Resolution No. AC/II(23-24).2.RPS2

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore ● Experience ● Excel

Syllabus for

Program: MSc

Program Code: RPSBCH

(As per the guidelines of National Education Policy 2020-Academic year 2024-25)

GRADUATE ATTRIBUTE

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 **A student completing Master's Degree in Science program will be able to:**
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, analyse, 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 **A student completing Master's Degree in Science program in the subject of Biochemistry will be able to:**
PO 1	Acquire necessary knowledge and skills to undertake a career in research, either in industry or in an academic set up.
PO 2	Compare and contrast the breadth and depth of scientific knowledge in the broad range of fields including Protein biochemistry, Bioenergetics, Diagnostic Biochemistry, Hormonal Biochemistry, Molecular Biology, Nutritional Biochemistry, and Nanotechnology.
PO 3	Extrapolate and comprehend the regulatory role of metabolic processes and understand the underlying cause of metabolic disorders
PO 4	Acquire thorough knowledge of Biochemical Techniques, Advanced Immunology, Physiology, Genetic Engineering, and Biotechnology
PO 5	Describe and express the biochemical basis of human diseases, protein structure and conformation, non-invasive diagnostics, clinical research, and its importance in drug development. Usage of this knowledge further for multitude of laboratory applications.
PO 6	Integrate and apply the techniques in Biophysics, Analytical Biochemistry, Clinical biochemistry, Microbiology, Molecular Biology and Basics in Bioinformatics
PO 7	Gain proficiency in laboratory techniques in both Biochemistry and Molecular Biology, and be able to apply the scientific method to the processes of experimentation and Hypothesis testing
PO 8	Develop and enhance skills & improve employability through academic, research and internship opportunities
PO 9	Gain exposure to basic research through the provision of PG research based project.
PO 10	Learn to work as a team as well as independently to compile and interpret Biological data, carry out Research investigations and draw conclusions

CREDIT STRUCTURE FOR MSc

Semester	Mandatory	Elective	RM	OJT/FP	RP/ Internship	Cum.Credits
1	14 (3+1)*3+2	4(3+1)	4	0	0	22
2	14 (3+1)*3+2	4(3+1)	0	4 FP	0	22
3	12 (3+1)*3	4(3+1)	0	0	6 RP	22
4	8 (3+1)*2	4(3+1)	0		10 OJT	22
Total CREDITS	**48**	**16**	**4**	**4**	**16**	**88**

PROGRAM OUTLINE

YEAR	SEM	CORE COURSE	Type of Course	COURSE TITLE	CREDITS
MSc II	III	RPSBCHO601	DSC I	Advanced Metabolism	3
		RPSBCHPO601	Practical DSC I	Practicals based on Major Theory	1
		RPSBCHO602	DSC II	Eukaryotic Molecular Biology	3
		RPSBCHPO602	Practical DSC II	Practicals based on Major Theory	1
		RPSBCHO603	DSC III	Advanced Endocrinology	3
		RPSBCHPO603	Practical DSC III	Practicals based on Major Theory	1
		RPSBCHO604	DSE	Plant Biochemistry	3
		RPSBCHPO604	Practical DSE	Practicals based on Theory	1
			Dissertation		6
	IV	RPSBCHE611	DSC I	Developmental Biology, Cancer & Immuno-deficiencies	3
		RPSBCHPE611	Practical DSC I	Practicals based on Major Theory	1
		RPSBCHE612	DSC II	Advanced Immunology	3
		RPSBCHPE612	Practical DSC II	Practicals based on Major Theory	1
		RPSBCHE613	DSE	Pathophysiology of Diseases & Clinical Research	3
		RPSBCHPE613	Practical DSE	Practicals based on Major Theory	1
			Internship		10

