AC/II(23-24).2.RPS3

# S. P. Mandali's

# Ramnarain Ruia Autonomous College

*(Affiliated to University of Mumbai)*

## Syllabus for Program: M.Sc. Biotechnology

## Program: MSc I

## Program Code: (RPSBTK)

(As per the guidelines of NEP2020-Academic year 2024-25)

# GRADUATE ATTRIBUTES

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

| GA | GA Description<br><br>**A student completing Master's Degree in Science program will be able to:** |
|---|---|
| **GA1** | Demonstrate in depth understanding in the relevant science discipline. Recall, explain, extrapolate and organize conceptual scientific knowledge for execution and application<br>and also to evaluate its relevance. |
| **GA 2** | Critically evaluate, analyze and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary. |
| **GA 3** | Access, evaluate, understand and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation. |
| **GA 4** | Articulate scientific ideas, put forth a hypothesis ,design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language. |
| **GA 5** | Demonstrate initiative, competence and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups. |
| **GA 6** | Use an objective, unbiased and non-manipulative approach in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance. |
| **GA 7** | Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills and lead a team for planning and execution of a task. |
| **GA 8** | Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements. |

# PROGRAM OUTCOMES

| PO | Description<br><br>**A student completing Master's Degree in Science program in the subject of Biotechnology will be able to:** |
|---|---|
| **PO 1** | Perceive the fundamental and advanced concepts in depth in the areas of biochemistry, molecular biology, immunology, medical microbiology and applying the conceptual knowledge to address the real time problems and exploring plausible solutions. |
| **PO 2** | Annotate the vast amount of biological data by retrieving, processing and analyzing through various tools of bioinformatics and biostatistics. |
| **PO 3** | Criticize and assess the phases encountered from laboratory to premarketing stages in clinical research along with reviewing case studies. |
| **PO 4** | Identify local and global environmental issues and establish scientific strategies to devise economical solutions converging towards sustainable development |
| **PO 5** | Comprehend the process of patent documentation .Employ the relevance of legal and ethical implications in intellectual property rights, GMO ,developmental biology and other fields of biotechnology. |
| **PO 6** | Outline, execute ,Analyze experimental procedures and research proposal thus ameliorate their scientific writing temperament and soft skills consequently refining their abilities to troubleshoot any research problems. |
| **PO 7** | Deduce the underlying principle of Nano technological and biotechnological processes and develop the skills to offer contemporary solutions. |

# Credit Structure for M.Sc Biotechnology

| Semester | Mandatory | Elective | RM | OJT/FP | RP/ Internship | Credits |
|---|---|---|---|---|---|---|
| 1 | 14 | 4 | 4 | 0 | 0 | 22 |
| 2 | 14 | 4 | 0 | 4 FP | 0 | 22 |
| 3 | 12 | 4 | 0 | 0 | 6 RP | 22 |
| 4 | 8 | 4 | 0 | | 10 OJT | 22 |
| **Total CREDITS** | **48** | **16** | **4** | **4** | **16** | **88** |

# PROGRAM OUTLINE

| YEAR | SEM | COURSE CODE | Type of Course | COURSE TITLE | CREDITS |
|---|---|---|---|---|---|
| M.Sc. I | I | RPSBTK.O501 | Discipline Specific Core I | Biochemistry | 3 |
| | | RPSBTKP.O501 | Practical DSC I | Practicals based on RPSBTK.O501 | 1 |
| | | RPSBTK.O502 | Discipline Specific Core II | Immunology-I | 3 |
| | | RPSBTKP.O502 | Practical DSC II | Practicals based on RPSBTK.O502 | 1 |
| | | RPSBTK.O503 | Discipline Specific Core III | Molecular Biology | 3 |
| | | RPSBTKP.O503 | Practical DSC III | Practicals based on RPSBTK.O503 | 1 |
| | | RPSBTK.O504 | Discipline Specific Core IV | Intellectual Property Rights | 2 |
| | | RPSBTKRM.O505 | RM | Research Methodology | 4 |
| | | **Student should select anyone of the following Course** | | | |
| | | RPSBTK.O506 | Discipline Specific Elective | Clinical Data Management | 3 |
| | | RPSMIC.O506 | Discipline Specific Elective | Clinical Microbiology Epidemiology | 3 |
| | | RPSBCH.O506 | Discipline Specific Elective | Plant Biochemistry | 3 |
| | | RPSBTKP.0506 / RPSMICP.O506 / RPSBCHP.O50 | Practical on DSE | Practicals based on RPSBTK.O506/ RPSMIC.O506/ RPSBCH.O506 | 1 |

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| . | II | RPSBTK.E511 | Discipline Specific Core I | Metabolism | 3 |
| | | RPSBTKP.E511 | Practical DSC I | Practicals based on RPSBTK.E511 | 1 |
| | | RPSBTK.E512 | Discipline Specific Core II | Immunology- II | 3 |
| | | RPSBTKP.E512 | Practical DSC II | Practicals based on RPSBTK.E512 | 1 |
| | | RPSBTK.E513 | Discipline Specific Core III | Bioinstrumentation | 3 |
| | | RPSBTKP.E513 | Practical DSC III | Practicals based on RPSBTK.E513 | 1 |
| | | RPSBTK.E514 | Discipline Specific Core IV | Developmental Biology | 2 |
| | | RPSBTK.E515 | On Job Training/Field Project | Feld project | 4 |
| | | **Student should select anyone of the following Course** | | | |
| | | RPSBTK.E516 | Discipline Specific Elective | Nanotechnology | 3 |
| | | RPSMIC.E516 | Discipline Specific Elective | Microbial Approaches to Quality Management | 3 |
| | | RPSBCH.E516 | Discipline Specific Elective | Nutraceuticals and Functional Foods | 3 |

