AC/II(20-21).2.RUS3

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for

Program: UG Biotechnology

Program Code: RUSBTK

(Credit Based Semester and Grading System for Academic Year 2020–2021)

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.

PROGRAM OUTLINE

YEAR	SEMESTER	COURSE CODE	COURSE TITLE	CREDITS
I	I	RUSBTK101	Basic chemistry I	2
		RUSBTK102	Bioorganic Chemistry	2
		RUSBTKP101	Practicals based on RUSBTK101 & RUSBTK102	2
		RUSBTK103	Biodiversity and cell biology	2
		RUSBTK104	Microbial techniques	2
		RUSBTKP103	Practicals based on RUSBTK103 & RUSBTK104	2
		RUSBTK105	Introduction to Biotechnology	2
		RUSBTK106	Molecular Biology-II	2
		RUSBTKP105	Practicals based on RUSBTK105 & RUSBTK106	2
		RUSBTK107	Foundation Course	2
I	II	RUSBTK201	Basic Chemistry-II	2
		RUSBTK202	Physical Chemistry	2
		RUSBTKP201	Practicals based on RUSBTK201 & RUSBTK202	2
		RUSBTK203	Physiology and Ecology	2
		RUSBTK204	Genetics	2

		RUSBTKP203	Practicals based on RUSBTK203 & RUSBTK204	2
		RUSBTK205	Tissue Culture & Scientific Writing and Communication Skills	2
		RUSBTK206	Enzymology, Immunology and Biostatics	2
		RUSBTKP205	Practicals based on RUSBTK205 & RUSBTK206	2
		RUSBTK207	Foundation Course	2
II	**III**	RUSBTK301	Biophysics	2
		RUSBTK302	Applied Chemistry- I	2
		RUSBTKP301	Practicals based on RUSBTK301 & RUSBTK302	2
		RUSBTK303	Immunology	2
		RUSBTK304	Cell Biology and Cytogenetics	2
		RUSBTKP303	Practicals based on RUSBTK303 & RUSBTK304	2
		RUSBTK305	Molecular Biology	2
		RUSBTK306	Bioprocess Technology & General Microbiology	2
		RUSBTKP305	Practicals based on RUSBTK305 & RUSBTK306	2

		RUSBTK307	Research Methodology and Scientific Writing	2
II	**IV**	RUSBTK401	Biochemistry	2
		RUSBTK402	Applied chemistry II: Physical Chemistry	2
		RUSBTKP401	Practicals based on RUSBTK401 & RUSBTK402	2
		RUSBTK403	Medical Microbiology	2
		RUSBTK404	Environmental Biotechnology	2
		RUSBTKP403	Practicals based on RUSBTK403 & RUSBTK404	2
		RUSBTK405	Biostatistics and Bioinformatics	2
		RUSBTK406	Molecular Diagnostics	2
		RUSBTKP405	Practicals based on RUSBTK405 & RUSBTK406	2
		RUSBTK407	Entrepreneurship Development	2
III	**V**	RUSBTK501	Cell Biology	2.5
		RUSBTK502	Biochemistry	2.5
		RUSBTKP501	Practicals based on RUSBTK501 & RUSBTK502	3
		RUSBTK503	Genetics and Molecular Biology	2.5
		RUSBTK504	Industrial Biotechnology	2.5
		RUSBTKP502	Practicals based on RUSBTK503 & RUSBTK504	3

		RUSBTK505	Forensic sciences-I	2
		RUSBTKP503	Practicals Based on RUSBTK505	2
III	**VI**	RUSBTK601	Immunology, Virology and Instrumentation	2.5
		RUSBTK602	Developmental biology and transgenesis	2.5
		RUSBTKP601	Practicals Based on RUSBTK601 & RUSBTK602	3
		RUSBTK603	Pharmacology	2.5
		RUSBTK604	Biosafety and Plant biotechnology	2.5
		RUSBTKP602	Practicals Based on RUSBTK603 & RUSBTK604	3
		RUSBTK605	Forensic sciences-II	2
		RUSBTKP603	Practicals Based on RUSBTK605	2

