AC/I(19-20).2.RPS3

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Syllabus for: M.Sc Part II

Program: M.Sc.

Course Code: BIOTECHNOLOGY (RPSBTK)

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

PROGRAM OUTCOME

At the end of program the students would be able to

- Adept in understanding the advanced sections of Biotechnology in the domain of cytogenetics, Biochemistry along with Molecular Biology ,Cell culture ,Immunology, Clinical research, Bioinformatics and IPR thereby understanding the applications and various opportunities in the field of biotechnology.
- Identify the problems and understand the gaps in vast array of scientific knowledge and would be driven to research and solve to fill those gaps and contribute immensely to scientific community.
- Posses high competitive edge with those of reputed Indian universities and would make them competent for jobs in various domains of industries
- Generate confidence and right attitude to approach the competitive exams like CSIR NET and SET and also to develop research proposals for grant
- Understand and work with multidisciplinary subjects in industries and research.
- Communicate and function scientifically in an efficient manner

PROGRAM SPECIFIC OUTCOME

- Rigorous evaluation through project based assignments on analytical techniques and bioprocess technology give our students an edge over others in acquiring deeper understanding of the concepts and its practical value in the advanced domains of biotechnology.
- Enabling students to understand the importance of handling vast amount of data whether retrieving, processing or analyzing through various tools of bioinformatics and biostatistics.
- Exposed to emerging domains of biotechnology like nanobiotechnology, clinical research opens up vast array of opportunities for research in these areas.
- Understanding of biotechnological applications, processes, its ethical implications and importance of intellectual property rights.

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Ramnarain Ruia College
Department of Biotechnology

Semester III					
Course code	**Unit**	**Topic**	**Credits**	**Lectures/week**	45hrs/week
Paper I : PTC and ATC **RPSBTK301**	Unit I	Plant tissue culture	4	1	15
	Unit II	Plant tissue culture		1	15
	Unit III	Animal tissue culture		1	15
	Unit IV	Animal tissue culture		1	15
Paper II : Medical Microbiology **RPSBTK302**	Unit I	Cytogenetics	4	1	15
	Unit II	Medical microbiology		1	15
	Unit III	Molecular diagnostics		1	15
	Unit IV	Biofilms		1	15
Paper III : Clinical Studies **RPSBTK303**	Unit I	Drug discovery and Pre clinical toxicology	4	1	15
	Unit II	Introduction to Clinical trials		1	15
	Unit III	Clinical study design		1	15
	Unit IV	Medical writing		1	15
Paper IV : Developmental Biology R**PSBTK304**	Unit I	Human Embryonic development:	4	1	15
	Unit II	Post fertilization events		1	15
	Unit III	Sex hormones and Implantation		1	15
	Unit IV	Infertility and reproductive vaccines		1	15
Practical	Practical based on all the four papers		2 credits each		
TOTAL CREDITS			24		

Semester IV					
Course code	**Unit**	**Topic**	**Credits**	**Lectures/week**	**45hrs/ week**
Paper I : Nanotechnology **RPSBTK401**	Unit I	Introduction, synthesis of nanomaterials	4	1	15
	Unit II	CNTs and nanomotors		1	15
	Unit III	Nanomedicine		1	15
	Unit IV	Applications of nanotechnology		1	15
Paper II : GMO and Environment **RPSBTK402**	Unit I	Introduction to GMOs	4	1	15
	Unit II	GMO crops		1	15
	Unit III	Solid waste management		1	15
	Unit IV	Biodegradation		1	15
Paper III : Bioinformatics, evolution and vitamins **RPSBTK403**	Unit I	Sequence Analysis	4	1	15
	Unit II	Applications of Bioinformatics		1	15
	Unit III	Phylogenetics		1	15
	Unit IV	Vitamins		1	15
Paper IV : Biostatistics **RPSBTK404**	Unit I	Introduction Statistics	4	1	15
	Unit II	Gauussian distribution and normality		1	15
	Unit III	Hypothesis testing		1	15
	Unit IV	ANOVA		1	15
Practical	Practical based on all the four papers	2 credits each			
TOTAL CREDITS			24		