Course Code DSC I: RPSBCHO601

Course Title: Advanced Metabolism

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand the major catabolic and anabolic pathways in metabolism of carbohydrates, lipids, amino acids and nucleotides.
CO 2	Describe regulatory mechanisms that control the metabolic pathways.
CO 3	Realize the Influence of Diet and hormonal signalling on metabolic pathways.
CO 4	Learn Biochemical functions and integrated metabolism of in brain, digestive system, liver, red cell, muscle and adipocyte.
CO 5	Illustrate the molecular mechanisms underlying major inherited diseases of metabolism.
CO 6	Understand the relationship between the properties of macromolecules and cellular activities, cell metabolism and chemical composition.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Advanced Metabolism RPSBCHO601	Credits/ Hours 3 / 45 Hours
I	**1**	**Carbohydrate Metabolism**	**15**
	1.1	Gluconeogenesis: Pathway and its Regulation	
	1.2	Glycogen Metabolism: Synthesis, breakdown, mechanisms of control of glycogen metabolism - Direct Allosteric Control of Glycogen Phosphorylase and Glycogen Synthase, Covalent Modification of Enzymes by Cyclic Cascades, Hormonal regulation, Maintenance of Blood Glucose Levels	
	1.3	Futile cycle, Rapoport Luebering cycle, Cori cycle, Glucose-Alanine cycle & their significance	
	1.4	Shuttles-Malate-Aspartate shuttle & Glycerol phosphate shuttle	
	1.5	Uronic acid pathway (biosynthesis, degradation & its significance), Galactose and fructose metabolism; Sorbitol pathway	
	1.6	Biosynthesis of oligosaccharides and glycoproteins, Synthesis of Blood Group Antigens	
	1.7	Regulated synthesis of starch and sucrose	
II	**2**	**Amino acid metabolism**	**15**
	2.1	Metabolism of individual amino acids Glycine, Phenylalanine, Tyrosine, Tryptophan, Glutamate	
	2.2	Metabolism of sulphur containing amino acids	
	2.3	Metabolism of branched-chain amino acid	
	2.4	Glucogenic and ketogenic amino acids.	
	2.5	Biosynthesis of amino acids Overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation	
	2.6	Precursor functions of amino acids	
	2.7	Biosynthesis of creatine and creatinine, polyamines (putresine, spermine, spermidine), catecholamines (dopamine, epinephrine, norepinephrine) and neurotransmitters (serotonin, GABA).	
III	**3**	**Lipid metabolism**	**15**
	3.1	Overview of β-oxidation pathway	
	3.1.2	β-oxidation of unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty	

		acid oxidation, peroxisomal β-oxidation, ω oxidation, ketone bodies metabolism, ketoacidosis	
	3.2	Fatty acid synthesis	
	3.2.1	Transport of mitochondrial Acetyl Co A to cytosol, Fatty acid synthase complex, Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation.	
	3.2.2	Biosynthesis of eicosanoids, cholesterol, steroids and isoprenoids	
	3.2.3	Synthesis of prostagladins, leukotrienes and thromboxanes. Synthesis of cholesterol, regulation of cholesterol synthesis. Synthesis of steroids and isoprenoids.	
	3.2.4	Biosynthesis of glycerophospholipids and sphingolipids	

PRACTICAL

	Course code- RPSBCHPO601 **Practical Title-** Practical I	1 Credit
1) 2) 3) 4) 5) 6) 7)	Estimation of glucose by the GOD-POD method Affinity studies of Glucokinase & Hexokinase Effect of physical status (active vs sedentary) on glucose metabolism Estimation of Amino Acids by Ninhydrin Method Determination of activity of urease Estimation of ammonia in the excreta of ammonotelic organisms Estimation of unsaturated fatty acids	

References:

