

AC/II(22-23).3.RPS3

**S. P. Mandali's**  
**Ramnarain Ruia Autonomous College**  
*(Affiliated to University of Mumbai)*



**Syllabus for**  
**Program: M.Sc.I**  
**Program Code: (RPSBTK)**

(As per the guidelines of NEP2020-Academic year 2023-24)

## 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
	<b>A student completing Master's Degree in Science program will be able to:</b>
GA 1	Demonstrate in depth understanding in the relevant science discipline. Recall, explain, extrapolate and organize conceptual scientific knowledge for execution and application 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
	<b>A student completing Master's Degree in Science program in the subject of Biotechnology will be able to:</b>
<b>PO 1</b>	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.
<b>PO 2</b>	Annotate the vast amount of biological data by retrieving, processing and analyzing through various tools of bioinformatics and biostatistics.
<b>PO 3</b>	Criticize and assess the phases encountered from laboratory to premarketing stages in clinical research along with reviewing case studies.
<b>PO 4</b>	Identify local and global environmental issues and establish scientific strategies to devise economical solutions converging towards sustainable development
<b>PO 5</b>	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.
<b>PO 6</b>	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.
<b>PO 7</b>	Deduce the underlying principle of Nano technological and biotechnological processes and develop the skills to offer contemporary solutions.

## PROGRAM OUTLINE

YEA R	SE M	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
<b>Student should select anyone of the following Course</b>					
		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.O506 / RPSMICP.O506/ RPSBCHP.O506	Practical on DSE	Practicals based on RPSBTK.O506/ RPSMIC.O506/ RPSBCH.O506	1

	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	Research Project	4
<b>Student should select anyone of the following Course</b>					
		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
		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 2023-24****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Elucidate the concept of different types of complicated carbohydrate molecules ,their structure and analytical methods for detection
<b>CO 2</b>	Differentiate between biosynthesis of nucleic acids and its consequences in dysregulation of it.
<b>CO 3</b>	Assess physiological significance of important co factors and molecules like lipids, peptides, endorphins, prostaglandins vitamins and co enzymes
<b>CO 4</b>	Discuss different types of inborn errors related to metabolism ,glycogen storage, amino acid metabolism, nucleic acid metabolism.
<b>CO 5</b>	Enumerate the concept of Neurobiology and establish a basic link to the immune system.
<b>CO 6</b>	Demonstrate practical skills in analyzing biomolecules in various biological samples and understand their significance.

**DETAILED SYLLABUS THEORY**

<b>Course Code</b>	<b>Unit</b>	<b>Course/ Unit Title</b>	<b>Credit/Hours</b>
<b>RPSBTK.O501</b>	<b>Unit I</b>	<b>Biochemistry of mucopolysaccharide and nucleic acid</b> 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).	3/45 15

		Diabetes: Type I, Type II, gestational. Glycogen storage disorders -von Gierke's disease, Cori's disease, Andersen's disease, McArdle's disease	
	<b>Unit II</b>	<p><b>Protein Biochemistry</b></p> <p>Determination- end group analysis, cleavage of disulphide bond, characterization of polypeptide chain, 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, symmetry, subunit composition determination. Amino acid metabolism- PKU, Alkaptonuria. Lipids- Tay-Sachs, Gaucher's disease Nucleic acids-Gout, Lesch Nyhan syndrome. Role of B group Vitamin in metabolic Pathways</p>	<b>15</b>
	<b>Unit III</b>	<p><b>Neurobiology and Neurochemistry</b></p> <p>Basics of neuronal synapse and excitation events.</p> <p>Neurochemistry: Special senses- taste, vision, odor, hearing.</p> <p>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.</p>	<b>15</b>

