

S.P. Mandali's
RAMNARAIN RUIA AUTONOMOUS COLLEGE



Syllabus for: T.Y. B.Sc

Program: B.Sc. Biotechnology

Course Code: BIOTECHNOLOGY (RUSBTK)

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

PROGRAM OUTCOMES

PO	PO Description
	A student completing Bachelor's Degree in Science program will be able to:
PO 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
PO 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
PO 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
PO 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
PO 5	Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
PO 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
PO 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
PO 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree in Science program in the subject of Biotechnology will be able to:
PSO 1	Adept in basic sciences along with a thorough understanding of biotechnology principles and chemical sciences to create a foundation for higher education with the insights into interdisciplinary approach.
PSO 2	Demonstrate the applications of fundamental biological processes from the molecular, cellular, industrial and environmental perspective.
PSO 3	Develop effective communication skills with improved individual and team work abilities in the domain of scientific research writing. Showcase their innovative ideas and research work efficiently.
PSO 4	Reflect, analyse and interpret information or data for investigating the problem in fields of biotechnology. Acquire scientific and entrepreneur skills to furnish sustainable solutions to coeval problems
PSO 5	Illustrate the relevance of ethical implications and standard laboratory practices in tissue culture techniques, forensic biology, developmental biology and other fields of biotechnology.
PSO 6	Apply the conceptual knowledge to develop coherent, efficacious and proficient practical, technical and analytical skills.

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

Syllabus for T.Y.BSc Biotechnology

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

Semester V				
Course code	Unit	Topic	Credits	Lecture s/week
Paper I : Cell Biology RUSBTK501	Unit I	Cell cycle and apoptosis	2.5	1
	Unit II	Cell signalling-I		1
	Unit III	Cell signalling-II		1
	Unit IV	Cancer biology		1
Paper II: Biochemistry RUSBTK502	Unit I	Carbohydrate metabolism	2.5	1
	Unit II	Protein biochemistry		1
	Unit III	Endocrinology-I		1
	Unit IV	Endocrinology-II		
Paper III: Genetics and Molecular Biology RUSBTK503	Unit I	Enzymes and vector	2.5	1
	Unit II	Cloning strategies and sequencing		1
	Unit III	Genetic mapping		1
	Unit IV	Gene editing and human genome		1
Paper IV: Industrial Biotechnology RUSBTK504	Unit I	Dairy technology	2.5	1
	Unit II	Brewing technology		1
	Unit III	Downstream processing		1
	Unit IV	Recent trends and development in industrial productions		
Paper V AC- Biosafety RUSBTKAC501	Unit I	Introduction to Biosafety	2	1
	Unit II	GLP		1
	Unit III	GMP & QA- QC		1
	Unit IV	Detection and testing of contaminants		1
Practicals of Biotechnology RUSBTKP501 & RUSBTKP502		Practical Based on all four papers	6	16
Practicals of AC RUSBTKACP501		Practicals based on AC	2	3
TOTAL CREDITS			20	

Semester VI				
Course code	Unit	Topic	Credits	Lectures/week
Paper I: Immunology, Virology and Instrumentation RUSBTK601	Unit I	Immunology	2.5	1
	Unit II	Virology		1
	Unit III	Spectrometry and tracer techniques		1
	Unit IV	Chromatography and centrifugation		1
Paper II: Developmental biology and transgenesis RUSBTK602	Unit I	Developmental biology	2.5	1
	Unit II	Assisted reproductive technology and stem cell banking		1
	Unit III	Genetic engineering of plants		1
	Unit IV	Transgenic animals		
Paper III: Pharmacology RUSBTK603	Unit I	Chemotherapeutic agents	2.5	1
	Unit II	General principles of pharmacology		1
	Unit III	Drug absorption and distribution		1
	Unit IV	Basic and regulatory toxicology		1
Paper IV: Environmental and Plant biotechnology RUSBTK604	Unit I	Biofuels and biogas	2.5	1
	Unit II	Industrial effluent treatment		1
	Unit III	Plant biotechnology		1
	Unit IV	Biofertilizers and biopesticides		1
Paper V: AC- Marine biotechnology and aquaculture RUSBTKAC601	Unit I	Marine biotechnology introduction and bioprospecting	2	1
	Unit II	Applications of marine biotechnology		1
	Unit III	Introduction to Aquaculture		1
	Unit IV	Applications of Aquaculture		1
Practicals of biotechnology RUSBTKP601 & RUSBTKP602		Practical Based on all four papers	6	16
Practicals of AC RUSBTKACP601		Practicals of AC	2	3
TOTAL CREDITS			20	