MSc Part II : Biotechnology

Semester III

Paper I - PTC and ATC

Course Objectives:

- The main objective of this course is to familiarize the students with tissue culture theory and basic lab practices
- To make them aware of various protocols and norms to be followed in these laboratories
- To help them understand the basic functioning, routine procedures and maintenance of these labs

Course Outcomes

- The student must be able to discuss the basic requirements of a tissue culture laboratory
- Student should be able to understand and carry out minor experiments in PTC, ATC following the required norms and protocols
- Student be able to understand the safety and precaution controls in these labs
- Student must be able to design and conduct simple experiments in ATC, PTC labs

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK301	I	Introduction to primary and secondary metabolism, important pathways leading to biosynthesis of secondary metabolites in plants, Metabolic products produced from in vitro culturing of plant cells, selection of plant cells/ tissues for production of a specific products, culture system in secondary plantproduct, Biotransformation of precursors by cell culturing, metabolic engineering for production of secondary metabolites, Hairy root culture, elicitation	4	15
	II	Cryopreservation -Principle and types. Germplasm conservation,		15

		Transgenic plants-Edible vaccine, Golden rice		
	III	Biology of cultured cells, Culture vessels, Culture Media, Microbial contamination, cross contamination. Cryopreservation		15
	IV	Primary culture: Types, isolation of tissues, culturing of different cells. Cell lines: Development, Subculture and propagation, immortalization of cell line, cell line designation, selection of cell lines, routine maintenance, Cytotoxicity, Transformation, Culture of tumor cells		15

References:

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

Paper II: Medical Microbiology

Course Objectives:

- This course is oriented to introduce advanced tools and techniques in medical microbiology
- Medical Microbiology introduces basic principles and then applies clinical relevance in four segments of the academic preparation for physicians: immunology, bacteriology, mycology, and virology.
- This rigorous course includes many etiological agents responsible for global infectious diseases

Course Outcomes:

- Students should be able to understand the basics of medical microbiology
- They should be able to comment and appreciate the significance of this field
- They are expected to develop an understanding of various disease related issues of medical microbiology

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK302	I	Chromosomal disorders, Karyotyping, G-banding, Chromosome analysis, variations, Chromosome painting,Molecular Cytogenetics, FISH, CGH	4	15
	II	Infections of Respiratory tract- Pneumonia, Tuberculosis. Nosocomial- Pseudomonas. Viral infections-HIV, Hepatitis. Fungal- Candidiasis		15
	III	**Introduction to molecular diagnostics, pros and cons , importance , molecular techniques,amplification based techniques(probe ,signal and target amplification) molecular diagnostics of pneumonia, tuberculosis,HIV, hepatitis and candidiasis**		15

	IV	Biofilms in medicine: Outline specifications: Stages in biofilm formation, Quorum sensing, biofilm in medical devices- implants &treatments, biofilms in pathogenesis, biofilm forming organisms- *E.coli, Pseudomonas spp, S.aureus*		15

References:

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

Paper III: Clinical Studies

Course Objectives:

- To be aware of the ethical issues involved in human subjects research;
- To become familiar with the roles and responsibilities of the principal investigator and the institution when conducting clinical research in the NIH intramural research program;
- To have an understanding of Food and Drug Administration (FDA) oversight of clinical research; and
- To become familiar with how developments in science and health are reported by the media and how to work effectively with reporters.

Course Outcomes:

- Students will understand ethical issues in human subjects research
- Students should be familiarized with Roles and responsibilities of the investigator and the institution
- Be aware of various related regulatory issues
- Know about the companies and organizations associated in this field

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK303	I	Drug discovery: Purpose, main steps, process, timeline etc. PreClinical toxicology: General Principals, Systemic toxicology, (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenecity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements	4	15
	II	Types of clinical trials, single blinding, double blinding, open access, randomized trials and their examples, interventional study, ethics committee and its members, cross over design etc and institution ethics committee/ independent ethics committee		15
	III	New drug discovery process- purpose, main steps involved in new drug discovery, process, timeline of each steps, advantages		15

		and purposes of each steps, Ethics in clinical research, unethical trials, thalidomide tragedy, Phase I, II, III, IV trials. Introduction and designing- Various phases of clinical trials, Post Marketing surveillance- methods		
	IV	Medical Writing: Literature search and medical articles, contract writing, publication, abstracts, bibliography, clinical study reports, principles and softwares in CDM (Clinical Data Management)		15