<b>Course Code</b>	<b>Practicals based on RPSBTK.O501</b>	<b>Credit/Hours</b> <b>1/30</b>
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<b>RPSBTKP.O501</b>	<ol style="list-style-type: none"><li>1. Preparation of buffers used in laboratory (Phosphate , Citrate , Acetate and Trisbuffer)</li><li>2. Isolation of starch from potato and its estimation by Anthrone method.</li><li>3. Study of phosphorolysis of glycogen in</li></ol>	<b>30</b>
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	<p>the Muscular tissue.</p> <ol style="list-style-type: none"> <li>4. Glucose estimation by paper/chip –Microfluidics</li> <li>5. Study of protein complexes using PAGE and detection by CBB and silver staining.</li> <li>6. The isolation and assay of glycogen from liver and skeletal muscles of bird /mammal.</li> <li>7. Estimation of Vitamin C from fruits.</li> <li>8. Estimation of Creatinine in blood /urine.</li> </ol> <p>Estimation of urate /creatinine ratio to diagnose Lesch-Nyhan syndrome</p> <ol style="list-style-type: none"> <li>9. Chemistry of thinking:             <ol style="list-style-type: none"> <li>a. Study of different regions of brain using models.</li> <li>b. Stroop test and blind spot test.</li> <li>c. Color blindness and optical illusions</li> </ol> </li> <li>10. Detection of LDH isozymes by electrophoresis.</li> <li>11. Electrophoretic analysis of haemoglobin</li> </ol>	
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## References:

1. Guyton, Text book of Medical Physiology, Saunders Publishers, 12th edition, 2010
2. Textbook of Biochemistry with Clinical Correlations, 7th Edition, Thomas M. Devlin, January 2010,
3. Proteins: biotechnology and biochemistry, 1<sup>st</sup> edition (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, Eric Conn & Paul Stumpf ; 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. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and Company, NY

**Course Code (DSC II-): RPSBTK.O502****Course Title: Immunology-I****Academic year 2023-24****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Elucidate the concept of antigen presentation and recognition patterns.
<b>CO 2</b>	Analyze the basics role and differentiate between complement pathways.
<b>CO 3</b>	Comment on role and function of Cytokines and cytokine profiling and interpret the role of oncogenes and different tumors of immune system.
<b>CO 4</b>	Criticize the path chosen by different effector molecules under various threats to immune system
<b>CO 5</b>	Show the skills to develop ,execute immuno based assays.
<b>CO 6</b>	Demonstrate the key process and mediators in inflammation.

**DETAILED SYLLABUS THEORY**

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

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

Course Code	Practicals based on RPSBTKP.O502	Credit/Hours
RPSBTKP.O502	<ol style="list-style-type: none"> <li>1. Antigen antibody reactions: VDRL</li> <li>2. Immuno-diffusion and immune-electrophoresis</li> <li>3. Perform Serum protein electrophoresis.</li> <li>4. Perform DOTBLOT</li> <li>5. Separation of T lymphocytes and B lymphocytes using nylon wool column</li> <li>6. Culturing of mononuclear lymphocytes</li> <li>7. Ficoll hypaque separation</li> <li>8. Sheep RBC rosetting</li> </ol>	<p>1/30</p> <p><b>30</b></p>

### References:

1. Immunology by Janis Kuby, W.H. Freeman & Co Ltd; 5th Revised edition.
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 (11 June 2011)

**Course Code (DSC III-): RPSBTK.O503**

**Course Title: Molecular Biology**

**Academic year 2023-24**

**COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Construct the details of chromatin structure and its functional implications.
<b>CO 2</b>	Elucidate the basis of gene expression and basic control processes involved in it.
<b>CO 3</b>	Comment on different post translational events , the underlying functional importance along with concepts of protein folding ,transport and protein sorting.
<b>CO 4</b>	Explain the techniques and principles involved in various next generation sequencing methods as an important aid the field of genomics.
<b>CO 5</b>	Acquire the skills to perform advanced molecular biology techniques.
<b>CO 6</b>	Analyze the concepts and mechanism of RNA interference.

