



# RKDF UNIVERSITY, RANCHI

**M.Sc. (Biochemistry)**

**SCHEME SEMESTER – I**

S.No.	Subject Code	Subject Name	Marks Distribution					
			Internal	External		Total		
				Max	Min	Max	Min	
1.	PBC101	Fundamentals of Biochemistry	30	70	21	100	35	
2.	PBC102	Microbiology	30	70	21	100	35	
3.	PBC103	Organic and Biophysical Chemistry	30	70	21	100	35	
4.	PBC104	Molecular Genetics	30	70	21	100	35	
<b>Total</b>							<b>400</b>	
<b><i>Practical</i></b>								
S.No.	Code	Subject Name	Max		Min			
1.	PBC155	Practical – General Biochemistry	100		50			



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry) Choice Based Credit System Semester - I

S.No.	Subject Code	Subject Name	L	T	P	Credit
1.	PBC101	Fundamentals of Biochemistry	3	1	0	4
2.	PBC102	Microbiology	3	1	0	4
3.	PBC103	Organic and Biophysical Chemistry	3	1	0	4
4.	PBC104	Molecular Genetics	3	1	0	4
5.	PBC155	al – General Biochemistry	0	0	8	4
<b>Total</b>			<b>12</b>	<b>4</b>	<b>8</b>	<b>20</b>



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Fundamentals of Biochemistry	PBC101

### **Unit I**

Structure of monosaccharides, oligosaccharides and polysaccharides, glycoproteins, glycolipids, proteoglycans, mutarotation, anomeration, epimerization, stability of polysaccharides.

Glycolytic pathway; regulation of the hexokinase, phosphofructokinases, Krebs' cycle; amphibolic nature of TCA cycle, glyoxylate cycle, glycogen breakdown, glycogen synthesis, regulation of glycogen metabolism, gluconeogenesis and its regulation, pentose phosphate pathways, metabolism of Fructose and Galactose

### **Unit II**

Structure and properties of fatty acids, storage and membrane lipids, phospholipids and cholesterol, Composition and synthesis of lipoproteins and their transport in the body, oxidation of fatty acids (beta & alpha), oxidation of long chain fatty acids, Synthesis of lipids, elongation of fatty acids, desaturation of fatty acids, regulation of fatty acid synthesis, cholesterol metabolism, regulation of cholesterol metabolism.

Structure, composition and properties of nucleic acids, *De-Novo* synthesis of purine and pyrimidine nucleotides and its regulation. Synthesis of nucleoside di- and triphosphates, deoxynucleotides and TMP and degradation of purine and pyrimidine nucleotides, salvage pathways of nucleotides synthesis.

### **Unit III**

Structure and properties of amino acids, Structure of protein (Primary, Secondary, Tertiary and Quaternary), essential and non-essential amino acids, general reactions of amino acid metabolism, urea cycle, synthesis of various molecules via amino acid metabolism intermediates, non-standard Amino Acids.

Structure and properties of vitamins, co-enzymes, biochemical action of vitamins and water- soluble vitamins, Biosynthesis of vitamins, role of vitamins in the metabolism.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Microbiology	PBC102

### **Unit-I**

Origin and evolution of microbial world; Pathway of discovery in Microbiology; Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese, Classification and bacterial and archaea systematics: conventional and modern methods of bacterial taxonomy. Classification of bacteria according to Bergey's manual, bacterial identification, general characteristics of archaea, eubacteria, acellular life forms

**Microbes Growth:** Definition of growth, mathematical expression of growth, growth curve, diauxic & synchronous growth, continuous culture. Effect of environmental on bacterial growth

### **Unit-II**

General characteristics of various groups of prokaryotes: bacteria including, Rickettsiae, Chlamydiae, Spirochaetes and Actinobacteria, Cyanobacteria and Mycoplasmas.

**Eubacteria:** cell structure, nutrition, isolation and cultivation. Diversity, nutrition, ecology, significance of gram-positive (Firmicutes, Actinobacteria) and gram-negative [Proteobacteria (cyanobacteria, Rhizobia), Deinococcus-Thermus, Spirochaetes, Bacteroidetes].

