# S.P. Mandali's

# RAMNARAIN RUIA AUTONOMOUS COLLEGE

**Program: M.Sc.**

**Course Code: BIOTECHNOLOGY (RPSBTK)**

(Choice Based Credit System (CBCS) with effect from academic year 2019-20)

# PROGRAM OUTCOME

At the end of program the students would be able to

- Adept in understanding the advanced sections of Biotechnology in the domain of cytogenetics, Biochemistry along with Molecular Biology ,Cell culture ,Immunology, Clinical research, Bioinformatics and IPR thereby understanding the applications and various opportunities in the field of biotechnology.
- Identify the problems and understand the gaps in vast array of scientific knowledge and would be driven to research and solve to fill those gaps and contribute immensely to scientific community.
- Posses high competitive edge with those of reputed Indian universities and would make them competent for jobs in various domains of industries
- Generate confidence and right attitude to approach the competitive exams like CSIR NET and SET and also to develop research proposals for grant
- Understand and work with multidisciplinary subjects in industries and research.
- Communicate and function scientifically in an efficient manner

# PROGRAM SPECIFIC OUTCOME

- Rigorous evaluation through project based assignments on analytical techniques and bioprocess technology give our students an edge over others in acquiring deeper understanding of the concepts and its practical value in the advanced domains of biotechnology.
- Enabling students to understand the importance of handling vast amount of data whether retrieving, processing or analyzing through various tools of bioinformatics and biostatistics.
- Exposed to emerging domains of biotechnology like nanobiotechnology, clinical research opens up vast array of opportunities for research in these areas.
- Understanding of biotechnological applications, processes, its ethical implications and importance of intellectual property rights.

# S.P. Mandali's

# RAMNARAIN RUIA AUTONOMOUS COLLEGE

**Syllabus for: M.Sc. Part I**

**Program: M.Sc.**

**Course Code: BIOTECHNOLOGY (RPSBTK)**

(Choice Based Credit System (CBCS) with effect from academic year 2019-20)

**S.P Mandali's**
**Ramnarain Ruia Autonomous College**
**Department of Biotechnology**

## Syllabus for M.Sc. I

Credit based and Grading system
To be implemented from Academic year **2019-20**

| **Semester I** | | | | |
|---|---|---|---|---|
| **Course code** | **Unit** | **Topic** | **Credits** | **Lectures/ week** |
| **Paper I : Biochemistry RPSBTK101** | ***Unit I*** | Biochemistry of mucopolysaccharide and nucleic acid | 4 | 1 |
| | ***Unit II*** | Protein Biochemistry | | 1 |
| | ***Unit III*** | Inborn errors of metabolism and nutritional disorders | | 1 |
| | ***Unit IV*** | Neurobiology and neurochemistry | | 1 |
| **Paper II : Immunology RPSBTK102** | ***Unit I*** | Molecular immunology | 4 | 1 |
| | ***Unit II*** | Cancer Immunology | | 1 |
| | ***Unit III*** | Clinical immunology | | 1 |
| | ***Unit IV*** | Effector mechanisms | | 1 |
| **Paper III :Molecular Biology RPSBTK103** | ***Unit I*** | Chromatin structure and gene expression | 4 | 1 |
| | ***Unit II*** | Post Transcriptional and translational events | | 1 |
| | ***Unit III*** | RNA interferences and epigenetics | | 1 |
| | ***Unit IV*** | Omics studies | | 1 |
| **Paper IV :Biochemical and Biophysical techniques RPSBTK104** | ***Unit I*** | Microscopic techniques | 4 | 1 |
| | ***Unit II*** | Spectroscopy | | 1 |
| | ***Unit III*** | Chromatography | | 1 |
| | ***Unit IV*** | Histochemical and Immunotechniques | | 1 |
| | **PracticalRPSBTK101, PracticalRPSBTK102 PracticalRPSBTK103, PracticalRPSBTK104** Practical based on all the four papers | | 2 credits each | |
| **TOTAL CREDITS** | | | 24 | |