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|---|---|---|---|---|---|
| | | RPSBTKP.E516 / RPSMICP.E516 / RPSBCHP.E516 | Practical on DSE | Practicals based on RPSBTK.E516/ RPSMIC.E516/ RPSBCH.E516 | 1 |

## Course Code (DSC I-): RPSBTK.O501

## Course Title:BIOCHEMISTRY

## Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br><br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Elucidate the concept of different types of heteropolysaccahrides ,their structure and analytical methods for detection |
| **CO 2** | Explain the processes of purine and pyrimidine synthesis and their degradation |
| **CO 3** | Discuss different types of disorders related to metabolism -glycogen storage, amino acid metabolism, nucleic acid metabolism. |
| **CO 4** | Categorize proteins into different types based on their structure and give their significance |
| **C05** | Assess the molecular characterization of protein using multiple technique |
| **CO 6** | Enumerate the concept of Neurobiology and establish a basic link to the immune system. |
| **CO 7** | Perform isolation and quantitative estimation of biomolecules from different biological samples. |



# DETAILED SYLLABUS THEORY

| Course Code | Unit | Course/ Unit Title | Credit/Hours 3/45 |
|---|---|---|---|

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|---|---|---|---|
| **RPSBTK.O501** | **Unit I** | **Biochemistry of mucopolysaccharide and nucleic acid**<br>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. PEM (Kwashiorkor and Marasmus). | **15** |

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|---|---|---|---|
| | | Diabetes: Type I, Type II, gestational. Glycogen storage disorders -von Gierke's disease, Cori'sdisease, Andersen's disease, McArdle's disease | |
| | **Unit II** | **Protein Biochemistry**<br>Determination- end group analysis, cleavage of disulphide bond, characterization of polypeptide cha, amino acid composition determination, specific peptide cleavage reaction, separation and purification of peptides, sequence determination, peptide mapping, Super secondary structures., Ramchandran plot, 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,<br>symmetry, subunit composition<br>determination. Amino Acid metabolism-<br>PKU, Alkaptonuria.Lipids-<br>Tay-Sachs, Gaucher's<br>disease<br>Nucleic acids-Gout, Lesch Nyhan syndrome. Role of B<br>group Vitamin in metabolic<br>Pathways | **15** |
| | **Unit III** | **Neurobiology and Neurochemistry**<br>Basics of neuronal synapse and<br>excitation events.<br>Neurochemistry: Special senses- taste, vision, odor, hearing.<br>,<br>PNI : Connections of CNS to the 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 to psychoneurotic drugs, Addiction. | **15** |

| **Course Code** | **Practicals based on RPSBTK.O501** | **Credit/Hours 1/30** |
|---|---|---|

| | | |
|---|---|---|
| **RPSBTKP.O501** | 1. Preparation of buffers used in laboratory (Phosphate , Citrate , Acetate and Trisbuffer)<br>2. Isolation of starch from potato and its estimation by Anthrone method.<br>2. Study of phosphorolysis of glycogen in the Muscular tissue.<br>4. Glucose estimation by paper/chip –Microfluidics<br>5. Study of protein complexes using PAGE and detection by CBB and silver staining.<br>6. The isolation and assay of glycogen from liver and skeletal muscles of bird /mammal.<br>7. Estimation of Vitamin C from fruits.<br>8. Estimation of Creatinine in blood /urine. Estimation of urate /creatinine ratio to diagnose Lesch-Nyhan syndrome<br>9. Chemistry of thinking:<br>a. Study of different regions of brain using models.<br>b. Stroop test and blind spot test.<br>c. Color blindness and optical illusions<br>10.Detection of LDH isozymes by electrophoresis. 11.Electrophoretic analysis of haemoglobin | **30** |

## References:


1. Guyton, Text book of Medical Physiology, Saunders Publishers, 12th edition,2010
2. Textbook of Biochemistry with Clinical Correlations, 7thEdition, Thomas M.Devlin, January2010,
3. Proteins: biotechnology and biochemistry,1st edition(2001),Gary Walsch, Wiley, USA
4. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, NewYork.
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), Donald Voet& Judith Voet , John Wiley and Sons, Inc.USA
8. Lehninger,Principles of Biochemistry.5thEdition(2008),David Nelson &Michael Cox, W.H. Freeman and Company

## Course Code (DSC II-): RPSBTK.0502
## Course Title: Immunology-I
## Academic year 2023-24

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Describe the organization and expression of immunological genes. |
| **CO 2** | Elucidate the B-cell and T-cell signalling pathways. |
| **CO 3** | Analyze the function the of effector T-cell and B-cell along with mechanism of immune responses in mucosal surfaces. |
| **CO 4** | Justify changes in immune mechanism during tumor development. |
| **CO 5** | Comment on role and function of Cytokines, types of cytokine receptors and cytokine profiling |
| **CO 6** | Demonstrate the key process and mediators in inflammation. |
| **CO 7** | Develop suitable immunotechniques for detection of different antigens of interest. |