**DETAILED SYLLABUS THEORY**

<b>Course Code</b>	<b>Unit</b>	<b>Course/ Unit Title</b>	<b>Credit/H ours 3/45</b>
<b>RPSBTK.O503</b>	<b>I</b>	<b>Chromatin structure and gene Expression</b> Chromatin structure and transcription. Regulation of chromatin structure , 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	<b>15</b>

		<p>of transcription factors, Regulation of RNA polymerase.</p> <p>Transcription in cell organelles (Mitochondria and chloroplast).</p> <p>RNA processing in eukaryotes: modifications, splicing and splicing machinery, processing of RNA. Editing and amplification</p> <p>Transcriptomics.</p>	
	<b>II</b>	<p><b>Post transcriptional events :</b></p> <p>Translation: in Prokaryotes and Eukaryotes. Initiation, elongation, and termination ,mRNA localization and stability.</p> <p>Modification folding and transport protein.</p> <p>Molecular chaperons in folding, Protein sorting and trafficking using signal proteins, ,RNAi, regulation of translation, Introduction to proteomics.</p>	<b>15</b>
	<b>III</b>	<p><b>Genomics</b></p> <p>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</p>	<b>15</b>

<b>Course Code</b>	<b>Practicals based on RPSBTK.O503</b>	<b>Credit/Hours</b>
<b>RPSBTK.O503</b>	<ol style="list-style-type: none"> <li>1. Extraction of genomic DNA from bacteria and blood</li> <li>2. Detection of genomic DNA using electrophoresis</li> <li>3. Purification of DNA from agarose gel.</li> <li>4. Preparation of competent cells</li> <li>5. Perform transformation of bacteria.</li> <li>6. Expression of recombinant GST protein.</li> <li>7. Detection of changes in the conformation of BSA by Viscosity measurement.</li> <li>8. Demonstration of Conjugation.</li> <li>9. Induction of Galactosidase in <i>E. coli</i> (and effect of inducers).</li> <li>10. RNA extraction and detection with AGE</li> </ol>	<p><b>1/30</b></p> <p><b>30</b></p>

	and quantify with U.V spectrophotometer.	
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**References:**

1. Genes XI, 11th edition (2012) Benjamin Lewin, Publisher-Jones and Bartlett 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., McGraw Hill Science. USA
4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj 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. Malcolm Campbell, Laurie J. Heyer Benjamin Cummings; 2<sup>nd</sup> edit

**Course Code (DSC IV-): RPSBTK.O504**  
**Course Title: Intellectual Property Rights**  
**Academic year 2023-24**

**COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Elaborate on the rules and regulations for patenting.
<b>CO 2</b>	Distinguish between copyright, Trademark, GI and Industrial designs.
<b>CO 3</b>	Interpret different case laws in biotechnology.
<b>CO 4</b>	Discuss the roles and responsibilities of the patent officer and the institution.
<b>CO 5</b>	Examine various patent applications.
<b>CO 6</b>	Summarize the various case studies associated.

## DETAILED SYLLABUS THEORY

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

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

1. [https://www.wipo.int/edocs/mdocs/africa/en/wipo\\_tiscs\\_znz\\_16/wipo\\_tiscs\\_znz\\_16\\_t\\_6.pdf](https://www.wipo.int/edocs/mdocs/africa/en/wipo_tiscs_znz_16/wipo_tiscs_znz_16_t_6.pdf)
2. <https://www.lexisnexisip.com/knowledge-center/totalpatent-one-and-the-usptos-seven-step-patent-search-strategy/>
3. <https://www.khuranaandkhurana.com/wp-content/uploads/2017/01/ANATOMY-OF-PATENT-SPECIFICATION.pdf>



4. [https://www.wipo.int/edocs/mdocs/aspac/en/wipo\\_ip\\_phl\\_16/wipo\\_ip\\_phl\\_16\\_t5.pdf](https://www.wipo.int/edocs/mdocs/aspac/en/wipo_ip_phl_16/wipo_ip_phl_16_t5.pdf)  
<http://www.mondaq.com/india/x/667450/Patent/Patent+Claims+And+Their+Types>

**Course Code (RM): RPSBTKRM.O505**

**Course Title: Research Methodology**

**Academic year 2023-24**

**COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	<b>A student completing this course will be able to:</b>
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.
CO 5	Analyse the process of scientific writing.
CO 6	Organize the data for writing a research paper.