SEMESTER V

Course Code: RUSBTK501

Course Title: CELL BIOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Construct the cell cycle with its components and control system
CO 2	Evaluate the role of apoptosis
CO 3	Differentiate between normal cell and cancerous cell
CO 4	Talk about the principles of cell signalling and apply those principles to different cell types
CO 5	Examine different pathways in cellular signalling and their activation and implication
CO 6	Deduce the role of cellular transporters, cell adhesion molecules and cell junctions. Analyze the permeability of cell membrane

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK501	**I**	**Cell cycle and apoptosis and cancer** 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 Cancer: Characteristics of normal cell and cancerous cell. Cancer as a micro evolutionary process: invasion metastasis, angiogenesis, Tumor- Benign and malignant	**15**

	II	**Cell signaling-I:** Cell signaling and signal transduction: Introduction General Principles of Cell Signaling, Signaling via G-Protein-linked Cell-Surface Receptors Signaling via Enzyme-linked Cell-Surface Receptors – protein tyrosine phosphorylation	**15**
	III	**Cell signaling-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 Signaling: Lessons from Computer-based "Neural networks"	**15**
	IV	**Cell permeability, transport and cell junctions:** Cell permeability, principles of membrane transport, Transporters and channels; Active transport, passive transport, types of transporters, types of ATP driven Pumps, Na+ K+ pump. Cell junctions; cell adhesions and extracellular material, Microvilli tight junctions, gap junctions, cell coat and cell recognition, cellular interactions	**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

Course Code: RUSBTK502

Course Title: BIOCHEMISTRY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Analyze the metabolism of carbohydrates and fates of various intermediate and end product. Estimate the amount of starch.
CO 2	Separate and purify protein molecules and estimate their concentration. Construct titration curve for amino acids
CO 3	Evaluate the levels of protein structure. Comment on different types of protein interactions
CO 4	Identify the function of different hormones and their role as cellular messengers
CO 5	Examine and differentiate the mechanisms of Type I and Type II hormones. Discuss the abnormalities associated with hormones
CO 6	Design project proposal for project

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	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	**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	**15**

		Complementary Interactions between Proteins and Ligands: Immunoglobulin's Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors - Details of Protein purification	
	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- Glucocortocoids, Pancreas- insulin and glucagon, Female gonads- estrogens and progesterone, Male gonads- testosterone, Placenta- hCG	**15**

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

Course Code: RUSBTKP501

Course Title: Practicals based on RUSBTK501 and RUSBTK502

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP501	1. Cytological identification of cancer cells. 2. Osmosis 3. Lipid Solubility of membrane 4. Production of micelles 5. Study the effect of physical and chemical parameters on cell permeability using beetroot cells 6. Titration curve of amino acids 7. Estimation of starch 8. Protein estimation by Bradford's method 9. Sample preparation and Protein separation by PAGE (native/ SDS) 10. Protein purification by dialysis 11. Estimation of adrenaline 12. Proposal writing for skill-based project	**3**

Course Code: RUSBTK503
Course Title: GENETICS AND MOLECULAR BIOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Perform and predict genetic maps in bacteria and bacteriophages
CO 2	Analyse the appropriate methods and parameters to be followed for selecting a particular enzyme and genetic vector. Perform restriction digestion and ligation.
CO 3	Apply principles of recombinant DNA technology in extraction of DNA, transformation, expression of genes and construction and screening of genetic libraries
CO 4	Compare different methods of sequencing and examine the importance of these methods in research
CO 5	Examine the importance of human genome project and gene editing and its implications in science and research
CO 6	Inspect the genes involved in cancer