# DETAILED SYLLABUS THEORY

| Course Code | Unit | Course/ Unit Title | Credit/Hours 3/45 |
|---|---|---|---|
| **RPSBTK.O502** | **I** | **Molecular immunology**<br>Organization and expression of immunological genes (BCR and TCR genes). Antibody genes and antibody engineering. T cell and B cell activation<br>. 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, parasitic, viral<br>infection with one example of each. | **15** |
| | **II** | **Cancer Immunology**<br>Origin and terminology, malignant | **15** |

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|---|---|---|---|
| | | transformation of cell, oncogenes and cancer<br>induction, tumors of the immune system, tumor antigens, immune response to tumor, Cancer Immunology – Correlation with MABS, Chimeric humanized antibodies and Notations, Cytokine profiling of T – Cells | |
| | **III** | **Clinical immunology**<br>Cytokines: properties, receptor, antagonists, diseases, Therapeutic use of cytokines, Experimental immunology:<br>Inflammation Key mediators of inflammation inflammation process,anti inflammatory drugs. | **15** |

| Course Code | Practicals based on RPSBTKP.0502 | Credit/Hours 1/30 |
|---|---|---|
| **RPSBTKP.0502** | 1. Antigen antibody reactions: VDRL<br>2. Immuno-diffusion and immune-electrophoresis<br>3. Perform Serum protein electrophoresis.<br>4. Perform DOTBLOT<br>5. Separation of T lymphocytes and B lymphocytes using nylon wool column<br>6. Cuturing of mononuclear lymphocytes<br>7. Ficoll hypaque separation<br>8. Sheep RBC rosetting | **30** |

## References:


1. Immunology by Janis Kuby, W.H. Freeman& Co Ltd; 5thRevisededition.
2. Fundamental Immunology 6th edition (August 2003): by William E., Md.Paul (Editor) By Lippincott Williams & Wilkins Publishers
3. Essential Immunology, Ivan M. Roitt (1994)– Blackwell Scientific Pub,Oxford.
4. Cellular and Molecular Immunology, 3rd Ed, Abbas, Saunders; 7 edition (

## Course Code (DSC I-): RPSBTK.O503

## Course TitleMolecular Biology

## Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Assess the details of chromatin structure and its functional implications. |
| **CO 2** | Elucidate the basis of gene expression and regulation involved in prokaryotes and eukaryotes |
| **CO 3** | Describe the changes in RNA during post transcriptional processing in eukaryotes. |
| **CO 4** | Elaborate on different post translational events , the underlying functional importance along with concepts of protein folding ,transport and protein sorting. |
| **CO5** | Illustrate principles and steps involved in advanced methods of sequencing as an important aid to the field of genomics. |
| **CO 6** | Analyze the concepts and mechanism of RNA interference. |
| **CO 7** | Perform traditional and advanced molecular biology techniques for used in genomics |

# DETAILED SYLLABUS THEORY

| Course Code | Unit | Course/ Unit Title | Credit/Hours 3/45 |
|---|---|---|---|
| **RPSBTK. O503** | **I** | **Chromatin structure and gene Expression**<br>Chromatin structure and transcription. Regulation of chromatin structure , Transcription in prokaryotes and | **15** |

| | | | |
|---|---|---|---|
| | | 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. Transcription in cell organelles (Mitochondria and chloroplast). RNA processing in eukaryotes: modifications, splicing and splicing machinery, processing of RNA. Editing and amplification Transcriptomics. | |
| | **II** | **Post transcriptional events :** Translation: in Prokaryotes and Eukaryotes. Initiation, elongation, and termination ,mRNA localization and stability. Modification folding and transport protein. Molecular chaperons in folding, Protein sorting and trafficking using signal proteins, ,RNAi, regulation of translation, Introduction to proteomics. | **15** |
| | **III** | **Genomics** 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, Whole exome analysis, Epigenetic inheritance and Retrotransposons | **15** |

| **Course Code** | **Practicals based on RPSBTK.O503** | **Credit/Hours 1/30** |
|---|---|---|

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|---|---|---|
| **RPSBTK.O503** | 1. Extraction of genomic DNA from bacteria and blood<br>2. Detection of genomic DNA using electrophoresis<br>3. Purification of DNA from agarose gel.<br>4. Preparation of competent cells<br>5. Perform transformation of bacteria.<br>6. Expression of recombinant GST protein.<br>7. Detection of changes in the conformation of BSA by Viscosity measurement.<br>8. Demonstration of Conjugation.<br>9. Induction of Galactosidase in *E. coli* (and effect ofinducers).<br>10. RNA extraction and detection with AGE and quantification with U.V spectrophotometer | **30** |

## References:


1. GenesXI,11the edition(2012) BenjaminLewin, Publisher-JonesandBarlettInc. 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),PalJ.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. Malcol Campbell, laurie J. Heyer Benjamin Cummings;2nd edit

## Course Code (DSC IV-): RPSBTK.O504

## Course Title: Intellectual

## Property Rights Academic year

## 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br><br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Demonstrate the role of TRIPS agreement ,copyright acts and trademark rights. |
| **CO 2** | Summarize different doctrine rules regarding intellectual property rights. |
| **CO 3** | Elucidate the legislative structure and remedies of IP protection laws. |
| **CO 4** | Distinguish between copyright, Trademark, GI and Industrial designs. |
| **CO 5** | Elaborate on the rules and regulations for patenting. |
| **CO 6** | Interpret the patent case studies of biotechnology inventions |
| **CO 7** | Discuss the roles and responsibilities of the patent officer and the institution. |