References:

1. EC R1 guidelines
2. ICMR ethical guidelines
3. D & C Rules – Schedule Y
4. Law Of Intellectual Property Rights Shiv Sahai Singh Deep & Deep Publications (p) Ltd
5. WTO And Intellectual Property Rights By TalwarSabanna (2007) Serials Publications
6. IPR: Unleashing the Knowledge Economy (2003) PrabuddhaGanguli Tata Mcgrow Hill publication

Paper IV: Developmental Biology

Course Objectives:

- A particular emphasis is the intimate connection between developmental biology and evolution, which will be a theme throughout the course.
- Additional emphasis is on the connection between mechanisms of normal development and disease etiology. The course will cover general principles of development and current important issues.
- Relevant ethical issues will be discussed.

Course Outcomes:

- Student would be able to apply key principles of developmental biology toward evaluating and analyzing primary literature in the field.
- Be able to explain key concepts, including mechanisms by which differential gene activity controls development, mechanisms that determine cell fate and mechanisms that ensure consistency and reliability of development.

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK304	I	Human Embryonic development: Events during fertilization, in-vitro fertilization, Zonapellucidaa, glycoprotein, Oelemma protein and their role in fertilization, sperm, antigens and their functional significance. Molecular and biochemical events during sperm function	4	15
	II	Post fertilization events: early embryonic development, establishing multi-cellularity, formation of blastula, embryonic germ layer, tracking of migrating cells.		15
	III	Molecular mechanism of sex hormone action and regulation of gene expression. Implantation and endometrium antigens involved in implantation. Immunology of pregnancy. Superovulation, embryo		15

		culture and embryo transfer technology		
	IV	Infertility and reproductive vaccines. Frontiers in contraceptive research. Cryopreservation of sex gametes and embryos. Ethical issues related to embryo research		15

References:
1. Langman's Medical Embryology (9th Edition 2004) T. W. Sadler. Lippincott Williams & Wilkins
2. Essential Developemental Biology (2nd Edition 2006) J. M. W. Slack Blackwell Publishing 11
3. Developemental Biology (8th Edition 2006) Scott F. Gilbert Sinauer Associates, Inc

Practicals Semester III
Based on Paper I to IV

Sr No.	Experiment TOTAL CREDITS : 08
I	PTC
1.	Media preparation: **MS, B5 and Coconut Water**
2.	Seed sterilization
3.	Callus induction and **characterization**
4.	**Subculture of Callus and plantlet establishment**
5.	Synthetic seed
6.	Somatic embryogenesis
II	ATC
1.	**Dissection of Chick Embryo**
2.	Monolayer formation (fibroblast)
3.	To assay the radical scavenging activity of tissue hydrolysate- DPPH method
4.	Techniques for cell preservation
III	Toxicology MTT Assay
IV	Study and present a published clinical case report
V	Medical diagnostic – Identification of organisms from specimens (Multiple drug resistant *S. aureus, Pseudomonas spps,Klebsiellapneumoniae, E. coli*); Staining of Biofilms
VI	Candling, Observing Chick embryo- stages of development, prepared slides/ Preserved specimen
VII	Developmental biology- Visit to laboratory/video lectures for latest development in the field. To be documented

M.Sc Part II SEMSTER IV

PAPER I: NANOTECHNOLOGY

Course Objectives:

- Student will have broad knowledge in your chosen discipline, with deep knowledge in its core concepts.
- Understanding applications of nanotechnology to medical systems
- Have an insight of naturally occurring nanostructures
- Understand upcoming applications of nanomaterials in food and allied industries

Course Outcomes:

