AC/II (20-21).2.RPS3

S. P. Mandali's

RamnarainRuia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for M.Sc Part I-II

Program: M.Sc

Program Code: Biotechnology (RPSBTK)

(Credit Based Semester and Grading System for academic year 2020–2021)

PROGRAM OUTCOMES

PO	PO Description **A student completing Master's Degree in Science program will be able to:**
PO 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.
PO 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.
PO 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.
PO 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.
PO 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.
PO 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.
PO 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.
PO 8	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

PROGRAM SPECIFIC OUTCOMES

PSO	Description **A student completing Master's Degree in Science program in the subject of Biotechnology will be able to:**
PSO 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.
PSO 2	Annotate the vast amount of biological data by retrieving, processing and analyzing through various tools of bioinformatics and biostatistics.
PSO 3	Criticize and assess the phases encountered from laboratory to premarketing stages in clinical research along with reviewing case studies.
PSO 4	Identify local and global environmental issues and establish scientific strategies to devise economical solutions converging towards sustainable development
PSO 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.
PSO 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.
PSO 7	Deduce the underlying principle of nanotechnological and biotechnological processes and develop the skills to offer contemporary solutions.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
I	I	RPSBTK101	Biochemistry	4
		RPSBTK102	Immunology	4
		RPSBTK103	Molecular Biology	4
		RPSBTK104	Biophysical and biochemical techniques	4
		RPSBTKP101,102,103,104	Practicals based on all four papers	2 credits each
	II	RPSBTK201	Metabolism	4
		RPSBTK202	Immunology	4
		RPSBTK203	Bioprocess Technology	4
		RPSBTK204	Bioinformatics,phylogenetics and vitamins	4
		RPSBTKP201 and RPSBTKP204	Practicals based on all four papers Research project(inhouse)	2 credits each
II	III	RPSBTK302	Medical Microbiology	4
		RPSBTK303	GMO and Environment	4
		RPSBTK304	Developmental Biology	4
		RPSBTKP301	Practicals based on RPSBTK301	2

		RPSBTKP302	Practicals based on RPSBTK302	2
		RPSBTKP303	Practicals based on RPSBTK303	2
		RPSBTKP304	Practicals based on RPSBTK304	2
	IV	RPSBTK401	Nanotechnology	4
		RPSBTK402	IPR & protection of inventions	4
		RPSBTK403	Clinical Studies	4
		RPSBTK404	Biostatistics	4
		RPSBTKP401 to RPSBTKP404	Project	2 credits each

SEMESTER I

Course Code:RPSBTK101

Course Title: Biochemistry
Academic year 2020-21

COURSE OUTCOMES:On course completion, the student should be able to:

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

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK101	I	**Biochemistry of mucopolysaccharide and nucleic acid** Glycosaminoglycans- Heparin, Chondroitin-sulphate, Dermatan-sulphate, Keratan-Sulphate. Analytical methods for carbohydrate analysis. Formation, structure and functions of Eicosanoid: Prostaglandins and Thromboxanes, Glycoprotein's (N6, O6, GPI6 linked and proteoglycans), Glycolipids and Lectins, Biosynthesis and degradation of purines and pyrimidines with regulation.	15
	II	**Protein Biochemistry** Primary structure of proteins and their determination- end group analysis, cleavage of disulphide bond, characterization of polypeptide cha, aminoacid composition determination, specific peptide cleavage reaction, separation and purification of peptides, sequence determination, peptide mapping, Super secondary structures.Secondary structure peptide group, Ramchandranplot,helical structure, beta structure, fibrous and globular structure, protein stability, electrostatic forces, hydrogen bond, hydrophobic interaction, disulphide bond, protein denaturation, stability of thermostable proteins.Quaternary structure- subunit interaction, symmetry, subunit composition determination.	15
	III	**Inborn errors of metabolism and nutritional disorders** PEM (Kwashiorkor and Marasmus). Diabetes: Type I, Type II, gestational. Glycogen storage disorders - von Gierke's disease, Cori'sdisease, Andersen's disease, McArdle's disease. Amino acid	15

		metabolism- PKU, Alkaptonuria. Lipids- Tay-Sachs, Gaucher'sdisease.Nucleicacids-Gout,Lesch-Nyhansyndrome.Role of B groupVitamins in metabolic pathways	
	IV	**Neurobiology and Neurochemistry** Structure and functions of neuron, types and physiologic anatomy of the Synapse, transmission of nerve impulses, ion channels,Neurotransmitters and neuropeptides, Electrical events during neuronal excitation and inhibition. Neurotoxins. Neurochemistry:Special senses-taste, vision, odor, hearing. Factors which enhance epinephrine inhibitors, Synapses, Addictions.Examples of each of the above mentioned factors. Introduction to psychoneurotic and neuropsychiatric drugs.	15

References:

1. Guyton, Text book of Medical Physiology, SaundersPublishers, 12th edition, 2010
2. Textbook of Biochemistry with Clinical Correlations, 7thEdition, Thomas M. Devlin, January 2010,
3. Proteins: biotechnology and biochemistry, 1stedition (2001), Gary Walsch, Wiley, USA
4. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.
5. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co.England.
6. Outlines of Biochemistry: 5th Edition, Erice Conn &PaulStumpf ; John Wiley and Sons, USA
7. Fundamentals of Biochemistry. 3rd Edition (2008), DonaldVoet& Judith Voet , John Wiley and Sons, Inc. USA
8. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and Company,NY.
9. Biochemistry: 7th Edition, (2012), Jeremy Berg, LubertStryer, W.H.Freeman and compan