# DETAILED SYLLABUS THEORY

| Course Code | Unit | Course/ Unit Title | Credit/Hours 2/30 |
|---|---|---|---|
| RPSBTK.O504 | I | **Intellectual Property Rights: International agreements and Indian legislature**<br>Introduction to IPR;<br>Globalization ; development of GATT, WTO, TRIPS agreement;<br>Important provisions under TRIPS (Article/s 3, 4, 31/31f) agreement;<br>Important provisions/ considerations under Geographical indications act, UPOV and PVPFRA<br>Indian Copyrights act (including sec 13, 14, 17, 18,<br>19, 33, 14/57)<br>Creative commons,<br>Indian Trademarks act (including trademark classification),<br>Madrid system for Trademarks,<br>Traditional knowledge and Bio-piracy, TKDL;<br>Differences among copyright, Trademark, GI and Industrial designs; Important doctrines (spring-board doctrine, doctrine of first-sale, idea-expression dichotomy,<br>IP transfer, IP Protection in India: Legislative structure and remedies (Infringement v/s passing<br>Off<br>remedies)<br>Civil<br>remedies:<br>1. Injunction: Permanent, Interlocutory/ temporary,<br>Mareva injunction<br>2. Anton-Pillar order<br>3. John Doe order<br>4. Damages &/or accounts of profit Criminal:<br>1. Imprisonment | 15 |

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|---|---|---|---|
| | | 2. Fine<br>3. Both<br>Custom remedies and de minimis principle | |

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|---|---|---|---|
| | II | **Indian Patents act, 1970**<br>Indian patents act, 1970 and rights of patentee (section 48),<br>Principles of patent protection (sec 83); Patenting biotech inventions:<br>objectives, concept of novelty, concept of inventive step, non-patentable objects (sec 3/4),<br>moral issues in patenting biotech inventions;<br>Important case laws under Biotechnology<br>a) Harvard onco-mouse case,<br>b) Diamond vs Chakrabarty case,<br>c) Turmeric case,<br>d) Hoodia cactus case.<br><br>Budapest treaty and protection of micro-organisms, Patent databases and patent search. International patent classification (https://www.wipo.int/classifications/ipc/en/)<br>Types of patents (Ordinary, Conventional, PCT, Patent of addition, Divisional patent, etc.), patent filing timeline<br>Parts of a patent application, Patent claims (types and embodiment),<br>Patent infringement based on sec 48 Exhaustion doctrine and parallel import<br>Transfer of patent rights and Compulsory licensing Important case laws: Glivec case (section 3d), Natco v/s Bayer case | 15 |

**References:**


1. https://www.wipo.int/edocs/mdocs/africa/en/wipo_tiscs_znz_16/wipo_tis cs_znz_1 6_t_6.pdf
2. https://www.lexisnexisip.com/knowledge-center/totalpatent-one-and- the-usptos seven-step-patent-search-strhttps://www.wipo.int/edocs/mdocs/aspac/en/wipo_ip_phl_16/wipo_ip_phl_16_t5.pdfhttp://www.mondaq.com/india/x/667450/Patent/PatentAnd+Thei

**Course Code (RM): RPSBTKRM.0505**

**Course Title: Research Methodology Academic year 2024-25**

## COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| CO 1 | Illustrate the meaning and objectives of research methodology. |
| CO 2 | Identify the problems involved in research. |
| CO 3 | Explain the need and significance of research designs. |
| CO 4 | Determine the significance of data collection and its relationship with research interpretation. |
| | hypothesis |
| CO 5 | Analyse the process of scientific writing and organizing the data for writing scientific paper. |
| CO 6 | Investigate the different types of plagiarism with examples. |



# DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credit/Hours 4/60 |
|---|---|---|---|
| RPSBTKRM.0505 | I | **introduction to research methodology and research problems**<br>Meaning of Research; Objectives of Research; Motivation in Research; | 15 |

| | | | |
|---|---|---|---|
| | | Types of Research; Research Approaches; Significance of Research; Types of research methods Research methods verses methodology , Research and scientific method ,Research process ,Criteria of good research :<br><br>Selection of a research problem , Necessity of defining a research problem ,Technique involved in defining a research problem | |
| | **II** | **ResearchDesign & Data Collection**<br><br>Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs; Developing a Research Plan-<br>Collection of Primary Data; Observation Method; Interview Method;Collection of Data through Questionnaires; Collection of Data through Schedules; Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method | **15** |
| | **III** | **Interpretation and hypothesis**<br><br>Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different steps in report writing, Layout of research report, Types of report, Mechanics of writing a research report, Precaution for writing a research report.<br><br>Importance of hypothesis, a. Kinds of hypothesis, b. Characteristics of good hypothesis, Formulation of hypothesis | **15** |
| | **IV** | **Scientific Writing**<br><br>Process of Scientific Writing: Thinking, Planning, Rough Drafts and Revising Contents.<br>Introduction to Scientific Reports and Writings Compilation of Experimental Data, Communication Methods in Science, Examples of Scientific and Unscientific Writing. Writing Papers, Reviews,Bibliography Plagiarism--Introduction to Plagiarism, Examples of Plagiarism. Introduction to Reference Management<br>software (Mendley) & Grammarly software | **15** |