SEMESTER V

TYBSC BIOTECHNOLOGY (2018-2019)

Paper I: Cell Biology

Course Objectives:

- To deepen the knowledge of cellular biology
- To help them get acquainted with cell cycle and apoptosis
- To understand detailed implications of cellular signalling
- To understand cancer biology

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

1. Comment on the overall cell cycle
2. Elucidate the role of apoptosis
3. Get an overall outlook about cancer biology
4. Talk about the principles of cell signalling
5. Comment on different pathways in cellular signalling and their activation and implication

Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK501	I Cell cycle and apoptosis	Cell cycle and programmed cell death- Overview of cell cycle, Components of cell cycle control system, intracellular control of cell cycle events, Programmed cell death (apoptosis)- intrinsic and extrinsic pathway of apoptosis , extracellular control of cell division, cell growth and apoptosis Mechanics of cell division- overview of M phase, mitosis and cytokinesis	2.5	15
	II Cell signalling-I	Cell signalling and signal transduction: Introduction General Principles of Cell Signalling, Signalling via G-Protein-linked Cell-Surface Receptors Signalling via Enzyme-linked Cell-Surface		15

		Receptors – protein tyrosine phosphorylation		
	III Cell signalling-II	Response to multiple extracellular signal molecules Morphogens, Lifetime of intracellular molecule, Binding reaction and role of Kd, Extracellular messengers and their receptors, Second messengers Role of Calcium and cAMP, Introduction, Calcium binding proteins, Role of Nitric oxide and nuclear receptors The Logic of Intracellular Signalling: Lessons from Computer-based "Neural networks"		15
	IV Cancer biology	Cancer: Introduction, Characteristics of normal cell and cancerous cell. Cancer as a micro evolutionary process: invasion metastasis, angiogenesis, Tumor-Benign and malignant, Molecular genetics of cancer, oncogenes and tumor suppressor genes, Cancer virus, Diagnosis, chemotherapy and preventive measures for cancer, Cytocidal infections and cell damage, Viruses and cancer, Viroids and Prions		15

References:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA

4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA

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PAPER II: Biochemistry

Course Objectives:

- To study in depth the biochemical pathways of cellular communication and system functioning
- To study metabolism in details with special reference to carbohydrates
- To study details about protein structure and their biochemistry
- Study endocrine system

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

1. Understand the metabolism of carbohydrates and fates of various intermediate and end products
2. Understand protein structure
3. Comment on different types of protein interactions
4. Understanding the mechanisms of hormones

Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK502	I Carbohydrate metabolism	Biochemical pathway for Synthesis and regulation of carbohydrates in Bacteria –Peptidoglycan Plants – starch and sucrose Animals – Glycogen synthesis and breakdown Gluconeogenesis, HMP pathway	2.5	15
	II Protein biochemistry	Protein structure: Protein Tertiary and Quaternary Structures, Protein Denaturation and Folding, Protein Function: Reversible Binding of a Protein to a Ligand: Oxygen-Binding Proteins Complementary Interactions between Proteins and Ligands: Immunoglobulin's Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors - Details of Protein purification		15
	III Endocrinology-I	Introduction to endocrinology-mechanism of action of group I and group II hormones, coordination of functions by chemical messengers, chemical structure and synthesis of hormones, hormone secretion, transport and clearance from blood Anterior Pituitary hormones and their control by hypothalamus : functions, regulation and abnormalities in growth hormones, Adrenocorticotropin, stimulating hormones		15

	IV Endocrinology-II	Posterior pituitary gland and its relation to hypothalamus Hormones of Posterior pituitary gland their functions, regulation and abnormalities - Oxytocin and vasopressin, thyroid gland functions, regulation and abnormalities - Thyroxine, calcitonin, Parathyroid gland- PTH, Adrenal medulla functions, regulation and abnormalities -epinephrine and nor epinephrine, Adrenal cortex- Glucocorticoids, Pancreas- insulin and glucagon, Female gonads- estrogens and progesterone, Male gonads- testosterone, Placenta- hCG	15