Practicals
RPSBTKP101

Course Code	Title	Credits
RPSBTKP101	1. Preparation of buffers used in laboratory (Phosphate , Citrate , Acetate and Tris buffer) 2. Isolation of starch from potato and its estimation by Anthrone method. 3. Study of phosphorolysis of glycogen in the muscular tissue. 4. Glucose estimation by paper/chip – Microfluidics 5. Study of protein complexes using PAGE and detection by CBB and silver staining. 6. The isolation and assay of glycogen from liver and skeletal muscles of bird / mammal. 7. Estimation of Vitamin C from fruits. 8. Estimation of Creatinine in blood /urine. Estimation of urate/creatinine ratio to diagnose Lesch-Nyhan syndrome 9. Chemistry of thinking: a. Study of different regions of brain using models. b. Stroop test and blind spot test. c. Color blindness and optical illusions 10. Detection of LDH isozymes by electrophoresis.	2

Course Code:RPSBTK102

Course Title: Immunology
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Elucidate the concept of antigen presentation and recognition patterns
CO 2	Analyze the basics,role and differentiate between complement pathways.
CO 3	Comment on role and function of Cytokines and cytokine profilling and interpret the role of oncogenes and different tumors of immune system
CO 4	Discuss methods and procedure of safe sterile Vaccine development
CO 5	Criticize the path chosen by different effector molecules under various threats to immune system
CO 6	.Show the skills to develop,executeimmuno based assays

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK102	I	**Molecular immunology** Organization and expression of immunological genes (BCR and TCR genes). Antibody genes and antibody engineering. T cell and B cell activation.InflammationKeymediatorsofinflammation ,inflammation process,anti inflammatory drugs	15
	II	**Cancer Immunology** Origin and terminology, malignant transformation of cell, oncogenes and cancer induction, tumors of the immune system, tumour antigens, immune response to tumor,	15

		tumor evasion of the immune system , cancer immunotherapy	
	III	**Clinical immunology** Cytokines: properties, receptor, antagonists, diseases, Therapeutic use of cytokines, Experimental immunology: Vaccine development (Recombinant, Combined and polyvalent vaccines), Cancer Immunology – Correlation with MABS, Chimeric humanized antibodies and Notations, Cytokine profiling of T –cells	15
	IV	**Effector mechanisms:** Mucosal immunity, Peyer's patches, gut barriers, oral immunization, Oral tolerance, Cytotoxic response, Effector functions of B, T and NK cells. Immune response during bacterial, parasitic, viral infection with one example of each	15

References:

1. Immunology by Janis Kuby, W.H.Freeman& Co Ltd; 5th Revised edition.
2. Fundamental Immunology 6th edition (August 2003): by WilliamE., Md. Paul (Editor) By Lippincott Williams & Wilkins Publishers
3. Essential Immunology, Ivan M. Roitt (1994)– Blackwell ScientificPub, Oxford.
4. Cellular and Molecular Immunology, 3rd Ed, Abbas, Saunders; 7 edition (11 June 2011)

Practicals
RPSBTKP102

Course Code	Title	Credits
RPSBTKP102	1. Antigen antibody reactions: VDRL 2. Immuno-diffusion and immune-electrophoresis 3. Perform Serum protein electrophoresis. 4. Perform DOT BLOT 5. Separation of T lymphocytes and B lymphocytes using nylon wool column 6. Sheep RBC rosetting	2

Course Code:RPSBTK103

Course Title: Molecular Biology
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Construct the details of chromatin structure and its functional implications.
CO 2	Elucidate the basis of gene expression and basic control processes involved in it
CO 3	Comment on different post translational events , the underlying functional importance along with concepts of protein folding,transport and protein sorting
CO 4	Explain the techniques and principles involved in various next generation sequencing methods as an important aid the field of genomics
CO 5	Acquire the skills to perform advanced molecular biology techniquies
CO 6	Interpret the functionality and importance of epigenetics and RNA interference

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK103	I	**Chromatin structure and gene expression**Chromatin structure and transcription. Regulation of chromatin structure , Transcription in prokaryotes and Eukaryotes, Structure of RNA polymerase (Channel in and	15

		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).	
	II	**Post Transcriptional and translational events** Post transcriptional events : RNA processing in eukaryotes: modifications, splicing and splicing machinery, processing of RNA. Editing and amplificationTranslation: 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,	15
	III	**RNA interferences and epigenetics** DNA rearrangement, RNAi, regulation of translation, RNA interference, Gene silencing, Epigenetic inheritance and Retrotransposons	15
	IV	**Omic studies** Omes and Omics, concepts and applications, genome overview at the level of chromosomes (with model organisms as example), strategies for large scale DNA sequencing. EST and STS, Whole Genome Analysis techniques. Next generation sequencing methods, organization, structure, and mapping of genomes (with model organisms as example) Introduction to proteomics, transcriptomics, metabolomics. Whole exome analysis	15

References:

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D.Watson, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
3. Molecular Biology, 5th Edition (2011), Weaver R., McGrawHill Science. USA
4. Fundamentals of Molecular Biology, (2009), Pal J.K. andSarojGhaskadbi, Oxford University Press. India
5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp Jones & Bartlett Learning, USA
6. Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcoln Campbell, laurie J. Heyer Benjamin Cummings;2nd edition

Practicals
RPSBTKP103

Course Code	Title	Credits
RPSBTKP103	1. Extraction of genomic DNA from bacteria and blood 2. Perform transformation of bacteria. 3. Expression of recombinant protein. 4. Purification of DNA from agarose gel. 5. Detection of changes in the conformation of BSA by viscosity measurement. 6. Demonstration of Conjugation. 7. Induction of Galactosidase in *E. coli* (and effect of inducers).	2