- Students will be familiar with the basics of nanotechnology, tools used for characterizing nanomaterials and specific applications of nanotechnology
- Have knowledge of latest developments in nanotechnology in the field of medical sciences and other commercial products
- Be able to appreciate the thrust in this science and feel encouraged to take it ahead in research

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK401	I	Introduction, synthesis of nanomaterials, biological methods, use of microbial system & plant extracts, use of proteins &templates like DNA. Characterization of nanomaterials, analysis techniques, properties of nanomechanical, optical, magnetic properties, electrical conductivity, thermal conductivity.	4	15
	II	Carbon nanotubes, Nanorobotics devices of nature: ATP synthase, the kinen, myosin, dynein, flagella modulated motion		15
	III	Nanomedicine: biopharmaceutics, implantable materials, implantable chemicals, surgical aids, diagnostic tools, nanosensors, nano scanning,		15

		nano enabled drug delivery system, nanorobotics in medicine.		
	IV	Application of nanomaterials in food, cosmetics, agriculture, environment management		15

References:

1. The Nanoscopeencyclopedia of nanoscience and nanochehnology, Vol I, V and VI (2005) Dr.ParagDiwan and AshishBharadwaj Pentagon Press New Delhi
2. Nano forms of carbon and its applications (2007) Prof.Maheshwar Sharon and Dr.Madhuri Sharon Manad Nanotech Pvt. Ltd.
3. Biotechnanotechnology lessons from Nature (2004) David Goodsell Wiley-Liss A John Wiley and sons
4. Nanotechnology- Basic science and emerging technologies (2005) WillsonKannangava, Smith, Simmons, Raguse Oversease Press
5. Texbook of Biotechnology (2005) R. C. Dubey S. Chand and Co.
6. Nanotechnology- Principles and practices S. K. Kulkarni Capital Publishing Co.

Paper II: GMO and Environment

Course Objectives:

- To introduce the student to the processing and control of genetically modified organisms with examples
- Learn about the Indian laws and system of regulating GMOs in our country
- Effects of human and industries on the environment
- Study sources of environmental contaminants and methods to combat them

Course Outcomes:

- By the end of this course student must be able to explain what GMOs and GM crops are.
- Understand the historical context of GMOs.
- Have an understanding on the development of GMOs to date.
- Be able to name frequently used GMO crops
- Describe the way modification is used to affect agriculture
- Discuss the potential risks & benefits of human activities on the environment
- Discuss the potential risks & benefits associated with GMO crop consumption
- Be able to make arguments for both sides of the debate

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK402	I	Genetically modified microorganisms, examples and methods, Humulin, ice minus bacteria, GM bacteria in bioremediation, use of PCR as a GMO identification tool, risks and controversies related to use genetically modified microorganisms. **Protein based assay methods, Toxicological evaluation**	4	15
	II	GE crops' Arabidopsis as a model plant for studies in genetic engineering; Protocols on food and feed safety assessments, acute oral safety study in rats and mice, sub chronic feeding study in rodents, protein thermal stability, pepsin digestibility, livestock feeding		15

	III	Solid waste treatment, pollution indicators & biosensors biodegradation of xenobiotics, pesticides, phytoremediation		15
	IV	Biodegration of waste from food, textile, petrochem , paper industries, biological detoxification, Removal of oil spillage & grease deposits		15

References:

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

PAPER III: BIOINFORMATICS

Course Objectives:

- To impart basic knowledge of bioinformatics
- To introduce different websites related to bioinformatics sources and databases
- To introduce the applications of the enormously growing database regulation
- To introduce advanced aspects of evolution and vitamins

Course Outcomes:

- Student would have learnt about Sequencing Alignment and Dynamic Programming
- Sequence Databases
- Evolutionary Trees and Phylogeny
- Be able to understand advanced concepts related to evolution and vitamins

