w.e.f. Session: 2019-20

Indira Gandhi University, Meerpur, Rewari

Examination Scheme
&
Syllabi
For
M.Sc. Biotechnology
(SEMESTER- I to IV)
(session 2019-21)

Indira Gandhi University, Meerpur, Rewari
Scheme of Examination for M.Sc. Biotechnology

Semester-I				**Credits = 32**				**Marks = 650**			
		Type	**Contact Hours Per Week**			**Credits**		**Examination Scheme**			**Total**
Paper	**Subjects**	**of**									
Code		**Course**	**Theory**	**Practical**	**Total**	**Theory**	**Practical**	**Total**	**Theory**	**Internal Assessment**	**Practical**	
BT 101	Cell Biology	CC	04	--	04	04	--	04	80	20	--	100
BT 102	Biomolecules and Metabolism	CC	04	--	04	04	--	04	80	20	--	100
BT 103	Biostatistics	CC	04	--	04	04	--	04	80	20	--	100
Discipline Centric Elective Course (Any two)												
BT 104	Tools and Techniques	DCEC	04	--	04	04	--	04	80	20	--	100
BT 105	Molecular Biology	DCEC	04	--	04	04	--	04	80	20	--	100
BT 106	Environmental Biotechnology	DCEC	04	--	04	04	--	04	80	20	--	100
Lab Courses												
BT 107	Lab Course-I	CC	--	04×03	12	--	02×03	06	--	--	50	50
	(Based on BT 101-103)											
BT 108	Lab Course-II	CC	--	04×02	08	--	02×02	04	--	--	50	50
	(Based on BT 104 -106)											
BT 109	Seminar	CC	--	--	--	--	--	01	--	--	--	25
BT 110	Self Study Paper	CC	--	--	--	--	--	01	--	--	--	25
	Total		**20**	**20**	**40**	**20**	**10**	**32**	**400**	**100**	**100**	**650**
		C.C = Core Course				DCEC = Discipline Centric Elective Course (DCEC)						

Scheme of Examination for M.Sc. Biotechnology

Semester-II				**Credits = 34**						**Marks = 700**		
		Type	**Contact Hours Per Week**			**Credits**			**Examination Scheme**			**Total**
Paper	**Subjects**	**of**										
Code		**Course**	**Theory**	**Practical**	**Total**	**Theory**	**Practical**	**Total**	**Theory**	**Internal**	**Practical**	
										Assessment		
BT 201	Immunology	CC	04	--	04	04	--	04	80	20	--	100
BT 202	Genetic Engineering	CC	04	--	04	04	--	04	80	20	--	100
BT 203	Animal Cell Culture & Vaccinology	CC	04	--	04	04	--	04	80	20	--	100
BT 204	Developmental Genetics	CC	04	--	04	04	--	04	80	20	--	100
Discipline Centric Elective Course(Any one)												
BT 205	Bioinformatics	DCEC	04	--	04	04	--	04	80	20	--	100
BT 206	Plant Biotechnology	DCEC	04	--	04	04	--	04	80	20	--	100
Foundation Elective Course												
BT 207	Communication Skills & Personality Development	FEC	02	--	02	02	--	02	40	10	--	50
Lab Courses												
BT 208	Lab course-I	CC	--	04×03	12	--	02×03	06	--	--	50	50
	(Based on BT 201-203)											
BT 209	Lab course-II	CC	--	04×02	08	--	02×02	04	--	--	50	50
	(Based on BT 204-206)											
BT 210	Seminar	CC	--	--	--	--	--	01	--	--	--	25
BT 211	Self Study Paper	CC	--	--	--	--	--	01	--	--	--	25
	Total		**22**	**20**	**42**	**22**	**10**	**34**	**440**	**110**	**100**	**700**
CC = Core Course		**DCEC: Discipline Centric Elective Course**							**FEC= Foundation Elective Course**			

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Scheme of Examination for M.Sc. Biotechnology

	Semester-III				**Credits = 35**						**Marks = 750**		
Paper		**Type**	**Contact Hours Per Week**			**Credits**			**Examination Scheme**			**Total**
Code	**Subjects**	**of**										
		Course	**Theory**	**Practical**	**Total**	**Theory**	**Practical**	**Total**	**Theory**	**Internal**	**Practical**	
										Assessment		
BT301	Bioprocess Technology	CC	04	--	04	04	--	04	80	20	--	100
BT302	Plant Development & Plant Tissue Culture	CC	04	--	04	04	--	04	80	20	--	100
BT303	Biology of Infectious Diseases	CC	04	--	04	04	--	04	80	20	--	100
BT304	Microbiology	CC	04		04	04		04	80	20		100
Discipline Centric Elective Course(Any one)												
BT305	Drug Designing and Pharmacogenomics	DCEC	04	--	04	04	--	04	80	20	--	100
BT306	Animal Biotechnology	DCEC	04	--	04	04	--	04	80	20	--	100
Open Elective Course/MOOCs Courses (SWAYAM)												
BT307	Environmental Pollution	OEC	03	--	03	03	--	03	80	20	--	100
Lab Courses												
BT308	Lab course-I	CC	--	04×03	12	--	02×03	06	--	--	50	50
	(Based on BT301 -303)											
BT309	Lab course-II	CC	--	04×02	08	--	02×02	04	--	--	50	50
	(Based on BT 304-306)											
BT310	Seminar	CC	--	--	--	--	--	01	--	--	--	25
BT311	Self Study Paper	CC	--	--	--	--	--	01	--	--	--	25
	Total		**20**	**20**	**40**	**20**	**10**	**35**	**400**	**100**	**100**	**750**
		C.C = Core Course			**DCEC = Discipline Centric Elective Course**				**OEC = Open Elective Course**			

Note: Students will choose/select this (BT307) paper/course from pool of elective papers to be offered by other departments/the University.

Scheme of Examination for M.Sc. Biotechnology

	Semester-IV				Credits = 32					Marks = 650		
		Type	Contact Hours Per Week			Credits			Examination Scheme			Total
Paper Code	Subjects	of Course	Theory	Practical	Total	Theory	Practical	Total	Theory	Internal Assessment	Practical	
BT 401	IPR & Biosafety	CC	04	--	04	04	--	04	80	20	--	100
BT 402	Diagnostics	CC	04	--	04	04	--	04	80	20	--	100
BT 403	Biotech Management	CC	04	--	04	04	--	04	80	20	--	100
BT 404	Proteomics and Genomics	CC	04	--	04	04	--	04	80	20	--	100
Discipline Centric Elective Course(Any one)												
BT 405	Bio-Entrepreneurship	DCEC	04		04	04		04	80	20		100
BT 406	Industrial Biotechnology	DCEC	04		04	04		04	80	20		100
Lab Courses												
BT 407	Lab work I (based on 401-403	CC	--	--	--	--	--	04	--	--	--	50
BT 408	Lab work II (based on 404-406	CC						04				50
BT 409	Seminar	CC	--	--	--	--	--	01	--	--	--	25
BT 410	Self Study Paper	CC	--	-	--	--	--	01	--	--	--	25
	Total		**16**	**--**	**16**	**16**	**--**	**32**	**320**	**80**	**--**	**650**

C.C = Core Course **DCEC = Discipline Centric Elective Course**

Duration = 2 Years (04 Semesters)
Total Marks = 2750
Total Credit = 133

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Indira Gandhi University, Meerpur, Rewari
M.Sc. - Biotechnology

Annexure -A

General Guidelines

1. Seminar

In each semester, there will be a paper on seminar presentation of 25 marks with 01 credit. In this paper, the student will be required to present a seminar of about 15-20 minutes on the theme/ topic such as review of research papers/ articles published in National/ International Journals in his/her area of interest. The topic will be selected by the student in consultation with the teacher allotted to him/her by the department..

An Internal committee of two teachers constituted the Chairperson of the department for each student will evaluate the seminar presentation. The evaluation (Internal evaluation only) will be based on the presentation of student, depths of subject matter and answer to questions. There will be a Coordinator to be nominated by the Chairperson of the Department among the teachers of the department.

For seminar, the topics should be chosen in the following manner:

Semester	topic (not related to the syllabi)
Semester	Basic Research Paper/Article
Semester	National Level Research paper/Article
Semester and onwards	Foreign Research paper/Article

2. Self Study Paper

In each semester, there will be a self study paper of 25 marks with 01 credit. The objective of this paper is to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students will select a topic of their own interest in the given area in consultation with their teachers/Incharge/mentors. After selecting a suitable title for the paper, the students will be required to prepare a hand written in his/her own handwriting report about 6-10 pages. The students will be required to submit the report after getting it checked by the concerned teacher and will be asked to re-submit the report after making the required corrections (if any) before the commencement of the examinations of that semester. The structure of the paper will include the following:

- Introduction
- Main Body
- Conclusion

The thoughts presented in the paper must be original work of the students.

