euplectella

Cnidaria: Medrepora, Millepora, Physalia, Porpita, Valella, Aurelia, Metridium  
Platyhelminthes: Taenia, Fasciola,  
Aschelminthes: Ascaris, Ancylostoma, Enterobius  
Annelida: Pheretima, Hirudinaria, Chaetopterus, Nereis, Aphrodite  
Arthropoda: Julus, Scolopendra, Peripatus, Carcinus, Limulus, Lepisma, Dragonfly, Musca, Acheta  
Mollusca: Pila, Unio, Mytilus, Loligo, Sepia, Octopus, Solen  
Echinodermata: Asterias, Ophiothrix, Echinus, Holothuria, Astrophyton  
Hemichordata: Balanoglossus

2. Identification of slides with two points of identification.  
Amoeba, Paramoecium, Ceratium, Plasmodium, Opalina, L.S. Sponge,  
Spicules of sponges, L.S. Hydra, Obelia, Bougainvillia, Larvae of Fasciola, Seta of Earthworm, Radula
3. Ecological Note – On any of the specimens in Exercise No 1  
Dissection of Earthworm, Cockroach  
Earthworm: Digestive, Nervous System,  
Cockroach: Digestive Reproductive, Nervous System

**BT-205                      PHYSICAL CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-206                      ORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-207                      INORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT 208**

**MM 50**

Seminar and Term – paper writing as assignment on Biostatistics/ Microbiology/Genetics/Animal Diversity.

**BT 209                      LAB COURSE- I**

**MM 100**

Practical examination of Chemistry I semester will be held along with IInd Semester annually.

**BT- 210                      LAB COURSE II**

**MM 100**

**(Plant Diversity, cell biol., Biochem. & Metabolism)**

- x Practical exam shall be conducted in two sessions of 4 hrs each
- x Each student will be given two major and one minor exercises in examination

Major exercises- Cell Biology and Biochemistry and metabolism (25+25=50 marks)

Minor exercise- Plant Diversity I and Bio-prospecting (25

marks) Viva - 15 marks

Practical record - 10 marks

Total - 100 marks



**BT- 211. LAB COURSE III (Microbiol., Genetics, Animal Diversity & Biostatistics)**

**MM  
100**

- x Practical exam shall be conducted in two sessions of 4 hrs each
- x Each student will be given two major and one minor exercises in examination

Major exercises- Microbiology and Animal Diversity (25+25=50 marks)

Minor exercise- Genetics and Biostatistics (25 marks)

Viva - 15 marks

Practical record - 10 marks

Total - 100 marks

## **SEMESTER III**

**BT 301**

**MEDICAL MICROBIOLOGY**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

### **Unit I**

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram positive bacteria: *S. aureus*, *S. pyogenes*, *B. anthracis*, *C. perferinges*, *C. tetani*, *C. botulinum*, *C. diphtheriae* *M. tuberculosis* *M. leprae*

### **Unit II**

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E. coli*, *N. gonorrhoea*, *N. meningitidis*, *P. aeruginosa*, *S. typhi*, *S. dysenteriae*, *Y. pestis*, *B. abortus*, *H. influenzae*, *V. cholerae*, *M. pneumoniae*, *T. pallidum* *M. pneumoniae*, *Rickettsiaceae*, *Chlamydiae*

### **Unit III**

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses

### **Unit IV**

Fungal and Protozoan infections

Dermatophytoses (*Trichophyton*, *Microsporun* and *Epidermophyton*)  
Subcutaneous infection (*Sporothrix*, *Cryptococcus*), systemic infection (*Histoplasma*, *Coccidoides*) and opportunistic fungal infections (*Candidiasis*, *Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

## **PRACTICAL**

- 1 Isolation of bacteria & their biochemical characterization.
- 2 Growth curve of bacteria
- 3 Antibiotic sensitivity of microbes, use of antibiotic disc
- 4 Testing quality of water (BOD, COD & E. coli count)

**BT 302**

**BIOANALYTICAL TOOLS**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

**UNIT I**

Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

**UNIT II**

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles

**UNIT III**

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC

**UNIT IV**

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, immuno electrophoresis, isoelectric focusing, western blotting.

Introduction to Biosensor and Nanotechnology and their applications.