**References:**

1. Research methodology: Methods and techniques – C R Kothari
2. Research Methodology - T Bhaskara Rao
3. The Craft of Scientific writing – Michael Alley
4. The Scientist's guide to writing – Stephen Heard
5. Writing Science – Joshua Schime

**Course Code (DSE-): RPSBTK.O506**

**Course Title: Clinical Data Management**

**Academic year 2024-25**

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Describe general principles and steps involved in systemic toxicology studies. |
| **CO 2** | Outline different phases of clinical trials and their significance. |
| **CO 3** | Interpret local and international guidelines for good clinical practice. |
| **CO 4** | Analyze the roles and responsibilities of the investigator and the institution. |
| **CO 5** | Examine and solve regulatory issues related to clinical studies. |
| **CO 6** | Elucidate the principle and types of clinical study protocols. |
| **CO 7** | Design clinical study reports. |

# DETAILED SYLLABUS THEORY

| Course Code | Unit | Course/ Unit Title | Credit/Hours 3/45 |
|---|---|---|---|
| **RPSBTK.O506** | **I** | **Drug discovery and Preclinical toxicology** Pre-Clinical toxicology: General Principals, Systemic toxicology, (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity,Tera togenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements. | **15** |

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|---|---|---|---|
| | **II** | **Introduction to Clinical trials**<br>Introduction to clinical trials, Historical guidelines in clinical research (Nuremberg code, Declaration of Helsinki and Belmonte report), ICH-GCP guidelines (E6-R1), Phases of clinical trials. | **15** |
| | **III** | **Clinical study design**<br>Clinical study methodology and regulations: Principles, types (single blinding, double blinding, open access, randomized trials and their examples), Design of protocol, CRF, e-CRF, IB, ICF and preparation of trial reports, Regulations involved (ICMR guidelines) and ethics. principles and software's in CDM | **15** |

| **Course Code** | **Practicals based on RPSBTK.O506** | **Credit/Hours 1/30** |
|---|---|---|
| **RPSBTK.O506** | 1. Action query based on various scenarios: vendor data query, eCRF data query, date Mis-Match query in ERCF on AE form and study conclusion form.<br><br>2. Design and Raise a query as per given scenario: data missing query, out of sequence data on AE/ CONMED (Adverse Event/ concomitant medication log) form missing labs query on visits already performed etc.<br><br>3. Designing eCRF form based on given protocol (only particular sections of protocol will be given)<br><br>4. Designing of eCRF completion guidelines based on given protocol.<br><br>5. Perform Screening process of various drug molecules from plant, algal and marine sources before performing preclinical toxicity study.<br><br>6. Perform preclinical toxicity study on cell lines and microorganisms using drugs screened in exp no.5<br><br>7. Various ways to resolve vendor issues. | **30** |

**References:-**


1. EC R1 guidelines.
2. ICMR ethical guidelines.
3. D & C Rules – Schedule Y.
4. Law Of Intellectual Property Rights Shiv Sahai Singh Deep & Deep Publications (p) Ltd.
5. WTO And Intellectual Property Rights By Talwar Sabanna (2007) Serials Publications.
6 IPR: Unleashing the Knowledge Economy(2003) Prabuddha Ganguli Tata Mcgraw Hill publicatio

# Modality of Assessment-DSC

## RPSBTK.O501, RPSBTK.O502 ,

## RPSBTK.O503,RPSBTK.O506 (DSE)

**Theory Examination Pattern:**

**A) Internal Assessment- 40%- 30 Marks**

| Sr No | Evaluation type | Marks |
|---|---|---|
| 1 | Class Test | 20 |
| 2 | Presentation | 10 |
| | **TOTAL** | **30** |

**B) External Examination (Semester End)- 60%- 45 Marks Semester End Theory Examination:**

1. Duration – The duration for these examinations shall be of **two hours**.
2. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q1 | 7/8 marks questions with option to any one | 15 | UNIT I |
| Q2 | 7/8 marks questions with option to any one | 15 | UNIT II |
| Q3 | 7/8 marks questions with option to any one | 15 | UNIT III |

| | | | |
|---|---|---|---|
| | **TOTAL** | **45** | |

**Practical Examination Pattern:**

**External Examination (Semester End)- 50**
**Marks Semester End Theory Examination:**

1. Duration – The duration for these examinations shall be of **three hours**.
2. Theory question paper pattern:

**Paper Pattern:**

| **Question** | | **Marks** |
|---|---|---|
| 1 | Lab work | 40 |
| 2 | Journal | 05 |
| 3 | Viva | 05 |
| | **TOTAL** | **50** |

# Modality of Assessment-DSC-IV

# RPSBTK.O504

**Theory Examination Pattern:**

**External Examination (Semester End)-- 50 Marks**

**Semester End Theory Examination:**

1. Duration – The duration for these examinations shall be of **One Hour**.
2. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q1 | a) 1M questions (any 5 out of 8 questions) b) 5M questions ( any 3 out of 5 questions) | 20 | Unit I |
| Q2 | a) 1M questions (any 5 out of 8 questions) b) 5M questions ( any 3 out of 5 questions) | 20 | Unit II |
| Q3 | 5M questions Mixed Bag Question (any 2 out of 3 questions) | 10 | Unit I & II |
| | **TOTAL** | **50** | |