Course Code:RPSBTK104

Course Title: Biophysical and biochemical techniques
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Summarize advanced and state of the art techniques with various types of electron microscopy.
CO 2	Compare different types of PCR and their applications.
CO 3	Enumerate different types of advanced molecular cloning methodology.
CO 4	Discuss on the variety of spectroscopic techniques with respect to molecular analysis
CO 5	Develop skills in handling and performing different chromatographic techniques.
CO 6	Analyze different aspects of immunological and histochemical techniques.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK104	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 LC-MS, 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
	IV	**Histochemical and Immunotechniques** Antibody generation, blotting techniques, Immuno - precipitation, Flow cytometry and immunofluorescence, detection of antigens in living cells, *in situ* localization by techniques such as FISH and GISH, Microarray	15

References:

1. Principles and Techniques of Biochemistry and Molecular Biology,7th edition Wilson K.M., Walker J.M., Cambridge University Press, UK (2010),
2. Biochemical spectroscopy. Vol 46 of Methods in Enzymology. (1995) Kenneth Sauer. Academic Press, USA
3. Modern experimental biochemistry 3rd edition Publisher, USA.edition. (2000) Rodney Boyer. Prentice Hall
4. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck , Prentice Hall, UK.

Practicals
RPSBTKP104

Course Code	Title	Credits
RPSBTKP104	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 PC 6. Demonstration Of HPLC/NM	2

Modality of Assessment (SEMESTER I)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1.	One Assignment/Case study/Project based / written assignment/ Presentations	20
2.	One Class Test (multiple choice questions/objectives/ match the column)	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **2.5hrs** duration.
2. Theory question paper pattern:

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

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1)A)	Any 1 out of 2		Unit I
Q.1)B)	Compulsory		
Q.2)A)	Any 1 out of 2		Unit II
Q.2)B)	Compulsory		
Q.3)A)	Any 1 out of 2		Unit III
Q.3)B)	Compulsory		
Q.4)A)	Any 1 out of 2		Unit IV
Q.4)B)	Compulsory		
	TOTAL	**60**	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	
Journal	5
Experimental tasks	15
Total	**20**

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Paper
Laboratory work	30
Total	**30**

SEMESTER I:PRACTICAL COMPONENT

- RESEARCH PLAN TO BE PROVIDED BY EACH STUDENT IN SEMESTER I OF 25M

Overall Examination & Marks Distribution Pattern

Semester I

Course	RPSBTK101/102/103/104			Grand total
	Internal	External	Total	
Theory	40	60	100	400
Practicals	20	30	50	200

SEMESTER II

Course Code:RPSBTK201

Course Title: Metabolism
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
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

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK201	I	**Lipid Metabolism** Lipid metabolism: Biosynthesis of fatty acids (saturated, monounsaturated, polyunsaturated), triglycerides and phospholipids.FAS Complex, regulation of fatty acid metabolism. Biosynthesis and regulation of cholesterol, prostaglandins, membrane lipids.	15

	II	**Physiological biochemistry** Regulation of acid-base balance, types and functions of acid-base buffers, respiratory mechanism of acid-base balance, renal control of acid base balance, clinical abnormalities associated with acid base imbalance. Water and electrolyte balance, clinical abnormalities. Kidney Diseases and diuretics: Acute renal failure, chronic renal failure, specific tubular disorders, treatment of renal failure.	15
	III	**Stress Metabolism in plants** Environmental stresses, salinity, water, stress, heat, chiling, anaerobiosis and heavy metals and their impact on plant browth and metabolism, criteria of stress tolerance. Secondary metabolites in plants- Nature, distribution and their role in plant protection. Steroid biotransformation	15
	IV	**Plant and microbial metabolism** Hatch slack pathway, Crassulacean acid metabolism, photorespiration and glyoxylate pathway with significance. Photosynthetic formation of hydrogen. Nitrogen fixation and role of nitrogenase, anammox reactions. Plant symbiosis with fungi: Arbuscular, mycorrhiza, Ectomycorrhiza	15

References:

1. Biochemistry, L Stryer, Freeman and Co, NY
2. Biochemistry, Zubay, Addison Wesley and Co.
3. Textbook of Physiology, Guyton
4. Principles of Biochemistry, Lehninger, 5th edition, Cox and Nelson, W.H.Freeman and Company,NY.
5. Physiology- Berne and Levy
6. Harper's Biochemistry- 27th edition
7. Text book of Human Biochemistry- Ed. G. P. Talwar
8. Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub, Madras

9. Human biochemistry – James Orten and Otto Neuhaus, 10th ed , CV Mosby co London

10. Human nutrition and dietetics-Davidson and Passmore
11. Plant physiology, Salisbury and Ross (2007) CBS publishers and distributors
12. Biochemistry and Physiology of Plant Hormones, Thomas Moore, Springer Verlag New York
13. Plant Biochemistry- Hans Walter Heldt, 3rd Edition, ElesvierAcademic Press
14. Introduction to Plant Biochemistry- T.W. Goodwin and E.L. Mercer
15. Plant Physiology- Devlin, CBS Publisher
16. Plant Biochemistry- Dey, Academic Press, 1999

Practicals
RPSBTKP201

Course Code	Title	Credits
RPSBTKP201	1. Estimation of Niacin by the CNBr method 2. Isolation of cholesterol and lecithin from egg yolks 3. Detection of Flavonoids in Plants. 4. Estimation of leghemoglobin. 5. Proline estimation in germinated seeds with and without stress 6. Estimation of phospholipids. 7. Assay of superoxide dismutase in salt stressed and normal plant. 8. Estimation of Ca^{++} / Zn^{++} by EDTA titrimetric method 9. *In-vitro* demonstration of phagocytosis and calculating phagocytic index 10. Demonstration of radioimmunoassay 11. Demonstration of Plackett-Burman design for formulation of Fermentation media.	2