| | | | | |
|---|---|---|---|---|
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| **Semester II** | | | | |
| **Course code** | **Unit** | **Topic** | **Credits** | **Lectures/ week** |
| **Paper I : Metabolism RPSBTK201** | ***Unit I*** | Lipid metabolism | 4 | 1 |
| | ***Unit II*** | Physiological biochemistry | | 1 |
| | ***Unit III*** | Stress metabolism in plants | | 1 |
| | ***Unit IV*** | Plant and microbial metabolism | | 1 |
| **Paper II : Immunology RPSBTK202** | ***Unit I*** | Immunological diseases | 4 | 1 |
| | ***Unit II*** | Hypersensitivity and Transplantation | | 1 |
| | ***Unit III*** | CMI and imaging | | 1 |
| | ***Unit IV*** | Psychoneuroimmunology | | 1 |
| **Paper III :Bioprocess technology RPSBTK203** | ***Unit I*** | Aeration and agitation in bioprocess | 4 | 1 |
| | ***Unit II*** | Food Rheology | | 1 |
| | ***Unit III*** | Applications of microbes and enzymes in food process operations and production | | 1 |
| | ***Unit IV*** | Enzymology | | 1 |
| **Paper IV RPSBTK204 Bioinformatics, Phylogenetics, Vitamin** | ***Unit I*** | Introduction to bioinformatics | 4 | 1 |
| | ***Unit II*** | Data analysis using microarray and other databases | | 1 |
| | ***Unit III*** | Phylogenetics | | 1 |
| | ***Unit IV*** | Vitamins | | 1 |
| **Practical** | Practical based on all the four papers **PracticalRPSBTK101, PracticalRPSBTK102 PracticalRPSBTK103, PracticalRPSBTK104** | | 2 credits each | |
| **TOTAL CREDITS** | | | | 24 |

**MSc PART I (BIOTECHNOLOGY)**
**SEMESTER I**

**Paper I: Biochemistry**

Course objectives:

- To study structural and functional details of carbohydrates and their analytical methods
- Physiological significance of peptides, co-factors, lipid molecules along with their structure and function
- To introduce inborn metabolic errors and those which occurs due to nutrition deficiencies
- To introduce and Understand the concept of neuro-immunology

Learning outcomes: After completion of this course, the student must be able to:

1. Elucidate the concept of different types of complicated carbohydrate molecules and their structures
2. Comment on analytical methods for detection of carbohydrates
3. Understand physiological significance of important co factors and molecules like lipids, peptides, endorphins, prostaglandins vitamins and co enzymes
4. Discuss different types of inborn errors related to metabolism, glycogen storage, amino acid metabolism, nucleic acid metabolism
5. Understand the concept of Neurobiology and establish a basic link to the immune system.

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| **RPSBTK 101** | **UNIT I** ***Biochemistry of mucopolysaccharide and nucleic acid*** | Glycosaminoglycans- Heparin, Chondroitin-sulphate, Dermatan-sulphate, Keratan-Sulphate. Analytical methods for carbohydrate analysis. Formation, structure and functions of Eicosanoid: Prostaglandins and Thromboxanes, Glycoprotein's (N6, O6, GPI6 linked and proteoglycans), Glycolipids and Lectins, Biosynthesis and degradation of purines and pyrimidines with regulation. | 4 | **15** |
| | **II** ***Protein Biochemistry*** | Primary structure of proteins and their determination- end group analysis, cleavage of disulphide bond, characterization of polypeptide cha, aminoacid composition determination, specific peptide cleavage reaction, separation and purification of peptides, sequence determination, peptide mapping, Super secondary structures. Secondary structure peptide group, Ramchandranplot,helical structure, beta structure, fibrous and globular structure, protein stability, electrostatic forces, hydrogen bond, hydrophobic interaction, disulphide bond, protein denaturation, stability of thermostable proteins. Quaternary structure- subunit interaction, symmetry, subunit composition determination. | | **15** |
| | **III** | PEM (Kwashiorkor and Marasmus). | | **15** |

| | | | | |
|---|---|---|---|---|
| | ***Inborn errors of metabolism and nutritional disorders*** | Diabetes: Type I, Type II, gestational. Glycogen storage disorders - von Gierke's disease, Cori's disease, Andersen's disease, McArdle's disease. Amino acid metabolism- PKU, Alkaptonuria. Lipids- Tay-Sachs, Gaucher'sdisease.Nucleic acids-Gout,Lesch-Nyhansyndrome.Role of B groupVitamins in metabolic pathways | | |
| | **IV** ***Neurobiology and Neurochemistry*** | Structure and functions of neuron, types and physiologic anatomy of the Synapse, transmission of nerve impulses, ion channels, Neurotransmitters and neuropeptides, Electrical events during neuronal excitation and inhibition. Neurotoxins. Neurochemistry: Special senses-taste, vision, odor, hearing. Factors which enhances epinephrine inhibitors, Synapses, Addictions. Examples of each of the above mentioned factors. Introduction to psychoneurotic and neuropsychiatric drugs. | | **15** |

**References**:


1. Guyton, Text book of Medical Physiology, SaundersPublishers, 12th edition, 2010

2. Textbook of Biochemistry with Clinical Correlations, 7th Edition, Thomas M. Devlin, January 2010,

3. Proteins: biotechnology and biochemistry, 1stedition (2001), Gary Walsch, Wiley, USA

4. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.

5. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co.England.

6. Outlines of Biochemistry: 5th Edition, Erice Conn & PaulStumpf ; John Wiley and Sons, USA

7. Fundamentals of Biochemistry. 3rd Edition (2008), DonaldVoet& Judith Voet , John Wiley and Sons, Inc. USA

8. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and Company,NY.

9. Biochemistry: 7th Edition, (2012), Jeremy Berg, LubertStryer, W.H.Freeman and company,NY

**PAPER II: Immunology**

Course objectives:

- To study Advanced immunology with respect to signaling pathways
- To study Molecular immunology with respect to major and minor molecular structures
- To study the therapeutic and experimental approach to clinical immunology
- To study cancer immunology
- To introduce different types of Effector mechanisms in the immune system

Learning outcomes: After completion of this course, the student must be able to:

1. Elucidate the concept of antigen presentation and recognition patterns
2. Understand the complement and lectin pathways
3. Discuss various types of molecules involved in the immune system
4. Comment on role and function of Cytokines
5. Discuss methods and procedure of safe sterile Vaccine development
6. Understand basis of Cancer immunology
7. Elucidate the basis of the Mechanisms of immune response
8. Elucidate the concepts involved in various Innate immune responses.

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| | ***Unit I: Molecular immunology*** | Organization and expression of immunological genes (BCR and TCR genes). Antibody genes and antibody engineering. T cell and B cell activation. | | **15** |
| | ***UnitII: Cancer Immunology*** | Origin and terminology, malignant transformation of cell, oncogenes and cancer induction, tumors of the immune system, tumour antigens, immune response to tumor, tumor evasion of the immune system , cancer immunotherapy | | **15** |
| | ***Unit III: Clinical immunology*** | Cytokines: properties, receptor, antagonists, diseases, Therapeutic use of cytokines, Experimental immunology: Vaccine development (Recombinant, Combined and polyvalent vaccines), Cancer Immunology – Correlation with MABS, Chimeric humanized antibodies and Notations, Cytokine profiling of T –cells | | **15** |
| | **Unit IV: *Effector mechanisms*:** | Mucosal immunity, Peyer's patches, gut barriers, oral immunization, Oral tolerance, Cytotoxic response, Effector functions of B, T and NK cells. Immune response during bacterial, | | **15** |

| | | | | |
|---|---|---|---|---|
| | | parasitic, viral infection with one example of each | | |

**References:**


1. Immunology by Janis Kuby, W.H.Freeman& Co Ltd; 5th Revised edition.

2. Fundamental Immunology 6th edition (August 2003): by WilliamE., Md. Paul (Editor) By Lippincott Williams & Wilkins Publishers

3. Essential Immunology, Ivan M. Roitt (1994)– Blackwell ScientificPub, Oxford.

4. Cellular and Molecular Immunology, 3rd Ed, Abbas, Saunders; 7 edition (11 June 2011)

**PAPER III: Molecular biology**

Course objectives:

- To study details of the Chromatin structure
- To study Gene expression and events involved in it
- To understand Post transcriptional events and its functional significance
- To introduce RNA interference and epigenetics and their functional importance
- To introduce the concept of Genomics and proteomics

Learning outcomes: After completion of this course, the student must be able to:

1. Understand the details of chromatin structure and its functional implications
2. Understand the basis of gene expression and basic control processes involved in it
3. Comment on different post translational events and the underlying functional importance
4. Comment on protein folding and transport
5. Understand protein sorting
6. Define the terms genomics and proteomics
7. Understand epigenetic changes and RNA interferences
8. Comment on the underlying significance of these studies and their significance in bioinformatics.