**Mycology and phycology:** General characters of fungi and algae, cultivation, cultural characteristics, microscopic morphology, importance of fungi and algae in industry and food production.

**Yeasts:** General characteristic, structure, classification, life cycles (important forms), sexual and asexual reproduction of yeast (*Saccharomyces cerevisiae*)

### **Unit-III**

**Virology-** Structure of animal viruses and plant viruses; satellite viruses; viroids; prions; diseases caused by animal viruses and plant viruses, genome organization of animal viruses; genome organization of DNA and RNA plant viruses, bacteriophages, lytic and lysogenic cycles, cultivation of viruses, diagnosis viruses



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**Protozoa:** Classification, morphology, reproduction, modes of nutrition, modes of transmission, life cycle, cultivation of protozoa. Structure and significance: *Entamoeba*, *Plasmodium*.

**Applied Microbiology-** Overview of applications of microorganisms in Agriculture, Environment, Food, Industry and Medical Sciences.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Organic and Biophysical Chemistry	PCB103

### UNIT I

Electronic Theory of valency: Valence Bond theory, Tetravalency of Carbon, Hybridization & Shapes of Molecules, Molecular orbital theory, Ionisation Potential, Electron affinity, Electronegativity, Dipole moments, Resonance, Hydrogen Bond, Vanderwaal's force, Electronic displacements in a molecule: Inductive effect, Mesomeric effect, Electronic effect, Inductomeric effect, Hyperconjugation, Steric effect.

### UNIT II

Types of Organic Reactions: Substitution, addition, elimination, rearrangement, condensation and polymerization.

Mechanism of substitution in the Benzene Ring: o-, p- and m-directing groups, The concept of resonance with reference to Benzene derivatives, Direct influence of substituents- electronic interpretation.

Isomerism: Structural Isomerism, Stereoisomerism: Geometrical isomerism (E&Z nomenclature), Optical isomerism: Optical activity, specific rotation, chirality, chiral centre, enantiomers, diastereomers, meso-compounds, DL & RS Nomenclature, Configuration and Conformation, dihedral angles, Conformational analysis of ethane, n-butane, cyclohexane, mono & di-substituted cyclohexane, boat and chair forms, eclipsed, gauche and staggered conformations, axial and equatorial bonds. Monosaccharides, Anomers, mutarotation, glycoside, epimers, glucopyranose, fructopyranose, periodic acid oxidation of sugars.

Heterocyclic Systems occurring in living system: Numbering of the ring and properties of pyran, furan thiozole, indole, pyridine, pyrimidine, quinone, purine, piperidine.

### UNIT III

Open, closed and isolated system; First law of thermodynamics, Enthalpy of formation, Bond Enthalpy and Enthalpy of a reaction, Hess Law, Internal Energy, Enthalpy; second law of thermodynamics,



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entropy, Helmholtz and Gibbs free energy, Criteria of Spontaneity; Third law of thermodynamics and calculation of entropy; application of first and second law of thermodynamics in understanding energies in living cells, chemical potential, Order & Molecularity of a reaction, Law of Mass action, equilibrium constant, Le Chatelier's Principle.

### **UNIT IV**

Physical properties and structure of water, ionization of water, pH scale, acid & bases, buffer, Handerson equation, ionization behaviour of amino acids and proteins, titration curve, buffer solution and their action.

### **UNIT V**

Free Radicals in Biological Systems: Oxygen as a free radical in the auto-oxidation of fats, Antioxidants (free radical inhibitors in the cell such as vitamin A, vitamin E, vitamin C, Seetc)

Nature of radio- activity, properties of  $\alpha$ ,  $\beta$ , and  $\gamma$  rays, measurement of radioactivity, use of radioactivity in research. In vivo and In vitro labelling techniques, double labeling, quenching, internal standard, channel ratio, external standard ratio, emulsion counting, radioactive decay & autoradiography.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Molecular Genetics	PCB104

### **Unit-I**

Basic principles of Mendelian genetics- Segregation and Independent assortment, alleles and multiple alleles; human pedigrees and inheritance; Chromosomal basis of inheritance; Gene interactions; Chromosome and its structure; sex determination and sex-linked inheritance; Dosage compensation, Mitochondrial and chloroplast inheritance, Hardy-Weinberg equilibrium; Calculation of allele frequency, Genes in early development; Maternal effect genes; Pattern formation genes; Homeotic genes.