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	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 transcriptases and Nucleases Vectors - Features and applications of pBR322, pUC19, cosmids, Phagemids, λ phage, M13	**15**

		bacteriophage vector, Shuttle vector, Expression vector pET YAC	
	II	**Cloning strategies and sequencing:** Methods of gene transfer in prokaryotes and eukaryotes; Recombinant selection and 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 Sequencing: Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing	**15**
	III	**Genetic Mapping:** Genetic mapping in bacteria and Bacteriophages: by conjugation, transformation and transduction. Mapping bacteriophage genes, Fine structure analysis of bacteriophage gene	**15**
	IV	**Gene editing and human genome cancer genetics:** Human genome mapping and its implications in health and disease Mechanisms and application: RNAi, ZNF (Zinc finger nucleases), TALENS(Transcription activator like effector nucleases) CRISPR cas system Molecular genetics of cancer, oncogenes and tumor suppressor genes	**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

Course Code: RUSBTK504
Course Title: INDUSTRIAL BIOTECHNOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Apply dairy and brewing technology at laboratory scale
CO 2	Suggest specific process parameters to be followed and maintained throughout the process
CO 3	Evaluate various commercial fermentation products and also know their production procedures
CO 4	Plan on setting up of a mini fermentation unit in their laboratories for lab scale fermentation or demonstration purposes
CO 5	Comment on product recovery and suggest appropriate methods to do the same
CO 6	Explore the trends and developments in industrial biotechnology

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK504	**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.	**15**
	II	**Brewing technology:**	**15**

		Production and types of: Wine, Beer (Lager and Ale), Vodka, Rum, Whiskey, Tequila Malo-lactic fermentation Production	
	III	**Downstream processing:** Introduction of DSP, Foam separation, Types of Precipitation, Filtration, Centrifugation, Chromatography in DSP, Cell disruption- physical and chemical methods. Solvent recovery, Membrane processes, Drying, Crystallization and Whole broth processing	**15**
	IV	**Trends and developments in industrial productions:** Brewing: Overview, Role of multinational companies, microbreweries and craft breweries, 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: production of Vitamin B12, Case study on production of vaccines Microbiological Assays for pharmaceutical products, Regulatory Microbiological testing in pharmaceuticals	**15**

References:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele Mercel Dekker Inc New York, 2nd edition
2. Microbial Technology Peppler,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

Course Code: RUSBTKP502

Course Title: Practicals based on RUSBTK503 and RUSBTK504

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP502	1. Transformation in *E. coli*. 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. 11. Bioassay of Vitamin B12	**3**

Course Code: RUSBTK505

Course Title: FORENSIC SCIENCES-I
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Obtain clarity on the functioning of the forensics division and its branches.
CO 2	Elucidate on the use of biotechnological techniques in forensics
CO 3	Talk about the types and nature of impressions and prints and apply the principle in their collection and identification.
CO 4	Understand the importance of collection and preservation of samples.
CO 5	Perform different types of analysis on the various samples.
CO 6	Plan and evaluate a crime scene. Solve case studies related to forensic sciences

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK505	**I**	**Introduction to Forensics:** Introduction to crime, Sociological aspects of crime and criminals in society Types of crime and its causes – property crimes, public order crimes, violent crimes, cybercrimes, juvenile delinquency Introduction to Forensic science – nature, need and function, history of forensic science and scope Criminal behaviour - Theories and literature studies, criminal inheritance and factors responsible, Laws and Principles, branches of Forensic Science (Criminalistics, Forensic Pathology, Forensic Anthropology, Forensic	**12**