**DETAILED SYLLABUS**

Course Code/ Unit	Unit	Course/ Unit Title	Credit/Hours 4/60
RPSBTKRM.O505	I	introduction to research methodology and research problems Meaning of Research; Objectives of Research; Motivation in Research;	15

		<p>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 :</p> <p>Selection of a research problem , Necessity of defining a research problem ,Technique involved in defining a research problem</p>	
	<b>II</b>	<p><b>Research Design &amp; Data Collection</b></p> <p>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- 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</p>	<b>15</b>
	<b>III</b>	<p><b>Interpretation and hypothesis</b></p> <p>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.</p> <p>Importance of hypothesis, a. Kinds of hypothesis, b. Characteristics of good hypothesis, Formulation of hypothesis</p>	<b>15</b>
	<b>IV</b>	<p><b>Scientific Writing</b></p> <p>Process of Scientific Writing: Thinking, Planning, Rough Drafts and Revising Contents. 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 software (Mendley) &amp; Grammarly software</p>	<b>15</b>

**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 Schimel

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

**Course Title: Clinical Data Management**

**Academic year 2023-24**

**COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Discuss the ethical issues in human subjects research.
<b>CO 2</b>	Imagine and understand the different phases of clinical trials.
<b>CO 3</b>	Analyze the roles and responsibilities of the investigator and the institution.
<b>CO 4</b>	Examine various regulatory issues related to clinical studies.
<b>CO 5</b>	Recall the companies and organizations associated in this field.
<b>CO 6</b>	Develop interest on designing clinical study protocols and clinical study reports.

**DETAILED SYLLABUS THEORY**

Course Code	Unit	Course/ Unit Title	Credit/Hours 3/45
<b>RPSBTK.O506</b>	<b>I</b>	<b>Drug discovery and Preclinical toxicology</b> 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.	<b>15</b>

	<b>II</b>	<b>Introduction to Clinical trials</b> 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.	<b>15</b>
	<b>III</b>	<b>Clinical study design</b> 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	<b>15</b>

<b>Course Code</b>	<b>Practicals based on RPSBTK.O506</b>	<b>Credit/Hours</b>
<b>RPSBTK.O506</b>	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.  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.  3. Designing eCRF form based on given protocol (only particular sections of protocol will be given)  4. Designing of eCRF completion guidelines based on given protocol.  5. Perform Screening process of various drug molecules from plant, algal and marine sources before performing preclinical toxicity study.  6. Perform preclinical toxicity study on cell lines and microorganisms using drugs screened in exp no.5  7. Various ways to resolve vendor issues.	<b>1/30</b>  <b>30</b>

## 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
	<b>TOTAL</b>	<b>30</b>

**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
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	<b>TOTAL</b>	<b>45</b>	
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**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:**

<b>Question</b>		<b>Marks</b>
1	Lab work	40
2	Journal	05
3	Viva	05
	<b>TOTAL</b>	<b>50</b>



## 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
	<b>TOTAL</b>	<b>50</b>	

## Modality of Assessment-RM

### RPSBTKRM.O505

#### 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
	<b>TOTAL</b>	<b>40</b>

#### 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
	<b>TOTAL</b>	<b>60</b>	

## Course Code (DSC I): Metabolism

Course Title: RPSBTK.E511

Academic year 2023-24

### COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	<b>A student completing this course will be able to:</b>
CO 1	Comment on the biosynthesis of various types of fatty acids and its significance and regulation.
CO 2	Explain the importance and levels of regulation of acid-base balance in body, their disorders and treatments.
CO 3	Comprehend the various stress experienced by plants and their consequences on growth and metabolism.
CO 4	Interpret the role played by secondary metabolites in plant defence system.
CO 5	Differentiate between the various carbon fixation cycles in plants and interaction of microbes with the environment.
CO 6	Elucidate the molecular structure and role of nitrogenase in the nitrogen cycle and importance of ammanox reactions in nature.