### **Unit-II**

Spontaneous and induced; Mechanisms of mutagenesis; Assay of mutagenic agents (Ames test); Chromosomal mutations- numerical (trisomy, polyploidy and aneuploidy) and structural changes and detection methods, somatic and germ line mutations, transposable elements, DNA repair, recombination error, SOS response and mutagenic repair.

Prokaryotic DNA Polymerase I, II and III, Eukaryotic DNA Polymerases, Fidelity and Catalytic Efficiency of DNA Polymerases, Okazaki Fragments, Replication Origin, Primosomes, Concurrent Replication Mechanism Involving Leading and Lagging Strands of DNA; Problems associated with linear replicons. Molecular basis of Recombination, Mutations and Repair.

### **Unit-III**

Prokaryotic RNA polymerase and sigma factors, Prokaryotic and eukaryotic promoters, Eukaryotic RNA Polymerases, Class I, II and III gene promoters, Enhancers and control regions of genes; mechanism of transcription- Prokaryotic and eukaryotic, Chromatin remodeling, Histone code and histone modifications, RNA processing and splicing

Genetic Code, Ribosome Structure, tRNAs, Aminoacyl tRNA synthetase, Initiation, Elongation, Termination, Translational Control, Operon Concept, Riboswitches, gene regulation in prokaryotes and eukaryotes





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## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Practical- General Biochemistry	PBC105

1. Introduction to laboratory safety precautions, personal hygiene, Glass wares, Instruments etc. (Centrifuge, pH meter, Colorimeter, Spectrophotometer, UV & VIS Spectrophotometer, Flame Photometer, Ultra Centrifuge, Electronic Balance, Chemical Analyzer & Elisa Reader etc.
2. Verification of Beer-Lambert's Law.
3. pH, Buffer Solutions and Titration
  - a. Preparation of Standard Solution and Buffer Solution
  - b) Determination pH of the given sample.
  - b) Titration of a mixture of a strong and weak acid
  - d) Titration of a strong acid with a strong base
  - c) Titration of a weak acid with a strong base
  - d) Titration of a polybasic acid with a strong base
  - e) Titration of a Amino acid (Neutral) with a strong base and acid
4. Qualitative test for Unknown Carbohydrate:-  
Molisch's test, Benedict's test, Barfoed's test / Bradford's method etc.
5. Qualitative test for Unknown Protein:-  
Biuret test, Ninhydrin test, Heller's Nitric Acid test etc.
6. Qualitative test for Unknown Lipid:-  
Salkowski's test, Emulsification, Saponification, etc.
7. Study of Urine Examination (Urinalysis):-
  - a) Physical examination
  - b) Chemical examination:
    - i) Normal constituents
    - ii) Abnormal constituents



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- c) Microscopic examination
- 8. Study of Fecal Material (Stool Examination):- Physical, Chemical & Microscopic
- 9. Chromatography:- Separation of sugars and amino acids using Paperchromatography
- 10. DNA Isolation.



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## M.Sc. (Biochemistry) SCHEME SEMESTER – II

S.No.	Subject Code	Subject Name	Marks Distribution					
			Internal	External		Total		
				Max	Min	Max	Min	
1.	PBC201	Immunology	30	70	21	100	35	
2.	PBC202	Plant Biotechnology	30	70	21	100	35	
3.	PBC203	Bioenergetics and Biomolecules	30	70	21	100	35	
4.	PBC204	Developmental Biology	30	70	21	100	35	
<b>Total</b>							<b>400</b>	
<b>Practical</b>								
S.No.	Code	Subject Name	Max		Min			
1.	PBC155	Practical - Immunology	100		50			