		Odontology, Forensic Engineering, Toxicology, Behavioural Sciences, Questioned Documents, Other Specialties)	
	II	**Crime scene investigation**: Types of crime scenes – primary, secondary, crime scenes based on size of evidence Forensic Scientists, Investigating officers and their assigned role and duties, Modus operandi General crime scene procedures and their management, Crime Scene survey, Crime Scene Documentation, collection and preservation of physical evidence, Packaging & Transportation of biological evidences, Blood, semen, urine, faecal matter, vomit, saliva, hair and fibre, explosive evidence (serology, Chemistry), Crime scene reconstruction. Role of forensic biologist (Protection of crime scene, Recognition of biological evidence)	**12**
	III	**Impressions and prints:** Footprints and shoe-prints: Importance, Gait Pattern, casting of footprints in Different medium, Taking Control samples. Tire Marks/prints and Skid marks, taking control samples, Forensic Significance. Lip Prints- Nature, Location, collection and evaluation, taking control samples, Forensic Significance. Bite Marks- Nature, Location, collection and evaluation, taking control samples, Forensic Significance. Ear Prints- Nature, Location, collection and evaluation, taking control samples, Forensic Significance. Tool Marks- Location, collection and evaluation, taking control samples, Forensic Significance. Finger Prints- Nature, Location, collection and evaluation, taking control samples, forensic significance, biometry, poroscopy and edgeoscopy	**12**

	IV	**Forensic DNA biology:** Introduction to and significance of DNA typing DNA typing methods for forensic analysis: SNPs Y chromosome DNA typing, Mitochondrial DNA analysis (mtDNA), X-Chromosome DNA typing, Non-Human DNA Testing, New Technologies, Automation, and Software, Proficiency Testing Lab accreditation, determination of secretor / non-secretor Lewis antigen, Bombay Blood group, Polymorphic enzymes typing – PGM, GLO, ESD, EAP, AK, ADA, etc., and their forensic significance, HLA typing, role Serogenetic markers in individualization, paternity disputes etc., Forensic cases solved using DNA typing	**12**

Course Code: RUSBTKP503

Course Title: Practicals Based on RUSBTK505

DETAILED SYLLABUS

Course Code	Title	Credits
RUSBTKP503	1. Collection and Packaging of Toxicological samples and Petroleum samples 2. Collection and Packaging of biological samples and Homicide case samples 3. To take plain and rolled fingerprints and identify fingerprint pattern. 4. To perform ridge counting and ridge tracing, Lifting and preservation of finger print 5. Collection and Examination of Lip prints and Ear prints 6. To perform electrophoresis for separation of various polymorphic enzymes. 7. Determination of secretor / non-secretor antigen from blood/ saliva. 8. Amylase in saliva (animal and human sources) 9. Luminol/ Phenolphthalein/ precipitin test for blood 10. Acid phosphatase for semen and Barberio test of semen 11. Extraction, isolation and detection of DNA from blood/saliva 12. Fingerprint analysis – powder analysis, ninhydrin spray test, Iodine development, silver nitrate 13. Case studies	**2**

References:

1. https://aboutforensics.co.uk/impression-evidence/
2. https://www.sciencedirect.com/topics/computer-science/sociological-aspect