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| **RPSBTK 103** | ***UnitI: Chromatin structure and gene expression*** | Transcription in prokaryotes and Eukaryotes, Structure of RNA polymerase (Channel in and Channel out). Types of RNA polymerases, Types of Promoters, initiation, elongation, termination and anti-termination. Initiation factor, role of transcription factors, Regulation of RNA polymerase Chromatin structure and transcription. Regulation of chromatin structure. Transcription in cell organelles (Mitochondria and chloroplast). | 4 | **15** |
| | ***UnitII: Post Transcriptional and translational events*** | RNA processing in eukaryotes: modifications, splicing and splicing machinery, processing of RNA. Editing and amplification Translationin Prokaryotes and Eukaryotes. mRNA localization and stability. Initiation, elongation, and termination, Modification folding and transport protein. Molecularchaperons in folding, Protein sorting and trafficking using signalproteins, Post transcriptional events and | | **15** |

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|---|---|---|---|---|
| | | translation. | | |
| | ***Unit III: RNA interferences and epigenetics*** | DNA rearrangement, RNAi, regulation of translation, RNA interference, Gene silencing, Epigenetic inheritance and Retrotransposons | | **15** |
| | **Unit IV: Omic studies** | Omes and Omics, concepts and applications, genome overview at the level of chromosomes (with model organisms as example), strategies for large scale DNA sequencing. EST and STS, Whole Genome Analysis techniques. Next generation sequencing methods, organization, structure, and mapping of genomes (with model organisms as example) Introduction to proteomics, transcriptomics, metabolomics. Whole exome analysis | | **15** |

**Reference:**


1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA

2. Molecular Biology of the Gene, 6th Edition (2008), James D.Watson, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA

3. Molecular Biology, 5th Edition (2011), Weaver R., McGrawHill Science. USA

4. Fundamentals of Molecular Biology, (2009), Pal J.K. andSaroj Ghaskadbi, Oxford University Press. India

5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp Jones & Bartlett Learning, USA

6. Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcoln Campbell, laurie J. Heyer Benjamin Cummings;
2nd edition

**PAPER IV: Biochemical and Biophysical techniques**

Course objectives:

- To Study different types of Microscopy techniques
- Emphasize on types and application of spectroscopic techniques
- Focus on varieties Chromatographic techniques
- To study advanced immuno- and Histochemical techniques

Learning outcomes: After completion of this course, the student must be able to:

1. Comment on advanced and state of the art techniques with various types of electron microscopy
2. Discuss on the variety of spectroscopic techniques with respect to molecular analysis
3. Discuss combination and detection methods with spectroscopy
4. Understand different aspects of immunological and histochemical techniques.

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| **RPSBTK104** | ***Unit I: Microscopic techniques*:** | Details of Scanning tunnelling microscopy and Scanning probe microscopy, atomic force microscopy, fluorescent microscopy, sample preparation and working for electron microscopy. | 4 | **15** |
| | ***Unit II: Spectroscopy*** | Introduction, principle and analysis using fluorescence spectroscopy, circular dichroism, ORD, NMR and ESR spectroscopy, Molecular structure determination Using X-ray diffraction,X –ray crystallography and NMR, Molecular Analysis using light scattering,mass spectrometry and LC-MS, GC-MS and surface plasma resonance methods,IR. | | **15** |
| | ***UnitIII: Chromatography*** | Introduction, principle and analysis using HPTLC, HPLC, GLC, Affinity chromatography and its types. Column details and theoretical plates, applications. IEF and 2D electrophoresis. Applications of the above techniques. | | **15** |
| | ***Unit IV: Histochemical and*** | Antibody generation, blotting techniques, Immuno - precipitation, Flow cytometry and | | **15** |

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|---|---|---|---|---|
| | ***Immunotechniques*** | immunofluorescence, detection of antigens in living cells, *in situ* localization by techniques such as FISH andGISH, Microarray | | |

**References:**


1. Principles and Techniques of Biochemistry and Molecular Biology,7th edition Wilson K.M., Walker J.M., Cambridge University Press, UK (2010),

2. Biochemical spectroscopy. Vol 46 of Methods in Enzymology. (1995) Kenneth Sauer. Academic Press, USA

3. Modern experimental biochemistry 3rd edition Publisher, USA.edition. (2000) Rodney Boyer. Prentice Hall

4. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck , Prentice Hall, UK.