The paper will be evaluated by the panel (one external and one internal examiner) to be appointed by the Chairperson of Department from the prescribed panel of the University.

The evaluation of Self Study paper will be done as given below:

- Evaluation of the paper 15 Marks
- Viva-voce on the paper 10 Marks
- Total 25 Marks

3. Current Affairs

In each semester, there will be a paper on current affairs of the concerned subject covering its latest developments. It will consist of 100 marks (80 marks-Theory+20 marks-Internal Assessment) with 04 credits.

Further, the concerned departments will design and approve the syllabi of this course/paper by respective PGBOS&R as per requirement of the subject. However, the Departments should suggest the relevant readings such as newspapers and magazines etc.

M.Sc. Biotechnology
Semester-I

BT101
Cell Biology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Biomembranes: Molecular composition and arrangement, functional consequences, Transport Recapitulation of the plasma membrane; diffusion, active transport and pumps, uniports, symports and antiports, Donnan equilibrium; ion movements and cell function: acidification of cell,organelles and stomach, Maintenance of cellular pH; cell excitation; bulk transport; Receptor mediated endocytosis, Transepithelial transport

The Extra Cellular Matrix and Cell interactions, Cell walls, The ECM and cell-matrix, nteractions,Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata Ca^{++} dependent and Ca^{++} independent Homophilic cell-cell adhesion

Unit-II

Cytoskeleton and cell movement: Structure and organization of actin filaments, Actin, myosin and cell movements, Structure and dynamic organizations of microtubules, Microtubule motors and movement, Intermediate filaments, Cilia and flagella, Cell matrix adhesion, Integrins, Collagen, Non-collagen components, Auxin and cell expansion, Cellulose fibril synthesis and orientation,Protein sorting and transport, Protein uptak into the ER, Membrane proteins and Golgi sorting, Mechanism of vesicular transport, Lysosomes, Molecular mechanism of secretory pathway.

Unit-III

Cell cycle: The eukaryotic cell cycle, Regulators of cell cycle progression, The events of M phase, Meiosis and fertilization, Genome organization, Chromosomal organization of genes and non-coding DNA, Mobile DNA, Morphological and functional elements of eukaryotic chromosomes,Cell – Cell signalling, Signaling molecules and their receptors, Function of cell surface receptors, Pathways of intracellular signal transduction, Signaling networks

Unit-IV

Cell death and cell renewal: Programmed cell death, Stem cells and the maintenance of adult tissues, Embryonic stem cells and therapeutic cloning, Biology of Cancer, The development and causes of cancer, Oncogenes, Tumor suppressor genes, Molecular approaches to cancer treatment, Biology of Ageing

Practicals:

1. Preparation of mitotic and meiotic chromosomes.
2. Calculation of morphometric data and preparations of idiogram.
3. Determination of chiasma frequency and terminalization coefficient.
4. Preparation of polytene chromosomes and mapping.

Suggested Readings:

1. Molecular Cell, Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York

M.Sc. Biotechnology
Semester-I

BT- 102
Biomolecules and Metabolism

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Chemical foundations of Biology –pH, pK, acids, bases, buffers, weak bonds, covalent bonds, Principles of thermodynamics. Classes of organic compounds and functional groups atomic and molecular dimensions, space filling and ball and stick models. Macro molecular and supra molecular assemblies. Water and its properties.

Unit-II

Amino acids and peptides-classification, chemical reactions and physical, properties,Sugars - classification and reactions, metabolism of carbohydrate, Heterocyclic compounds-and secondary metabolites in living systems -nucleotides, pigments, isoprenoids, Separation techniques for different biomolecules.
Bio-energetics and oxidative phosphorylation. Blood clotting – biochemistry, body fluids –pH and acid base balance and their importance in clinical biochemistry, muscle contraction. Techniques in the study of proteins, carbohydrates and lipids.

Unit-III

Physical techniques in proteins, nucleic acids and polysaccharides structure analysis (UV, IR, MMR, LASER, MASS, Fluorescence spectroscopy, Differential calorimetry, X–ray Crystallography, Ultra Centrifugation, Electron cryomicrography, Scanning Tunneling microscopy.

Unit-IV

Lipids- classification, structure and functions Proteins-protein and protein legand interactions, end group analysis, hierarchy in structure, Ramachandran map.
Conformational properties of polynucleotides, Polysaccharides - types, secondary and tertiary structural features, analysis- theoretical and experimental; Protein folding – biophysical and cellular aspects, enzymes coenzymes, in born errors of metabolism.

Practicals:

1. Titration of amino acids
2. Colorimetric determination of pK
3. Model building using space filling/ball and stick models
4. Reactions of amino acids, sugars and lipids
5. Isolation of DNA and protein
6. Quantitation of Proteins and Sugars
7. Analysis of oils-iodine number, saponification value, acid number
8. UV, Visible, Fluorescence and IR spectroscopy, Absorption spectra
9. Separation techniques - Centrifugation, Chromatography (Gel permeation, Ion exchange, TLC etc. and Electrophoresis
10. Mitosis & Meiosis study

M.Sc. Biotechnology
Semester-I

BT- 103
Biostatistics

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Permutations and combinations, Functions, Limits and Continuity, Exponential and Logarithmic functions, Differential Calculus : Rules of differentiation, Higher derivatives, Maxima and minima, Integration, Integration by parts, Definite integrals, Properties of definite integrals, Elementary ideas of differential Equations.

Unit-II

Types of data, Collection and Graphical representation of data, Measures of central tendency: Mean, Median, Mode, Quartile, Percentile. Measures of Dispersion: Range, Variance, Standard deviation, Coefficient of Variation, Correlation and Regression.

Unit-III

Probability and its applications: Laws of Addition and Multiplication, Compound Probability, Bayes theorem. Probability distributions: Binomial, Poisson and Normal distributions and their applications.

Testing of hypothesis: Parameter and Statistic, Sampling distribution and Standard error, Null and Alternative hypotheses, Simple and composite hypotheses, Two types of errors, Level of significance and Power of the test, One tailed and two tailed tests.

Unit-IV

Tests of significance: t and Z tests for mean and proportion for one and two samples, Chi square test of goodness of fit and independence. F test, Analysis of variance for one way and two way classification, Elementary ideas of Designs of Experiments.

Practicals

Descriptive statistics: Systemic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion (using calculators).
Correlations (Product Moment and Spearman's Rank Correlation) and Linear Regression
Tests of significance (Mean, Standard Deviation, proportion, Correlation Coefficient)
Chi Square Test of Goodness of fit, test of independence of attributes, Analysis of Variance (One way and Two way).

Books recommended:

1. Daniel, Wayne W. (2007) Biostatistics: A Foundation for Analysis in Health Sciences 10th Edition, Wiley Series.
2. Pagano, Marcello and Gauvreau, Kimberlee (2000) Principles of Biostatistics, 2nd Edition, CRC Press
3. Chap T. Le, Introductory Biostatistics (2017), Wiley India Pvt Ltd.
4. P.N. Arora and P. K. Malhan, Biostatistics, Himalaya Publishing House
5. B. K. Mahajan, Methods in Biostatistics: For Medical Students and Research Workers, JPB

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M.Sc. Biotechnology
Semester-I

BT- 104
Tools and Techniques

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

UNIT-I

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanning and transmission electron microscopes.

Centrifuge technique: Principle, types of centrifuge, density gradient centrifuge in isolation of cell, cell organelles and biomolecules.

UNIT-II

Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC) and FPLC. Application of chromatographic technique in biology.

Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).

UNIT-III

Spectroscopy: Fluorescence, UV, visible, Infarad, Atomic absorption spectroscopy, NMR and ESR spectroscopy; Mass spectrometery (LC-MS, GC-MS), X-ray diffraction. Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography. Application of different spectroscopic technique in biology.

UNIT-IV

Nature and types of radiation, preparation of labelling biological sample, detection and measurement of radiation, GM counter, Scientillation counter. Flow cytometery. Safety measurement in handling radioisotopes, ELISA, RIA and non-radiolabelling.

Suggested Laboratory Exercises

1. Demonstration of working of different types of microscopes.
2. Demonstration of Chromatography i.e. TLC, HPLC, GC.
3. To demonstrate the separation of proteins with the help of electrophoresis.
4. To study various molecular biology techniques i.e. PCR.
5. To demonstrate the use of spectrophotometer.
6. Purification of protein by column chromatography.
7. Visit of various laboratories in the university, preparation and submission of report.