3. https://saylordotorg.github.io/text_social-problems-continuity-and-change/s11-02-types-of-crime.html; https://www.justia.com/criminal/offenses/sex-crimes/public-indecency/
4. https://law.jrank.org/pages/12004/Causes-Crime.html
5. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/forensic_science/general_forensic/01._introduction_to_forensic_science/et/4761_et_01et.pdf
6. http://www.jpgmonline.com/article.asp?issn=0022-3859;year=2000;volume=46;issue=4;spage=303;epage=8;aulast=Tewari
7. https://sci-hub.tw/https://doi.org/10.1016/B978-0-12-802219-1.00013-4
8. https://pressbooks.bccampus.ca/criminalinvestigation/chapter/chapter-8-crime-scene-management/
9. https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1392&context=jclc
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3722715/
11. Analysis and Identification of Bite Marks in Forensic Casework; Sandeep Kaur1 , Kewal Krishan1 , Preetika M Chatterjee1 and Tanuj Kanchan
12. http://www.latent-prints.com/images/Oliver.pdf; http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000690/M011457/ET/1516188816FSC_P3_M35_e-text.pdf
13. https://www.nap.edu/read/1866/chapter/4
14. Forensically relevant SNP classes, Bruce Budwole, Forensic laboratory. DOI: 10.2144/000112806
15. Y chromosome STR typing in crime casework; Lutz Roewer. DOI: 10.1007/s12024-009-9089-5
16. Forensic typing of short tandem repeat markers on the X and Y chromosomes: DOI: 10.1016/j.fsigen.2015.03.013
17. Use of non-human DNA analysis in forensic science: A mini review; Arati Iyengar, Sibte Hadi; https://doi.org/10.1177/0025802413487522
18. Introduction to non-human DNA typing; 10.1016/B978-0-12-382165-2.00049-0
19. Assessment of Lewis Blood group antigens and secretor status in autopsy samples; A. Busuttil, C.C. Blackwell et al.; https://doi.org/10.1016/0379-0738(93)90221-U
20. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/692
21. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/699
22. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/690
23. https://www.ncbi.nlm.nih.gov/pubmed/15570103
24. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5418305/
25. https://juniperpublishers.com/jfsci/pdf/JFSCI.MS.ID.555755.pdf
26. https://www.ncbi.nlm.nih.gov/pubmed/14527299
27. https://www.researchgate.net/publication/288174234_New_Technologies_and_Automation
28. http://www.evidencemagazine.com/index.php?option=com_content&task=view&id=1894&Itemid=9
29. https://link.springer.com/chapter/10.1007/978-3-642-77324-2_126
30. https://www.ncbi.nlm.nih.gov/pubmed/12415830
31. https://www.ijser.org/researchpaper/Determination-of-Serological-Markers-Blood-group-markers-of-Biological.pdf
32. http://www.forensicsciencesimplified.org/fwtt/how.html
33. https://www.sirchie.com/catalog/category/view/id/102/?___store=international_english
34. http://www.tracksceneinvestigation.com/TSI%20PDFs/CASTING.pdf
35. https://emedicine.medscape.com/article/320160-overview
36. Earprints in forensic investigation; Lynn Meijerman, Andrew Thean & George Maat; https://link.springer.com/article/10.1385/FSMP:1:4:247
37. Forensic Examination and Interpetation of tool marks by David Baldwin, John Birkett, Owen Facey and Gilleon Rabey.

Modality of Assessment (SEMESTER V)

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, Infographs/ Industrial visit report/Presentations/ Mind-map or concept map etc.)	20
2	One class Test (multiple choice questions / objective)	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

Duration - These examinations shall be of **2 hours duration**.

Theory question 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)

Paper Pattern:

Question	Options	Marks	Questions Based 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:

PAPERS: RUSBTKP501, RUSBTKP502, RUSBTKP503

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	10
Experimental tasks	30
Total	40

Note- Similar pattern for internal practical will be followed for all three Practical papers.

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Marks
Laboratory work *2 Major practicals* *1 Minor practicals* *Viva/ Spots*	*60* *20 & 25 M or 20M each* *10 M* *05 M or 10 M*
Total	60

Overall Examination & Marks Distribution Pattern

Course	RUSBTK501			RUSBTK502			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP501						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK503			RUSBTK504			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP502						
	Internal			External			
Practicals	40			60			100

Course	RUSBTK505		
	Internal	External	Total
Theory	40	60	100
	RUSBTKP503		
Practicals	Internal	External	Total
	40	60	100

SEMESTER VI

Course Code: RUSBTK601

Course Title: IMMUNOLOGY, VIROLOGY AND INSTRUMENTATION

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Discuss the ongoing and future implications of immunology. Prepare vaccine in laboratory and check its sterility
CO 2	Draw the structure of MHC molecules
CO 3	Talk about the host interactions with reference to viral attacks. Demonstrate phage assay.
CO 4	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
CO 5	Apply the basic principles and working of essential instruments to Biotechnological research
CO 6	Examine the different parameters to select a particular chromatography and centrifugation technique. Separate samples using these techniques.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	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	**15**

		antigens, TCR, BCR , accessory molecules: structure, function Introduction to CAR-T cell Vaccines and its types	
	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 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 Viroid and Prions	**15**
	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 5^{th} , 7^{th} edition
15. Immunology by Riott
16. Immunology Palan and Pathak