## PRACTICALS - SEMESTER I

**Paper I BIOCHEMISTRY RPSBTKP101 2 Credits**

1. Preparation of buffers used in laboratory (Phosphate , Citrate , Acetate and Tris buffer)
2. Isolation of starch from potato and its estimation by Anthrone method.
3. Study of phosphorolysis of glycogen in the muscular tissue.
4. Glucose estimation by paper/chip – Microfluidics
5. Study of protein complexes using PAGE and detection by CBB and silver staining.
6. The isolation and assay of glycogen from liver and skeletal muscles of bird / mammal.
7. Estimation of Vitamin C from fruits.
8. Estimation of Creatinine in blood /urine. Estimation of urate/creatinine ratio to diagnose Lesch-Nyhan syndrome.
9. Chemistry of thinking:

a. Study of different regions of brain using models.

b. Stroop test and blind spot test.

c. Color blindness and optical illusions

10. Detection of LDH isozymes by electrophoresis.



**Paper II Immunology : RPSBTKP102 2 credits**

1. Antigen antibody reactions: VDRL
2. Immuno-diffusion and immune-electrophoresis
3. Perform Serum protein electrophoresis.
4. Perform DOT BLOT
5. Separation of T lymphocytes and B lymphocytes using nylon wool column
6. Sheep RBC rosetting

**Paper III Molecular Biology: RPSBTKP1032 credits**

1. Extraction of genomic DNA from bacteria and blood
2. Perform transformation of bacteria.
3. Expression of recombinant protein
4. Purification of DNA from agarose gel
5. Detection of changes in the conformation of BSA by viscosity measurement.
6. Demonstration of Conjugation
7. Induction of Galactosidase in *E. coli* (and effect of inducers).

**Paper IV Biochemical and Biophysical techniques:RPSBTKP104 2 credits**

1. Use of UV spectrophotometry to determine the concentration of protein
2. Demonstration and interpretation of NMR, HPLC, GC read- outs.
3. Separation of sugars in coconut water using TLC.
4. Determination of enzyme activity by Zymogram.
5. Affinity chromatography for purification of immunoglobulins.
6. Visit to a facility housing EM and other analytical tools.

## SEMESTER II

### PAPER I: *METABOLISM*

Course objectives:

- To understand the biosynthesis and regulation of fatty acid metabolism.
- To elaborate on the importance of acid-base balance and to renal clinical abnormalities associated with it.
- To study on various impacts of environmental stress on plant metabolism.
- To get a detailed view on photosynthetic carbon reactions and microbial metabolism.

Learning outcomes: After completion of this course, the student must be able to:

1. Comment on the biosynthesis of various types of fatty acids and its significance and regulation.
2. Explain the importance and levels of regulation of acid-base balance in body, their disorders and treatments
3. Comprehend the various stress experienced by plants and their consequences on growth and metabolism and role played by secondary metabolites.
4. Differentiate between the various carbon fixation cycles in plants and interaction of microbes with the environment.

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| **RPSBTK201** | **I** ***Lipid Metabolism*** | Lipid metabolism: Biosynthesis of fatty acids (saturated, monounsaturated, polyunsaturated), triglycerides and phospholipids.FAS Complex, regulation of fatty acid metabolism. Biosynthesis and regulation of cholesterol, prostaglandins, membrane lipids. | **4** | **15** |
| | **II** ***Physiological biochemistry*** | Regulation of acid-base balance, types and functions of acid-base buffers, respiratory mechanism of acid-base balance, renal control of acid base balance, clinical abnormalities associated with acid base imbalance. Water and electrolyte balance, clinical abnormalities. Kidney Diseases and diuretics: Acute renal failure, chronic renal failure, specific tubular disorders, treatment of renal failure. | | **15** |
| | **III** ***Stress Metabolism in plants*** | Environmental stresses, salinity, water, stress, heat, chiling, anaerobiosis and heavy metals and their impact on plant browth and metabolism, criteria of stress tolerance. Secondary metabolites in plants- Nature, distribution and their role in plant protection. Steroid biotransformation | | **15** |
| | **IV** ***Plant and microbial metabolism*** | Hatch slack pathway, Crassulacean acid metabolism, photorespiration and glyoxylate pathway with significance. Photosynthetic formation of hydrogen. Nitrogen fixation and | | **15** |

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|---|---|---|---|---|
| | | role of nitrogenase, anammox reactions. Plant symbiosis with fungi: Arbuscular, mycorrhiza, Ectomycorrhiza | | |