Suggested reading:

1. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
2. Cooper, T.G. 1977. Tools in Biochemistry. John Wiley, New York, USA.
3. Dryer, R. L. and Lata, G. F. 1989. Experimental Biochemistry. Oxford University Press, New York.
4. Hames, B.D.(Ed.).1998. Gel Electrophoresis of Proteins: A Practical Approach, 8th edition. PAS, Oxford University Press, Oxford, UK.
5. Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.
6. Wilson, K. and Walker, J. 1994. Practical Biochemistry: Principles and Techniques, 4th edition. Cambridge University Press, Cambridge, UK.

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M.Sc. Biotechnology
Semester-I

BT- 105
Molecular Biology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

DNA Replication: Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, enzymes and accessory proteins involved in DNA replication and DNA repair.
Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements in mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing, Modifications in RNA: 5‟-Cap formation, Transcription termination, 3‟-end processing and .polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

Unit-II

Translation: Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co- and post translational modifications of proteins.
Protein Localization: Synthesis of secretory and membrane protein, Import into nucleus, mitochondria, chloroplast and peroxisomes, Receptor mediated endocytosis ,Oncogenes and Tumor Suppressor Genes: Viral and cellular oncogenes, tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins

Unit-III

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer head, hairpin and other ribozymes, strategies for designing ribozymes, Applications of Antisense and ribozyme technologies
Homologous Recombination: Holliday junction, gene targeting, gene disruption, FLP/FRT and' Cre/Lox recombination, RecA and' other recombinases Molecular Mapping of Genome: Genetic and physical maps,. physical mapping and map-based cloning, choice of mapping population, Simple sequence repeat loci, Southern and fluorescence in situ hybridization for genome analysis,Chromosome micro dissection and micro cloning.

Unit-IV

Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, Molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease. prognosis, genetic counseling, Pedigree, varietal etc. Animal trafficking and poaching; Germplasm maintenance, taxonomy and Bio-diversity

Genome Sequencing: Genome sizes., organelle genomes, Genomic libraries, YAC, BAC libraries, Strategies for sequencing genome, Packaging, transfection and recovery of clones, Application of Sequencing sequence information for identification of defective genes.

Practicals:

1. Isolation of genomic DNA
2. Southern blotting
3. RFLP analysis
4. Isolation of RNA
5. Isolation of polyA + RNA
6. Northern blotting
7. Preparation of probes
8. In vitro Transcription
9. In vitro translation
10. Metabolic labeling of proteins and immuno precipitation

M.Sc. Biotechnology
Semester-I

BT-106
Environmental Biotechnology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Environmental Biotechnology: An overview, concept, scope and market Biological control of air pollution.
Bacterial examination of water for potability.
Testing of water for physiochemical parameters including BOD & COD.
Solid waste: Sources and management (composting, verrmicomposting and methane production).

Unit – II

Waste water : origin, composition and treatment. Physical, chemical and biological treatment of waste water. Aerobic processes: activated sludge, oxidation ponds, trickling filter towers, and rotating discs. Anaerobic processes: anaerobic digesters, anaerobic filters and up flow sludge blanket reactors. Microbiology and biochemistry of aerobic and anaerobic waste water treatment processes.

Treatment of industrial effluents: distillery effluent, paper and pulp mill effluent, tannary effluent, textile dye effluent, removal of heavy metals from waste waters.

Unit – III

Bioremediation : Bioremediation of fuel oils and lubricants in soil and water. Degradation of sulphur compounds present in coal and petroleum. Microbial degradation of xenobiotics, genetic engineering of biodegradation pathways.

Environmental Monitoring: Biosensors for environmental applications, BOD sensor, ammonia sensor, Nitrite sensor and sulphite ion sensor. Indicator organisms: Safety indicators and Quality indicators

Unit – IV

Microbial Insecticides : Bacteria, fugi and viruses. Use of R-DNA technology to enhance the efficacy microbial insecticides.
Biofertilizers
Microbes in oil recovery and bioleaching.
Biodeterioration of stored plant food materials, leather, wool, metals, textiles, stone & related building. Control of microbial bideterioration.

Recommended Books:

1. Environmental Chemistry. A.K. De, Wiley Eastern Ltd., New Delhi.

2. Introduction to Biodeterioration. D. Allsopp and K.J. Seal, ELBS/Edward Arnold.

3. Advanced Environmental Biotechnology by S.K. Agarwal. APH Publishing, New Delhi, (2005).

4. Bioremediation Protocols. David S. (1997), Humana Press, New Jersey.

5. Environmental Science and Technology. Stankey E.M. (1997), Lewis Publishers, New York.

6. Microbial Biotechnology: Fundamentals of Applied Microbiology (2nd edition). Glazer and Nikaido Cambridge University Press, (2007).

7. Biodegradation and Bioremediation: Soil Biology. Singh A. and Ward O.P. (2004), Springer

M.Sc. Biotechnology
Semester-II

BT- 201
Immunology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Introduction; Phylogeny of Immune System- Innate and acquired immunity; Clonal nature of immune response; Organization and structure of lymphoid organs; Nature and Biology of antigens and super antigens; Antibody structure and function; Antigen - antibody interactions

Unit -II

Major histocompatibility complex, BCR & TCR, generation of diversity; Complement system; Cells of the Immune system: Hematopoiesis and differentiation; Lymphocyte trafficking, B-Iymphocytes, T-Iymphocytes, Macrophages, Dendritic cells; Natural killer and Lymphokine - activated killer cells, Eosinophils, Neutrophils and Mast Cells; Regulation of immune response: Antigen processing and presentation, generation of humoral and cell mediated immune responses: Activation of B- and T Lymphocytes.

Unit -III

Cytokines and their role in immune regulation: T-cell regulation, HHC restriction; Immunological tolerance; Cell - mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis; antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity; Hypersensitivity.

Unit -IV

Autoimmunity; Transplantation; Immunity to infectious agents (interacellular parasites, he1minthcs & viruses); Tumor Immunology; AIDS and other Immunodeficiency; Hybridoma Technology and Monoclonal antibodies.

Practicals :

1. Blood film preparation and identification of cells
2. Lymphoid organs and their microscopic organization
3. Immunization, Collection of Serum
4. Double diffusion and Immune-electrophoresis

5. Transfection of Hela Cells
6. Radial Immuno diffusion
7. Purification of IgG from serum
8. Separation of mononuclear cells by Ficol1-Hypaque
9. Con-A induced proliferation of thymocytes (by MTT method)
10. ELISA
11. Hapten Conjugation and quantitation
12. Immunodiagnostics (demonstration using commercial kits)

Suggested Readings:

1. Benjamin E. (1996), Immunology – A short course 3rd Edition, John Wiley, New York.
2. Kuby J. (1997), Immunology, 3rd Edition, W.H. Freeman & Co., New York.
3. Roitt, I.M. (1997), Essential Immunology, 9th Edition, Oxford Black Well Science, London.
4. Tizard I.R. (1995), Immunology – An introduction, 4th Edition, Philadephia Sauders College press.
5. Gupta P.K. (2003), Biotechnology and Genomics, Rastogi Publications, Meerut.
6. Anant Narayan, Text Book of Immunology.
7. Pommerville et al (2004), Alcamo‟s Fundamentals of Microbiology, Jones and Barteett Publishers.
8. Richard Coico (2009) Immunology - A short course, Geoffrey Sunshine (Wiley Blackwell).
9. William Paul (1999) Fundamentals of immunology , (Lippincott Williams & Wilkins).
10. Peter John Wood, Dorling KInderseley (2007), Understanding immunology, (Pearson Education, India).

M.Sc. Biotechnology
Semester-II

BT- 202
Genetic Engineering

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Scope of Genetic Engineering, Milestones in Genetic Engineering. Isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation cloning, gene expression. Cloning and patenting of life forms. Genetic engineering guidelines, Molecular Tools and Their Applications, Restriction enzymes, modification enzymes, DNA and RNA markers.

Unit -II

Nucleic Acid Purification, Yield Analysis, Nucleic Acid Amplification and its Applications, Gene Cloning Vectors, Restriction Mapping of DNA Fragments and Map Construction, Nucleic Acid Sequencing, cDNA Synthesis and cloning , mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening, Alternative Strategies of Gene Cloning. Transgenic and gene knockout technologies. Targeted gene replacement, chromosome engineering

. Unit -III

Cloning interacting genes-Two-and three hybrid systems, cloning differentially expressed genes. Nucleic acid microarray arrays Site-directed Mutagenesis and Protein Engineering, How to Study Gene Regulation? DNA transfection, Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays
Expression strategies for heterologous genes, Vector engineering and codon optimization, host engineering,in vitro transcription and translation, expression in bacteria expression in yeast, expression in insect cells, expression in mammalian cells, expression in plants.