Course Code: RUSBTK602
Course Title: DEVELOPMENTAL BIOLOGY AND TRANSGENESIS
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Summarize the basic functions of gametogenesis, fertilization, post fertilization events
CO 2	Apply the principles of embryology to infertility
CO 3	Deduce and choose appropriate method of ART to be used based on infertility conditions. Analyse the semen sample
CO 4	Examine the methodology used for transgenesis of plants and animals
CO 5	Understand the applications of transgenic organisms in research
CO 6	Select a particular method of transgenesis according to their applications and advantages/limitations

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	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	**15**
	II	**Assisted reproductive technology and Stem cell banking:** Infertility, causes of infertility, managing infertility through ART: IVF, ICSI, GIFT and ZIFT, Artificial	**15**

		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	
	III	**Genetic engineering in plants:** Genetic engineering of plants; Methodology. Plant transformation with the Ti plasmid of *A. tumefaciens*, 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	**15**
	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
13. Stem cell banking for Regenerative and Personalized medicine: Biomedicines 2014 by David T. Harris

Course Code: RUSBTKP601
Course Title: Practicals Based on RUSBTK601 &RUSBTK602

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP601	1. TAB vaccine and Sterility of injectables 2. Phage assay: Demonstration 3. Separation of components from a mixture using Affinity chromatography (Kit may be used) 4. Separation of components from a mixture using ion exchange chromatography (Kit may be used) 5. Separation of components from a mixture using Size exclusion chromatography (Kit may be used) 6. HPLC method validation. 7. TLC of fatty acids/plant pigments 8. Column: chalk chromatography 9. Sucrose density gradient centrifugation 10. Density gradient centrifugation for blood 11. Chick embryo candling and inoculation methods Demonstration experiment. 12. Semen analysis 13. Isolation of Protoplast and fusion 14. Skill based project	**3**

Course Code: RUSBTK603
Course Title: PHARMACOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Elucidate the concepts of pharmacology and apply the principles in estimation of toxicity of different agents
CO 2	Comment on causes of allergic reactions with response to drug or poison
CO 3	Obtain clarity about mechanism of absorption of drugs from different tissues
CO 4	State the mechanism of action of different antimicrobials. Perform and evaluate different antibiotic sensitivity tests.
CO 5	Predict which antimicrobial agents to be used based on the causative agent
CO 6	Examine the mechanism of different poisons and toxins

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	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	**15**

		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, Antifungal drugs, Antiviral drugs Cancer: Introduction, Diagnosis & treatment, chemotherapy and preventive measures for cancer	
	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 drugs is dealt with under individual agents**)**, Incapacitating	**15**

		agents: drugs used for torture, Nonmedical use of drugs	

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

Course Code: RUSBTK604
Course Title: BIOSAFETY AND PLANT BIOTECHNOLOGY
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Identify the potential hazards in laboratory or workplace and suggest first aid and safety methods
CO 2	Prepare/design SOPs of instruments
CO 3	Assess quality assurance and quality control of different products
CO 4	Assess quality assurance and quality control of different products
CO 5	Comment on different advanced techniques and their uses in plant biotechnology
CO 6	Produce biofertilizer/biopesticide in laboratory and study their effects on plant growth

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK604	**I**	**Introduction to Biosafety:** Introduction, Biological Risk Assessment, Hazardous, Genetically modified hazards, Cell cultures, Hazardous Characteristics of Laboratory Procedures, Potential Hazards Associated with Work Practices, Safety Equipment and Facility Safeguards, Pathogenic risk and management Biosafety in biotechnology and rDNA technology	**15**