**References:**


1. Biochemistry, L Stryer, Freeman and Co, NY
2. Biochemistry, Zubay, Addison Wesley and Co.
3. Textbook of Physiology, Guyton
4. Principles of Biochemistry, Lehninger, 5th edition, Cox and Nelson, W.H.Freeman and Company,NY.
5. Physiology- Berne and Levy
6. Harper's Biochemistry- 27th edition
7. Text book of Human Biochemistry- Ed. G. P. Talwar
8. Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub, Madras
9. Human biochemistry – James Orten and Otto Neuhaus, 10th ed , CV Mosby co London
10. Human nutrition and dietetics-Davidson and Passmore
11. Plant physiology, Salisbury and Ross (2007) CBS publishers and distributors
12. Biochemistry and Physiology of Plant Hormones, Thomas Moore, Springer Verlag New York
13. Plant Biochemistry- Hans Walter Heldt, 3rd Edition, ElesvierAcademic Press
14. Introduction to Plant Biochemistry- T.W. Goodwin and E.L. Mercer
15. Plant Physiology- Devlin, CBS Publisher
16. Plant Biochemistry- Dey, Academic Press, 1999

**PAPER II: *IMMUNOLOGY***

Course objectives:

- To understand and differentiate between various immunological diseases and their implications
- To study various types of hypersensitivity reactions and the mechanism involved in them.
- To elaborate on different cell imaging techniques *in-vitro and in vivo*
- To study the role of psychology and neurology on immune system.

Learning outcomes: After completion of this course, the student must be able to:

1. Differentiate between different intricate aspects of various immunological diseases
2. Comment on various factors involved in hypersensitivity reactions and their emphasis on treatment.
3. Understand assays and techniques involved in *in-vitro and in vivo* imaging.
4. Comment on the immunological aspects emotions on human body.

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| **RPSBTK202** | **I** ***Immunological diseases*** | Autoimmunity mechanisms, Altered antigens, Systemic Lupus erythematosus, Graves diseases, Rheumatoid arthritis, Myasthenia Gravis, Multiple sclerosis, animal models of autoimmunity, GvH, Immunodeficiency (Primary &secondary): phagocytic, humoral, CMI, combined HLA association with disease. | **4** | **15** |
| | **II** ***Hypersensitivity and Transplantation*** | Types of hypersensitivity reactions, Mechanism, Factors involved and their treatment, Immunology of transplantation. | | **15** |
| | **III** ***CMI and imaging*** | Cell Cytotoxicity, mixed lymphocyte reaction, Apoptosis, Cell cloning, Reporter Assays,Peptibodies- production and application; Cell imaging Techniques- *In vitro*and *In vivo*; Immuno-electron microscopy; *In vivo* cell tracking techniques; Application based microarray, Phage display | | **15** |
| | **IV** ***Psychoneuro-immunology*** | Connections of CNS to immune system and *vice versa.* Psychological modulation of immunity, stress and immunity, implication for diseases, functional significance - inflammation and acute phase response, role of glucocorticoids, stress response, energy demand and balance, Introduction and History of Neuroendocrine circuitry, disorder of | | **15** |

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|---|---|---|---|---|
| | | Thoughts and volition – Schizophrenia, Addition of Action of Drug. | | |

**References:**


1. Immunology 5th edition Janis Kuby

2. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul (Editor) By Lippincott Williams & Wilkins Publishers

3. Essential Immunology, Ivan M. Roitt (1994)– Blackwell ScientificPub, Oxford.

4. Cellular and Molecular Immunology, 3rd edition, Abbas

5. Psychoneuroimmunology, Stress, and Infection, By HermanFriedman, Thomas W. Klein, Andrea L. Friedman, CRC Press, 1996

## PAPER III: *BIOPROCESS TECHNOLOGY*

Course objectives:

- To focus on the effect of bioprocess parameters on fermentation process.
- To understand the rheological properties of food.
- To elaborate on the role of enzymes and microbes in food processing and production.
- To study the basic concepts and detailed kinetics of enzyme biochemistry.

Learning outcomes: After completion of this course, the student must be able to:

1. Comment on the affect of process parameters on fermentation and their measurement and control.
2. Differentiate between the rheological properties of various food textures.
3. Comprehend on enzyme functions and reactions in food process.
4. Understand of mechanism of enzyme reactions in detail and the role of inhibitors on them.