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## M.Sc. (Biochemistry) Choice Based Credit System Semester - II

S.No.	Subject Code	Subject Name	L	T	P	Credit
1.	PBC201	Immunology	3	1	0	4
2.	PBC202	Plant Biotechnology	3	1	0	4
3.	PBC203	Bioenergetics and Biomolecules	3	1	0	4
4.	PBC204	Developmental Biology	3	1	0	4
5.	PBC255	Practical – Immunology	0	0	8	4
<b>Total</b>			<b>12</b>	<b>4</b>	<b>8</b>	<b>20</b>



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## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Immunology	PBC201

### **Unit-I**

Basic concept of immune system, cells and organs of immunesystem, lymphoid cells (B- lymphocytes, T- lymphocytes and Null cells), mononuclear cells (phagocytic cells and their killing mechanisms), granulocytic cells (neutrophils, eosinophils and basophils), mast cells and dendritic cell. Structure and functions of primary and secondary lymphoid organs.

**Innate Immunity:** TLR receptors and sensing of PAMPs. Opsonization, Fc Receptors, prostaglandins and leukotrienes. Antigen, super antigens, immunogens, adjuvants, antigen processing, antibody structure and function, classification of immunoglobulins, concept of variability, cross reactivity, isotypes, allotypes and idiotypic markers, class switching, receptor and soluble form of immunoglobulins.

### **Unit-II**

B and T cell development, differentiation, maturation, clonal anergy, humoral immune response, B cell differentiation, antibody engineering, BCR and pre-BCR, Receptor editing, complement system, classical and alternative pathways, concept of histocompatibility, structure and function of class I and class II MHC molecules, structure of HLA complexes. T cell receptors

Antigen presentation cells, APC-T cell interaction, T cell differentiation in thymus, Th1, Th2, Th17, Treg cells and cytokines, chemokines, cytotoxic T cells, natural killer cells, dendritic cells.

### **Unit-III**

Antigen dependent cell cytotoxicity, cytotoxicity reactions, CD8+ T cell cytotoxicity, autoimmunity, acquired immunodeficiency, hypersensitivity reactions, grafting and transplantation immunology, host-pathogen interaction, immunotherapy, T cell immunotherapy & B cell immunotherapy.

Vaccines, different types of vaccines and its significance, monoclonal and polyclonal antibody production, hybridoma technology.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Plant Biochemistry	PBC202

### Unit-I

**Plant cell:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins, stomatal movement, transpiration, photoperiodism and biological clocks, plant movement.

**Photosynthesis:** Photosynthetic apparatus, pigments of photosynthesis, Calvin cycle (C3 plants), Hatch slack (C4 plants) & CAM pathways of carbon reduction and its regulation, Structure, function and regulation of RUBISCO, Crassulacean acid metabolism in plants.

**Photorespiration:** photorespiration pathway and significance, cyanide resistance, relationship between photosynthesis, photorespiration.

### Unit-II

**Phytohormones:** Biosynthesis, transport, physiological effects, mode of action and signal transduction of auxins, gibberlic acid, abscisic acid, ethylene and cytokinins in germination, embryogenesis, growth and development of plant.

**Nitrogen metabolism:** Nitrogen fixation, nitrogenase complex, biochemistry and genetics of nitrogen fixation and ammonium assimilation, structure of 'NIF' genes and its regulation, structural features of nitrate reductase and nitrite reductase, regulation of nitrate and sulphate assimilation.

**Secondary plant metabolites:** Nature, distribution, biosynthesis and function of plant metabolites, biosynthesis of nicotine. Biochemistry of plant toxins, phytohemagglutinins, lathyrrogens, nitriles, protease inhibitors, protein toxins, role of secondary metabolites in chemical defence.

### Unit-III

**Plant stress physiology:** Plant stress, plant responses to abiotic and biotic stresses, salinity, water, heat, chilling, anaerobiosis, heavy metals, radiations and their impact on plant growth and metabolism, mechanisms of resistance to biotic stress and abiotic stress, antioxidative defence mechanism.