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK403	I	**Database search using ENTREZ (G Query) Hidden Marker Model (Equation, Eg Gene finding/ exon intron finding, Signal peptide finding) Motif finding using HMM, ANN (Eg Prosite) Sequence alignment, MSA-algorithm under clustal W (ref: N Gautam) Protein sequence analysis, Protein structure analysis (Secondary: Chou Fasman algorithm, GOR algorithm; Tertiary : Homology modelling, Threading, Ab initio, Structure prediction)**	4	15
	II	**Microarray data analysis (Printing techniques, Features of microarray, Flag features of microarray, Data normalization in microarray) Human genome project and specialised databases under NCBI (Eg OMIM, chromosome, PubMed) Proteomics Consesnsus sequence, PSSM Sequence logo**		15
	III	**Darwinism and neo Darwinism theories of evolution. Population genetics and different forces**		15

		acting on it. **Bioinformatics tools for phylogenetic analysis.** **Evolution in detail Darwinism and neo Darwinism theories of evolution. Population genetics and different forces acting on it.** **Bioinformatics tools for phylogenetic analysis**		
	IV	**NIH ODS for vitamins; B1, 2,3,5,6,7,12; A D E K** **Major focus on sources, activity of vitamins, deficiency disorders, overconsumption effects.**		15

References:

1. Computer Based Decision Making in Medicine E. A. Shortifile American Elsevier
2. Bioinformatics : Sequence and Genome Analysis (Second Edition 2004) David W. Mount ColdspringHarbor Laboratory Press
3. Bioinformatics and Functional Genomics (2003) Jonathan Pevsner John Wiley & Sons Publications
4. **Buxevanis**

PAPER IV: BIOSTATISTICS

Course Objectives:

- To recognize and give examples of different types of data arising in public health and clinical studies
- Interpret differences in data distributions via visual displays
- Calculate and interpret confidence intervals for population means and proportions
- To help them be able to select an appropriate test for comparing two populations on a continuous measure, when the two-sample t-test is not appropriate
- Choose an appropriate method for comparing proportions between two groups; construct a 95% confidence interval for the difference in population proportions

Course Outcomes:

- Student would be able to Calculate standard normal scores and resulting probabilities
- Interpret and explain a p-value
- Perform a two-sample t-test and interpret the results; calculate a 95% confidence interval for the difference in population means
- Understand and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations
- Understand and interpret relative risks and odds ratios when comparing two populations

Course Code	UNIT	TOPICS	Credits	Lectures
RPSBTK404	I	Statistical population, sample from population, Random sample. Central Tendency: Mean, Median and Mode, Standard Deviation Confidence intervals	4	15
	II	Gaussian Distribution and testing for normality, Non-parametric tests (Sign test, Wilcoxon test, Mann-Whitney Test, Krushkal- Whllis test,), transforming data to create Gaussian Distribution		15
	III	Test of Significance. Hypothesis testing:- Theory of errors - Type I and Type II errors, Null hypothesis, P values-one v/s two tail P values,		15

		t-test(paired & unpaired), z-test, Chi square test, contingency table.		
	IV	Comparing three or more groups- Introduction to ANOVA, One way ANOVA, repeated measures ANOVA, Friedman Test. Correlation and Regression: Linear and multiple Correlation and Regression.		15

References:

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

Practicals Semester IV

Based on Paper I to IV

Sr. No.	Experiment TOTAL CREDITS : 08
1.	**Classification of biological databases specially cover NCBI and INSDC**
2.	**Phylogenetic analysis using Bvotstrap and Homology modelling**
3.	Multiple alignment- Phylogenetic tree
4.	BLAST – orthologs, paralogs, Homologs
5.	Motif finding
6.	KEGG
7.	Structure of proteins – identification of chains helices, special groups, metal ions etc. CATH/SCOP classification of a given protein
8.	Nanoparticles – synthesis chemical and biological methods, Spectroscopic analysis
9.	Bioremediation- isolation of metal tolerant organisms & study their growth characteristics and pattern
10.	Composting – physical and chemical parameters
11.	GMO validation – kit based/ demo

Students will have to undergo a mandatory hand on project in an established laboratory for 4-5 months. This should involve one or more relevant instrumentation technique. Thesis on the same to be evaluated by the guide for 70M based on the students' performance, written matter and experimentation. A certificate/mark list to be appended with the thesis. External examiner to assess for the 70M/ 65M as a presentation during practical exams, along with internal examiner who will also assess the student for 60M/ 65M.