. Unit -IV

Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins. Phage Display, T-DNA and Transposon Tagging. Role of gene tagging ingene analysis, T-DNA and Transposon Tagging. Identification and isolation of genes through T-DNA or Transposon. Gene therapy: Vector engineering strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

Practicals:

1. Bacterial culture and antibiotic selection medias. Prepration of competent cells.
2. Isolation of plasmid DNA.
3. Isolation of lambda phage DNA.
4. Quantitation of nucleic acids.
5. Agarose gel electrophoresis and restriction mapping of DNA
6. Construction of restriction map of plasmid DNA.
7. Cloning plasmid/phagemid vectors.
8. Preparation of helper phage and its titration
9. Preparation of single stranded DNA template
10. DNA sequencing
11. Gene expression in E. coli and analysis of gene product
12. PCR and Reporter Gene assay (Gus/CAT/b-GAL)
13. Western Blotting

Suggested Readings

1. Gene cloning and DNA analysis – An Introduction (2006) 5th edition, T.A Brown, Blackwell publisher.
2. Essential genes (2006), Benzamin Lewin, Pearson education international.
3. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, NewYork.
4. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primose and R.M Twyman, Blackwell publishing.
5. Principles of Genetic Engineering (2009), Mousumi Debnath, pointer publisher, Jaipur.
6. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.
7. Human Molecular Genetics (2004) 3rd edition, Tom Strachan & Andrew P Read, Garland science.
8. Molecular Biology of Gene (2008) 6th edition, Watson, Baker,Bell. Gann,Levine and Losick, Pearson education Inc.
9. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
10. Molecular Cloning : A Laboratory Manual (2000), J. sambrook, E.F. Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York
11. DNA Cloning : A Practical Approach (1995) , D.M. Glover and B.D. Hames, IRL Press, Oxford,
12. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes (1998), S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.

M.Sc. Biotechnology
Semester-II

BT- 203
Animal Cell Culture & Vaccinology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Equipments and materials for animal cell culture technology, Primary and established cell line cultures. Introduction to the balanced salt solutions and simple growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Role of carbon dioxide. Role of serum and supplements, Serum & protein free defined media and their application.

Unit -II

Measurement of viability and cytotoxicity, Biology and characterization of the cultured cells, measuring parameters of growth, Basic techniques of mammalian cell culture *in vitro* disaggregation of tissue and primary culture maintenance of cell culture cell separation. Scaling-up of animal cell culture, Cell synchronization, Cell cloning and micromanipulation, Cell transformation, Application of animal cell culture, Apoptosis.

Unit –III

Instruments related monitoring of temperature, sterilization, environment, quality assurance and related areas, production techniques, growing the microorganisms in maximum titre, preservation techniques to maintain good antigen quality, freeze drying.

Unit –IV

History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Introduction to newer vaccine approaches namely- subunit vaccines, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines, edible vaccines, nanoparticles in vaccine delivery systems

Practicals:

1. Preparation of tissue culture medium and membrane filtration
2. Preparation of single cell suspension from spleen and thymus
3. Cell counting and cell viability
4. Macrophage monolayer from PEC, and measurement of phagocytic activity
5. Trypsinization of monolayer and sub culturing
6. Cryopreservation and thawing
7. Measurement of doubling time
8. Inoculation of embryonated chicken eggs for cultivation of virus
9. Harvesting of virus from the inoculated embryo
10. Immunization of laboratory animals
11. Titration of antibodies against the recombinant protein

Suggested Readings:

1. Culture of Animal Cells- A manual of basic techniques by R.I. Freshney
2. Barry R Bloom, Paul-Henri Lambert 2002. *The Vaccine Book.* Academic Press
3. Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *The new generation vaccines.* 3rd Ed. Informa Healthcare.
4. Lowrie DB & Whalen R. 2000. *DNA Vaccines.* Humana Press.

M.Sc. Biotechnology
Semester-II

BT- 204
Developmental Genetics

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Structure, chemistry, dynamics and regulation of sperm locomotion, capacitation and egg-surface targeting. Molecular biology, cytology and biochemistry of ovogenesis: Synthesis and storage of maternal transcripts, proteins and cell organelles. rDNA amplification in amphibia; transcription on lampbrush chromosomes, ovulation and hormonal control in mammals.

Unit-II

Molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species-specificity. Egg activation, early cleavages and blastocyst formation in mammals and biochemical and cellular changes during the passage down the oviduct to the uterus.

Unit-III

Implantation and formation of the placenta in mammals. Gastrulation in mammals-formation of primitive streak, morphogenetic movements and neural induction. Organogenesis and foetal development. Pattern forming genes and expression in Drosophila and mammalian embryos Development of the mammalian brain-cerebral cortex-cell lineages. Lens development-fibre differentiation, programmed morphogenetic histogenetic cell death (apoptosis). Erythropoeisis, myelopoeisis. Ageing.

Unit-IV

Introduction to stem cells - Embryonic Stem Cells, Adult stem cells, Molecular basis Pluripotentency and its application, Stem cell niches, Stem cell renewal, Cell cycles regulators in stem cells. Epigenetic mechanism of cellular memory, Germ line Stem Cells, Stem Cells and Cloning, Nuclear cloning and Epigenetic reprogramming; Growth Factors and Signal Cascades BMP, Nodal, Wnt, Notch and Retenoid signaling during gastrulation.

Practicals:

1. To study the different stages of development in frog and chick through permanent slides.
2. To study the spermatogenesis of rat and grasshopper through slides.
3. To prepare the permanent stained slides of developing stages from fertilized egg of hen.
4. To study different larvae in invertebrates from permanent slides.
5. To study the larvae of invertebrates (Redia, Cercaria, Arthropod larvae, Glochidium larva) through permanent slides.
6. Study of salivary gland chromosomes of larvae of chironomus/Drosophila from permanent slides.
7. Study of metaphase karyotypes from photographs/permanent slides of Drosophila, grasshopper and man/rat.
8. Study of sex-chromatin Bars body from human buccal mucosa.
9. Demonstration of monohybrid and dihybrid cross, Co-dominance, Incomplete dominance and Epistasis with the help of beads and photographs.

Suggested Readings:

1. Developmental Biology (2003) - Gilbert S. F, Sinauer Asso.
2. Principles of Development (2002) - Wolpert L et al., Oxford University Press
3. The Art of the Genes (1999) - How Organisms Make Themselves Coen E. Oxford University Press
4. Genetic Analysis of Animal Development (1993) 2nd ed. - Wilkins A. S., Wiley-Liss
5. Biological Physics of the Developing Embryo (2005) - Forgacs G. & Newman S. A., Cambridge University Press.
6. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, TwoVolume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells, 2012, Academic Press.
7. R. Lanza, J. Gearhart et al (Ed), Essential of Stem Cell Biology, Elsevier Academic press.

M.Sc. Biotechnology
Semester-II

BT- 205
Bioinformatics

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Computers: An overview of computers, architecture; generations; Concept of programming , Introduction to MS Office, MS Access, introduction to C, Introduction to Database; Introduction to computer networking; topology; Scope and Applications of bioinformatics.

Unit-II

Introduction to PERL: Scalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input/output, Standard Input Conditional and logical operators, loops, Regular expression, Pattern matching, Subroutines.
Applications of PERL in Bioinformatics: Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Generating random numbers, simulating DNA mutation, generating random DNA, Analyzing DNA.

Unit-III

Biological Sequence Databases: Overview of various primary and secondary databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are GeneBank, EMBL, DDBJ, Swiss Prot, PIR, and MIPS for primary sequences. Databases like TIGR, Hovergen, TAIR, PlasmoDB, ECDC etc., to be discussed. Preliminary ideas of query and analysis of sequence information.
Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, NeedlemanWusch&SmithWaterman algorithms. Analysis of computational complexities and the relative merits and demerits of each method.Theory of scoring matrices and their use for sequence comparison.

Unit-IV

Database Search Algorithms: Methods for searching sequence databases like FASTA and BLAST algorithms. Statistical analysis and evaluation of BLAST results. Pattern Recognition Methods in Sequence Analysis: Concept of a sequence pattern, regular expression based patterns. The use of pattern databases like PROSITE and PRINTS. Concept of position specific weight matrices and their use in sequence analysis. Theory of profiles and their use with special reference to PSIBLAst. Markov chains and Markov models and their use in gene finding. Concept of HMMS, the Forward backward and the Viterbi algorithm. The Baum Welch algorithm for training aHMM. Use of profile HMM for protein family classification.

