

SCHEME

OF

STUDIES AND

EXAMINATIONS

M.Sc BIO-TECHNOLOGY
2012-13 ONWARDS

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
(SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M. Sc (BIOTECHNOLOGY)
1st YEAR (SEMESTER – I)
Credit Based Scheme w.e.f. 2011-12

S. No.	Course No.	Course Title	Teaching Scheme			Examination Scheme				Credit	Duration of Exam (Hours)
			L	P	Total	Sessional Marks	External Marks		Total		
							Theory	Practical			
1	BT-501 MS	CELL AND MOLECULAR BIOLOGY	4	-	4	50	100	-	150	4	3
2	BT-503 MS	BIOCHEMISTRY	4	-	4	50	100	-	150	4	3
3	BT-505 MS	MICROBIOLOGY-I	4	-	4	50	100	-	150	4	3
4	BT- 507 MS	BIOSTATISTICS AND COMPUTER APPLICATIONS	4	-	4	50	100	-	150	4	3
5	BT-509 MS	BIOTECHNOLOGY LAB - I	-	4	4	50	-	50	100	2	6
6	BT-511 MS	BIOTECHNOLOGY LAB – II	-	4	4	50	-	50	100	2	6
7	BT-513 MS	BIOTECHNOLOGY LAB – III	-	4	4	50	-	50	100	2	6
TOTAL			16	12	28	350	400	150	900	22	

Note:

- **The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.**
- **Electronic gadgets, including cellular phones are not allowed in the examination.**

**DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
(SONEPAT)**

SCHEME OF STUDIES & EXAMINATIONS

M. Sc (BIOTECHNOLOGY)

1st YEAR (SEMESTER – II)

Credit Based Scheme w.e.f. 2011-12

S. No.	Course No.	Course Title	Teaching Scheme			Examination Scheme				Credit	Duration of Exam (Hours)
			L	P	Total	Sessional Marks	External Marks		Total		
							Theory	Practical			
1	BT-502 MS	BIOINSTRUMENTATION	4	-	4	50	100	-	150	4	3
2	BT-504 MS	IMMUNOLOGY-I	4	-	4	50	100	-	150	4	3
3	BT-506 MS	GENETIC ENGINEERING-I	4	-	4	50	100	-	150	4	3
4	BT-508 MS	INTRODUCTION TO BIOINFORMATICS	4	-	4	50	100	-	150	4	3
5	BT- 510 MS	BIOTECHNOLOGY LAB - IV	-	4	4	50	-	50	100	2	6
6	BT-512 MS	BIOTECHNOLOGY LAB – V	-	4	4	50	-	50	100	2	6
7	BT-514 MS	BIOTECHNOLOGY LAB – VI	-	4	4	50	-	50	100	2	6
TOTAL			16	12	28	350	400	150	900	22	

Note:

- The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
- Electronic gadgets, including cellular phones are not allowed in the examination.
- Each student has to undergo a professional training of at least 4 weeks from a biotechnology-based industry/ research Institute/ laboratory. Its evaluation will be carried out in the 3rd Semester.

**DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
(SONEPAT)**

SCHEME OF STUDIES & EXAMINATIONS

M. Sc (BIOTECHNOLOGY)

2nd YEAR (SEMESTER – III)

Credit Based Scheme w.e.f. 2011-12

S. No.	Course No.	Course Title	Teaching Scheme			Examination Scheme				Credit	Duration of Exam (Hours)
			L	P	Total	Sessional Marks	External Marks		Total		
							Theory	Practical			
1	BT-601 MS	GENOMICS AND PROTEOMICS-I	4	-	4	50	100	-	150	4	3
2	BT-603 MS	ENZYMOLGY AND ENZYME TECHNOLOGY-I	4	-	4	50	100	-	150	4	3
3	BT-605 MS	INDUSTRIAL BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
4	BT- 607 MS	PLANT BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
5	BT-609 MS	BIOTECHNOLOGY LAB – VII	-	4	4	50	-	50	100	2	6
6	BT-611 MS	BIOTECHNOLOGY LAB – VIII	-	4	4	50	-	50	100	2	6
7	BT-613 MS	BIOTECHNOLOGY LAB – IX	-	4	4	50	-	50	100	2	6
8	BT-615 MS	TRAINING REPORT PRESENTATION	-	2	2	50	-	-	50	2	-
TOTAL			16	14	30	400	400	150	950	24	