**PRACTICAL**

- 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 pea 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 of NADH

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

**UNIT I: Anatomy**

The shoot and root apical meristem and its histological organization, simple

& complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

**UNIT II: Plant water relations and micro & macro nutrients**

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing

Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

**UNIT III: Carbon and nitrogen metabolism**

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, calvin cycle, CAM plants, photorespiration, compensation point

Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants

**UNIT IV: Growth and development**

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene): Physiological role and mode of action, seed dormancy and seed germination, concept of photo-periodism and vernalization

**PRACTICAL**

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of plasmolysis by *Tradescantia* leaf peel.
3. Demonstration of opening & closing of stomata.
4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.
6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

**BT 304**

**PLANT DIVERSITY II**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

**UNIT I: Pteridophytes**

General characters of pteridophytes, affinities with bryophytes & gymnosperms, classification, economic importance, study of life histories of fossil Pteridophytes – Rhynia

**UNIT II: Pteridophytes: Type studies**

Life histories of Selaginella- (Heterospory and seed habit), Equisetum, Pteris, Lycopodium

**UNIT III: Gymnosperms**

General characters, classification, geological time scale, theories of fossil formation, types of fossils, fossil gymnosperms- Williamsonia & Glossopteris, telome and steel concept

**UNIT IV: Gymnosperms: Type studies**

Life histories of Cycas & Pinus, economic importance of gymnosperms

**PRACTICAL**

1. Examination of morphology and anatomy of vegetative and reproductive parts of Selaginella, Equisetum & Pteris.
2. Examination of morphology and anatomy of vegetative & reproductive parts of - Cycas & Pinus
3. Plant collection (pteridophytes & gymnosperms)

**BT-305**

**PHYSICAL CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-306**

**ORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-307: INORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

## **SEMESTER IV**

**BT 401**

**ANIMAL DIVERSITY II**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

### **UNIT I: Proto-chordates, Pisces and Ambhibia**

Proto-chordates: Outline of classification, General features and important characters of Herdmania, Branchiostoma

Origin of Chordates

Pisces: Migration in Pisces, Outline of classification

Amphibia: Classification, Origin, Parental care, Paedogenesis

### **UNIT II: Reptilia, Aves and Mammalia**

Reptelia: Classification, Origin

Aves: Classification, Origin, flight- adaptations, migration

Mammalia: Classification, Origin, dentition

### **UNIT III: Comparative anatomy of vertebrates I**

Comparative anatomy of various systems of vertebrates: Integumentary, digestive respiratory systems.

### **UNIT IV: Comparative anatomy of vertebrates II**

Comparative Anatomy of vertebrates – Heart, Aortic arches, Kidney & urino-genital system, Brain, Eye, Ear

Autonomic Nervous system in Mammals

### **PRACTICAL**

1. Identification & Classification upto order of the following:

Proto-chordata: Salpa, Doliolum, Herdmania, Branchiostoma

Cyclostomata: Myxine, Petromyzon

Chondrichthyes: Scoliodon, Zygnema, Pristis, Trygon, Raja, Chimaera

Ostiechthyes: Labeo, Mystus, Catla, Hippocampus, Anabas, Echeneis, Lophius, Polypeterus

Amphibia: Rana, Hyla, Amblystoma, Necturus, Proteus.

Reptiles: Hemidactylus, Calotes, Draco, Phrynosoma, Naja Vipera, Bungarus

Aves: Columba, Alcedo, Passer

Mammalia: Ornithorhynchus, Macropus, Didelphes, Dasypus

2. An Ecological Note on any one of the specimens in Experiment 1

3. Identification of the following slides

Mammalian Histology: Liver, Lung, Intestine, Kidney, Ovary, Testes

Salpa, Doliolum, Spicules of Herdmania, Tadpole of Frog

4. Preparation of a permanent mount of Salpa, Placoid scales, spicules of Herdmania, Pharynx of Amphioxus, Tadpole Larva of frog

5. Identification of endoskeletons of frog and rabbit

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

**UNIT I: DNA structure and replication**

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bidirectional replication, DNA polymerases, The replication complex: prepriming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication

**UNIT II: DNA damage, repair and homologous recombination**

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, non homologous end joining. Homologous recombination: models and mechanism

**UNIT III: Transcription and RNA processing**

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains

Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation

RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing

**UNIT IV: Regulation of gene expression and translation**

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system)

Genetic code and its characteristics

Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins

**PRACTICAL**

1. Isolation of DNA from bacterial cells
2. Isolation of Plasmid DNA by alkaline method
3. Agarose gel electrophoresis of genomic DNA & plasmid DNA
4. Preparation of restriction enzyme digests of DNA samples



**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

**UNIT I: Gametogenesis and Fertilization**

Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis

Fertilization - Definition, mechanism, types of fertilization.

Different types of eggs on the basis of yolk

**UNIT II: Early embryonic development**

Cleavage: Definition, types, patterns & mechanism

Blastulation: Process, types & mechanism

Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers

Fate Maps in early embryos

**UNIT III: Embryonic Differentiation**

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level

Concept of embryonic induction

Primary, secondary & tertiary embryonic induction

Neural induction and induction of vertebrate lens

**UNIT IV: Organogenesis**

Neurulation, notogenesis, development of vertebrate eye.