Practicals:

1. Retrieve Nucleotide sequences from NCBI serve.
2. Retrieve Protein sequences from PDB.
3. Analysis of sequences Similarity using BLAST/pBLAST/nrBLAST
4. To predict protein secondary structures by using iPred.
5. Perform phylogenetic analysis using PHYLIP.
6. Perform multiple sequence alignment by using ClustalW.
7. Primer design
8. Computational modeling of genomic, transcriptomic and proteomic

Suggested readings:

1. JinXiong. 2006. Essential Bioinformatics. Cambridge publisher
2. ZhumurGhosh and BibekanandMallick. 2008. Bionformatics: Principles and Applications. Oxford University Press publisher
3. OrpitaBosu and SimminderKaurThukral. 2007. Bioinformatics. Oxford University Press publisher
4. M.Lesk. 2002. Introduction to Bioinformatics. Oxford University Press publisher
5. Dan E. Krane, Michael L. Raymer, Michaeel L. Raymer, Elaine NicponMarieb. 2002. Fundamental Concepts of Bioinformatics Benjamin/Cummings
6. P. Rastogi and N. Mendiritta. 2013. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th Revised edition.
7. Mount and David W .2004. Bioinformatics: sequence and genome analysis. Cshl Press, 2nd edition
8. Harisha S. 2007. Fundamentals of Bioinformatics. I K International Publishing House Pvt. Ltd .
9. Dan E. Krane. 2003. Fundamentals concepts of bioinformatics. Dorling Kindersley (RS); First edition .
10. David Edwards and Jason Stajich. 2009. Bioinformatics: Tools and Applications. Published by Springer.

M.Sc. Biotechnology
Semester-II

BT-206

Plant Biotechnology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit - I

Plant genetic transformation:

Organization of plant genome – Nuclear genome, Chloroplast genome and mitochondrial genome. Transposon and T – DNA tagging.

Chloroplast transformation – vector designing, method and advantages *Agrobacterium* mediated transformation – Ti and Ri plasmids, role of virulence genes, mechanism of T-DNA transfer, vectors based on Ti and Ri plasmids – cointegrate and binary vectors, technique and factors affecting *Agrobacterium*mediated transformation of plants.

Direct gene transfer – particle bombardment, PEG-mediated, electroporation, microinjection and alternative methods.

Screenable and selectable markers, molecular characterization of transformants. Marker free methodologies, methods for multiple gene transfer in plants.

Gene silencing in transgenic plants.

Unit - II

Strategies for introducing biotic and abiotic stress resistance/tolerance:

Viral resistance; Fungal resistance; Insect resistance; Herbicide resistance; Various abiotic stresses (like drought, salinity, temperature and flooding).

Genetic engineering of plants for molecular farming/pharming:

Production of medically related proteins in plants, nutritional enhancement of plants (carbohydrates, seed storage proteins, vitamins), manipulation of flower colors and other value addition compounds (like industrial enzymes).

Unit - III

Plant cells as biofactories for the production of secondary metabolites:

Production of useful secondary metabolites through plant cell cultures;

Strategies used for high yield of product – development and selection of high yielding cell line cultures, optimization of factors affecting yield of plant cells (physical culture conditions, media and other biochemicals), bioreactors and immobilized plant cell culture, biotransformation, permeabilization of cells and removal of secreted products.

Unit - IV

Intellectual Property Rights, Biosafety and Ethical Issues – Intellectual property rights (IPR); Patents, trade secrets, copyright, trademarks; Plant genetic resources; GATT & TRIPPS; Patenting of biological material; Patenting of transgenic organisms and genes; Plant breeders rights (PBRs) and farmers rights; Concerns about GM crops– environmental, biosafety and ethics**.**

Recommended Books:

1. Plant Genetic Engineering Vol. 1 - 6 (2003) Singh R. P and Jaiwal P. K. (Eds.), Sci tech publishing LLC, USA.
2. Elements of Biotechnology by P. K. Gupta, Rastogi pub.
3. Biotechnology in crop improvement (1998) by H. S. Chawla, International Book distributing company.
4. Gene transfer to plants by Potrykus I. and Spangenberg G., Springer Verlag, Germany.
5. Plant tissue culture – Theory and Practice (2005) by Bhojwani S. S. and Razdan M. K., Elsevier publication.
6. Plant biotechnology (2000) by Hammond J, McGarvey P. and Yusibov V. (Eds.) Springer verlag, Germany.
7. Plant gene isolation – Principles and practice (1996) by Foster G.D. and Twell D., John Wiley & Sons, USA.
8. Plant Biotechnology – The genetic manipulation of plants (2003) by Slater A., Scott N. and Fowler M., Oxford pub.
9. Practical application of Plant Molecular Biology (1997) by Henry R.J., Chapman and Hall.
10. Plants, genes and agriculture (1994) by Chrispeels M.J., Sadava D.E, Jones & Bartlett pub., UK.

M.Sc. Biotechnology
Semester-II

BT- 207
Communication Skills Personality Development

Maximum Marks: 50
Theory Examination: 40
Internal Assessment: 10
Time: 3 hrs

Note: The examiner shall set nine questions in all covering the whole syllabus. Question No.1 will be compulsory and consist of 04 small questions of two marks each, covering the whole syllabus. The remaining 8 questions will be set from the syllabus on two questions from each unit basis; out of which the students will attempt four questions selecting one from each unit. All questions carry 08 marks each.

Unit I

Writing Skills

Letter Writing, Resume Writing, CV Writing, Difference between bio-data, Resume and CV, cover letter, Preparation of Report, Paragraph writing

Unit II

Interview Skills

Job Interview: Importance and Factors Involving Job Interview; Characteristics of Job Interview; Job Interview Process; Job Interview Techniques- Manners and etiquettes to be maintained during an interview; Sample Questions Commonly asked During Interview, Dress Code, Mock-Interview, How to be Successful in an Interview.

Unit III

Oral Presentation

Delivering a Presentation, Tools that enhance the effect of the presentation, conducting presentations in a smooth and self-assured manner. Group presentation, Group discussions, Group projects. Group Discussion, Differences between group discussion and debate, Narrating a story/an incident.

Unit IV

Technology-based Communication

Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Suggested readings

1. Sethi, J & et al. A Practice Course in English Pronunciation, Prentice Hall of India, New Delhi.
2. Sen, Leena. Communication Skills, Prentice Hall of India, New Delhi.
3. Prasad, P. Communication Skills, S.K. Kataria & Sons.
4. Bansal, R.K. and J.B. Harrison. Spoken English, Orient Language.
5. Roach Peter. English Phonetics and Phonology.
6. A.S. Hornby's. Oxford Advanced Learners Dictionary of Current English, 7th Edition.
7. T. Balasubramaniam: Phonetics & Spoken English.

M.Sc. Biotechnology
Semester-III

BT- 301
Bioprocess Technology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Theory

UNIT I

Microbes in food industries, Preservation of foods by different methods such as high temperature, low temperature, chemical additives and irradiation. Basic concepts of D-value, Z-value, 12-D concept and F-value. Biochemical changes caused by microorganisms, Spoilage of various types of food product (Milk, meat, bread, fruits and vegetables). Food poisoning (Botulism, *Staphylococcal aureus* infection , Salmonellosis, Shigellosis, Food infections caused by *C. jejuni*, *H. pylori*, *Y. enterocolitica*, *V. cholerae*, *V. parahaemolyticus, B. cereus*) and microbial toxins, microbial standards for different foods.

UNIT II

Basic concepts of upstream and downstream processes, Different parts of Bioreactor; aeration and agitation system (e.g. baffles, spargers, impellers); pH, temperature, redox potential and oxygen measurement and its control in a bioreactor; Use of computers in a bioreactor; Microbial production and uses of antibiotics like penicillin, streptomycin, tetracycline, immunosupressor, enzymes like proteases, amylases, cellulases, lipases, glucose isomerases, glucose oxidases, bacterial insecticides and Xanthan gum; Basic concept of Immobilized enzyme technology.

UNIT III

Microbial production of anti-cancer agents and antioxidant drug: production of CoQ10, beta-caretonid, astaxanthine, demethylated colchicines; and its derivative, glucosamine, Steroid transformation, Microbial production of Industrial alcohol , Microbial production of beer, ale, wine, whisky, rum, vodka, brandy, champagne, Microbial production of methanol and unsaturated fatty acid, Microbial production and uses of riboflavin, Vitamin B12, L-lysine and Glutamic acid production, Use of microbes in mineral recovery.

UNIT IV

Biological warfare agents; Mode of action of antibiotics (acting on cell walls, cell membranes, protein biosynthesis and nucleic acid biosynthesis); antiviral chemotherapy; Anti-fungal chemotherapy, Mechanism of drug-resistance and multiple drug-resistance; Bacterial vaccines: conventional: killed/attenuated; DNA; peptide; recombinant proteins and edible vaccines; Various sterilization techniques: biohazard hood, BSL 1, 2, 3, 4.