Course Code:RPSBTK202

Course Title: Immunology
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Differentiate between different intricate aspects of various immunological diseases.
CO 2	Comment on various factors involved in hypersensitivity reactions and their emphasis on treatment.
CO 3	Discuss the making and role of different types of vaccines
CO 4	Demonstrate the principle techniques and applications involved in *in-vitro and in vivo* imaging.
CO 5	Interpret how the psychology affect the immunological aspects of human body.
CO 6	Enumerate the implications of various disorders associated with dysregulation of pschyoneuroimmunology.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK202	I	**Immunological diseases** Autoimmunity mechanisms, Altered antigens, Systemic Lupus erythematosus, Graves diseases, Rheumatoid arthritis, Myasthenia Gravis, Multiple sclerosis, animal models of autoimmunity, GvH, Immunodeficiency (Primary &secondary): phagocytic, humoral, CMI, combined HLA association with disease.	15

	II	**Hypersensitivity and Transplantation** 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** Cell Cytotoxicity, mixed lymphocyte reaction, Apoptosis, Cell cloning, Reporter Assays,Peptibodies- production and application; Cell imaging Techniques- *In vitro*and*In vivo*; Immuno-electron microscopy; *In vivo* cell tracking techniques; Application based microarray, Phage display	15
	IV	**Psychoneuro- immunology** Connections of CNS to immune system and vice versa. Psychological modulation of immunity, stress and immunity, implication for diseases, functional significance - inflammation and acute phase response, role of glucocorticoids, stress response, energy demand and balance, Introduction and History of Neuroendocrine circuitry, disorder of Thoughts and volition – Schizophrenia, Addition of Action of Drug.	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 ScientificPub, Oxford.
4. Cellular and Molecular Immunology, 3rd edition, Abbas
5. Psychoneuroimmunology, Stress, and Infection, By HermanFriedman, Thomas W. Klein, Andrea L. Friedman, CRC Press, 1996

Practical
RPSBTKP202

Course Code	Title	Credits
RPSBTKP202	Research Project Undertaken by students	2

Course Code:RPSBTK203

Course Title: Bioprocess Technology
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Explain the effect of process parameters on fermentation and their measurement and control.
CO 2	Differentiate between the rheological properties of various food textures.
CO 3	Comprehend on enzyme functions and reactions in food process.
CO 4	Analyze the role of microbes in processing the food and developing commercial food products.
CO 5	Summarize the mechanism of enzyme reactions in detail and the role of inhibitors on them.
CO 6	Elucidate the basic mechanism of different types of enzymes and their widespread applications.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK203	I	**Aeration and agitation in bioprocess** Large scale animal and plant cell cultivation; Aeration and agitation in bioprocess; KLa, Measurement and control of bioprocess parameters.	15

	II	**Food Rheology** Introduction to Food Rheology, Food rheology vs Food texture, Rheology of food dispersion, Food polymers and gels, foams and dough rheology, processing and food rheology, test and application of food rheology.	15
	III	**Applications of microbes and enzymes in food processing** Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup; Interesterified fat; Hydrolyzed protein and their downstream processing; baking by amylases, deoxygenation and desugaring by glucoses oxidase. Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods. Microbes and their use in pickling, producing colours and flavours. Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products; Bacteriocins from lactic acid bacteria - Production and applications in food preservation	15
	IV	**Enzymology** Enzyme – Concept and kinetics, active site formation and its significance, Michaelis-Mentonequation – Derivation and transformation, Enzyme inhibition and types of inhibitors, control of enzyme activity, allosteric regulations, parameters affecting enzyme activity. Types of enzymes: isoenzymes, ribozymes, abzymes, substrate specificity and coenzymes	15

References:

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

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

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

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

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

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

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

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

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

Practical
RPSBTKP203

Course Code	Title	Credits
RPSBTKP203	Research Project Undertaken by students	2

Course Code:RPSBTK204

Course Title: Bioinformatics,Phylogenetics and vitamins
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Classify different types of biological databases.
CO 2	Summarize about various computational methods and tools used for protein secondary structure prediction and genome analysis
CO 3	Describe various sequence alignment tools and its significance**.**
CO 4	Identify and understand important terms in evolution and population genetics
CO 5	Compare different bioinformatic tools for phylogenetic analysis.
CO 6	Comprehend the sources,biological function and dietary disorder associated with water soluble and fat soluble vitamins.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK204	I	**Introduction to Bioinformatics – Sequence Analysis**Database search using ENTREZ (G Query) , Hidden Marker Model, Equation (Ex :Gene finding/ exon-intron finding, Signal peptide finding), Motif finding using HMM, ANN (Ex:Prosite) Sequence alignment, MSA- algorithm under Clustal W ,Protein sequence analysis,Protein structure analysis, Secondary, (Chou Fasman algorithm, GOR algorithm, Tertiary (Homology modelling, Threading, Ab initio, Structure prediction)	15

	II	**Applications of Bioinformatics** Microarray data analysis,Printingtechniques,Features of microarray,Flag features of microarray,Data normalization in microarray,Human genome project and specialised databases under NCBI (Eg OMIM, chromosome, PubMed),Proteomics, Consesnsus sequence, PSSM,Sequence logo.	15
	III	**Phylogenetics** Darwinism and neo Darwinism theories of evolution. Population genetics and different forces acting on it. Bioinformatics tools for phylogenetic analysis.	15
	IV	**Vitamins** National Institutes of Health Office of Dietary Supplements (ODS) for sources, activity of vitamins, deficiency disorders, overconsumption effects of Vitamins: Water soluble- B1, 2,3,5,6,7,12 Fat soluble- A, D, E, K	15

References:

1. Bioinformatics – A practical guide to the analysis of genes and proteins by A.D. Baxvanis
2. Bioinformatics by N. Gautam (2006)
3. Bioinformatics : Sequence and Genome Analysis (Second Edition 2004),David W. Mount , (Coldspring Harbor Laboratory Press)
4. Bioinformatics and Functional Genomics (2003), Jonathan Pevsner, John Wiley and sons.
5. iGenetics by Peter J.Russel, 3rd Edition, Pearson Publications
6. Handbook of Vitamins: https://ods.od.nih.gov/factsheets/list-VitaminsMineral