Note:

- The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
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**DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
(SONEPAT)**

SCHEME OF STUDIES & EXAMINATIONS

M. Sc (BIOTECHNOLOGY)

2nd YEAR (SEMESTER – III)

Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teaching Scheme			Examination Scheme				Credit	Duration of Exam (Hours)
			L	P	Total	Sessional Marks	External Marks		Total		
							Theory	Practical			
1	BT-601 MS	GENOMICS AND PROTEOMICS-I	4	-	4	50	100	-	150	4	3
2	BT-603 MS	ENZYMOLOGY AND ENZYME TECHNOLOGY-I	4	-	4	50	100	-	150	4	3
3	BT-605 MS	INDUSTRIAL BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
4	BT- 607 MS	PLANT BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
5	BT-609 MS	BIOTECHNOLOGY LAB – VII	-	4	4	50	-	50	100	2	6
6	BT-611 MS	BIOTECHNOLOGY LAB – VIII	-	4	4	50	-	50	100	2	6
7	BT-613 MS	BIOTECHNOLOGY LAB – IX	-	4	4	50	-	50	100	2	6
8	BT-615 MS	TRAINING REPORT PRESENTATION	-	2	2	50	-	-	50	2	-
TOTAL			16	14	30	400	400	150	950	24	

Note:

- The students will be allowed to use non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.
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DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
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SCHEME OF STUDIES & EXAMINATIONS
M. Sc (BIOTECHNOLOGY)
2nd YEAR (SEMESTER – IV)
Credit Based Scheme w.e.f. 2011-12

S. No.	Course No.	Course Title	Teaching Scheme			Examination Scheme				Credit	Duration of Exam (Hours)
			L	P	Total	Sessional Marks	External Marks		Total		
							Theory	Practical			
1	BT-602 MS	MEDICAL BIOTECHNOLOGY	4	-	4	50	100	-	150	4	3
2	BT-604 MS	ANIMAL BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
3	BT-606 MS	ENVIRONMENT BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
4	BT-608 MS	BIOETHICS, BIOSAFETY AND IPR	4	-	4	50	100	-	150	4	3
6	BT-610 MS	BIOTECHNOLOGY LAB –X	-	4	4	50	-	50	100	2	6
7	BT-612 MS	BIOTECHNOLOGY LAB - XI	-	4	4	50	-	50	100	2	6
8	BT-614 MS	SEMINAR	-	2	2	50	-	-	50	2	-
TOTAL			16	10	26	350	400	100	850	22	

Note:

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DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
(SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M. Sc (BIOTECHNOLOGY)
2nd YEAR (SEMESTER – IV)
Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teaching Scheme			Examination Scheme				Credit	Duration of Exam (Hours)
			L	P	Total	Sessional Marks	External Marks		Total		
							Theory	Practical			
1	BT-602 MS	MEDICAL BIOTECHNOLOGY	4	-	4	50	100	-	150	4	3
2	BT-604 MS	ANIMAL BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
3	BT-606 MS	ENVIRONMENT BIOTECHNOLOGY-I	4	-	4	50	100	-	150	4	3
4	BT- 608 MS	BIOETHICS, BIOSAFETY AND IPR	4	-	4	50	100	-	150	4	3
6	BT-610 MS	BIOTECHNOLOGY LAB –X	-	4	4	50	-	50	100	2	6
7	BT-612 MS	BIOTECHNOLOGY LAB - XI	-	4	4	50	-	50	100	2	6
8	BT-614 MS	SEMINAR	-	2	2	50	-	-	50	2	-
TOTAL			16	10	26	350	400	100	850	22	

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BT – 501 MS CELL AND MOLECULAR BIOLOGY