PRACTICALS:

Production and estimation of antibiotics (Penicillin and Streptomycin)
Production and estimation of alcohol
Operation of bioreactor.
Demonstration of different biosafety levels with at least one example of pathogenic microorganism exploited in each group.
Demonstration of different sterilization techniques
Isolation of coliforms from the contaminated water and MPN number

SUGGESTED READINGS:

Principles of fermentation technology, Stanbury P.F. et al, Butterworth-Heinemann Ltd, Oxford
Industrial Microbiology by Casida
Industrial Microbiology by Cruger
Food Microbiology by Frazier

M.Sc. Biotechnology
Semester-III

BT- 302
Plant Development and Plant Tissue Culture

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Theory

UNIT I

Embryogenesis: Early event in embryo, Genetics of embryo development, Gene interaction during embryo development, Pattern mutants (Apical-basal axis mutants- Short integuments mutants,Gnoml emb30 mutants, Segment deletion mutants-Monopteros mutants , Gurke mutants and Radial axis mutants-Knoll mutants).Summary about pattern formation in embryogenesis.

Unit -II

SAM organization, Developmental changes in zonation of SAM, Molecular biology of SAM by mutants. Organization of Root Apical Meristem and promeristem, Genetics of root and root hair development; Role of positional information in root; Genetics of vascular tissue differentiation, Genetics of leaf development in dicots & monocots, Genetic control over trichome development.

Unit -III

Molecular genetics of anther and pollen development, Genetics of ABC model of flower development. Function and regulation of homeotic gene expression, Cadastral functions of homeotic genes, Molecular functions of MADS box genes, Genetics of floral meristem and floral organ identity genes, Control of whorl formation in flower; Developmental stages of the endosperm maturation and desiccation , Genetic control over seed germination and dormancy (*VP1* gene in Maize, *AB1-3, LEC1* and *FUS3* gene in *Arabidopsis*).

UNIT-IV

Plant tissue culture: Laboratory Organization; Media preparation and sterilization techniques; Concept of cellular differentiation and totipotency; Types of cultures, protoplast culture and somatic hybridization; Anther and pollen culture.

PRACTICALS:

Study of Cytohistological zonation in the shoot apical meristem in sectioned double-stained permanent slides.

Examination of L.S. of root apical meristem from a permanent slide preparation.

Study of phyllotaxy in different plants.

Study of V.T.S. of leaves of dicots and monocots plants.

Study of epidermal peels of leaves of dicots & monocots to study the development and final structure of stomata and prepare stomatal index.

Study of T.S. of stem of various plants having primary and secondary anomalous structure. Composition and preparation of various culture media: Knop medium and Murashige and Skoog‟s media.

SUGGESTED READINGS:

Howell, S.H. 1998. Plant Growth and Development.A Molecular approach. Academic Press, San Diego.

Mauseth, J.D. 1988. Plant Anatomy. Benjamin Cummings. California.

Lyndon, R.F. 1990. Plant Development. The Cellular Basis. Unnin Hyman, London.

Waisel, Y., Eshel, A. and Kafkaki, V. (eds) 1996. Plant Development (2nd edition), Cambridge University Press, Cambridge.

Dekker.M. 2013. Plant Roots: the Hidden Half (4^{th} edition), CRC press, New York.

Taiz et al., 2015. Plant Physiology and Development, 5^{th} edition.

Bajaj, Y.P.S. Biotechnology in Agriculture and Forestry Plant Protoplasts and Genetic Engineering I., Springer Verlag, Berlin. 1989.

Bhojwani, S.S. & M.K. Razdan. Plant Tissue Culture – Theory and Practices.5 th Ed. Elsevier Science Pub. Co. Inc., New York.776pp. 2005.

Butcher, D.N. & D.S. Ingram. Plant Tissue Culture, Edward Arnold Ltd., U.K. 1976.

Razdan, M.K. An Introduction to Plant Tissue Culture. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.397 pp. 2001.

Reinert, J. and M.M Yeoman. Plant Cell and Tissue Culture-A Laboratory Manual, Springer Verlag, Berlin. 83pp. 1982.

Smith, R.H. Plant Tissue Culture, Technique and Experiments.2 nd Ed. Academic Press, New York.231pp. 2000.

Session: 2019-20

M.Sc. Biotechnology
Semester-III

BT- 303
Biology of Infectious Diseases

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Theory

UNIT I

Bacteria: Representative diseases to be studied in detail are - tetanus, diphtheria, cholera, typhoid, tuberculosis, leprosy, plague, and syphilis. Infections caused by anaerobic bacteria, spirochetes, chlamydia, rickettsiae.
Viruses: Representative diseases to be studied in detail are - viral hepatitis, influenza, rabies, polio and AIDS and viral cancers.
Fungi: Diseases to be taken up in following categories: superficial, subcutaneous, systemic and opportunistic mycoses.
Protozoa: Diseases to be discussed are - amoebiasis, toxoplasmosis, trichomoniasis & leishmaniasis.

UNIT II

Disease burden: microbial, viral, fungal and parasitic. Investigation of epidemics; Methods of culturing and assaying: bacterial, viral and parasitic. Classification: fungal, protozoal, helminthic, bacterial and viral; Replication of DNA, RNA+ve and RNA-ve viruses, retroviruses.

UNIT III

Bacterial and viral vectors; Biological warfare agents; Mode of action of antibiotics and antiviral: molecular mechanism of drug resistance (MDR); Anti-viral chemotherapy; Anti-fungal chemotherapy; Viral vaccines: conventional: killed/attenuated; DNA; peptide; recombinant proteins.

UNIT IV

Hospital-acquired infections (nosocomial), immune compromised states. Water and waste management for water-borne diseases. . Modern approaches for diagnosis of infectious diseases: Basic concepts of gene probes, dot hybridization and PCR assays. Sterilization techniques: biohazard hoods; containment facilities, BSL 2, 3, 4.

PRACTICALS

Staining techniques.

Haemagglutination test.

Commercial kits-based diagnosis.

Antibiotic sensitivity(bacterial).

Electron microscopy (demo)

Bacterial culture

Agar gel diffusion

ELISA

Preparation of axenic cultures

M.Sc. Biotechnology
Semester-III

BT-304
Microbiology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

The Beginning of Microbiology Discovery of the microbial world by Antony van Leeuwenhoek: Controversy over spontaneous generation, Role of microorganisms in transformation of organic matter and in the causation of diseases Development of pure culture methods Enrichment culture methods, developments of microbiology in the twentieth century. Methods in Microbiology Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition Construction of culture media; Enrichment culture techniques for isolation of chemoautotrophs,' chemoheterotrophs and photosynthetic microorganisms.

Microbial Evolution, Systematic and Taxonomy, Evolution of earth and earlier life forms; Primitive organisms and their metabolic strategies and molecular coding; New approaches to bacterial taxonomy classification including ribotypeing Ribosomal RNA sequencing; Characteristics of primary domains Taxonomy, Nomenclature and Bergey's Manual

Unit-II

Microbial Growth The definition of growth, mathematical expression of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen; Culture collection and maintenance of cultures Overview of Basic Metabolism & Microbial Nutrition

Metabolic Diversity among Microorganisms Photosynthesis in microorganisms;

Role of Chlorophylls, carotenoids and phycobilins; Calvin cycle; Chemolithotrophy; Hydrogen - iron - nitrite - oxidizing bacteria; Nitrate and sulfate reduction; Methanogenesis and acetogenesis; Fermentations - diversity, syntrophy, role of anoxic decompositions; Nitrogen metabolism;" Nitrogen fixation; Hydrocarbon transformation

Unit-III

Prokaryotic Diversity Bacteria: Purple and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendaged bacteria; Spirilla; Spirochaetes; Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci: Mycobacteria: Rickettsias, Chlamydies and Mycoplasma. Archaea: Archaea as

earliest Life forms: Halophiles; Methanogens;' Hyperthermophilic urchaea; Thermoplasma Eukaryotic : Algae, Fungi, Slime molds and Protozoa.
Viruses: Bacterial, Plant, Animal and Tumor viruses; Discovery, classification and structure of viruses; Lysogeny: DNA viruses: Positive strand Negative strand, and double stranded RNA viruses; Replication: Examples of Herpes, Pox, Adenoviruses, Retroviruses, Viroids and Prions

Unit-IV

Prokaryotic Cells: Structure-function Cell walls of eubacteria (peptidoglycan) and related molecules; Outer-membrane of Gram negative bacteria; Cell wall and cell membrane synthesis; Flagella and motility; Cell inclusions like end spores, gas vesicles Chemotherapy/Antibiotics Antimicrobial agents; Sulfa drugs; Antibiotics: Penicillins and Cephalosporins; Broad spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics
Genes, Mutation and. Mutagenesis UV and chemical mutagenesis Types of mutation; Ames test for mutagenesis; Methods of genetic analysis Bacterial Genetic System Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons, Bacterial genetics map with reference to E.coli Viruses and Their Genetic System Phage I and its life cycle: RNA phages RNA viruses; Retroviruses
Genetic systems of Yeast and Neurospora Extra-Chromosomal Inheritance

