



SIES

**College of Arts,
Science &
Commerce**

**RISE WITH EDUCATION
Sion (West), Mumbai – 400022.
(Autonomous)**

Faculty: Science

Program: M.Sc.

Subject: BIOTECHNOLOGY

Academic Year: 2018 – 2019

M.Sc Part II

**Credit Based Semester and Grading Syllabi approved
by Board of Studies in Biotechnology to be brought into
effect from June 2018.**

PREAMBLE

Biotechnology, broadly defined, includes any technique that uses living organisms, or parts of such organisms, to make or modify products, to improve plants or animals, or to develop microorganisms for specific use. The interdisciplinary nature of biotechnology integrates living systems including animal, plant and microbes and their studies from molecular biology to cell biology, from biochemistry to biophysics, from genetic engineering to stem cell research, from bioinformatics to genomics-proteomics, from environmental biology to biodiversity, from microbiology to bioprocess engineering, from bioremediation to material transformation and so on.

Biotechnology is the science of today and tomorrow. It has applications in all major service sectors. i.e. health, agriculture, industry, environment etc. Biotechnology as an application science has taken firm footing in many countries, abroad where a number of transgenic crops, genetically modified food and recombinant therapeutic molecules for human and animal health are available in the market. Biotechnology as a science of service to human society is yet to make inroads in India

With the advent of World Wide Web in the early nineties and its subsequent growth, the latest research trends have become accessible from drawing rooms across the globe. This acted as a positive feedback mechanism in increasing the pace of research in all fields including Chemical Engineering and Bio-technology. This was the motivation for an in depth analysis of what is actually required for today's technology. It is also important to take advantage of the freely available software to enhance the quality and quantity of material that can be covered in the class room.

This restructured syllabus is therefore intended to combine the principles of physical, chemical and biological sciences along with developing advanced technology. The undergraduate curricula is prepared to impart primarily basic knowledge of the respective subject from all possible aspects. In addition, students will be trained to apply this knowledge particularly in day-to-day applications of biotechnology and hence get a flavor of research

Semester III				
Course Code	Course Type	Course Title	Credits	Lectures/week
SIPSBT31	Theory	PTC and ATC	4	4
SIPSBT32	Theory	Medical Microbiology	4	4
SIPSBT33	Theory	Clinical Studies	4	4
SIPSBT34	Theory	Developmental Biology	4	4
SIPSBTP35	Practicals	Practicals based on SIPSBT31 and SIPSBT32	4	4
SIPSBTP36	Practicals	Practicals based on SIPSBT33 and SIPSBT34	4	4
Semester IV				
Course Code	Course Type	Course Title	Credits	Lectures/week
SIPSBT41	Theory	Nanotechnology	4	4
SIPSBT42	Theory	GMO and Environment	4	4
SIPSBT43	Theory	Bioinformatics	4	4
SIPSBT44	Theory	Biostatistics	4	4
SIPSBTP45	Practicals	Dissertation Project	4	4
SIPSBTP46	Practicals	Practicals based on SIPSBT41, SIPSBT42, SIPSBT43 and SIPSBT44	4	4

SEMESTER III

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT31	PTC and ATC		
Course Objectives	To understand: <ul style="list-style-type: none"> • Metabolism in plants and PTC • Cryopreservation technique for cells • Animal tissue culturing • Cell lines and cytotoxicity 		
Unit 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 plant product; Biosynthesis- batch, continuous cultures, immobilized plant cell, Biotransformation of precursors by cell culturing, metabolic engineering for production of secondary metabolites, Hairy root culture, elicitation	4	15
Unit II	Cryopreservation -Principle and types. Germplasm conservation, Transgenic plants-Edible vaccine, Golden rice		15
Unit III	Biology of cultured cells, Culture vessels, Culture Media, Microbial contamination, Cross contamination, Cryopreservation		15
Unit 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