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References:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
3. Biochemistry , 4th edition (2010), Voet and Voet, John Wiley and sons, USA
4. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
5. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd
6. General Microbiology, 5th edition- Roger Stainer

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PAPER III: Genetics and Molecular Biology

Course Objectives:

- To learn mapping of genes with the help of bacteriological models
- To understand nature of gene and variations in gene fragments
- To study different enzymes used in molecular biology
- To learn transport of gene and genetic fragments through molecular vehicles i.e. vectors
- To understand the concept of genetic Libraries along with their maintenance, structure and application
- To study gene and RNA editing

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

1. Perform statistical analysis and predict maps of gene sequences
2. Predict causes of unexpected outcomes of a given gene exchange study
3. Comment on various segments of a gene involved in regulation of the expression of a given gene product
4. Enlist various types of naturally available as well as artificially synthesized vectors that can be used to transfuse genes from one cell to the other
5. Comment on appropriate methods and parameters to be followed for selecting a genetic vector
6. State the use of vectors in storage materials of genetic libraries
Comment on the types, basic procedure, maintenance and applications of genetic libraries.

Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK503	I Enzymes and vectors	Enzymes - Sources, types, mode of action and applications of Restriction endonucleases, DNA polymerases, Ligases, Kinases, Phosphatases, Terminal transferases, Reverse transcriptase's and Nucleases Vectors - Features and applications of pBR322, pUC19, cosmids, Phagemids, λ phage, M13 bacteriophage vector, Shuttle vector, Expression vector pET YAC	2.5	15
	UNIT II Cloning strategies and sequencing	Gene cloning-Isolation and purification of DNA; Isolation of gene of interest: Restriction digestion, electrophoresis, blotting, cutting, and joining DNA, methods of gene transfer in prokaryotes and eukaryotes ; Recombinant selection and		15

		<p>screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART, HRT; Expression of cloned DNA molecules and maximization of expression; Cloning strategies genomic DNA libraries, cDNA libraries, chromosome walking and jumping</p> <p>Sequencing: Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing</p>		
	Unit III Genetic Mapping	<p>Genetic mapping in bacteria and Bacteriophages: by conjugation, transformation and transduction. Mapping bacteriophage genes, Fine structure analysis of bacteriophage gene</p>		15
	Unit IV Gene editing and human genome	<p>Human genome mapping and its implications in health and disease</p> <p>Mechanisms and application: RNAi, ZNF(Zinc finger nucleases), TALENS(Transcription activator like effector nucleases) CRISPR cas system</p>		15

References:

1. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
4. Biotechnology – Fundamentals and applications by S.S. Purohit.
5. Genomes 3rd Edition T.A. Brown.
6. Biotechnology B.D. Singh.
7. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.
8. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)
9. TALEN and CRISPR/Cas genome editing systems: tools of discovery: A.A.Nemudryi review
10. Molecular diagnostics- Fundamentals, Methods and Clinical applications by Lela Buckingham

PAPER IV: Industrial Biotechnology

Course Objectives:

- To study different types of fermentation processes
- To emphasize on the significance strain development for optimal product formation
- To study various commercial fermentation products
- To understand the methods and procedures of recovering and formulating the final industrial product
- To study downstream processing

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

1. Suggest an appropriate fermenter for a desired biological product
2. Comment on dairy and brewing technology
3. Suggest specific process parameters to be followed and maintained throughout the process
4. Enlist various commercial fermentation products and also know their production procedures
5. Set up mini fermentation units in their laboratories for lab scale fermentation or demonstration purposes
6. Comment on product recovery and suggest appropriate methods to do the same

Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK504	Unit I Dairy Technology	Milk: Normal flora, changes in raw milk, enumeration. Factors affecting bacteriological quality. Preservation methods, Pasteurisation. Starter Cultures. Fermented products-Production process and spoilage- Cheese: Swiss and Cheddar, Butter, Yogurt and Buttermilk.	2.5	15
	Unit II Brewing technology	Production and types of: Wine , Beer(Lager and Ale), Vodka, Rum, Whiskey, Tequila Malo-lactic fermentation Production		15
	III Downstream processing	Introduction of DSP, Foam separation, Types of Precipitation, Filtration, Centrifugation, Chromatography in DSP, Cell disruption-		15

		physical and chemical methods. Solvent recovery, Membrane processes, Drying, Crystallization and Whole broth processing.		
	Unit IV Recent trends and developments in industrial productions	Brewing: Overview, Role of multinational companies, microbreweries and craft breweries, Global growth in wine drinking, Development of new wine industries, Rise of flavoured alcoholic beverages, Calorie counting and health perception, organic and biodynamic production, Use of GM crops and microorganisms Therapeutic aspect of industrial production: Case study on production of vaccines		15

References:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele Mercel Dekker Inc New York, 2nd edition
2. Microbial Technology Pepler, H.J and Perlman, D 2nd Academic Press Practicals
3. Industrial Microbiology Prescott and Dunn CBS publishers
4. Dairy technology by Yadav and Grower
5. Fermentation technology by Stanbury and Whittkar
6. Handbook of alcoholic beverages- Technical, Analytical and nutritional aspects- Alan J Buglass- Vol I Wiley
7. Fundamentals of Microbiology by Frobisher
8. Industrial Microbiology by A.H. Patel
9. Industrial Microbiology by Casida

PRACTICALS OF BIOTECHNOLOGY

COURSE CODE	TITLE	CREDITS
RUSBTKP501	<ol style="list-style-type: none">1. Cytological identification of cancer cells.2. Study the effect of physical and chemical parameters on cell permeability using beetroot cells3. Detection of diabetes mellitus by diabetic profile tests4. Estimation of starch5. Protein estimation by Bradford's method6. Protein separation by PAGE (native/ SDS)7. Protein purification by dialysis8. Estimation of adrenaline9. Proposal writing for skill based project	3

COURSE CODE	TITLE	CREDITS
RUSBTKP502	<ol style="list-style-type: none"> 1. Transformation in <i>E.coli</i>. 2. Genomic DNA Extraction: Animal cells. 3. Restriction enzyme digestion and ligation (Kit may be used). 4. Replica plate technique 5. Gradient plate technique 6. Bacterial gene expression (Kit may be used). 7. Estimation of Milk protein-Pynes method 8. Detection of calcium and phosphorus in milk 9. Production and microbiological analysis of Yoghurt/cheese/butter 10. Production of Wine/Vodka and study of its physico-chemical properties 	3

TYBSC BIOTECHNOLOGY

SEMESTER VI

PAPER I: Immunology, Virology and Instrumentation

Course Objectives:

- To understand detailed applications of the immunology
- To understand structural and Medical implications of different types of common viruses
- To study different instruments used in regular Biotechnological work with respect to their working and principle

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

1. Discuss the ongoing and future implications of immunology
2. Talk about the host interactions with reference to viral attacks
3. Comment on different types of viruses and their distinguishing characteristics

Medical concerns and strategies for dealing with viral attacks on humans as well as other living organisms

4. Enlist various essential instruments used regularly in Biotechnology related work and state it's applications
5. Understand the working and principles of these instruments

Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK601	I Immunology	MHC class I and II Structure , function, arrangement, interaction with epitopes, polymorphism, role of MHC in diseases, antigen presentation: endogenous antigen , exogenous antigens, TCR, BCR , accessory molecules: structure, function Introduction to CAR-T cell	2.5	15
	II Virology	Introduction to viruses- Position in biological spectrum Virus properties, General structure of viruses Baltimore Classification and Taxonomy(ICTV), Cultivation of viruses, Virulent phages and Lytic cycle - T even phages, One step growth experiment		15

		Temperate phages and lysogeny -lambda phage, Reproduction of ds DNA phages Hepatitis/ss RNA(influenza), animal viruses and plant Virus(TMV) Virus purification and assays Cytocidal infections and cell damage Viruses and cancer Viroids and Prions		
	III Spectrometry and tracer techniques	Principle, instrumentation and working of Fluorescence, Luminometry, Infrared, Atomic absorption Isotopes in Biology: Detection Techniques of Radioactivity using GM counter, Scintillation counter, Applications of Tracer techniques in Biology		15
	IV Chromatography and centrifugation	Chromatography: Principle, working and application of Affinity, Ion-exchange, Gel permeation, HPLC- Method development and validation, GC. Centrifugation: Types, principle, working and applications of Differential and Density Gradient - Isopycnic, Rate, zonal, Gradient materials, preparation, sample application, recovery, choice of rotors.		15

References:

1. Mim's Medical Microbiology 5th edition
2. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
3. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A 18th edition
4. Medical Microbiology by Patrick Murray 5th edition
5. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown

6. Understanding Viruses by Teri Shors
7. Biophysics (2002) Vasantha Pattabhi and N. Gautham, Kluwer Academic Publishers
8. Physical Biochemistry: principles and applications, 2nd edition (2009), David Sheehan , John Wiley & Sons Ltd
9. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): JulyAugust.
10. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
11. Biochemistry , 4th edition (2010), Voet and Voet, John Wiley and sons, USA
12. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd
13. Biophysical Chemistry by Upadhayay and Nath
14. Immunology by Kuby 5th , 7th edition
15. Immunology by Riott
16. Immunology Palan and Pathak

PAPER II: DEVELOPMENTAL BIOLOGY AND TRANSGENESIS

Course Objectives:

- To introduce to basic concepts of developmental biology
- To understand basics of assisted reproductive technology and stem cells
- To understand the procedure for creating transgenic plants and animals

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

1. Understand basics of gametogenesis, fertilization, post fertilization events
2. State the methods used for transgenesis of plants and animals
3. Comment on the vectors used for transgenesis
4. Understand the applications of transgenic organisms

Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK602	I Developmental biology	Mammalian embryonic development: Reproductive systems, Gametogenesis, Fertilization, Cleavage, Implantation, Gastrulation, cell fate and lineages of three germ layers, fate map Concept of differentiation and embryonic induction	2.5	15
	II Assisted reproductive technology and Stem cell banking	Infertility, causes of infertility, managing infertility through ART: IVF, ICSI, GIFT and ZIFT, Artificial insemination, test tube baby, Embryo transfer New techniques in ART Stem cells, sources of stem cells, cord blood banking, collection and banking process, public and private banks, applications/uses of stem cell banks		15
	III Genetic engineering in	Genetic engineering of plants; Methodology. Plant transformation with the Ti		15

	plants	plasmid of <i>A.tumefaciens</i> , Ti plasmid derived vector system - Transgenic plants: Physical methods of transferring, genes to plants : electroporation, microprojectile bombardment, liposome mediated, protoplast fusion, Vectors for plant cells, Improvement of seed quality protein	
	IV Transgenic animals	Transgenic mice- methodology- retroviral method, DNA microinjection, ES method, genetic manipulation with cre-loxP, Vectors for animal cells, Transgenic animals recombination system, Cloning live stock by nuclear transfer, Transgenic fish	15

References:

1. Principles and techniques in biochemistry and molecular biology (2010), Keith Wilson and John Walker, 7th
2. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
3. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
4. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
5. Developmental Biology; Scott Gilbert; 9th Edition
6. Langman's medical embryology- T.W. Sadler
7. Development of chordate biology- Verma and Agarwal
8. Review article: Assisted reproductive technology: techniques and limitations- by Mr. Begum
9. Review article: Assisted reproductive technology- Simon M Kelly
10. Umbilical cord blood banking: Consensus statement of the Indian Academy of Pediatrics
11. Umbilical cord blood banking- Royal college of Obstetrician & Gynaecologists
12. Collection, Processing and Banking of Umbilical Cord Blood Stem cells for Clinical use in transplantation and regenerative medicine- David T. Harris

PAPER III: BASIC PHARMACOLOGY

<p>Course Objectives:</p> <ul style="list-style-type: none"> • To understand different antimicrobial agents • To learn the general principles of pharmacology • To understand the concept of toxicology • To study the mechanism of drug absorption and distribution • To understand basic and regulatory toxicology <p>Learning Outcomes: After completion of this course, student must be able to:</p> <ol style="list-style-type: none"> 1. Elucidate the concepts of pharmacology 2. Comment on causes of allergic reactions with response to drug or poison 3. Obtain clarity about mechanism of absorption of drugs from different tissues 4. State the mechanism of action of different antimicrobials 				
Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK603	I Chemotherapeutic agents	Discovery and Design of antimicrobial, Classification of Antibacterial agents, Selective toxicity, MIC, MLC, Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin Injury to plasma membrane: Polymyxin, Inhibition of protein synthesis: Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides Erythromycin, Inhibition of nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole, Antimetabolites: Sulphonamides, Trimethoprim Drug resistance: Mechanism origin, transmission, Use and misuse of antimicrobial agents,	2.5	15