Practicals

1. Preparation of liquid and solid media for growth of microorganisms Isolation and maintenance .of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms Isolation of pure cultures from soil and water
2. Growth; Growth curve; Measurement of bacterial' population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon und nitrogen sources on growth.
3. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores
4. Study of mutations by Ames test.
5. Assay of antibiotics und demonstration of antibiotic resistance
6. Analysis of water for potability and determination of MPN
7. Bacterial transformation
8. Biochemical characterization of selected microbes
9. Transduction
10. One step growth curve of coliphage
11. Isolation of Plasmids
12. $C0_2$ fixation by photosynthetic microbes

M.Sc. Biotechnology
Semester-III

BT- 305
Drug Designing and Pharmacogenomics

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

UNIT-I

General ideas of drug designing, 2D and 3D QASR, concept of a pharmacophore and pharmacophore based searches of ligand databases. Concepts of COMFA. Methods for simulated docking

UNIT-II

Drug response to patients, Structural influence in the Drug response. Efficacy and metabolism of drugs. Drug metabolism pathways and adverse drug reactions. Detoxification and poisoning and Drug discovery and approval. Metabolic changes of drugs and related organic compounds - Ayurgenomics - Genomics and Modern Medicine. Pharmacogenomics and Pharmacognosy

UNIT-III

Concepts of Pharmacogenetics, Pharmacogenomics- Introduction, basic concepts about genetic diseases. Personalized medicine- introduction and importance. The genetics of therapeutic targets and gene-based targets. Pharmacogenomics necessity in drug designing. Polymorphisms- Introduction, types and importance in Drug targets. Prediction of structural changes among sequences by the influence of polymorphisms. Genetic analysis of human variation, Microsatellite for studying genetic variation.

UNIT-IV

Tools for pharmacogenomics analysis. Pharmacokinetics (PK), Pharmacodynamics (PD). Process in Structural Pharmacogenomics- Target Structure optimization, Validation, lead identification, ADME prediction, synthesis, assays and Clinical trials.

SUGGESTED READINGS:

Rapley R and Harbron S. Molecular analysis and Genome discovery. John Willey & Sons, Ltd. 2004.
Falconer DS, Mackay TFC, Introduction to Quantitative Genetics. 4th Edition.
Daniel A. Brazeau, PhD, and Gayle A. Brazeau. A Required Course in Human Genomics, Pharmacogenomics and Bioinformatics.
Rosenberg NA, Pritchard JK, Weber JL, Cann HM, Kidd KK, Zhivotovsky LA, Feldman MW Science, Vol 298 (5602), 2381-2385, 2002.
Anderson JL, Horne BD, Stevens SL, et al. for the Couma-Gen Investigators. Randomized Trial of Genotype-Guided Versus Standard Warfarin Dosing in Patients Initiating Oral Anticoagulation. Circulation. 2007,116, 2563

M.Sc. Biotechnology
Semester-III

BT-306
Animal Biotechnology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit -I

Animal Biotechnology- Scope, global perspective and new horizons, Historical per- spective, and economically important livestock breeds, Model animals in animal bi- otechnology and genetic engineering.

Somatic Cell Genetics: Production of hybrid cells, Properties of hybrids, Applica- tions hybrid cells,

Unit -II

Gene Transfer into Animal Cells: DNA transfer techniques into mammalian cells: calcium phosphate precipitation, DEAE-dextran procedure, polycation DMSO, mi-croinjection, electroporation; Selectable markers, viral vectors for gene transfer into mammalian cells: SV40, adenovirus, vaccinia, bovine papiloma virus, baculovirus, retrovirus.

Transgenic animals: Transgenic mice: Methodology and applications; Transgenic cattle, Livestock transgenesis- production of drugs using animals

Unit -III

Biotechnology in livestock assisted reproduction, biodiversity and conservation:
Biotechnology in conservation of livestock diversity, Superovulation, Embryo biotechnology- Embryo collection, evaluation, and transfer, IVF and *in vitro*embryo production, Cryobanking of germplasm, oocytes and sperm, Somatic cell nuclear transfer, Stem cells technology in livestock

Unit-IV

Animal cloning: Concepts of animal cloning, Principles and techniques of cloning, Applications of animal cloning.

Animal genomics: crucial role for health and biomedical sciences. Models used in animal genomics. Functional genomics and livestock traits assessment, Livestock in the post genomic era of biology and medicine

Recommended Books:

1. Animal Cell Biotechnology, Vol. 1-6 Spier, R.E. and Griffiths, J.B. (eds), Academic Press.
2. Animal Cell Culture - Practical Approach, Ed. John R.W. Masters, Oxford.
3. Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
4. Biotechnology, Vol. 7b 1993 Rehm. H.J. and Reed, G.(eds) VCH Publica- tions.
5. Comprehensive Biotechnology. Vol. **I,** Murray Moo-Young (ed.) 1985, Aca- demic Press, USA
6. Culture of Animal Cells:A Manual of Basic Technique and Specialized Applications(6th edition). R. Ian Freshney. Wiley- Blackwell, (2010).
7. Genetic engineering: An introduction to gene analysis and exploitation in euk- aryotes Kingsman, S.M. and Kingsman, AJ. 1988. Blackwell scientific Publ. U.K.
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th Ed. (2009). Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. ASM Press, USA.
9. Molecular Genetics 2 Strachan, Tom and Read, Andrew P. New York and London: Garland Science, (2010).

M.Sc. Biotechnology
Semester-IV

BT- 401
IPR & Biosafety

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Theory

Unit I

Introduction to Intellectual Property

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP

IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS

Unit II

Concept of 'prior art'

Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation

Basics of Patents

Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application

Unit III

Patent filing and Infringement

Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe and US Patenting by research students, lecturers and scientists-University/organizational rules in India and abroad, credit sharing by workers, financial incentives Patent infringement- meaning, scope, litigation, case studies and examples

Unit IV

Biosafety

Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Important Links

http://www.w3.org/IPR/
http://www.wipo.int/portal/index.html.en
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in www.iprlawindia.org/ - 31k - Cached - Similar page
http://www.cbd.int/biosafety/background.shtml
http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

SUGGESTED READINGS:

Peter Dabrock, Jochen Taupitz , Jens Ried (Editor) Trust in Biobanking: Dealing with Ethical, Legal and Social Issues in an Emerging Field of Biotechnology. Springer, 2012.
Robert A. Bohrer, A Guide to Biotechnology Law and Business, Carolina Academic Press, 2007.
Richard Sherlock & JD Morrey, Ethical Issues in Biotechnology, 2002.
Selected papers from scientific journals and websites

M.Sc. Biotechnology
Semester-IV

BT- 402
Diagnostics

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

UNIT –I

Quality control, GMP and GLP, records. Biochemical disorders. Immune disorders.Immunodiagnostics: Infectious diseases and its diagnosis, respiratory diseases (influenza,etc.)Viral diseases-HIV etc., bacterial diseases, enteric diseases, parasitic diseases andmycobacterium diseases., Phage display, immunoarrays, FACs.

UNIT II

Chromosomal disorders : autosomal; sex chromosomal; karyotype analysis. G-banding, in *situ* hybridization (FISH and on-FISH), and comparative genomichybridization (CGH).Cancer cytogenetics: spectral karyotyping.

UNIT III

DNA diagnostics: PCR based diagnostics; ligation chain reaction, southern blotdiagnostics, array-based diagnostics, DNA sequencing, genetic profiling, single nucleotide polymorphism. Haemoglobinopathies.

UNIT- IV

Neuro developmental disorders, Neuro degenerative disorders, Dynamic mutations, Biochemical diagnostics: inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders.

SUGGESTED READINGS:

Genes VIII (2004) by B. Lewin, Oxford University Press.
Molecular Diagnostics: Fundamentals, Methods & Clinical applications (2007). Lele Buckingham and Maribeth L. Flaws.
Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis.
An Introduction to Genetic Analysis (2000) by A.J.F. Griffiths, J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart, W.H. Freeman, New York.

M.Sc. Biotechnology
Semester-IV

BT- 403
Biotech Management

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

UNIT –I

Structure of a Biotechnology Company, Scientific Principles, Start-up of Biotechnology Company, New Product Development, Management Styles and Strategies, Planning, organization , Leading & Controlling.

UNIT II

Sales & Marketing Principles, Sales & Marketing Principles, Legal Issues in Biotechnology, Moral Issues in Biotechnology Fundamentals of Marketing, Research Methodology, Principles of Management, Marketing Management, Strategic Management.

UNIT III

Health Care Overview and Reimbursement in Biotechnology (The concept of return investment), Business Communication, Managerial Economics Human Resource Management.