1. Biochemistry - U. Sathyanarayana - Books and Allied (P) Ltd. Kolkata.
2. Biochemistry - Voet, D. and Voet, J.G. - John Wiley & Sons, Inc. USA.
3. Biochemistry by L. Stryer W.H. Freeman Press, San Francisco, USA.
4. Outlines of Biochemistry - E.E. Conn and P.K. Stumpf – Wiley Eastern, New Delhi.
5. Text book of Biochemistry - J.L Jain
6. Text Book of Biochemistry - D.M. Vasudevan
7. Text Book of Biochemistry - A.C. Deb, 9th revised edition (2017)
8. Biochemistry - Garret, R.H. and Grisham, C.M. (2005) Thomson Learning INC.
9. Biochemical methods - S Sadashivam and A Manickam - New Age International publishers
10. Laboratory Manual in Biochemistry - J. Jayaraman - New Age International
11. An Introduction to Practical Biochemistry - Plummer David

Course Code DSC II: RPSBCHO602

Course Title: Molecular Biology II

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Define the molecular events of DNA Replication, transcription, and translation process
CO 2	Enlist different types of repair mechanisms and explain their mechanisms
CO 3	Outline the principle of gene organization and the roles of promoters, coding, and termination sequences
CO 4	Compare and state differences in the transcription process occurring in prokaryotes and eukaryotes
CO 5	Discuss how gene expression is regulated at the post-transcriptional level
CO 6	Analyse the tools and techniques for construction of recombinant DNA, cloning vectors & genomic and cDNA library
CO 7	Recall the applications of RDT in various field
CO 8	Make use of theoretical concepts of molecular biology and develop experimental acumen.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Molecular Biology II RPSBCHO602	Credits/ Hours 3 / 45 Hours
I	**1**	**Central Dogma of Eukaryotes**	**15**
		DNA Replication in eukaryotes	
	1.1.	Features of eukaryotic chromosome, Eukaryotic DNA polymerases	
	1.2.1	Proteins and accessory molecules essential in the initiation, and elongation steps	
	1.2.2	Mechanism (Pre-RC assembly, Initiation, elongation & termination)	
	1.3	Concept of Okazaki fragment maturation, long & short flap processing, Stalled replication fork, End replication problem and role of telomerases	
		Transcription in eukaryotes	
	1.4	Role of promoter & regulatory elements, Eukaryotic RNA polymerases	
	1.5	Mechanism of RNA transcription in eukaryotes - Formation of pre-initiation complex, initiation, elongation and termination, Phosphorylation of RNAPII	
	1.6	mRNA splicing, Processing of tRNA, Base modifications in tRNA, Eukaryotic rRNA processing (arrangement of eukaryotic rDNA), Role of snoRNA	
		Translation in eukaryotes	
	1.7	Mechanism of eukaryotic translation: Initiation, elongation & termination	
	1.8.1	Signal hypothesis	
	1.8.2	Role of signal peptide & its role in Protein sorting, Protein localization in Nucleus	
II	**2**	**Gene Regulation in prokaryotes & eukaryotes**	**15**
	2.1	Gene regulation in prokaryotes	
	2.1.1	Principles of gene regulation, Constitutive & inducible genes, one cistron-one subunit concept	
	2.1.2	Negative and positive regulation	
	2.2	Concept of operons, regulatory proteins, activators, repressors, DNA binding domains, allosteric site	
	2.3	Lac, Tryptophan and Arabinose operon – Structure, inducers (allolactose, IPTG), Negative control & Positive control of lac operon	
	2.4	Gene regulation in Eukaryotes	

	2.4.1	Role of regulatory transcription factors in eukaryotic gene regulation-general TF and Regulatory TF, TFIID and Mediator	
	2.4.2	Regulation of galactose metabolism in yeast	
	2.4.3	Regulatory RNAs in eukaryotes: synthesis and mechanism of siRNA and miRNA	
III	**3**	**Genetic Mapping**	**15**
	3.1	Genetic Transfer and Mapping In Bacteria	
	3.1.1	Use of conjugation to map the order of genes along the E. coli chromosome	
	3.1.2	Cotransduction can be used to map genes that are within 2 minutes of each other	
	3.2	Intragenic mapping in Bacteriophages	
	3.3	Genetic linkage, Genetic recombinations: Holliday models	
	3.4	Genetic mapping in plants & animals, Frequency of recombination, Map distance	
	3.5.1	Trihybrid Crosses Can Be Used to Determine the Order and Distance Between Linked Genes	
	3.5.2	Gene mapping – Genome mapping (genetic mapping, Physical mapping)	
	3.6	Tetrad analysis Problems based on above concept	
	3.7	Mitotic Recombination	