Practicals
RPSBTKP204

Course Code	Title	Credits
RPSBTKP204	1. Classification of biological databases specially cover NCBI and INSDC 2. Phylogenetic tree using Bootstrap 3. BLAST – orthologs, paralogs and homologs 4. Motif finding 5. KEGG 6. Structure of proteins – identification of chains helices, special groups, metal ions etc. 7. CATH/SCOP classification of a given protein 8. Homology modelling	2

Modality of Assessment (SEMESTER II)

Theory Examination Pattern:

C) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1.	One Assignment/Case study/Project based / written assignment/ Presentations	20
2.	One Class Test (multiple choice questions/objectives/ match the column)	20
	TOTAL	**40**

D) External Examination- 60%- 60 Marks

Semester End Theory Examination:

3. Duration - These examinations shall be of **2.5hrs** duration.
4. Theory question paper pattern:

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

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1)A)	Any 1 out of 2		Unit I
Q.1)B)	Compulsory		
Q.2)A)	Any 1 out of 2		Unit II
Q.2)B)	Compulsory		
Q.3)A)	Any 1 out of 2		Unit III
Q.3)B)	Compulsory		
Q.4)A)	Any 1 out of 2		Unit IV
Q.4)B)	Compulsory		
	TOTAL	**60**	

Practical Examination Pattern:

C) Internal Examination: 40%- 20 Marks

Particulars	
Journal	5
Experimental tasks	15
Total	**20**

D) External Examination: 60%- 30 Marks

Semester End Practical Examination:

Particulars	Paper
Laboratory work	30
Total	**30**

SEMESTER II:PRACTICAL COMPONENT

- RESEARCH PROJECT TO BE EXECUTED FOR THE RESEARCH PLAN SUBMITTED IN SEMESTER I WHICH CONSTITUTE 100M

Overall Examination & Marks Distribution Pattern

Semester II

Course	RPSBTK 201/202/203/204			Grand total
	Internal	External	Total	
Theory	40	60	100	400
Practicals	20	30	50	200

SEMESTER III

Course Code: RPSBTK301

Course Title: PTC and ATC
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the basic requirements of a tissue culture laboratory
CO 2	Design and carry out minor experiments in PTC, ATC following the required norms and protocols
CO 3	Make use of the safety and precaution controls in these labs
CO 4	Formulate and conduct simple experiments in ATC, PTC labs
CO 5	Apply different preservation techniques in ATC and PTC
CO 6	Formulate and illustrate the essential methodologies in ATC and PTC

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK301	I	**Plant tissue culture-** Introduction to primary and secondary metabolism, important pathways leading to biosynthesis of secondary metabolites in plants, Metabolic products produced from in vitro culturing of plant cells, selection of plant cells/ tissues for production of a specific products, culture system in secondary plant product .Biotransformation of precursors by cell culturing, metabolic engineering for production of secondary metabolites, Hairy root culture, elicitation	15
	II	**Plant tissue culture-II** Cryopreservation -Principle and types. Germplasm conservation, Transgenic plants- Edible vaccine, Golden rice	15

	III	**Animal tissue culture-I** Biology of cultured cells, Culture vessels, Culture Media, Microbial contamination, cross contamination. Cryopreservation, Primary culture: Types, isolation of tissues, culturing of different cells. Cell lines: Development, Subculture and propagation	15
	IV	**Animal tissue culture-II** Immortalization of cell line, cell line designation, selection of cell lines, routine maintenance, Cytotoxicity, Transformation, Culture of tumor cells, Scaffolds for Tissue Engineering: Classification of scaffold materials - examples, criteria for ideal scaffold, control of architecture, Scaffold design and fabrication techniques. Bioartificial organs: Artificial tissue and artificial skeleton. Three dimensional cell culture and tissue growth, 3D printing of tissue, cells and organs. Bioartificial heart, Bioartificial kidney. Tissue regeneration: Tissue regeneration driven by growth hormones, Stem Cells as source in regeneration of tissues, Therapeutic applications: Tissue therapy, Drug-vaccine-viral delivery in RM. Bioethical Issues.	15

References:

1. Plant Cells in liquid culture (1991) Author : Payne Shuler, Hanser Publishers
2. Biochemistry and molecular biology of plants by Buchanan, Gruissem, Jones; 1 st Edi ; I.K International publishers
3. Textbook of Plant Pharmaceuticals by Chandrakant Kokate; 1 st edition; Elsevier
4. Plant Biotechnology by K.G. Ramawat , 1 st Ed. S.Chand and Company
5. Culture of Animal Cells: A Manual of Basic Techniques by Ian Freshney

Practicals

RPSBTKP301

Course code	Title	Credits
RPSBTKP301	1. Media preparation (MS, B5 and coconut water) 2. Seed sterilization: Physical & Chemical methods. Check the efficiency of seed sterilization using both the methods. 3. Explant preparation, inoculation & initiation of tissue culture. 4. Callus induction and characterisation 5. Subculture of callus and plantlet establishment 6. Synthetic seed 7. Somatic embryogenesis 8. Establishment of suspension cultures. (Periodic subculture of callus can be done on solid media/ semisolid media / liquid media) 9. Dissection of chick embryo 10. Monolayer formation (fibroblast) and passaging. 11. To assay the radical scavenging activity of tissue hydrolysate- DPPH method 12. Techniques for cell preservation 13. Karyotyping with Giemsa staining 14. Observation of Normal and transformed cell line 15. Toxicology MTT Assay	2