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**Plant defence:** Genetic basis of plant-pathogen interactions, antio R-Avr gene interactions and isolation of R genes, hypersensitive response (HR), systemic acquired resistance (SAR) and induced systemic resistance (ISR).



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## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Bioenergetics and Biomolecules	PBC203

### UNIT I

A:- Introduction- Energy transformation, Biological oxidations, Oxygenases, hydroxylases, dehydrogenases, free energy on hydrolysis of ATP, standard free energy change of ATP hydrolysis, electrochemical potential, photons energy inter conversions, ionophores and shuttle systems.

B:- The mitochondrial respiratory chain- order and organization of carriers. The Q cycle, chemiosmotic theory and oxidative phosphorylation, P/O and H/P ratios, respiratory quotient, uncouplers and inhibitors of electron transport chain. Fractionation and reconstitution of respiratory chain complexes and ATP – synthase complex.

### UNIT II

Carbohydrate:- Classification, Structure, General Properties and function of Monosaccharides, Polysaccharides and complex carbohydrate (Amino sugar, proteoglycans and glycoprotein), Stereoisomerism and optical isomerism of sugar, reactions of aldehyde and ketone groups, ring structure and anomeric forms, mutarotation, reaction of sugar due to hydroxyl group.

Glycolysis, TCA cycle, Alternate pathways of carbohydrate metabolism (Gluconeogenesis, Glyoxalate cycle, pentose phosphate pathway, biosynthesis of starch and cellulose, glycogen metabolism); Regulation of Blood glucose, Homeostasis, hormonal regulation of carbohydrate metabolism.

### UNIT III

Lipid:- Introduction, Classification, Nomenclature, Structure and Properties of Saturated and Unsaturated fatty acids

Triacyl glycerol: Nomenclature and properties

Characterization of fat hydrolysis, saponification value, rancidity of fats, Reichert-Meissel number and reaction of glycerol.

Properties and Functions of Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidyl





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serine, phosphatidyl inositol, plasmalogens), Sphingomyelins, Glycolipids (cerebrosides and Gangliosides), Phospholipid, Isoprenoids and Sterols.

Fatty acid Biosynthesis: Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Fatty acid oxidation:  $\alpha$ ,  $\beta$ ,  $\omega$  oxidation and lipo-oxidation. Lipid Biosynthesis: Biosynthesis of triacylglycerols, phosphoglycerides and sphingolipids, Biosynthetic pathways for terpenes, steroids and prostaglandins. Ketone bodies: Formation and utilization. Metabolism of circulating lipids: chylomicrons, LDL, HDL and VLDL. Free fatty acids. Lipid levels in pathological conditions.

### UNIT IV

Protein and Amino acids:- Polypeptide chain. Primary (Peptide confirmation, N- and C-terminal, Peptide cleavage), Secondary ( $\alpha$  helix,  $\beta$  pleated sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of Proteins, stability of protein structure, Biosynthesis, degradation and regulation of important amino acids. Protein sequencing, Urea cycle and its regulation.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Development Biology	PBC204

### Unit-I

Basic features of development in animals, gametogenesis, types of eggs, fertilization, cleavage, and blastula, modification of development in evolution, generation of multicellular embryo, formation of germ layers, patterning of vertebrate body plan, Hormonal regulation of gametogenesis in male and female of mammals.

**C. elegans:** Study of cell lineage, mosaic development and organogenesis. **Drosophila:** Pattern formation, polarity determination of embryo, formation of body segments, Homeotic genes. **Mouse:** Vertebrate development, determining function of genes during development by generation of knockout and knock-in models. **Arabidopsis:** Organization of shoot and root apical meristem; shoot and root development.

### Unit-II

Properties of stem cells, embryonic stem cells, mesenchymal stem cells, hematopoietic stem cells, inducible pluripotent stem cells, epithelial to mesenchymal transition, cancer stem cells, embryonic signature in cancer stem cells, stem cell markers and factors.

Differential gene transcription, differential RNA processing, DNA methylation and control of gene transcription, control of gene expression at the level of translation.