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| **RPSBTK203** | **I** ***Aeration and agitation in bioprocess*** | Large scale animal and plant cell cultivation; Aeration and agitation in bioprocess; KLa, Measurement and control of bioprocess parameters. | **4** | **15** |
| | **II** ***Food Rheology*** | Introduction to Food Rheology, Food rheology vs Food texture, Rheology of food dispersion, Food polymers and gels, foams and dough rheology, processing and food rheology, test and application of food rheology. | | **15** |
| | **III** ***Applications of microbes and enzymes in food processing*** | Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup; Interesterified fat; Hydrolyzed protein and their downstream processing; baking by amylases, deoxygenation and desugaring by glucoses oxidase.<br>Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods.<br>Microbes and their use in pickling, producing colours and flavours.<br>Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products;<br>Bacteriocins from lactic acid bacteria - Production and applications in food preservation | | **15** |
| | **IV** ***Enzymology*** | Enzyme – Concept and kinetics, active site formation and its significance, | | **15** |

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|---|---|---|---|---|
| | | Michaelis-Menton equation – Derivation and transformation,<br>Enzyme inhibition and types of inhibitors, control of enzyme activity, allosteric regulations, parameters affecting enzyme activity.<br>Types of enzymes: isoenzymes, ribozymes, abzymes, substrate specificity and coenzymes | | |

**References:**


1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.

2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.

3. Stanbury RF and Whitaker A., Principles of FermentationTechnology, Pergamon press, Oxford, 1997.

4. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.

5. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo,1973.

6. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Young M.M., Reed Elsevier India Private Ltd, India, 2004.

7. El-Mansi, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007.

8. Biochemistry, L Stryer, Freeman and Co, NY

9. Principles of biochemistry , Lehninger, 5th edition, Cox and Nelson, W.H.Freeman company.

**PAPER IV: *BIOINFORMATICS, PHYLOGENETICS AND VITAMINS***

Course Objectives:

- To impart basic knowledge of bioinformatics
- To introduce different websites related to bioinformatics sources and databases
- To introduce the applications of the enormously growing database regulation

Course Outcomes:

- Student would have learnt about Sequencing Alignment and Dynamic Programming
- Sequence Databases
- Evolutionary Trees and Phylogeny

| Course Code | UNIT | TOPICS | Credits | Lectures |
|---|---|---|---|---|
| **RPSBTK 204** | **I** ***Introduction to Bioinformatics – Sequence Analysis*** | Database search using ENTREZ ( G Query) , Hidden Marker Model, Equation (Ex :Gene finding/ exon-intron finding, Signal peptide finding), Motif finding using HMM, ANN (Ex:Prosite) Sequence alignment, MSA- algorithm under Clustal W ,Protein sequence analysis,Protein structure analysis, Secondary, (Chou Fasman algorithm, GOR algorithm, Tertiary (Homology modelling, Threading, Ab initio, Structure prediction) | **4** | **15** |
| | **II** ***Applications of Bioinformatics*** | Microarray data analysis,Printing techniques,Features of microarray,Flag features of microarray,Data normalization in microarray,Human genome project and specialised databases under NCBI (Eg OMIM, chromosome, PubMed),Proteomics, Consesnsus sequence, PSSM,Sequence logo. | | **15** |
| | **III** ***Phylogenetics*** | Darwinism and neo Darwinism theories of evolution. Population genetics and different forces acting on it. Bioinformatics tools for phylogenetic analysis. | | **15** |
| | **IV** ***Vitamin*** | National Institutes of Health Office of Dietary Supplements (ODS) for sources, activity of vitamins, deficiency disorders, overconsumption effects of Vitamins: Water soluble- B1, 2,3,5,6,7,12 Fat soluble- A, D, E, K | | **15** |

**References:**

1. Bioinformatics – A practical guide to the analysis of genes and proteins by A.D. Baxvanis

2. Bioinformatics by N. Gautam (2006)

3. Bioinformatics : Sequence and Genome Analysis (Second Edition 2004), David W. Mount , (Coldspring Harbor Laboratory Press)

4. Bioinformatics and Functional Genomics (2003 ), Jonathan Pevsner, John Wiley and sons.

5. iGenetics by Peter J.Russel, 3rd Edition, Pearson Publications
6. Handbook of Vitamins: https://ods.od.nih.gov/factsheets/list-VitaminsMinerals/

# PRACTICALS

## SEMESTER II

**PAPER I: *METABOLISM:* RPSBTKP201** **(2 Credits)**

1. Estimation of Niacin by the CNBr method.
2. Isolation of cholesterol and lecithin from egg yolks.
3. Detection of Flavonoids in Plants.
4. Estimation of leghaemoglobin.
5. Proline estimation in germinated seeds with and without stress
6. Estimation of phospholipids.
7. Assay of superoxide dismutase in salt stressed and normal plant.
8. Estimation of $Ca^{++}$ / $Zn^{++}$ by EDTA titrimetric method.