PRACTICAL

	Course code- RPSBCHPO602 **Practical Title-** Practical II	1 Credit
1)	Isolation of histones from yeast cells	
2)	Study of inhibitors on protein synthesis by yeast cells	
3)	Determination of gene order and construction of a gene map (dihybrid & trihybrid cross)	
4)	Compute gene distance for the given sequence	
5)	Chi-square analysis to distinguish between linkage and independent assortment	
6)	Ordered & Unordered Tetrad analysis	
7)	Use of conjugation to map the order of genes	
8)	β-galactosidase Activity Assay in Permeabilized Yeast	

References:

1. Genetics Analysis and Principles by Robert J. Brooker
2. Molecular Biology of Cell: Bruce Alberts, 4th Edition, Garland Science
3. Tropp, B.E. Molecular Biology. Genes to Proteins.2011 (4th Ed.) Jones and Bartlett publications.
4. Freifelder, D. Essential of Molecular Biology, 1998 (3rd Ed.)

5. Lewin, B. Gene X, Jones & Bartlett, 2009
6. Molecular Cell Biology by James Dernell, Harvey Lodish and David Baltimore, W.H. Freeman & Co., 2007 (6th Ed.).
7. From Genes to Genomes by Bale J.W. & Schantz M. V. (2003).
8. Gene Biotechnology by Jogdand

Course Code DSC III: RPSBCHO603

Course Title: Advanced Endocrinology

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Study the historical experiments that lead to the discovery of various hormones
CO 2	Deeply understand the communication between the nervous system and the endocrine system
CO 3	Learn the structure, functions and the disorders associated with the various hormones starting from the pituitary hormones to the gonadal hormones.
CO 4	Appreciate and analyze the endocrine regulation of the various metabolisms such as carbohydrate metabolism, Protein metabolism, calcium homeostasis, menstrual cycle, pregnancy and menopause.
CO 5	Apply the knowledge of hormones in assay of hormones such as T3, T4 and TSH and understand the strategy behind contraception.
CO 6	Present a case study on a hormonal and a metabolic disorder

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Advanced Endocrinology RPSBCHO603	Credits/ Hours 3 / 45 Hours
I	**1**	**Hormones regulating Metabolism, Calcium homeostasis and Growth**	**15**
	1.1.1	Thyroid gland- Histology	
	1.1.2	Biosynthesis of thyroid hormone and its regulation: Role of TRH and TSH in T4 synthesis and response	
	1.1.3	Physiological and biochemical action of Thyroxine	
	1.1.4	Pathophysiology of thyroxine secretion: Hyper and hypothyroidism, Goitre, Graves' disease, Cretinism, Myxoedema	
	1.2.1	Regulation of calcium homeostasis: PTH, Vitamin D and calcitonin	
	1.2.2	Mechanism of Ca2+ regulation and pathways involving bone, skin, liver, gut and kidneys	
	1.2.3	Pathophysiology - rickets, osteomalacia, osteoporosis	
	1.3	Regulation of Growth: growth hormone and somatomedin	
	1.4	Endocrine disorders - gigantism, acromegaly, dwarfism, pygmies	
	1.5	Physiology and biochemical actions of Growth factors- EGF, PDGF and EPO	
II	**2**	**Hypothalamic- hypophysial system & Hormones of the adrenals**	**15**
	2.1	Hypothalamic - Pituitary axis: anatomy, histology, vasculature and secretions	
	2.2.1	Physiological and biochemical actions of hypothalamic hormones and Anterior pituitary hormones	
	2.2.2	Hormone feed- back regulatory cascade	
	2.3.1	Posterior pituitary hormones –structure, physiology	
	2.3.2	Biochemical actions of AVP and Oxytocin; Diabetes insipidus	
	2.4	Histology of Adrenal Gland	
	2.5	Physiology and action of Aldosterone; the Renin Angiotensin System	
	2.6.1	Physiology and Biochemical actions of Cortisol	