### DETAILED SYLLABUS THEORY

Course Code	Unit	Course/ Unit Title	Credit/Hours
RPSBTK.E511	Unit I	<b>Lipid Metabolism</b> 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.	3/45 15

	<b>Unit II</b>	<b>Physiological biochemistry</b> 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	<b>15</b>
	<b>Unit III</b>	<b>Plant and microbial metabolism</b> Environmental stresses, salinity, water, stress, heat, chilling, 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	<b>15</b>

<b>Course Code</b>	<b>Practicals based on RPSBTK.E511</b>	<b>Credit/Hours</b>
<b>RPSBTK.E511</b>	1. Isolation of cholesterol and lecithin from egg yolks 2. Detection of Flavonoids in Plants. 3. Estimation of leghemoglobin. 4. Proline estimation in germinated seeds with and without stress 5. Estimation of phospholipids. 6. Assay of superoxide dismutase in salt stressed and Normal plant. 7. Estimation of Zn <sup>++</sup> by EDTA titrimetric method 8. Estimation of Ca <sup>++</sup> by EDTA titrimetric method. 9. NPK Test	<b>1/30</b>  <b>30</b>

**References:**

- Biochemistry, L Stryer, Freeman and Co, NY
- Biochemistry, Zubay, Addison Wesley and Co.
- Textbook of Physiology, Guyton
- Principles of Biochemistry, Lehninger, 5<sup>th</sup> edition, Cox and Nelson, W.H. Freeman and Company, NY.
- 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, C Mosbyco London

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

**Course Title: Immunology**

**Academic year 2023-24**

**COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Differentiate between different intricate aspects of various Immunological diseases.
<b>CO 2</b>	Comment on various factors involved in hypersensitivity reactions and their emphasis on treatment.
<b>CO 3</b>	Analyze in detail the immunological aspects involved during transplantation.
<b>CO 4</b>	Discuss the making and role of different types of vaccines.
<b>CO 5</b>	Demonstrate the principle techniques and applications involved in invitro and in vivo imaging.
<b>CO 6</b>	Interpret principles techniques and applications of various immunotechniques,

**DETAILED SYLLABUS**

<b>Course Code/ Unit</b>	<b>Unit</b>	<b>Course/ Unit Title</b>	<b>Credit/Hours</b>

			<b>3/45</b>
<b>RPSBTK.E512</b>	<b>I</b>	<b>Autoimmunity and Immunodeficiency</b> 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.	<b>15</b>
	<b>II</b>	<b>Hypersensitivity and Transplantation</b> 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	<b>15</b>
	<b>III</b>	<b>CMI and imaging</b> Cell Cytotoxicity, mixed lymphocyte reaction, Apoptosis, Peptibodies- production and application; Cell imaging Techniques- <i>In vitro</i> and <i>In vivo</i> ; Immuno-electron microscopy; <i>In vivo</i> cell tracking techniques; Application based microarray, Phage display Antibody generation, blotting techniques, Immuno-precipitation, Flow cytometry, detection of antigens in living cells, <i>in situ</i> localization by techniques such as FISH and GISH	<b>15</b>

**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

<b>Course Code</b>	<b>Practicals based on RPSBTK.E512</b>	<b>Credit/Hours</b> <b>1/30</b>
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<b>RPSBTK.E512</b>	1. <i>In-vitro</i> demonstration of phagocytosis	<b>30</b>
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	and calculating phagocytic index. 2. Latex bead agglutination / precipitation test for detection of rheumatoid factor (RF) 3. Allergen detection test. 4. Assay for plaque forming cells. (Video DEMO) 5. Cell-imaging Techniques <i>In vitro</i> and <i>In vivo</i> ; Immuno-electron microscopy; <i>In vivo</i> cell tracking techniques; Microarrays. 6. Demonstration of radioimmunoassay 7. Western blotting 8. ELISA 9. HLA typing	
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**Course Code(DSC-III): RPSBTK.E513**

**Course Title: Bioinstrumentation**

**Academic year 2023-24**

**COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Summarize advanced and state of the art techniques with various types of electron microscopy.
<b>CO 2</b>	Compare different types of PCR and their applications.
<b>CO 3</b>	Enumerate different types of advanced molecular cloning methodology
<b>CO 4</b>	Discuss on the variety of spectroscopic techniques with respect to molecular analysis
<b>CO 5</b>	Develop skills in handling and performing different chromatographic techniques.
<b>CO 6</b>	Understanding the recent applications of advanced techniques.



## DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credit/Hours 3/45
RPSBTK.E513	I	<b>. Advanced microscopic and PCR techniques</b> 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	<b>Spectroscopy</b> 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	<b>Chromatography</b> 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 2. Separation of sugars in coconut water using TLC 3. Determination of enzyme activity by Zymogram. 4. Affinity chromatography for purification of immunoglobulins. 5. Standardization /optimization of PCR	30

	6. Separation of molecules using HPLC and interpretation of data 7. Demonstration Of HPLC/NMR/GC 8. Fluorescence microscopy	
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**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

**Course Code (DSC-IV) : RPSBTK.E514**

**Course Title: Developmental Biology**

**Academic year 2023-24**

**COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	<b>A student completing this course will be able to:</b>
<b>CO 1</b>	Apply the key principles of developmental biology toward evaluating and analyzing primary literature in the field.
<b>CO 2</b>	Explain significant concepts including mechanisms by which differential gene activity controls development, mechanisms that determine cell fate and mechanisms that ensure consistency and reliability of development.
<b>CO 3</b>	Explain the molecular mechanisms of sex hormone and infertility issues.
<b>CO 4</b>	Appraise and criticize 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 Human Embryonic development: Events during	15

		<p>fertilization, in-vitro fertilization, Zona pellucida, glycoprotein, Oolemma protein and their role in fertilization, sperm, antigens and their functional significance. Molecular and biochemical events during sperm function early embryonic development, establishing multi cellularity, formation of blastula, embryonic germ layer, tracking of migrating cells</p>	
	<b>II</b>	<p><b>Sex hormones , Implantation and infertility</b>          Molecular mechanism of sex hormone action and regulation of gene expression. Implantation and endometrium antigens involved in implantation          Immunology of pregnancy. Superovulation, embryo culture and embryo transfer technology          Infertility and reproductive vaccines,          Cryopreservation of sex gametes and embryos.          Ethical issues related to embryo research</p>	<b>15</b>

### References:

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

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

**Course Title: Nanotechnology**

**Academic year 2023-24**

**COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
<b>A student completing this course will be able to:</b>	
<b>CO 1</b>	Discuss the basics of nanotechnology, tools used for characterizing nanomaterials and specific applications of nanotechnology.
<b>CO 2</b>	Examine the nanorobotics devices of nature.
<b>CO 3</b>	Analyse and interpret the latest developments in nanotechnology in the field of medical sciences.
<b>CO 4</b>	Explain drug delivery system using nanotechnology.
<b>CO 5</b>	Apply nanomaterials in food, cosmetics, agriculture, environment Management.
<b>CO 6</b>	Assess and appreciate the thrust in this science and feel encouraged to take it ahead in research.

**DETAILED SYLLABUS**

Course Code/ Unit	Unit	Course/ Unit Title	Credit/Hours 3/45
RPSBTK.E516	I	<b>Introduction to nanotechnology - principles and applications</b> 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

	<b>II</b>	<b>Nanotubes &amp; nanorobotics</b> Carbon nanotubes, Nanorobotics devices of nature: ATP synthase, the kinen, myosin, dynein, flagella modulated motion,	<b>15</b>
	<b>III</b>	<b>Applications of nanomaterials</b> 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.	<b>15</b>

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

### 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
	<b>TOTAL</b>	<b>30</b>

**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
	<b>TOTAL</b>	<b>45</b>	

**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
	<b>TOTAL</b>	<b>50</b>

**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) 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 questions (any 2 out of 3 questions)	10	Unit I & II
	<b>TOTAL</b>	<b>50</b>	

## 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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