**PAPER II: *IMMUNOLOGY*: RPSBTKP202** **(2 Credits)**

1. *In-vitro* demonstration of phagocytosis and calculatingphagocytic index.
2. Latex bead agglutination / precipitation test for detection of rheumatoid factor (RF).
3. Assay for plaque forming cells. (Video DEMO)

a. Raising antibodies in laboratory animals (Video DEMO)

b. Cell-imaging Techniques *In vitro* and *In vivo ;* Immuno-electron microscopy; *In vivo* cell tracking techniques; Microarrays.

4. Demonstration of radioimmunoassay.

**PAPER III: *BIOPROCESS TECHNOLOGY:* RPSBTKP203** **(2 Credits)**

1. Demonstration of Plackett-Burman design for formulation of Fermentation media.
2. Pigment production and isolation from a microbial source (yeast, Fungi or bacteria)

3. Physico-chemical characterization of an industrial effluents.

4. Detection of different food enzymes by simple tests (amylase, catalase,invertase,papain,pectinase,pepsin).

5. Study of pickling process (sauerkraut / pickled cucumbers) with respect to physical, chemical / biochemical and biological changes occurring during the pickling process.

**PAPER IV:*BIOINFORMATICS, PHYLOGENETICS AND VITAMINS***
**: RPSBTKP104** **(2 Credits)**

1. Classification of biological databases specially cover NCBI and INSDC

2. Phylogenetic tree using Bootstrap

3. BLAST – orthologs, paralogs and homologs

4. Motif finding

5. KEGG

6. Structure of proteins – identification of chains helices, special groups, metal ions etc. CATH/SCOP classification of a given protein

7. Homology modelling

## MODALITY OF ASSESSMENT

**Theory Examination Pattern:**

**A) Internal Assessment - 40% :40 marks.**

| Sr No | Evaluation type | Marks |
|---|---|---|
| 1 | One Assignment/Case study/Project based / written assignment/ Presentations | 20 |
| 2 | One Class Test (multiple choice questions/objectives/ match the column) | 20 |

**B) External examination - 60 %**

**Semester End Theory Assessment - 60 marks**

i. Duration - These examinations shall be of **2.5 hours** duration.

ii. Paper Pattern:

1. There shall be **4** questions each of **15** marks. On each unit there will be one question.
2. All questions shall be compulsory with internal choice within the questions.

| Questions | Options | Marks | Questions on |
|---|---|---|---|
| *Q.1)A)* | *Any 1 out of 2* | *8* | *Unit I* |
| *Q.1)B)* | *Compulsory* | *7* | |
| *Q.2)A)* | *Compulsory* | *8* | *Unit II* |
| *Q.2)B)* | *Any 1 out of 2* | *7* | |
| *Q.3)A)* | *Any 1 out of 2* | *8* | *Unit III* |
| *Q.3)B)* | *Compulsory* | *7* | |
| *Q.4)A)* | *Compulsory* | *8* | *Unit IV* |
| *Q.4)B)* | *Any 1 out of 2* | *7* | |

**Practical Examination Pattern: External (Semester end practical examination):**

| Particulars | Practical(Sem I) | Practical (Sem II) |
|---|---|---|
| *Laboratory work* | *40* | *40* |
| *Viva* | *5* | *5* |
| *Journal* | *5* | *5* |
| **Total** | **50** | **50** |

## PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examination.**

**Overall Examination and Marks DistributionPattern**

**Semester I and II**

| **Course** | ***RPSBTK 101/102/ 103/ 104*** | | | ***RPSBTK201/ 202 / 203/ 204*** | | | **Grand Total** |
|---|---|---|---|---|---|---|---|
| | **Internal** | **External** | **Total** | **Internal** | **External** | **Total** | |
| **Theory** | **40** | **60** | **100** | **40** | **60** | **100** | **800** |
| **Practicals** | | **50** | **50** | | **50** | **50** | **400** |