### Unit-III

Primary cells, cell lines, immortalization of cells, basic steps of cell culture, isolation of primary cells and stem cells, cryopreservation of cell lines, Cell culture assays (cell viability and cytotoxicity tests, migration and invasion assays), applications of animal cell culture in testing of drugs and production of pharmaceutical proteins.

Medical embryology and teratology, Genetic errors of human development, in-vitro fertilization, environmental assaults on human development, design of future medicines like gene therapy, therapeutic cloning and regeneration therapy.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Practical – Immunology	PBC255

- Serum separation, Storage.
- Antibody titer by ELISA method.
- Precipitin reaction by double immune diffusion and radial immune diffusion (Ouchterlony and Mancini's methods)
- Separation of mononuclear cells by Ficoll-Hypaque
- Immunodiagnostics using commercial kits
- Blood smear identification of leucocytes by Giemsa stain
- Detection of antigens by immune blotting techniques, western blotting



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## M.Sc. (Biochemistry) SCHEME SEMESTER – III

S.No.	Subject Code	Subject Name	Marks Distribution				
			Internal	External		Total	
				Max	Min	Max	Min
1.	PBC301	Clinical Biochemistry	30	70	21	100	35
2.	PBB302	Genetic Engineering	30	70	21	100	35
3.	PBB303	Enzymology	30	70	21	100	35
4.	PBC304	Environmental Biochemistry	30	70	21	100	35
<b>Total</b>						<b>400</b>	
<i>Practical</i>							
S.No.	Code	Subject Name	Max		Min		
1.	PBC355	Practical – Analytical Biochemistry	100		50		



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry) Choice Based Credit System Semester - I

S.No.	Subject Code	Subject Name	L	T	P	Credit
1.	PBC301	Clinical Biochemistry	3	1	0	4
2.	PBB302	Genetic Engineering	3	1	0	4
3.	PBB303	Enzymology	3	1	0	4
4.	PBC304	Environmental Biochemistry	3	1	0	4
5.	PBC355	Practical – Analytical Biochemistry	0	0	8	4
<b>Total</b>			<b>12</b>	<b>4</b>	<b>8</b>	<b>20</b>



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Clinical Biochemistry	PBC301

### **Unit-I**

Quality control, accuracy, precision, specificity, sensitivity and limitation of errors allowable in the laboratory; Chemistry, composition & functions of lymph, CSF, and synovial fluid;

Urine formation, excretion and urine analysis; collection of bloods, anti-coagulants, preservatives of blood; Composition, chemistry & functions of specialized tissues like i.e. bone, brain, adipose tissue, etc.

Clinical investigation of sugar levels in blood and urine; factors influencing blood glucose level; carbohydrate tolerance tests, glycogen storage diseases;

Biosynthesis of bile acids, bile pigments and steroid hormones, plasma lipoproteins, Disorders associated with lipid metabolism and its therapeutic intervention, ketone bodies and ketosis

### **Unit-II**

Hemoglobin, Met-Hb, embryonic-Hb, heme metabolism associated diseases, sickle cell anemia, thalassemia, malnutrition, measurement of fuel values of foods, measurement and calculation of BMR, Metabolic disorders of amino acid metabolism and urea cycle, phenylketonuria, alkaptonuria, albinism, Lesch-Nyhan syndrome, disorders of nucleic acids metabolism

Biochemical mechanism of blood clotting and hemorrhagic disorders, disseminated intravascular coagulation, acquired prothrombin complex disorders.

Biochemistry of vitamins and micronutrients, biochemical basis of diseases with their deficiency

### **Unit-III**

Electrolytes, reabsorption of electrolytes, acid-base balance, regulation of electrolyte content of body fluids and maintenance of pH, regulation of sodium and water balance, renin-angiotensin system, clinical investigation of sodium, potassium, chloride;

Pathophysiology of different diseases like diabetes, Jaundice, Fatty liver, atherosclerosis, and osteoporosis;



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Functional test of liver, kidney, thyroid, gastrointestinal and pancreas, biochemical diagnosis of diseases by enzymatic assays;

Clinical tissue analysis, biopsy, liquid biopsy, circulating RNA and DNA as molecular diagnosis of different diseases.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Genetic Engineering	PBC302

### **Unit-I**

rDNA Technology: Restriction enzymes, restriction modification system, DNA ligase, E. coli DNA polymerase I and Klenow enzyme, T4 DNA polymerase, reverse transcriptase, polynucleotide kinase, alkaline phosphatase.