Course Code: RPSBTK302

Course Title: MEDICAL MICROBIOLOGY
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Explain the basics of medical microbiology
CO 2	Comment and appreciate the significance of this field
CO 3	Develop an understanding of various disease related issues of medical microbiology
CO 4	Analyse and interpret the molecular techniques involved in medical microbiology
CO 5	Formulate and develop molecular diagnostic techniques for various infections
CO 6	Determine the role of biofilms in the field of medicine

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK302	I	**Cytogenetics** Chromosomal disorders, Karyotyping, G- banding, Chromosome analysis, variations, Chromosome painting, Molecular Cytogenetics, FISH, CGH	15
	II	**Medical microbiology** Infections of Respiratory tract- Pneumonia, GI tract infection- , Shigella, Vibrio,Salmonella, Nosocomial- S.pyogenes, Klebsiella. Viral infections-HIV, Hepatitis (ELISA). Fungal- Candidiasis. Parasitic: Malaria, Leishmania and Dengue, Ebola, SARS, Nipah, CoronaVirus	15
	III	**Molecular diagnostics** Introduction to molecular diagnostics, pros and cons, importance, molecular techniques, amplification based techniques (probe, signal and target	15

		amplification). Molecular diagnostics for Pneumonia, Tuberculosis, Pseudomonas, HIV, Hepatitis. Candidiasis	
	IV	**Biofilms** Biofilms in medicine:Outline specifications: Stages in biofilm formation, Quorum sensing, biofilm in medical devices- implants & treatments, biofilms in pathogenesis, biofilm forming organisms- *E.coli, Pseudomonas spp, S.aureus*	15

References:

1. Industrial Microbiology an Introduction Michael, Neil, John & Gary
2. Diagnostic Microbiology 5th edition Elmer Koneman, Stephen Allen Lippincott
3. Molecular Microbiology: Diagnostic Persing, Tenover, ASM press Washington
4. Principles & Practice (2004) Versalone DC
5. Pharmaceutical microbiology 7th ed., (2004) Hugo Russell's Edited by Stephen P. Denyer, Hodges and Sean P. Gorman

Practicals

RPSBTKP302

Course code	Title	Credits
RPSBTKP302	1. Medical diagnostic – Identification of organisms from specimens (Salmonella, Shigella, Klebsiella pneumoniae,). 2. Staining of Biofilms 3. ELISA for Hepatitis, 4. PCR based diagnosis for Malaria	2

Course Code: RPSBTK303

Course Title: GMO AND ENVIRONMENT
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student must be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Explain the importance GMOs and GM crops
CO 2	Elaborate on the development of GMOs to date
CO 3	Describe the use of genetic modification in agriculture
CO 4	Discuss the potential risks & benefits of human activities on the environment
CO 5	Discuss the potential risks & benefits associated with GMO crop consumption
CO 6	Articulate the concept of bioremediation of waste from different industries

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK303	I	**Introduction to GMOs** Genetically modified microorganisms, examples and methods, Humulin, ice minus bacteria, GM bacteria in bioremediation, use of PCR as a GMO identification tool, risks and controversies related to use genetically modified microorganisms. Proteins based assay methods, Toxicological evaluation.	15
	II	**GMO crops**	15

		GE crops' Arabidopsis as a model plant for studies in genetic engineering; Protocols on food and feed safety assessments, acute oral safety study in rats and mice, sub chronic feeding study in rodents, protein thermal stability, pepsin digestibility, livestock feeding	
	III	**Solid waste management** Solid waste treatment, pollution indicators & biosensors, biodegradation of xenobiotics, pesticides, phytoremediation	15
	IV	**Biodegradation** Biodegradation of waste from food, textile, petrochemicals, paper industries, biological detoxification, Removal of oil spillage & grease deposits, Valerization, Radioactive waste, pollution measurement by MHRD guidelines.	15

References:

1. Environmental Biotechnology (2nd Edition, 2005) Alan Scragg Oxford University Press
2. Environmental Biotechnology- Basic Concepts and Applications (2006) InduShekhar Thakur I. K. International Pvt. Ltd.
3. Environmental Biotechnology M. H. Fulekar Oxford & IBH Publishing

Practicals
RPSBTK303

Course code	Title	Credits
RPSBTKP303	1. Bioremediation- isolation of metal tolerant organisms & study their growth characteristics and pattern. 2. GMO validation – kit based/ demo 3. Isolation of pesticides degraders 4. Pollution indicators- Detection and Identification.	2

Course Code: RPSBTK304

Course Title: DEVELOPMENTAL BIOLOGY

Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Apply the key principles of developmental biology toward evaluating and analyzing primary literature in the field.
CO 2	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.
CO 3	Summarize the post fertilization events.
CO 4	Explain the molecular mechanisms of sex hormone.
CO 5	Discuss the immunology of pregnancy.
CO 6	Appraise and criticize the ethical issues in embryo research.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK304	I	**Human Embryonic development** Human Embryonic development: Events during fertilization, in-vitro fertilization, Zona pellucida, glycoprotein, Oelemma protein and their role in fertilization, sperm, antigens and their functional significance. Molecular and biochemical events during sperm function	15
	II	**Post fertilization events** Post fertilization events: early embryonic development, establishing multicellularity, formation of blastula, embryonic germ layer, tracking of migrating cells.	15
	III	**Sex hormones and Implantation** Molecular mechanism of sex hormone action and regulation of gene expression. Implantation and endometrium antigens involved in implantation.	15

		Immunology of pregnancy. Superovulation, embryo culture and embryo transfer technology	
	IV	**Infertility and reproductive vaccines** Infertility and reproductive vaccines. Frontiers in contraceptive research. Cryopreservation of sex gametes and embryos. 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. Slack Blackwell Publishing
3. Developemental Biology (8th Edition 2006) Scott F. Gilbert Sinauer Associates, Inc

Practicals
RPSBTKP304

Course code	Title	Credits
RPSBTKP304	1. Candling, Observing Chick embryo- stages of development, prepared slides/ Preserved specimen 2. Developmental biology- Visit to laboratory/video lectures for latest development in the field. To be documented	2