Fate of different primary germlayers

Development of behaviour: constancy & plasticity

Extra embryonic membranes, placenta in Mammals

**PRACTICAL**

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of *Anopheles* mosquito

**Note:** Examiner will set one compulsory and eight other questions at least two from each unit. The compulsory question will be of 10 marks and should cover entire syllabus. Students will attempt four other questions i.e. one from each unit.

**UNIT I: Digestion and Respiration**

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice

Respiration: Exchange of gases, Transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen dissociation curve, Chloride shift

**UNIT II: Circulation**

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood

Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat

**UNIT III: Muscle physiology and osmoregulation**

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

**UNIT IV: Nervous and endocrine coordination**

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters

Mechanism of action of hormones (insulin and steroids)

Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions

**PRACTICAL**

1. Finding the coagulation time, blood groups, RBC count, TLC, DLC
2. Demonstration of action of an enzyme
3. Determination of Haemoglobin

**BT-405                      PHYSICAL CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical).

**BT-406                      ORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical).

**BT-407: INORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical).

**BT 408**

**MM 50**

Seminar and Term – paper writing as assignment on Molecular Biology/Developmental biology / Physiology.

**BT 409                      LAB COURSE I**

**MM 100**

Practical examination of Chemistry III semester will be held along with IV Semester annually.

**BT-410      LAB COURSE II                      MM100**  
**(Bioanalytical tools, Pl. Physiol. Pl. Diversity & Med. Microbiology)**

Practical exam shall be conducted in two sessions of 4 hrs each

Each student will be given two major and one minor exercise in examination

Major exercises- Microbiology and Analytical tools (25+25=50 marks)

Minor exercise- Plant diversity II and Plant physiology (25 marks)

Viva - 15 marks

Practical record- 10 marks

Total - 100 marks

**BT- 411**                      **LAB COURSE III**    **MM**  
(Mol. Biol., Animal Diversity, Developmental and Mammalian                      **100**  
Physiol.)

x Practical exam shall be conducted in two sessions of 4 hrs each.

x Each student will be given two major and one minor exercises in examination

Major exercises- Molecular Biology and Mammalian Physiology  
(25+25=50 marks)

Minor exercise- Development Biology and Animal diversity-II (25 marks)

Viva	-	15 marks
Practical record	-	10 marks
Total	-	100 marks

## **SEMESTER V**

**BT 501**

**BIOINFORMATICS**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

### **UNIT I**

History of Bioinformatics. The notion of Homology.

Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

### **UNIT II**

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web.

Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

### **UNIT III**

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

### **UNIT IV**

**Searching Databases:** SRS, Entrez, Sequence Similarity Searches-BLST, FASTA, Data Submission.

**Genome Annotation:** Pattern and repeat finding, Gene identification tools.

## **PRACTICAL**

1. Sequence information resource
2. Understanding and using on web: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
4. Understanding and using on web: PDB, Swissprot, TrEMBL
6. Using various BLAST and interpretation of results.

**BT 502**

**RECOMBINANT DNA TECHNOLOGY**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

**UNIT I**

Gene Recombination and Gene transfer: Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser.

**UNIT II**

Changing genes: site-directed mutagenesis and Protein engineering: Primer extension is a simple method for site directed mutation, PCR based site directed mutagenesis, Random mutagenesis, Use of Phage display techniques to facilitate the selection of mutant peptides, Gene shuffling, production of chimeric proteins.

**UNIT III**

Genetic engineering in animals: Production of transgenic mice, ES cells can be used for gene targeting in mice, Applications of gene targeting, Using Yeast to study Eukaryotic gene function, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines, Transgenic animals, Production of proteins of Pharmaceutical value.

**UNIT IV**

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *Arhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors

**PRACTICAL**

1. DNA isolation from plants
2. DNA isolation from E.coli
3. Spectrophotometer analysis of DNA
4. Agarose gel electrophoresis of DNA
5. Plasmid DNA isolation
6. Restriction digestion of DNA
7. Southern Blotting
8. Making competent cells
9. Transformation of competent cells.

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

**UNIT I**

Immune Response - An overview, components of mammalian immune system, molecular structure of Immunoglobulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

**UNIT II**

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

**UNIT III**

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Auto-immune diseases, Immunodeficiency-AIDS.

**UNIT IV**

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.

**PRACTICAL**

1. Differential leucocytes count
2. Total leucocytes
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

**UNIT I**

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam and Gilbert and Sangers method. Chain termination method, Pyrosequencing, Genome Sequencing methods: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

**UNIT II**

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organismal Genomes and Databases.

**UNIT III**

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

**UNIT IV**

Introduction to Proteomics, The proteome. Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.