Cloning Methodologies: Plasmids and plasmid vectors, new generation of plasmid cloning vectors, Lambda vectors - insertion and replacement vectors, cosmids. High capacity cloning vectors – YACs, BACs and PACs. Shuttle vectors. Expression vectors - pMAL, GST, pET-based vectors. Eukaryotic expression vectors. Protein purification: His-tag, GST-tag, MBP-tag etc. Vectors used for cloning in animal cells: SV-40, vaccinia/baculo and retroviral vectors. Plant based vectors, Ti vectors.

### **Unit-II**

Genomic and cDNA library preparation: Methods for construction of genomic and cDNA libraries – vectors used, generation of cDNAs, preparation of genomic DNA for library construction. Lambda in vitro packaging. Methods used in the identification and analyses of recombinant DNA clones. Protein-protein interaction and yeast two hybrid system. Phage display. Principles of maximizing protein expression

RNA interference & rDNA therapy: Introduction to siRNA, siRNA technology, microRNA, construction of siRNA vectors, principle and application of gene silencing. Production of insulin, drug, vaccines, diagnostic probe of genetic diseases. Gene therapy

### **Unit-III**

Transgenic Technology: Gene knockout and knock-in, Generation of transgenic animals and its application, Cre-loxP recombination technology, Homologous and Non-homologous recombination, Gene isolation, gene transfer systems, Ti plasmid, plant virus vectors, electroporation, microinjection, microprojectile technology, particle bombardment, Generation of transgenic plants and its application,





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Plant tissue culture, anther and pollen culture, protoplast culture, protoplast fusion, cybrid, somatic hybrid, somatic embryogenesis, embryo rescue, application of recombinant DNA technology in photosynthetic efficacy, nitrogen fixation efficiency and resistance to environmental stresses.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Enzymology	PBC303

### UNIT I:

Nomenclature and Classification of Enzymes Characteristics Enzymes .Three dimensional structure of Enzymes- RNase Biological role of Enzymes

**UNIT II:** Multi enzyme system: Structure and Dynamics Occurrence, Isolation and their properties Polygenic nature of multienzyme system

Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthase complex

Immobilized multi enzyme system and their application

### UNIT III

Concept of ES complex, Active site, Derivation of Michaelis-Menten equation for uni substrate reaction, Different plots for the determination  $K_m$  and  $V_{max}$  and their significance, Significance and evaluation of energy of activation, Collision state theories and transition

Kinetics of zero and first order reaction, methods for measuring Kinetic and rate constants of enzymic reactions & their magnitude. Factors affecting the rate of enzyme -catalyzed reaction

Kinetics of multi substrate reactions, Derivation of the rate of expression for ping pong, random and ordered bi-bi mechanism, use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanism.

### UNIT IV

Acid Base catalysis, Covalent catalysis, proximity, orientation effect, Strain and Distortion theory Chemical modification of active site groups

Mechanism of enzymatic action of Lysozyme, Glyceraldehydes, 3 Phosphate dehydrogenase, aldolase, triose phosphate isomerase & Alcohol dehydrogenase. Water soluble vitamins and their coenzymes, Mechanism of catalysis of serine, proteases, Ribonuclease.