	2.6.2	Regulation of cortisol synthesis: POMC and CRH	
	2.7.1	Adrenal medullary Hormones: Epinephrine and Norepinephrine	
	2.7.2	The Fight or flight response; Dual receptor hypothesis	
	2.8	General adaptation syndrome: acute and chronic stress response	
	2.9	Pathophysiology – Addison's disease, Conn's syndrome, Cushing syndrome.	
III	**3**	**Pancreatic, GI tract and Reproductive hormones**	**15**
	3.1	Cells involved in release of gastrointestinal hormones	
	3.1.1	Gastrin family of hormones	
	3.1.2	CCK: the secretin family of hormones	
	3.1.3	Incretins; Ghrelin	
	3.2	Summary of hormone metabolite control of GI function	
	3.3	Hormones of the Pancreas: Structure, synthesis, physiology and biochemical actions of insulin and glucagon	
	3.4	Adipocyte hormones: Adiponectin and leptin; Appetite and satiety control	
	3.5	Pathophysiology - . Type I and type II Diabetes mellitus, Obesity and Metabolic syndrome	
	3.6	Male and female sex hormones	
	3.6.1	Interplay of hormones during ovarian and uterine phases of menstrual cycle	
	3.6.2	Placental hormones; role of hormones during parturition and lactation	
	3.6.3	Hormone based contraception	
	3.6.4	Concept - ammenorrhea, menorrhagia, PMS, PCOS, Menopause	

PRACTICAL

	Course code- RPSBCHPO603 **Practical Title-** Practical III	1 Credit
1) 2) 3) 4)	Estimation of serum electrolytes Estimation of serum Calcium by colorimetric method Study of human menstrual cycle Case study on Diabetes mellitus, obesity & metabolic syndrome	

5) 6)	Case study on hormonal changes in males & Females Visit to a Pathology lab & Report Writing	

References

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (NewYork), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962- 1.
2. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.
4. Guyton and Hall Textbook of Medical Physiology 13th Edition by John E. Hall, Elsevier
5. Harrison's Endocrinology, Second Edition by J. Larry Jameson
6. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893- 300-6.

Modality of Assessment: Semester III

Disciple Specific Course

A) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class test	20
2	Class test/ Project/ Assignment/ Presentation	10
	TOTAL	**30**

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

Semester End Theory Examination:

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

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 4	15	UNIT I
Q2.	Any 3 out of 4	15	UNIT II
Q3.	Any 3 out of 4	15	UNIT III
	TOTAL	**45**	

Semester End Practical Examination:

Practical Examination Pattern:

	Particulars	Marks
1	Laboratory work	40
2	Viva	05
3	Journal	05
	TOTAL	**50**

Semester IV

Course Code DSC I: RPSBCHE611

Course Title: Developmental Biology, Cancer & Immuno-deficiencies

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	understanding of the concepts of early animal development
CO 2	develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals.
CO 3	Comprehend the basics of cancer and identify with the concept of cancer as a disease and the process of carcinogenesis
CO 4	Perform the basic and the advanced molecular techniques used in cancer diagnostics and interpret the results
CO 5	Make objective decisions about the harmful effects of cancer causing agents and create awareness about them among the common man
CO 6	Recognize clinical signs and symptoms that would warrant a work-up for a primary immunodeficiency disorder
CO 7	Select the laboratory work-up required to diagnose the more common immunodeficiency disorders
CO 8	Describe the treatment options for patients with primary immunodeficiency disorders including immunoglobulin replacement