MSC PART II

Modality of Assessment (SEMESTER III)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1.	One Assignment/Case study/Project based / written assignment/ Presentations	20
2.	One Class Test (multiple choice questions/objectives/ match the column)	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **2.5 hours** duration.
2. Theory question paper pattern:
   - There shall be 4 questions each of 15 marks. On each unit there will be one question.
   - All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1)A)	Any 1 out of 2		Unit I
Q.1)B)	Compulsory		
Q.2)A)	Any 1 out of 2		Unit II
Q.2)B)	Compulsory		
Q.3)A)	Any 1 out of 2		Unit III
Q.3)B)	Compulsory		
Q.4)A)	Any 1 out of 2		Unit IV
Q.4)B)	Compulsory		
	TOTAL	**60**	

Practical Examination Pattern:

A) Internal Examination: 40%- 20 Marks

Particulars	Marks
Journal	05
Experimental tasks	15
Total	**20**

B) External Examination: 60%- 30 Marks

Semester End Practical Examination:

Particulars	Marks
Laboratory work	30
Total	**30**

Overall Examination & Marks Distribution Pattern

Semester III

Course	RPSBTK301/302/303/ 304			Grand Total
	Internal	External	Total	
Theory	40	60	100	400
Practicals	20	30	50	200

SEMESTER IV

Course Code: RPSBTK401

Course Title: NANOTECHNOLOGY
Academic year 2020-21

COURSE OUTCOMES: On course completion, the students should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the basics of nanotechnology, tools used for characterizing nanomaterials and specific applications of nanotechnology
CO 2	Examine the nanorobotics devices of nature
CO 3	Analyse and interpret the latest developments in nanotechnology in the field of medical sciences
CO 4	Explain drug delivery system using nanotechnology
CO 5	Apply nanomaterials in food, cosmetics, agriculture, environment management
CO 6	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	Lectures
RPSBTK401	I	**Introduction, synthesis of nanomaterials** 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 nanomechanical, optical, magnetic properties, electrical conductivity, thermal conductivity.	15
	II	**CNTs and nanomotors**	15

		Carbon nanotubes, Nanorobotics devices of nature: ATP synthase, the kinen, myosin, dynein, flagella modulated motion	
	III	**Nanomedicine** Nanomedicine: biopharmaceutics, implantable materials, implantable chemicals, surgical aids, diagnostic tools, nanosensors, nano scanning, nano enabled drug delivery system, nanorobotics in medicine.	15
	IV	**Applications of nanotechnology** Application of nanomaterials in food, cosmetics, agriculture, environment management	15

References:

1. The Nanoscopeencyclopedia of nanoscience and nanochehnology, VolI, V and VI (2005) Dr.ParagDiwan and AshishBharadwaj 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. Biotechnanotechnology lessons from Nature (2004) David Goodsell Wiley-Liss A John Wiley and sons
4. Nanotechnology- Basic science and emerging technologies (2005) WillsonKannangava, Smith, Simmons, RaguseOversease Press
5. Texbook of Biotechnology (2005) R. C. Dubey S. Chand and Co.
6. Nanotechnology- Principles and practices S. K. Kulkarni Capital Publishing Co.

Course Code: RPSBTK402

Course Title: IPR & PROTECTION OF INVENTIONS
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Elaborate on the rules and regulations for patenting
CO 2	Distinguish between copyright, Trademark, GI and Industrial designs
CO 3	Interpret different case laws in biotechnology
CO 4	Discuss the roles and responsibilities of the patent officer and the institution
CO 5	Examine various patent applications
CO 6	Summarize the various case studies associated

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK402	I	**Introduction to Intellectual Property** Introduction to IPR; Globalization & development of GATT, WTO, TRIPS agreement; Important provisions under TRIPS (Article/s 3, 4, 31/31f) agreement; Important provisions under Geographical indications act, PVPFRA; Traditional knowledge and Bio-piracy; Differences among copyright, Trademark, GI and Industrial designs; Classification of trademark; conventional v/s non-conventional.	15
	II	**Concept of 'prior art'** Indian patents act 1970 and rights of patentee (section 48), Principles of patent protection (sec 83); Patenting biotech inventions: objectives, concept of novelty, concept of inventive step, non-patentable objects (sec 3/4), Budapest treaty and protection of micro-organisms, moral issues in patenting biotech	15

		inventions; Important case laws under Biotechnology; Harvard onco-mouse case, Diamond vs Chakrabarty case, Turmeric case, Hoodia cactus case, Patent databases and patent search. International patent classification (https://www.wipo.int/classifications/ipc/en/) Analysis and report formation	
	III	**Patent filing and Infringement.** Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: ordinary patent application (provisional and complete specifications, timeline); PCT (timeline) and conventional patent applications; Patent-of-addition v/s divisional patent, publication of patents-gazette of India, status in Europe and US. Parts of a patent; How to write a claim, types of claims (independent v/s dependent claims, Markush claims, Omnibus claims, biotechnology claims, etc.), Patenting by research students, lecturers and scientists- University/organizational rules in India and abroad, credit/royalty sharing by workers and financial incentives. Patent infringement- meaning, scope, litigation, case studies and examples. Important case studies: Glivec case (section 3d), Natco v/s Bayer case of compulsory licensing	15
	IV	**Important aspects of IP protection** IP transfer, patent filing, types of patent, types of claim, claim drafting, patent search. Exhaustion doctrine and article 6 of TRIPS agreement in conjunction with sec 48 of Indian patents act 1970; case studies; fair dealing and de minimis principle. IP enforcement (proactive vs reactive measures):-civil, criminal and custom remedies.Article 34 of TRIPS agreement. Legislative structure and IP protection in India, role of IPAB. Copyright protection: Rights of copyright owner (sec14, economic rights; sec 57, moral rights),Contract of service v/s Contract for service (sec 17) and idea-expression dichotomy under Indian copyright act 1957; spring-board doctrine, doctrine of first-sale and Creative commons (CC). Levels of trademark protection (based on trade name). Passing off v/s trademarks infringement	15