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT32	Medical Microbiology		
Course objectives	To understand: <ul style="list-style-type: none"> • Chromosome disorders and analysis • Pathogenesis of infections • Molecular diagnostic techniques for infections • Biofilms and their resistance 		
Unit I	Chromosomal disorders, Karyotyping, G banding, Chromosome analysis, variations, chromosome painting	4	15
Unit II	Infections of Respiratory tract- Pneumonia, Tuberculosis. Nosocomial- <i>Psuedomonas</i> . Viral infections- HIV, Hepatitis. Fungal- Candidiasis		15
Unit III	Molecular diagnostics for Pneumonia, Tuberculosis, <i>Pseudomonas</i> , HIV, Hepatitis, Candidiasis		15
Unit IV	Biofilms in medicine		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT33	Clinical Studies		
Course Objectives	To understand: <ul style="list-style-type: none"> • Clinical trials, its types and role of ethical committee • Importance of preclinical toxicology • Process of new drug discovery • Medical writing 		
Unit I	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. Institutional Ethics Committee / Independent Ethics Committee.	4	15
Unit II	Pre clinical toxicology: General principles, systemic toxicology (single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, Animal toxicity requirements		15
Unit III	New drug discovery process: purpose, main steps involved in new drug discovery, process, timelines of each steps, advantages and purposes of each steps, ethics in clinical research, unethical trials, thalidomide tragedy. Introduction and designing – various phases of clinical trials, Phase I, II, III and IV trials, post market surveillance - methods		15
Unit IV	Medical writing: Literature search and Medical articles, Contact writing, Publications, Abstracts, Bibliography, Clinical study reports, Principles in softwares in CDM (Clinical Data Management)		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT34	Developmental Biology		
Course Objectives	<p>To acquaint the students with concept of fertilization and embryogenesis</p> <p>To introduce them to the techniques of cryopreservation, in vitro fertilization and contraception</p>		
Unit I	Human Embryonic development: Events during fertilization, in-vitro fertilization, Zona pellucida, glycoprotein, Oolemma protein and their role in fertilization, sperm antigens and their functional significance. Molecular and biochemical events during sperm function	4	15
Unit II	Post fertilization events: early embryonic development, establishing multi-cellularity, formation of blastula, embryonic germ layer, tracking of migrating cells.		15
Unit III	Molecular mechanism of sex hormone action and regulation of gene expression. Implantation and endometrium antigens involved in implantation. Immunology of pregnancy. Superovulation, embryo culture and embryo transfer technology.		15
Unit IV	Infertility and reproductive vaccines. Frontiers in contraceptive research. Cryopreservation of sex gametes and embryos. Ethical issues related to embryo research.		15

PRACTICALS

SIPSBTP35

100 M

PRACTICALS BASED ON SIPSBT31 and SIPSBT32

1. PTC
 - a. Media preparation
 - b. Seed sterilization
 - c. Callus induction
 - d. Isolation and induction of anther cultures using hibiscus
 - e. Protoplast isolation
 - f. Somatic embryogenesis
2. ATC
 - a. Trypsinization and staining of animal cells
 - b. Monolayer formation (fibroblast)
 - c. To assay the radical scavenging activity of a tissue hydrolysate – DPPH method
 - d. Techniques of cell preservation
3. Toxicology – MTT assay
4. Medical diagnostic – Identification of organisms from specimens (Multidrug resistant *S. aureus*, *Pseudomonas spp.*, *Klebsiella pneumoniae*, *E. coli*)
5. Staining of biofilms

SIPSBTP36

100 M

PRACTICALS BASED ON SIPSBT33 and SIPSBT34

1. Study and present a published clinical case report
2. Candling, Observing chick embryo – stages of development; prepared slides / preserved specimens
3. Developmental Biology – visit to a laboratory / video lectures for latest developments in the field (to be documented)

SEMESTER IV

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT41	Nanotechnology		
Course Objectives	To understand: <ul style="list-style-type: none"> • Nanomaterials, methods of synthesis and their properties • Nanorobotics in nature • Applications of nanomaterials in fields such as medicine, food, agriculture, etc 		
Unit 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
Unit II	Carbon nanotubes; Nanorobotics devices of nature: ATP synthase, the kinen, myosin, dynein, flagella modulated motion.		15
Unit III	Nanomedicine: biopharmaceutics, implantable materials, implantable chemicals, surgical aids, diagnostic tools, nanosensors, nano scanning, nano enabled drug delivery system, nanorobotics in medicine.		15
Unit IV	Application of nanomaterials in food, cosmetics, agriculture, environment management		