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Developmental Biology, Cancer & Immuno-deficiencies RPSBCHE611	Credits/ Hours 3 / 45 Hours
I	**1**	**Developmental Biology**	**15**
	1.1	Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation	
	1.2	Morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants	
	1.3	Gametogenesis, fertilization (in humans & sea urchin)	
	1.4	Early development, cell surface molecules in sperm-egg recognition in animals	
	1.5	Embryonic cleavage	
	1.6	Formation of germ layers in animals	
	1.7	Sexual reproduction in plants - Gametogenesis, double fertilization in plants	
II	**2**	**Cancer**	
	2.1	Genetic basis of cancer	
	2.2	Experimental evidenced for transformation of cell	
	2.3	Oncogenes	
	2.3.1	Identification of chromosomal oncogene	
	2.3.2	Gain of function mutation	
	2.3.3	Conversion of proto-oncogene to oncogene	
	2.3.4	Missense mutation, Gene amplification , chromosomal translocation , viral integration	
	2.4	Tumor suppressor gene- Role of p53 and RB gene	
	2.5	Assays – Trypan blue exclusion method, MTT assay, Soft Agar Colony Formation Assay	
	2.6	Molecular profiling for classification of cancer,	
	2.7	DNA microarray	
	2.8.1	Cancer therapy- Antimetabolites, Chemotherapy (purine & pyrimidine analog), Demethylating agents	
	2.8.2	Cancer immunotherapy	
III	**III**	**Immuno-deficiencies**	**15**
	3.1	Introduction	
	3.2	Primary Immuno-deficiencies	
	3.2.1	Immunodeficiencies of the Lymphoid Lineage – SCID, WAS, IFN- γ receptor defect, XLA, XHM, CVI	

	3.2.2	Immunodeficiencies of the Myeloid Lineage – reduction in neutrophil count, CGD, Chediak-Higashi Syndrome, LAD	
	3.2.3	Immunodeficiencies & Complement defects	
	3.3	Secondary Immuno-deficiencies - AIDS	
	3.3.1	Structure & Genetic basis of HIV, Mode of transmission,	
	3.3.2	Immunologic abnormalities associated with HIV infection	
	3.4	Treatment of Immuno-deficiencies	

PRACTICAL

	Course code- RPSBCHPE611 **Practical Title-** Practical I	1 Credit
1) 2) 3) 4) 5) 6) 7)	Study of developmental stages of human foetus Types of cleavage in different organisms Visualization of cells by methylene blue Visualization of cells by Trypan blue Study of viability of cells using Neutral Red Assay Experimental Models of Immunodeficiency - Nude mice, Scid Mouse HIV Test Kit	

References

1) Developmental Biology by Barresi –Gilbert
2) Guyton and Hall Textbook of Medical Physiology 13th Edition by John E. Hall, Elsevier
3) Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.
4) Immunology by Rao C Vaman