		Antifungal drugs, Antiviral drugs		
	II General principles of pharmacology	Mechanism of drug action , drug receptors and biological responses second-messenger systems, the chemistry of drug–receptor binding, dose–response relationship: therapeutic index, ED, LD, Potency and Intrinsic Activity, Drug antagonism		15
	III Drug Absorption and distribution	Absorption of drugs from the alimentary tract, factors affecting rate of gastrointestinal absorption, absorption of drugs from lungs and skin , absorption of drugs after parenteral administration factors influencing drug distribution , binding of drugs to plasma proteins, Physiological barriers to drug distribution		15
	IV Basic and regulatory toxicology	Background Definitions Causation: degrees of certainty Classification, Causes Allergy in response to drugs, Effects of prolonged administration: chronic organ toxicity , Adverse effects on reproduction Poisons: Deliberate and accidental self-poisoning, Principles of treatment Poison-specific measures General measures , Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, herbicides and pesticides, biological substances (overdose of medicinal		15

		drugs is dealt with under individual agents), Incapacitating agents: drugs used for torture, Nonmedical use of drugs		
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References:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig,C.R, Stitzel,R.E 5th edition
3. Clinical Pharmacology Bennet,PN,Brown,M.J, Sharma,P 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier
5. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
6. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A 18th edition
7. Medical Microbiology by Patrick Murray 5th edition
8. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown
9. Understanding Viruses by Teri Shors
10. Mim's Medical Microbiology 5th edition
11. Casarett & Doull's Toxicology- The Basic Science Of Poisons

PAPER IV: ENVIRONMENTAL AND PLANT BIOTECHNOLOGY

Course Objectives:

- To understand the importance of Environmental biotechnology and parameters
- To study the importance of biogas and biofuels
- To introduce to the various treatment procedures applied for wastewater and industrial effluents
- To understand the important techniques in plant biotechnology
- To understand the applications of biofertilizers and biopesticides

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

1. Set up reactor system for biogas, biofuel, biodiesel
2. Set up mini water treatment plant
3. To study biodegradation of waste using treatment plants
4. Comment on different techniques and their uses in plant biotechnology
5. To produce biofertilizer and biopesticide in laboratory

Course Code	UNIT	TOPICS	Credits	Lectures
RUSBTK604	I Biogas and biofuels	Biomass sources: Waste sources, liquid, solid, Agrobased sources, Energy scenarios, Biogas technology- biogas plant & types, biodigester. Biogas- composition, production and factors affecting production, uses Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Case studies on Biogas and biofuels, Advanced biofuels Details of carbon credits	2.5	15
	II Industrial effluent treatment	Biological processes for industrial effluent treatment, aerobic biological treatment- activated sludge process, CASP, advanced activated sludge processes (any two) Biological filters, RBC, FBR Anaerobic biological treatment- contact digesters, packed bed		15

		reactors, anaerobic baffled digesters, UASB		
	III Introduction to plant biotechnology	Introduction, Micropropagation, , Somaclonal Variations, Haploid Plants, Embryo Rescue, Somatic Hybrids And Cybrids, Germplasm Conservation, Molecular Markers And Maps		15
	IV Biofertilizers and biopesticide	Biofertilizer: Nitrogen-fixing Rhizobacteria – Symbiotic Nitrogen Fixers, Nonsymbiotic Nitrogen Fixers, Plant Growth Promoting Microorganisms- Phosphate- Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance Plant Growth Promotion by Fungi- Mycorrhizae, Arbuscular Mycorrhizae, Ectomycorrhizae Microbial Inoculants- Inocula, Carriers, and Applications, Monoculture and Co- culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations Biopesticides - types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application)		15

References:

1. Environmental Biotechnology Allan Scragg Oxford University press
2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International
3. Environmental Biotechnology (Industrial pollution management) S.N. Jogdand Himalaya Publishing House
4. Biotechnology- expanding horizons: B D Singh
5. Microbial Technology Pepler, H.J and Perlman, D 2nd Academic Press Practicals

6. Research paper: Use of carbon credits/trading for environmental protection (Environmental science E-ISSN no. 2454-9916, Volume 2 Issue 9)