	II	**GLP, GMP and QA-QC:** Concept of GLP and GMP**,** Requirements and implementation of GMP, Practicing GLP, Guidelines to GLP Documentation of Laboratory work, Documentation of GMP practices , Preparation of SOPs Calibration records , Validation of methods, Regulatory certification, Quality assurance and Quality control and: concept of QA & QC, Requirements for implementing QA & QC	**15**
	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,andApplications,MonocultureandCo-cultureInoculantFormulations Biocontrol,Polymicrobial Inoculant Formulations Biopesticides - types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi(characteristics, physiology, mechanism of action and application)	**15**

References:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
3. WHO handbook on GLP
4. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
5. Plant tissue culture by K.G.Ramawat
6. Plant tissue culture by KK Dey

7. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International
8. Biotechnology- expanding horizons: B D Singh
9. Microbial Technology Peppler,H.J and Perlman,D 2nd Academic Press Practicals
10. Environmental Biotechnology by M.H. Fulekar
11. Advances in Biotechnology by S.N. Jogdand

Course Code: RUSBTKP602

Course Title: Practicals Based on RUSBTK603 &RUSBTK604

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP602	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. First aid methods and safety in laboratory/ workplace 7. Biosafety: Signs and Symbols 8. Validation of measuring cylinders, colorimeters 9. Calibration of pH meter and weighing balance 10. Isolation of phosphate solubilising organism 11. Quantitative measurement of phosphate solubilisation 12. Isolation of Rhizobium and Azatobacter 13. Study the effect of plant growth using them as microbial inoculants 14. Extraction of biopolymer from Azatobacter	**3**

Course Code: RUSBTK605
Course Title: FORENSIC SCIENCES-II
Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Obtain clarity on the variety of instruments that can be used for evidence analysis
CO 2	Apply the different instrumentation techniques for different samples/evidences
CO 3	Elucidate on the importance of the different branches of forensic laboratories
CO 4	Talk about the significance of evidence in analysis and perform the analysis for different samples.
CO 5	Comprehend the role of explosives and ballistics.
CO 6	Solve case studies related to forensic biology

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Lectures
RUSBTK605	**I**	**Analytical techniques in forensic sciences:** Instrumentation in Forensic Analysis (2 – 3 examples of each) Applications of Microscopy, spectroscopy (Atomic absorption, Flame spectrometry, inductive coupled plasma spectrometry), electrophoresis, chromatography (GC, HPLC), gravimetric analysis and Volumetric analysis, Thermal methods (TGA, DTA, DSC), NMR, Neutron Activation Analysis Serological Techniques	**12**

		Electrophoretic methods: Agarose gel, SDS Natured /Denatured. DNA Quantification: Slot Blot Assay, Southern Northern Western blotting Various methods of development of fingerprints: conventional methods, physical and chemical methods, florescent method, Magnetic Powder method, fuming method, laser method. PCR in forensic science	
	II	**Evidence analysis:** Determination of human and animal origin from bones, hairs, nails, skin, body tissue, and fluids strains viz. blood, menstrual blood, semen, saliva, sweat, pus, vomit, etc., through immune diffusion and immune – electrophoresis. Identification of blood: Properties Blood Grouping History of Bloodstain Pattern interpretation Target surface considerations, Size, Shape and Directionality of bloodstains Spattered blood, other Bloodstain Patterns Interpretation of Bloodstain on clothing and footwear	**12**
	III	**Forensic science and its branches:** Analysis of Skeletal Remains Forensic Anthropology (Skeletal system & bone formation, Skeletal indicators of health & injuries, Identification of joint wear & deterioration, Estimation of Age, Sex & race, Estimation of time since death, Human v/s animal bone morphology) Facial Reconstruction Forensic Odontology (Development of dental structure, Estimation of Age, Sex & race) Forensic Pathology (Decomposition Muscular Physiology, causes of death – Asphyxia, drowning, Post mortem Examination - Wounds, injuries	**12**