# Modality of Assessment-RM

# RPSBTKRM.0505

**Theory Examination Pattern:**

**C) Internal Assessment- 40%- 40 Marks**

| Sr No | Evaluation type | Marks |
|---|---|---|
| 1 | Class Test | 20 |
| 2 | Research Review/ Research Proposal Writing | 20 |
| | **TOTAL** | **40** |

**D) External Examination (Semester End)- 60%- 60 Marks**

**Semester End Theory Examination:**

3. Duration – The duration for these examinations shall be of **two Hours**.
4. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| 1 | 3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one | 15 | Unit I |
| 2 | 3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one | 15 | Unit II |
| 3 | 3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one | 15 | Unit III |
| 4 | 3 questions of 5 M each from 4 Questions OR 7/8 marks questions with option to any one | 15 | Unit IV |
| | **TOTAL** | **60** | |

## Course Code (DSC I): Metabolism

## Course Title: RPSBTK.E511

## Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Explain the biosynthetic pathways of different types of fatty acids and their regulation |
| **CO 2** | State the mechanism and control of acid- base balance , disorders associated with it and treatments |
| **CO 3** | Comprehend the different stress experienced by plants and their consequences on growth and metabolism. |
| **CO 4** | Interpret the role played by secondary metabolites in plant defense systems. |
| **CO 5** | Differentiate between the different carbon fixation cycles in plants and their regulation |
| **CO 6** | Elucidate the molecular structure and role of nitrogenase in the nitrogen cycle and significance of anammox reaction. |
| **CO 7** | Elaborate on molecular association of endomycorrhiza and plants and their significance in development of plant. |

# DETAILED SYLLABUS THEORY

| Course Code | Unit | Course/ Unit Title | Credit/Hours 3/45 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **RPSBTK.E511** | **Unit I** | **Lipid Metabolism**<br>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. metabolomics. | **15** |

| | | | |
|---|---|---|---|
| | **Unit II** | **Physiological biochemistry**<br>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** |
| | **Unit III** | **Plant and microbial metabolism**<br>Environmental stresses, salinity, water, stress, heat, chiling, anaerobiosis and heavy metals and their impact on plant growth Hatch slack pathway, Crassulacean acid metabolism, photorespiration and glyoxylate pathway with significance. Photosynthetic formation of hydrogen. Nitrogen fixation and role of nitrogenase, anammox reactions. Plant symbiosis with fungi: Arbuscular, mycorrhiza, Ectomycorrhiza | **15** |

| **Course Code** | **Practicals based on RPSBTK.E511** | **Credit/Hours 1/30** |
|---|---|---|
| **RPSBTK.E511** | 1. Isolation of cholesterol and lecithin from egg yolks<br>2. Detection of Flavonoids in Plants.<br>3. Estimation of leghemoglobin.<br>4. Proline estimation in germinated seeds with and withoutstress<br>5. Estimation of phospholipids.<br>6. Assay of superoxide dismutase in salt stressed and Normal plant.<br>7. Estimation of $Zn^{++}$ by EDTA titrimetric method<br>8. Estimation of $Ca^{++}$ by EDTA titrimetric method.<br>9. NPK Test | **30** |

## References:


1. Biochemistry, L Stryer, Freeman and Co,NY
2. Biochemistry, Zubay, Addison Wesley andCo.
3. Textbook of Physiology,Guyton

4. Principles of Biochemistry, Lehninger, 5thedition, Cox and Nelson, W.H.Freeman and Company,NY.
5. Physiology- Berne andLevy
6. Harper's Biochemistry- 27thedition
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 , CMosbyco London

**Course Code(DSC-II ): RPSBTK.E512**

**Course Title: Immunology**

**Academic year 2024-25**

## COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION<br><br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Describe organ specific and systemic autoimmune diseases and primary and secondary immunodeficiencies. |
| | Elaborate on different genetic and environmental factors responsible for autoimmune and immunodeficiency diseases. |
| **CO 2** | Differentiate between types of hypersensitivity reactions, mechanisms of hypersensitivity reactions and their possible treatment. |
| **CO 3** | Analyze in detail the immunological aspects involved during organ transplantation. |
| **CO 4** | Discuss the making and use of different types of non traditional vaccines |
| **CO 5** | Demonstrate the principle, techniques and applications involved in invitro and invivo imaging. |
| **CO 6** | Elucidate experimental assays for studying cytotoxicity and apoptosis. |
| **CO 7** | Illustrate the principles and application of blotting and insitu hybridization techniques |
| **CO 8** | Develop suitable immunotechniques for detection of different antigens of interest |

# DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credit/Hours |
|---|---|---|---|

| | | | 3/45 |
|---|---|---|---|
| **RPSBTK.E512** | **I** | **Autoimmunity and Immunodeficiency**<br>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. | **15** |
| | **II** | **Hypersensitivity and Transplantation**<br>Types of hypersensitivity reactions, Mechanism, Factors involved and their treatment, Immunology of transplantation. purified macromolecules as vaccine, Recombinant vector Vaccine, DNA Vaccines ,multivalent Subunit Vaccines | **15** |
| | **III** | **CMI and imaging**<br>Cell Cytotoxicity, mixed lymphocyte reaction, Apoptosis, 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 Antibody generation, blotting techniques, Immuno - precipitation, Flow cytometry, detection of antigens in living cells, *in situ* localization by techniques such as FISH and GISH | **15** |