7. Environmental Biotechnology by M.H. Fulekar

8. Advances in Biotechnology by S.N. Jogdand

9. Case studies on Biogas & Biofuels by MNRD

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PRACTICALS OF BIOTECHNOLOGY

COURSE CODE	TITLE	CREDITS
<p>RUSBTKP601</p>	<ol style="list-style-type: none"> 1. Phage assay: <i>Demonstration</i> 2. Separation of components from a mixture using Affinity chromatography (Kit may be used) 3. Separation of components from a mixture using ion exchange chromatography (Kit may be used) 4. Separation of components from a mixture using Size exclusion chromatography (Kit may be used) 5. HPLC method validation. 6. Density gradient centrifugation 7. Chick embryo candling and inoculation methods Demonstration experiment. 8. Semen analysis 9. Isolation of Protoplast and fusion 10. Skill based project 	<p>3</p>

COURSE CODE	TITLE	CREDITS
RUSBTKP602	<ol style="list-style-type: none"> 1. Antibiotic sensitivity test using agar cup method 2. Antibiotic sensitivity test using paper disc method 3. Antibiotic sensitivity test using ditch method. 4. Synergistic action of two drugs 5. LD 50, ED 50 evaluation using suitable models 6. Isolation of phosphate solubilising organism 7. Quantitative measurement of phosphate solubilisation 8. Isolation of Rhizobium and Azatobacter 9. Study the effect of plant growth using them as microbial inoculants 10. Extraction of biopolymer from Azatobacter 	3

References:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press_Taylor& Francis (2017)
3. R. S. K. Barnes, R. N. Hughes(auth.)-An Introduction to Marine Ecology, Third Edition-Wiley-Blackwell (1999)
4. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)
5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)
6. W. Evans-Trease and Evans Pharmacognosy 15 th ed.-Saunders (2010)
7. Hanbook of Fisheries And Aquaculture- Omprakash Sharma- Agrotech Publication

MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40% :40 marks.

Sr No	Evaluation type	Marks
1	One Assignment (Case study/Project based/Animation/ Review writing/ Video demonstration/ Pictorial or flow sheet representation/ Industrial visit report etc.)	20
2	One class Test (multiple choice questions / objective)	20

B) External examination - 60 %

Semester End Theory Assessment - 60 marks

- i. Duration - These examinations shall be of **2 hours** duration.
- ii. Paper Pattern:
 1. There shall be **04** questions each of **15** marks. On each unit there will be one question.
 2. All questions shall be compulsory with internal choice within the questions (60% options)

Questions	Options	Marks	Questions on
Q.1)A)	Any 5 out of 8	5	Unit I
Q.1)B)	Any 2 out of 3	10	
Q.2)A)	Any 5 out of 8	5	Unit II
Q.2)B)	Any 2 out of 3	10	
Q.3)A)	Any 5 out of 8	5	Unit III
Q.3)B)	Any 2 out of 3	10	
Q.4)A)	Any 5 out of 8	5	Unit IV
Q.4)B)	Any 2 out of 3	10	

Practical Examination Pattern:

(A) Internal Examination: Pattern for one Practical paper

Heading	Practical
<i>Journal</i>	<i>10</i>
<i>*Test (2 practicals-15M each)</i>	<i>30</i>
Total	40

(Internal Practical exam pattern is same for both practical papers and AC)

**Sem VI- Practical paper I (25M Internal project evaluation + 5M practical)*

(B) External (Semester end practical examination): Pattern for one practical paper

Particulars	Practical
<i>Laboratory work</i>	<i>60</i>
<i>2 Major practicals</i>	<i>20 & 25 M each</i>
<i>1 Minor practicals</i>	<i>10 M each</i>
<i>Viva/ Spots</i>	<i>05 M each</i>
Total	60

(External Practical exam pattern is same for both practical papers and AC)

Skill based project in Semester VI - 50M

Internal evaluation- 25M

External evaluation- 25M

PRACTICAL BOOK/JOURNAL

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

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

Overall Examination and Marks Distribution Pattern

Semester—V & VI

Course	<i>RUSBTK501/601</i>			<i>RUSBTK502/602</i>			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	<i>RUSBTKP501/601</i>						
	Internal			External			
Practicals	40			60			100

Course	<i>RUSBTK503/603</i>			<i>RUSBTK504/604</i>			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	<i>RUSBTKP502/602</i>						
	Internal			External			
Practicals	40			60			100

Course	<i>RUSBTKAC501/601</i>		Grand Total
	Internal	External	
Theory	40	60	100
	<i>RUSBTKP501/601</i>		
Practicals	40	60	100