		Digestive System & Digestive paths of macromolecules, enzymes & end products, Undigested stomach contents post mortem, Role of a Forensic Pathologist) Forensic Entomology (Basic principle of insect biology, Life cycle, Estimation of time since death, Dipterans Larval Development, Successional Colonization of Body, Determination of displacement and disturbance of the body)	
	IV	**Ballistics and forensic laboratories:** Introduction of Fire arms. Proof marks Introduction to and types of Ballistics (internal, external and terminal ballistics) Role of forensic sciences in explosives Petroleum – Introduction and its forensic examination for adulteration Growth of Forensic Science Laboratories in India – Central and State level laboratories, Educational setup in Forensic Science in India Services and functionalities provided by various FSLs, Various divisions in the FSL – Ballistics, Biology, Chemistry Documents, Physics, Psychology, Serology, Toxicology	**12**

Course Code: RUSBTKP603

Course Title: Practicals Based on RUSBTK605

DETAILED SYLLABUS

Course code	Title	Credits
RUSBTKP603	1. Microscopic examination of hair of different animals such as Dogs, Cats, Cow, Horse, Goats, humans etc. (M-18) 2. Separation & detection of biological fluid by using HPLC. 3. Cement analysis by volumetric and gravimetric method. 4. Detection of Blood Alcohol Content. 5. Blood spatter analysis. 6. PCR analysis of given sample. 7. TLC of analgesics/ semen (M-08 Serology) 8. TLC of ink and dyes. 9. Capillary electrophoresis 10. Detection of saliva by gel-based starch-iodide test. 11. Reinsch's test for detection of arsenic in forensic sample 12. Copper-sulphate pyridine test for detection of cyanate 13. Prussian blue test for detection of cyanide in the sample. 14. Zwikker's test for Thiobarbiturates in sample. 15. McNally's test for presence of salicylates and salicylic acid in sample. 16. Lieberman's test for detection of phenols, resorcinols as well as alpha- & beta-naphthol. 17. Ammonium Molybdate test for detection of arsenites and phosphates. 18. Case studies	**2**

References

1. Forensic analytical technique- Barbara Stuart
2. Latent print development- Brian Yamashita and Mike French
3. Forensic Analysis of Biological Evidence- R.E. Gaensslen
4. Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence- Second Edition- Brian J. Heard

Modality of Assessment (SEMESTER VI)

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 or Infograph/ Mind map or concept map / Industrial visit report/Presentations etc.)	20
2	One class Test (multiple choice questions / objective)	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

Duration - These examinations shall be of **2 hours** duration.

Theory question 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)

Paper Pattern:

Question	Options	Marks	Questions Based 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:

PAPERS: RUSBTKP601, RUSBTKP602, RUSBTKP603

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	10
*Experimental tasks	30
Total	40

***Project work for semester VI in RUSBTKP601 (Internal project evaluation- 25 M)**

Note- Similar pattern for internal practical will be followed for all three Practical papers.

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Particulars	Marks
Laboratory work *2 Major practicals** *1 Minor practicals* *Viva/ Spots*	*60* *20 & 25 M or 20M each* *10 M* *05 M or 10 M*
Total	60

***Skill based project in Semester VI (RUSBTKP601) - 50M**

Overall Examination & Marks Distribution Pattern

Course	RUSBTK601			RUSBTK602			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Course	RUSBTKP601						
	Internal			External			

Practicals	**40**	**60**	**100**

Course	**RUSBTK603**			**RUSBTK604**			**Grand Total**
	Internal	**External**	**Total**	**Internal**	**External**	**Total**	
Theory	**40**	**60**	**100**	**40**	**60**	**100**	**200**
Course	**RUSBTKP602**						
	Internal			**External**			
Practicals	**40**			**60**			**100**

Course	**RUSBTK605**		
	Internal	**External**	**Total**
Theory	**40**	**60**	**100**
	RUSBTKP603		
Practicals	**Internal**	**External**	**Total**
	40	**60**	**100**