References:

1. https://www.wipo.it/wipo_magazine/en/2011/03/article_0002.html
2. https://www.wipo.int/edocs/mdocs/africa/en/wipo_tiscs_znz_16/wipo_tiscs_znz_16_t_6.pdf
3. https://www.lexisnexisip.com/knowledge-center/totalpatent-one-and-the-usptos-seven-step-patent-search-strategy/
4. https://www.khuranaandkhurana.com/wp-content/uploads/2017/01/ANATOMY-OF-PATENT-SPECIFICATION.pdf
5. https://www.wipo.int/edocs/mdocs/aspac/en/wipo_ip_phl_16/wipo_ip_phl_16_t5.pdf
6. http://www.mondaq.com/india/x/667450/Patent/Patent+Claims+And+Their+Types

Course Code: RPSBTK403

Course Title: CLINICAL STUDIES

Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the ethical issues in human subjects research
CO 2	Imagine and understand the different phases of clinical trials
CO 3	Analyse the roles and responsibilities of the investigator and the institution
CO 4	Examine various regulatory issues related to clinical studies
CO 5	Recall the companies and organizations associated in this field
CO 6	Develop interest on medical writing and design a clinical study report

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK403	I	**Drug discovery and Preclinical toxicology** Pre-Clinical toxicology: General Principals,	15

		Systemic toxicology, (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements	
	II	**Introduction to Clinical trials** 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** 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.	15
	IV	**Medical Writing** Medical Writing: Literature search and medical articles, contract writing, publication, abstracts, bibliography, clinical study reports, principles and softwares in CDM (Clinical Data Management)	15

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 TalwarSabanna (2007) Serials Publications
6. IPR: Unleashing the Knowledge Economy (2003) PrabuddhaGanguli Tata Mcgrow Hill publication

Course Code: RPSBTK404
Course Title: BIOSTATISTICS
Academic year 2020-21

COURSE OUTCOMES: On course completion, the student should be able to:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Calculate standard normal scores and resulting probabilities
CO 2	Interpret and explain a p-value
CO 3	Perform a two-sample t-test and interpret the results; calculate a 95% confidence interval for the difference in population means
CO 4	Discuss and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations
CO 5	Analyse and interpret relative risks and odds ratios when comparing two populations
CO 6	Evaluate correlation and regression

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Lectures
RPSBTK404	I	**Introduction to Statistics** Statistical population, sample from population, Random sample. Central Tendency: Mean, Median and Mode, Standard Deviation Confidence intervals	15
	II	**Gaussian distribution and normality** Gaussian Distribution and testing for normality, Non-parametric tests (Sign test, Wilcoxon test, Mann-Whitney Test, Krushkal- Whllis test,), transforming data to create Gaussian Distribution	15
	III	**Hypothesis testing**	15

		Test of Significance. Hypothesis testing:- Theory of errors - Type I and Type II errors, Null hypothesis, P values-one v/s two tail P values, t-test(paired & unpaired), z-test, Chi square test, contingency table.	
	IV	**ANOVA** Comparing three or more groups- Introduction to ANOVA, One way ANOVA, repeated measures ANOVA, Friedman Test. Correlation and Regression: Linear and multiple Correlation and Regression.	15

References:

1. Introduction to Biostatistics (Second Edition-2005) N. Gurumani M J P Publishers
2. Basic Biostatistics (2008) B. Burt GerstmanJones and Bartlett Publishers
3. Biostatistics: A foundation For Analysis In Health Sciences (7th Edition 1999) Wayne W.
Daniel John Wiley & Sons Inc.
4. Fundamentals of Biostatistics (2006) Veer BalaRastogiAne Books India
5. Biostatistics- The Bare Essentials (Second Edition 2000) NosmanStreiner B. C. Decker Inc.

Practicals RPSBTKP401 to RPSBTKP404

Students will have to undergo a mandatory hands on project for 200M in an established laboratory/ Institute/ Industry/ Parent institute for 4-6 months. Submit Dissertation thesis and present it to the examiners during final exam.

MSC PART II

Modality of Assessment (SEMESTER IV)

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1.	One Assignment/Case study/Project based / written assignment/ Presentations	20
2.	One Class Test (multiple choice questions/objectives/ match the column)	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **2.5 hours** duration.
2. Theory question paper pattern:
   - There shall be 4 questions each of 15 marks. On each unit there will be one question.
   - All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
Q.1)A)	Any 1 out of 2		Unit I
Q.1)B)	Compulsory		
Q.2)A)	Any 1 out of 2		Unit II
Q.2)B)	Compulsory		
Q.3)A)	Any 1 out of 2		Unit III
Q.3)B)	Compulsory		
Q.4)A)	Any 1 out of 2		Unit IV
Q.4)B)	Compulsory		
	TOTAL	**60**	

Practical Examination Pattern:

Students will have to undergo a mandatory hands on project for 200M in an established laboratory for 4-6 months

A) Internal Examination: 40%- 80 Marks

Particulars	Marks
Guide	40
Panel of Departmental Teachers	40
Total	**80**

B) External Examination: 60%- 120 Marks

Semester End Practical Examination:

Particulars	**Paper**
Semester End Examiner	60
Semester End Examiner	60
Total	**120**

Overall Examination & Marks Distribution Pattern

Semester IV

Course	**RPSBTK401/402/ 403/404**			**Grand Total**
	Internal	**External**	**Total**	
Theory	**40**	**60**	**100**	**400**
Practicals	20	**30**	**50**	**200**