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT42	GMO and Environment		
Course Objectives	<p>To understand the concept of genetically modified organisms</p> <p>To acquaint the students with solid waste treatment biodegradation methods</p>		
Unit I	Genetically modified microorganisms, examples and methods, Humulin, Ice minus bacteria, GM bacteria in bioremediation, use of PCR as GMO identification tool, risks and controversies related to use of GMO. Indian GM research information system, About Indian GMO research information system (IGMORIS), about the website; Biosfety data of any two approved genes available on the database	4	15
Unit II	GE crops – <i>Arabidopsis</i> as a model plant for studies in genetic engineering; Protocols on Food and feed safety assessments, Acute oral safety study in rats and mice, Subchronic feeding study in rodents, Protein thermal stability, Pepsin digestibility, Live stock feeding study		15
Unit III	Solid waste treatment, pollution indicators and biosensors, biodegradation of xenobiotics, pesticides, phytoremediation		15
Unit IV	Biodegradation of waste from food, textile, petrochem, paper industries, biological detoxification. Removal of oil spillage and grease deposits		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT43	Bioinformatics		
Course Objectives	The objective of this course is to enable the students to understand the nuances of bioinformatics with respect to biological databases, gene and motif finding, protein analysis, gene expression profiling and human genome analysis		
Unit I	Organization of biological data, databases (raw and processed), Querying in data bases. ^[1] Primers in biology (Designing of primers, kinds of primers)	4	15
Unit II	Gene finding, motif finding and multiple sequence alignment. Protein sequence analysis (theory and algorithms). Protein structure analysis and applications.		15
Unit III	Gene expression profiling and its applications. ^[1] Microarray technology and basics. Microarray analysis and organization of data. Human genome analysis		15
Unit IV	Proteomics. ^[1] Exploration of data bases, retrieval of desired data, BLAST etc. ^[1] Gene clusters and fusions, consensus sequences, exon intron finder, sequence logo.		15

COURSE CODE	TITLE	CREDITS	LECTURES
SIPSBT44	Biostatistics		
Course Objectives	Students will be exposed to concepts of statistical population and their distribution They will also be learning about the hypothesis testing via various parametric and non-parametric tests, ANOVA, correlation and regression		
Unit I	Statistical population, sample from population, Random sample. Central Tendency: Mean, Median and Mode, Standard Deviation, Confidence intervals	4	15
Unit II	Gaussian Distribution and testing for normality, Non-parametric tests (Sign test, Wilcoxon test, Mann-Whitney Test, Kruskal-Wallis test,), Transforming data to create Gaussian Distribution		15
Unit 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, t-test (paired & unpaired), z-test, Chi square test, contingency table.		15
Unit 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

PRACTICALS

SIPSBTP45

100 M

Dissertation Project

SIPSBTP46

100 M

PRACTICALS BASED ON SIPSBT41, SIPSBT42, SIPSBT43 and SIPSBT44

1. Bioremediation – isolation of metal tolerant organism and study their growth characteristics and pattern
2. Composting – physical and chemical parameters
3. GMO validation (kit based / demo)
4. Nanoparticles – synthesis by chemical and biological methods; Spectroscopic analysis
5. Multiple alignment – Phylogenetic tree
6. BLAST – homologs, orthologs and paralogs
7. Motif finding
8. KEGG
9. Structure of proteins – identification of chains, helices, special groups, metal ions, etc.
10. CATH / SCOP classification of a given protein

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EVALUATION SCHEME

The performance of the learner shall be evaluated into TWO Parts.

The learner's performance shall be assessed by Internal Assessment of **40 Marks** and Semester End Examination (theory) of **60 Marks for each term**.

Practical examination will be conducted at end of each semester for **200 Marks**.

The allocation of marks for the Internal Assessment and Semester End Examinations are as follows:-

Internal Assessment – 40 Marks

Semester End Examination – 60 Marks

S. No.	Particulars	Marks
	All questions are compulsory Number of questions – 5 (Five) Each question carries 12 Marks	
1.	Q1 – Question based on Unit I	12 Marks
2.	Q2 – Question based on Unit II	12 Marks
3.	Q3 – Question based on Unit III	12 Marks
4.	Q4 – Question based on Unit IV	12 Marks
5.	Q5 – Short notes from Unit I-IV	12 Marks
	TOTAL	60 Marks