**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 Scientific Pub,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

| Course Code | Practicals based on RPSBTK.E512 | Credit/Hours 1/30 |
|---|---|---|
| **RPSBTK.E512** | 1. *In-vitro* demonstration of phagocytosis | **30** |

| | | |
|---|---|---|
| | and calculating phagocytic index.<br>2. Latex bead agglutination / precipitation test for detection of rheumatoid factor (RF)<br>3. Allergen detection test.<br>4. Assay for plaque forming cells.<br>(Video DEMO)<br>5. Cell-imaging Techniques *In vitro* and *In vivo ;* Immuno-electron microscopy; *In vivo* cell tracking techniques; Microarrays.<br>6. Demonstration of radioimmunoassay<br>7. Western blotting<br>8. ELISA<br>9. HLA typing | |

**Course Code(DSC-III): RPSBTK.E513**

**Course Title:**

**Bioinstrumentation Academic**

**year 2024-25**

## COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Elaborate advanced and state of the art techniques with different types of electron microscopy and probe microscopy techniques |
| **CO 2** | Compare different types of PCR and their applications. |
| **CO 3** | Illustrate different types of advanced molecular cloning methodology |
| **CO 4** | Discuss on the principle and working of advanced spectroscopic techniques. |
| **CO 5** | Determine structural characterization using spectroscopy and spectrometry techniques |
| **CO 6** | Design different chromatographic techniques for separation and analysis of |
| **CO 7** | Perform molecular and analytical techniques for characterization of biomolecules |

# DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credit/Hours 3/45 |
|---|---|---|---|
| **RPSBTK.E513** | **I** | . **Advanced microscopic and PCR techniques** Details of Scanning tunnelling microscopy and Scanning probe microscopy, atomic force microscopy, fluorescent microscopy, sample preparation and working for electron microscopy. types of PCR: Multiplex PCR, Nested PCR, RT – PCR, Real time-PCR ,Gibson assembly, golden gate, CPEC, CRISPR CAS system | **15** |
| | **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 LCMS, GC-MS and surface plasma resonance methods ,IR. | **15** |
| | **III** | **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** |

| Course Code | Practicals based on RPSBTK.E513 | Credit/Hours 1/30 |
|---|---|---|

| | | |
|---|---|---|
| **RPSBTK.E513** | 1. Use of UV spectrophotometry to determine the concentration of protein<br>2. Separation of sugars in coconut water using TLC<br>3. Determination of enzyme activity by Zymogram.<br>4. Affinity chromatography for purification of immunoglobulins.<br>5. Standardization /optimization of PCR<br>Separation of molecules using HPLC and interpretation of data<br>6. Demonstration Of HPLC/NMR/GC<br>7. Fluroscence microscopy | **30** |

**References:**


1. Principles and Techniques of Biochemistry andMolecularBiology,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. PrenticeHall
4. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck , Prentice Hall, UK


## Course Code (DSC-IV) : RPSBTK.E514
## Course Title: Developmental
## Biology Academic year 2024-25

## COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able:- |
|---|---|
| CO 1 | Assessmolecular events during fertilization. |
| CO 2 | Elucidate molecular and biochemical changes in early embryonic developmemt |
| CO 3 | Describe the development of embryonic germ layer. |
| CO 4 | Explain the molecular mechanisms of sex hormone. |
| CO 5 | Justify changes in immune system behavior in female body during pregnancy |
| CO 6 | Elucidate the causes and corrective measures of infertility in male and females |
| CO 7 | Comment on the ethical issues in embryo research. |

# DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credit/Hours 2/30 |
|---|---|---|---|
| **RPSBTK.E514** | **I** | **Human Embryonic development** 15<br>Human Embryonic development: Events during fertilization, in-vitro fertilization, Zona pellucida, glycoprotein, Oelemma protein and their role in<br>fertilization, sperm, antigens and their<br>functional significance. Molecular and<br>biochemical events during sperm function early embryonic<br>development, establishing multi cellularity,<br>formation of blastula, embryonic<br>germ layer,<br>tracking of migrating cells | **15** |
| | **II** | **Sex hormones , Implantation and infertility** Molecular mechanism of sex hormone action and regulation of gene expression.<br>Implantation and endometrium antigens involved in implantation Immunology of pregnancy.<br>Superovulation,<br>embryo culture and embryo transfer technology<br>Infertility and reproductive vaccines,<br>Cryopreservation of sex gametes and embryos.<br>Ethical issues related to embryo research | **15** |

**References:**


1. Langman's Medical Embryology ( 9th Edition 2004)
T. W.Sadler. Lippincott Williams &Wilkins
2. Essential Developemental Biology (2nd Edition 2006) J.
M. W. SlackBlackwell Publishing

**Course Code(DSE): RPSBTK.E516**

**Course Title:**

**Nanotechnology**

**Academic year 2024-25**

## COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| CO 1 | Review physical and chemical properties of nanoparticles and their quantum principles |
| CO 2 | Discuss the synthesis of nanoparticles using different biological methods. |
| CO 3 | Characterize nanoparticles using advance microscopic and spectroscopic techniques. |
| CO 4 | Describe naturally existing nanorobotic machinery in eukaryotes |
| CO 5 | Elaborate the structure and functions of carbon nanotubes |
| CO 6 | Analyze and interpret the latest developments in nanotechnology in the field of medical sciences. |
| CO 7 | Explain nanotechnological drug delivery system with suitable examples. |
| CO 8 | Assess nanotechnology based process and products in food, cosmetics, agriculture, environment Management. |
| CO 9 | Design experimental procedures for synthesis and characterization of nanoparticles from various biological sources and perform cytotoxicity assay of nanoparticles. |

## DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credit/Hours 3/45 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **RPSBTK.E516** | **I** | **Introduction to nanotechnology - principles and applications** Introduction, synthesis of nanomaterials, biological methods, use of microbial systems & plant extracts, use of proteins & templates like DNA, Characterization of nanomaterials, analysis techniques, properties of nano mechanical, optical, magnetic properties, electrical conductivity, thermal conductivity. | **15** |

| | | | |
|---|---|---|---|
| | II | **Nanotubes & nanorobotics**<br>Carbon nanotubes, Nanorobotics devices of nature: ATP synthase, the kinen, myosin, dynein, flagella modulated motion, | **15** |
| | III | **Applications of nanomaterials**<br>Nanomedicine : biopharmaceuticals ,implantable materials, implantable chemicals, surgicals aids ,diagnostic tools ,Nano sensors and nano scanning, nano enabled drug delivery system, nanorobotics in medicine. Application of nanomaterials in food, cosmetics, agriculture, environment management. | **15** |

| Course Code | Practicals based on RPSBTK.E516 | Credit/Hours 1/30 |
|---|---|---|
| **RPSBTK.E516** | 1. Antibacterial studies of silver nanoparticles by MIC method.<br>2. Testing the cell viability of metal oxide nanoparticles using tissue culture technique.<br>3. Synthesis of Metal Nanoparticles by Chemical reduction method and their UV-VIS absorption studies.<br>4. Synthesis of nanoparticles using bacterial systems and their UV-VIS absorption studies.<br>5. Synthesis of nanoparticles using plant extract and their UV- VIS absorption studies.<br>6. Synthesis of nanoparticles using fungal system and their UV- VIS absorption studies.<br>7. Analysis of nanoparticles using UV vis spectrophotometer, TEM ,SEM -data interpretation. | **30** |

**References:**


1. The Nano scope encyclopedia of nanoscience and nanotechnology,VolI, VandVI (2005) Dr.Parag Diwan and Ashish Bhardwaj Pentagon Press New Delhi.
2. Nano forms of carbon and its applications (2007) Prof .Maheshwar Sharon and Dr.Madhuri Sharon Manad Nanotech Pvt.Ltd.
3. Biotech Nanotechnology lessons from Nature (2004) David Goodsell Wiley- Liss A John Wiley and sons.
4. Nanotechnology- Basic science and emerging technologies (2005) Willson Kannangava, Smith, Simmons, Raguse Overseas Press.

5. Textbook of Biotechnology (2005) R. C. Dubey S. Chand and Co..

# Modality of Assessment-DSC

# RPSBTK.E511, RPSBTK.E512 , RPSBTK.E513

# &

# RPSBTK.E516 ( DSE)

**Theory Examination Pattern:**

**A) Internal Assessment- 40%- 30 Marks**

| Sr No | Evaluation type | Marks |
|---|---|---|
| 1 | Class Test | 20 |
| 2 | Presentation | 10 |
| | **TOTAL** | **30** |

**B) External Examination (Semester End)- 60%- 45 Marks Semester End Theory Examination:**

1. Duration – The duration for these examinations shall be of **two hours**.
2. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q1 | 7/8 marks questions with option to any one | 15 | UNIT I |
| Q2 | 7/8 marks questions with option to any one | 15 | UNIT II |
| Q3 | 7/8 marks questions with option to any one | 15 | UNIT III |
| | **TOTAL** | **45** | |

**Practical Examination Pattern:**

**External Examination (Semester End)- 50**

**Marks Semester End Theory Examination:**

1. Duration – The duration for these examinations shall be of **three hours**.

2. Theory question paper pattern:

**Paper Pattern:**

| Question | | Marks |
|---|---|---|
| 1 | Lab work | 40 |
| 2 | Journal | 05 |
| 3 | Viva | 05 |
| | **TOTAL** | **50** |

# Modality of Assessment-DSC-IV RPSBTK.E514

**Theory Examination Pattern:**

**External Examination (Semester End)-- 50 Marks**

**Semester End Theory Examination:**

5. Duration – The duration for these examinations shall be of **One Hour**.
6. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q1 | a) 1M questions (any 5 out of 8 questions)<br>b) 5M questions ( any 3 out of 5 questions) | 20 | Unit I |
| Q2 | a) 1M questions (any 5 out of 8 questions)<br>b) 5M questions ( any 3 out of 5 questions) | 20 | Unit II |
| Q3 | 5M questions Mixed Bag questions (any 2 out of 3 questions) | 10 | Unit I & II |
| | **TOTAL** | **50** | |

# Modality of Assessment

# Research Project

# RPSBTK.E516

**The students need to carry out research project in the college in the even semester and submit a duly completed research thesis/ dissertation at the end of the semester**

Total Marks allotted to Research Project = 100

Distribution of Marks

| | |
|---|---|
| External examiner | 50 M |
| Internal Examiner | 50 M |

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