**PRACTICAL**

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. NCBI Genome site
4. Detection of Open Reading Frames using ORF Finder
5. Proteomics 2D PAGE database
6. Softwares for Protein localization.
7. Hydropathy plots
8. Native PAGE
9. SDS PAGE



**BT-505                      PHYSICAL CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-506                      ORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

**BT-507: INORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical)

## **SEMESTER VI**

**BT 601**

### **I.P.R. ENTREPRENEURSHIP BIOETHICS & BIOSAFETY**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

#### **UNIT-I**

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

#### **UNIT II**

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

#### **UNIT III**

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

#### **UNIT IV**

Biosafety – Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

#### **PRACTICAL**

1. Proxy filing of Indian Product patent.
2. Proxy filing of Indian Process patent.
3. Planning of establishing a hypothetical biotechnology industry in India

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

**UNIT I**

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

**UNIT II**

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and-mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

**UNIT III**

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

**UNIT IV**

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

**PRACTICAL**

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. DNA isolation from animal tissue
7. Quantification of isolated DNA
8. Resolving DNA on Agarose Gel.

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

**UNIT I**

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

**UNIT II**

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.

**UNIT III**

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting  $K_{La}$ . Bioprocess measurement and control system with special reference to computer aided process control.

**UNIT IV**

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

**PRACTICAL**

1. Calculation of bacterial growth curve.
2. Calculation thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

**BT 604 PLANT BIOTECHNOLOGY & ENVIRONMENTAL  
BIOTECHNOLOGY**

**MM 40+10 IA**

**Time: 3 Hours**

**Note:** Examiner is requested to set one compulsory and eight other questions at least two from each unit. The compulsory question should be of 10marks and should cover entire syllabus. Student should attempt four other questions i.e. one from each unit.

**UNIT I**

Introduction to *in vitro* methods. Terms and definitions. Use of growth regulators. Embryo culture, embryo rescue after wide hybridization and its applications Introduction to the processes of embryogenesis and organogenesis and their practical applications. Clonal multiplication of elite species (Micropropagation) axillary bud, shoot-tip and meristem culture. Haploids and their applications, Somaclonal variations and applications.

**UNIT II**

Endosperm culture and production of triploids. Single –cell suspension cultures. Introduction to protoplast isolation: Principles and applications. Various steps in the regeneration of protoplasts. Somatic hybridization – an introduction. Use of markers for selection of hybrid cells. Practical applications of somatic hybridization (hybrids vs cybrids).

**UNIT III**

Microbiological quality of food and water. Treatment of municipal waste and industries effluents. Degradation of pesticides and other toxic chemicals by microorganisms (Bioremediation).

**UNIT IV**

Thuringiensis toxin as a natural pesticide. Biological control of other insects swarming the agricultural fields. Enrichment of ores by microorganisms. Biofertilizers, Nitrogen fixing microorganisms enrich the soil with assimilable nitrogen.

**PRACTICAL**

1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explant for culture.
4. Significance of growth hormones in culture medium.
7. To demonstrate various steps of Micropropagation.
8. Calculation of Total Dissolved Solids (TDS) of water sample.
9. Calculation of BOD & COD of water sample.

**BT-605                      PHYSICAL CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical).

**BT 606                      ORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical).

**BT-607                      INORGANIC CHEMISTRY**

**MM 40+10 IA**

**Time: 3 Hours**

The Course contents of Chemistry will be the same as that of Chemistry of B.Sc. (Medical).

**BT 608                      PROJECT**

**MM 50**

Project report and presentation.

**BT 609                      LAB COURSE I                      MM 100**

Practical examination of Chemistry V Semester will be held along with Semester VI annually.

**BT-610                      LAB COURSE II                      MM100**

**(Bioinformatics, rDNA Tech, Immunology, Genomics & Proteomics)**

Practical exam shall be conducted in two sessions of 4 hrs each

- x Each student will be given two major and one minor exercises in examination

Major exercises- r-DNA Technology, Immunology		(25+25=50 marks)
Minor exercise- Genomics & Proteomics/Bioinformatics		(25 marks)
Viva	-	15 marks
Practical record	-	10 marks
Total	-	100 marks

**BT- 611**

**LAB COURSE III**

**MM 100**

**(Animal Biotech, Bioprocess Tech, Plant Biotech, Environmental Biotech, IPR)**

- x Practical exam shall be conducted in two sessions of 4 hrs each
- x Each student will be given two major and one minor exercises in examination

Major exercises- Plant & Env. Biotechnology, Bioprocess technology		(25+25=50 marks)
Minor exercise- Animal Biotechnology and IPR & Entrepreneurship		(25 marks)
Viva	-	15 marks
Practical record	-	10 marks
Total	-	100 marks