Course Code DSC II: RPSBCHE612

Course Title: Advanced Immunology

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Learn the fundamental principles of immune response including molecular, biochemical and cellular basis of immune homeostasis
CO 2	Develop various aspects of immunological response and how its triggered and regulated
CO 3	Explain the specific interactions of Antigens and antibodies and the diversity of antibodies developed at the germ line DNA
CO 4	Complete knowledge of the molecular mechanisms and kinetics of the immune responses, both humoral and cell mediated immunity
CO 5	Enhance the knowledge of various immune-techniques ranging from precipitation and agglutination reactions to ELISA, Radio immunoassay and flow cytometry.
CO 6	The course will aid in understanding the principles of Graft rejection, Auto immunity and Antibody based therapy.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Advanced Immunology RPSBCHE612	Credits/ Hours 3 / 45 Hours
I	**1**	**MHC, Antigen processing and presentation & TCR**	**15**
	1.1	Major histocompatibility complex	
	1.1.1	MHC polymorphism & organization of MHC genes-class I & class II	
	1.1.2	Cellular distribution & structure of class I & II molecules	
	1.1.3	MHC and immune responsiveness – Determinant-selection model and Holes-in-the-repertoire model	
	1.1.4	MHC and disease susceptibility (Hereditary haemochromatosis)	
	1.2	Antigen processing and presentation	
	1.2.1	Self MHC restriction of T cells	
	1.2.2	Cytosolic and endocytic pathway	
	1.2.3	Presentation of non-peptide antigens	
	1.3	T-cell Receptor	
	1.3.1	Structure, organization & rearrangement of TCR genes	
	1.3.2	TCR receptor complex TCR – CD3	
	1.3.3	TCR accessory membrane molecules	
	1.3.4	Ternary TCR-peptide-MHC complex	
II	**2**	**B- and T-lymphocytes**	**15**
	2.1	T-cell Maturation	
	2.2	Thymic selection of T-cell repertoire – Positive and negative selection, central issues in thymic selection	
	2.3	TH-cell activation	
	2.4	T-cell differentiation	
	2.5	Peripheral γδ T-cell	
	2.6	Cytotoxic T-cells	
	2.7	B-cell maturation	
	2.8	B-cell activation and proliferation – Thymus dependent and Thymus independent	
	2.9	Formation of T-B conjugates	
III	**3**	**Cytokines & Immune response in health & diseases**	**15**
	3.1	Humoral and cell mediated immune response	

	3.1.1	Cytokines - Introduction, Properties	
	3.1.2	Cytokine receptors	
	3.1.3	Biological functions of cytokines	
	3.1.4	Therapies based on Cytokines	
	3.2	Hypersensitivity reactions	
	3.2.1	Gel & Coomb's classification - types of hypersensitivity reactions	
	3.3	Transplantation immunology	
	3.3.1	Types of transplant; immunological basis of allograft rejection.	
	3.4	Autoimmunity	
	3.4.1	Organ specific –Myasthenia gravis; Hashimotos thyroiditis; Graves' Disease; Systemic – Rheumatoid arthritis, Systemic lupus erythematosus	

PRACTICAL

	Course code- RPSBCHPE612 **Practical Title-** Practical II	1 Credit
1) 2) 3) 4) 5) 6) 7) 8) 9)	Preparation of blood smear and Differential leucocyte count. Separation of lymphocytes by Ficoll Hypaque method Lymphocyte viability testing by trypan blue Assays based on precipitation reactions - Ouchterlony double immunodiffusion (DID) and Mancini radial immunodiffusion (SRID). Assays based on agglutination reactions - Blood typing (active) & passive agglutination (C reactive protein kit & virtual lab). Estimation of Rheumatoid factor Demonstration of Enzyme linked immunosorbent assay (ELISA) & DOT ELISA Separation of serum proteins by PAGE Virtual Lab to study immunological Techniques	

References-

1. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7th ed., Wilson, K., and Walker, J. (eds), Cambridge University Press (New Delhi)
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D.,Wiley Blackwell (West Sussex)
3. Analytical Biochemistry by David Holme and Hazel Peck

4. Introduction to Instrumentation in Life Sciences (2012) Bisen, P.S. and Sharma, A., CRC Press/Taylor and Francis Group (California), ISBN:978-1-4665-1240-
5. Biophysical Chemistry (2013), Schimmel, C.R.C., Macmillan Higher Education
6. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
7. Chromatography – G. Abbott
8. Biochemical methods, S Sadashivam and A Manickam, new age international publishers
9. J. Jayaraman , Laboratory Manual in Biochemistry, 2003, New Age International

Modality of Assessment: Semester IV

Disciple Specific Course

A) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class test	20
2	Class test/ Project/ Assignment/ Presentation	10
	TOTAL	**30**

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

Semester End Theory Examination:

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

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 4	15	UNIT I
Q2.	Any 3 out of 4	15	UNIT II
Q3.	Any 3 out of 4	15	UNIT III
	TOTAL	**45**	

Semester End Practical Examination:

Practical Examination Pattern:

	Particulars	Marks
1	Laboratory work	40
2	Viva	05
3	Journal	05
	TOTAL	**50**