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## M.Sc. (Biochemistry)

### UNIT V: -

General mechanism of enzyme regulation

Reversible and irreversible covalent modification of enzymes Monocyclic and Multicyclic cascade system with specific examples

Feedback inhibition and feed forward stimulation, Enzyme repression, induction and degradation Allosteric enzymes, concerted/symmetric and sequential model for their action and significance Competitive, non-competitive, uncompetitive, linear mixed type inhibition and their kinetics, Suicide inhibitor Protein-ligand binding measurement, analysis of binding isotherm, Co- operativity phenomenon with special reference to aspartate transcarbamoylase & phosphofructo kinase, Hill & scatchard plot



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## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc. (Biochemistry)	Environmental Biochemistry	PBC304

### **Unit-I**

Environmental components: Atmosphere, structure and chemical composition of atmosphere, Internal structure of the Earth, rocks and their classification, minerals and their classification. Weathering and soil formation, soil profile, soil classification, soils of India. Global Water Balance. Origin and composition of sea water. Hydrological cycle. Classification of trace elements, mobility of trace elements, biogeochemical cycles.

### **Unit-II**

Fundamentals of Ecology: Definition, subdivisions. Ecosystems: concept of ecosystems, aquatic ecosystem, terrestrial ecosystem, energy flow in ecosystems, nutritional flux. Food-chains, Food web, ecotone, edge effects, ecological habitat & niche, ecological pyramids and ecosystem stability, concept of habitat and niche.

Biomes and Habitat Diversity: Classification of biomes, major biotic elements of each biome and their characteristics. Population and community ecology, population growth curves, life history strategies (r & k selection); concept of metapopulation. Ecological succession, primary and secondary, mechanism of succession.

### **Unit-III**

Global environmental issues and International laws: Global warming, Green house effect, ozone depletion, acid rains, hazardous waste, CITES etc. Earth's carbon cycle, carbon sequestration, sustainable development.

Bioremediation: Introduction and types of bioremediation, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, Phytoremediation.

Chemical toxicology: Biochemical effects of heavy metals (Pb, As, Hg, Cd), pesticides, insecticides, herbicides, weedicides, larvicides.



# RKDF UNIVERSITY, RANCHI

## M.Sc. (Biochemistry)

Branch	Subject title	Subject Code
M.Sc.(Biochemistry )	Practical –Analytical Biochemistry	PBC355

1. Complete Blood Count (C.B.C) / Hemogram

Serological Tests :- VDRL/RPR, ASO Titer, CRP test, RA test, Widal test and Pregnancy test etc.

3. ELISA for any Hormone

4. ABO grouping and Rh typing

5. Quantitative Study of Biocatalyst (Assay of Enzymes):- SGPT, SGOT, Alkaline phosphatase, Amylase etc.

6. Identification of Food Adulterants':

a) Test for dilution of milk with water

b) Test for starch in milk or milk products

c) Test for Argemone oil in Mustard oil

d) Test for common sugar in honey

e) Test for khesari Dal in Besan of other Dal

f) Test for coloured saw in turmeric powder

7. Detection of vitamin C in fruit juices.

8. Chemical Analysis of milk

9. Column Chromatography

10. Gel Electrophoresis



# RKDF UNIVERSITY, RANCHI

M.Sc. (Biochemistry)

SEMESTER - IV

Branch	Subject Title	Subject Code	Marks Distribution		Credit
			Max	Min	
M.Sc. Biochemistry	Dissertation	PBC455	500	250	20

Overall project dissertation may be evaluated under the following heads:

- Motivation for the choice of topic
- Project dissertation design
- Methodology and Content depth
- Results and Discussion
- Future Scope &References
- Presentation style
- Viva-voce

### PROJECT WORK/ DISSERTATION/ PAPER PRESENTATION

Each student has to submit two copies of the dissertation work duly forwarded by the HOD of Department concerned. The forwarded copies will be submitted in the Department of Biotechnology, RKDF University, for evaluation (Seven days before the seminar).

The paper will consist of

- (a) Field work/Lab work related to the project.
- (b) Preparation of dissertation based on the work undertaken.
- (c) Presentation of project work in the seminar on the assigned topic in the P.G. Department of Biotechnology, RKDF University, Ranchi & open viva thereon.
- Student alone or in a group of not more than five, shall undertake one Project approved by the Subject Teacher/H.O.D. of the Department/College concerned. The progress of the Project shall be monitored by the faculty members at regular intervals.

OR

- Paper presentation on ‘Topic provided’ and group discussion.

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