UNIT IV

Concepts and characteristics of information; Importance of MIS; Communication - type, channels &barriers; Financial management, planning and *control*, Management Information Systems, Logistics& Supply Chain Management, Decision Science, Sales and Distribution, Financial and Cost Accounting

SUGGESTED READINGS:

Principles of Management – P.C.Tripathi, P.N.Reddy – Tata McGraw Hill
Management – Stephen Robbins – Pearson Education/PHI – 17th Edition, 2003.
Management Fundamentals – Concepts, Application, Skill Development, Robers- Lusier Thomson

M.Sc. Biotechnology
Semester-IV

BT- 404
Proteomics and Genomics

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Theory

UNIT I

Genome sequencing strategies and programs, new technologies for highthroughput sequencing, methods for sequence alignment and gene annotation; Approaches to analyze differential expression of genes - ESTs, SAGE, microarrays and their applications; gene tagging; gene and promoter trapping; knockout and knock-down mutants; dynamic modulation of protein structure and function

UNIT II

Comparative genomics of model plants and related crop species; Recombination-based cloning techniques; RNAi and gene silencing, genome imprinting, small RNAs and their biogenesis, role of small RNAs in heterochromatin formation and gene silencing, genomic tools to study methylome and histone modifications.

UNIT III

Analysis of proteins by different biochemical and biophysical procedures like CD (Circular Dichroism), NMR, UV/Visible and fluorescent spectroscopy, protein identification and analysis on ExPASy server, other protein related databases, 1-D and 2-D gel electrophoresis for proteome analysis, Sample preparation, gel resolution and staining; Mass spectrometry based method for protein identification like PMF (protein mass fingerprinting) and LCMS

UNIT IV

Image analysis of 2D gels: Data acquisition, spot detection & quantitation, gel matching, data analysis, presentation, databases, conclusions; DIGE (Differential In Gel Electrophoresis), alternatives to 2-DE for protein expression analysis; Analysis of post-translational modifications and protein-protein interactions; protein chips and arrays, future directions in proteomics, scope of functional proteomics.

PRACTICALS:

Gateway cloning
Real-time PCR
Northern and Western Blotting
Bioluminescence imaging
Phage titration, Phage library amplification
Site-directed mutagenesis
2D electrophoresis
Differential staining procedures including MS-compatible staining
Gel filtration chromatography for desalting
Native molecular weight determination
Immunoprecipitation for antibody quantification

SUGGESTED READINGS:

Buchanan B, Gruissem G, and Jones R (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
Hammes GD (2005) Spectroscopy for the Biological Sciences; Wiley Interscience, USA. Harlow and Lane D (Eds.) (1988) Antibodies – A Laboratory Manual; Cold Spring Harbor Laboratory, USA.
Lieber DC (2006) Introduction to Proteomics: Tools for New Biology; Humana Press, NJ.
Pennington SR, Dunn MJ (Eds.) (2002) Proteomics: From Protein Sequence to Function, BIOS Scientific Publishers, United Kingdom.
Sambrook J and Russell DW (2001). Molecular Cloning – A Laboratory Manual, Vols I – III, Cold Spring Harbor Laboratory, USA.
Singer M and Berg P (1991). Genes and Genomes: A Changing Perspective; University Science Books, CA, USA.

M.Sc. Biotechnology
Semester-IV

BT- 405
Bio-Entrepreneurship

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Theory

UNIT-I

Accounting and Finance

Taking decision on starting a venture; Assessment of feasibility of a given venture/new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/Plan for seeking loans from financial institution and Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management; Basics in accounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping; Estimation of income, expenditure, profit, income tax etc.

UNIT-II

Marketing

Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, branding issues; Developing distribution channels; Pricing/Policies/Competition; Promotion/ Advertising; Services Marketing

UNIT-III

Negotiations/Strategy

With financiers, bankers etc.; With government/law enforcement authorities; With companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes; Crisis/ Avoiding/Managing; Broader vision–Global thinking

Information Technology

How to use IT for business administration; Use of IT in improving business performance; Available software for better financial management; E-business setup, management.

UNIT-IV

Human Resource Development (HRD)

Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up.

Fundamentals of Entrepreneurship

Support mechanism for entrepreneurship in India

Role of knowledge centre and R&D

Knowledge centres like universities and research institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies.

Case Study

1. Candidates should be made to start a „mock paper company", systematically following all the procedures.
   • The market analysis developed by them will be used to choose the product or services. SEMESTER - IV 25 M.Sc (General Biotechnology)
   • A product or service is created in paper and positioned in the market. As a product or services available only in paper to be sold in the market through the existing links. At this juncture, the pricing of the product or the service needs to be finalized, linking the distribution system until the product or services reaches the end consumer.
   • Candidates who have developed such product or service could present the same as a project work to the Panel of Experts, including representatives from industry sector. If the presented product or service is found to have real potential, the candidates would be exposed to the next level of actual implementation of the project.
2. Go to any venture capital website (like sequoiacap.com) and prepare a proposal for funding from

SUGGESTED READINGS:

Dynamics of Entrepreneurial Development & Management, Vasant Desai – Himalaya Publishing House
Entrepreneurship Development –Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2006 (2 & 4)
Entrepreneurship Development – S.S.Khanka – S.Chand & Co.

Session: 2019-20

M.Sc. Biotechnology
Semester-IV

BT- 406
Industrial Biotechnology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note*: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Introduction to industrial microbiology: Sources of industrially important microbes, strain development, types of fermentation and fermenters, process optimization, and recent developments in fermentation technology.

Unit-II

Downstream processing of microbial products: Filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane processes, drying (lyophilization and spray drying), and crystallization

Unit-III

Fermentation economics: Basic objective for successful economically viable fermentation process, cost break down for well established fermentation processes, market potential of the products, cost aspects of various stages in the processes development including effluent treatment

Unit-IV

Production aspects: Microbial strains, substrates, strain improvement, flow diagrams, product optimization, and applications of industrial alcohol (ethanol and butanol), amino acids (lysine, phenylalanine, tryptophan), antibiotics (cephalosporins, tetracyclines, polyenes), enzymes and immobilized enzymes, SCP, microbial polyesters, biosurfactants, and recombinant products (insulin, somatostatin, thaumatin).

STUDY MATERIALS:

1. Biotechnology: A Text Book of Industrial Microbiology by W. Crueger & A. Crueger, Panima Publishing Corporation, New Delhi/Bangalore, 2000.
2. Principles of Fermentation Technology by P.F. Stanbury, W. Whitaker &S.J. Hall, Aditya Books (P) Ltd., New Delhi, 1997.
3. Modern Industrial Microbiology & Biotechnology by N. Okafer, Scientific Publishers, Enfield, USA., 2007.
4. Fermentation Microbiology and Biotechnology by El Mansi & Bryce, Taylor & Francis, London, Philadelphia, 1999.
5. Fermentation Biotechnology by O.P. Ward, Open University Press, Milton Keynes, U.K., 1989
6. Industrial Microbiology: An Introduction by Waites, Morgan, Rockey & Highton, Blackwell Science, 2001.
7. Biochemical Engineering and Biotechnology by B. Atkinson & F. Mavituna , The Nature Press, 1982
8. Microbial Biotechnology: Fundamentals of Applied Microbiology by Glazer & Nikaido , W.H. Freeman and Co., New York, 1995.
9. Modern Food Microbiology, 4th edition by J.M. Jay, Springer, 2006.
10. Fundamental Food Microbiology , 3rd edition by B. Ray., CRC press, 2006.
11. Food Microbiology: Fundamentals and Frontiers, 2nd edition by Michael P. Doyle, Larry R. Beuchat, Thomas J. Montville, ASM press, 2001.
12. Food Microbiology by M.R. Adams & M.O. Moss., Royal Society of Chemistry, 2000.
13. Food Microbiology by M.R. Adams, Royal Society of Chemistry, 2008.

PRACTICALS

(Based on theory papers)

1. To determine the specific growth rate and generation time of a bacterium during submerged fermentations.
2. To compare glucoamy;ase production by parent and mutant of thermphilic fungus *Thermomucor indicae* under submerged and SSF conditions.
3. To grow yeast (*S. cerevisiae*) and fungus (*Rhizopus* sp.) in artificial medium and to calculate the yield and productivity of the biomass produced.
4. To make wine from different juices by fermentation.
5. To compare glucoamylase production of free and immobilized sporangiospores of *Thermomucor indicae*.
6. Amplification of DNA by PCR
7. RAPD analysis
8. Overexpression of proteins and analysis by SDS-PAGE
9. Purification of recombinant protein
10. Western Blotting analysis
11. Preparation of competent cells and determination of transformation efficiency
12. Alpha-complementation
13. Phage titration
14. Bacterial transduction
15. Bacterial conjugation
16. Bacterial transposition