M. Sc. Semester - I (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	3 Hours
			Examination		

UNIT-I:	Basic Structure and function of cells and their organelles: Cellular and subcellular differences between prokaryotes and eukaryotes, structure and functions of cellular organelles. Transport across biomembranes: Transport of nutrients, ions and macromolecules across membranes, facilitated transport, group translocation, active transport. Protein sorting and vesicular trafficking: Transport of molecules into and out of the nucleus, transport of proteins into mitochondria and chloroplasts, transport from the ER through golgi apparatus to lysosomes.
UNIT-II:	Cell-Cell Interactions: General principles of cell to cell communication, cell adhesion and role of different adhesion molecules, extracellular matrix. Cell cycle and Regulation: Molecular events and model systems, mechanics of cell division, regulation of cell cycle. Cell Signaling: Signalling via G- Protein- linked cell surface receptors and via enzyme- linked cell surface receptors, two component signalling.
UNIT-III:	Basic concepts of genetic information: DNA and RNA as genetic material, chemical structure and base composition of nucleic acids, supercoiling of DNA, DNA reassociation kinetics (cot curve analysis), DNA organization into chromatin, bacterial and eukaryotic genomic organization. Genetic Material: replication and repair: enzymes and proteins of DNA replication, prokaryotic and eukaryotic replication mechanism, replication in phages and retroviruses, DNA repair mechanisms.
UNIT-IV:	Transcription: Mechanism of transcription in prokaryotes and eukaryotes, RNA polymerases, post- transcriptional processing of tRNA, rRNA and mRNA. Translation: Characteristics of genetic code, translational mechanism in prokaryotes and eukaryotes, post translational modification and transport of proteins. Regulation of gene expression: Operon concept, positive and negative control, lac, trp and arb operon, catabolite repression, attenuation, regulation of gene expression in eukaryotes.

TEXT / REFERENCE BOOKS:

1. Cell and Molecular Biology, ed. EDP. De Robertis and EMF De Robertis, Lippincot Williams & Wilkins Pvt Ltd.
2. Molecular Cell Biology, ed. Harvey Lodish and D. Baltimore W.H Freeman & Co. 4th ed.2000.
3. Cell Biology, ed. Smith and Wood, Chapman and Hall.
4. Molecular biology of Cell, ed. Bruce Alberts, James D.Watson, Garland Publishing.
5. Essential of Molecular Biology, ed. Malacinski, Freifelder Jones, Bartlet Publisher.
6. Cell & Molecular Biology, Concepts & Experiments, ed. Gerald Karp, John Wiley & Sons.
7. The cell – a molecular approach, ed. Cooper, A.S.M.Press.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT – 503 MS BIOCHEMISTRY
M. Sc Semester - I (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

UNIT-I: **Proteins** – Classification based on structure and function, forces stabilizing protein structure and shape, different levels of structural organization.

Carbohydrates – Structure and properties of monosaccharides, oligosaccharides and polysaccharides, and their biological functions.

UNIT-II: **Lipids**– Classification– simple and complex lipids, fatty acids– structure and nomenclature, soap value, acid value, iodine number, rancidity, structure and function of triacylglycerols, phospholipids, glycolipids and steroids.

Nucleic acids: Physical & chemical properties of nucleic acids, structure and properties of purine & pyrimidine bases, nucleosides & nucleotides, biological functions of DNA & RNA species, double helical model of DNA structure and forces responsible for it , A, B, & Z –DNA.

UNIT-III: **Metabolism:** General introduction, catabolism and anabolism.

Carbohydrate Metabolism- Glycolysis, Tricarboxylic acid cycle, Gluconeogenesis, Glycogenolysis, glycogen synthesis and their regulation.

Lipid Metabolism- fatty acid oxidation, beta - oxidation of saturated fatty acids, oxidation of unsaturated and odd carbon fatty acids, regulation of fatty acid oxidation, alpha & omega oxidation of fatty acids, ketogenesis, biosynthesis of saturated fatty acids, elongation and desaturation of fatty acids, biosynthesis of triacylglycerols.

UNIT-IV: **Protein Metabolism** : Essential & non essential amino acids, degradation & biosynthesis of amino acids, urea cycle: reactions, regulation and its linkage with the citric acid cycle, nitrogen cycle, regulation of amino acid bio synthesis.

Nucleic Acid Metabolism: De-novo biosynthesis of purine and pyrimidines, regulation of purine & pyrimidine biosynthesis, salvage pathway, formation of deoxyribonucleotides, catabolism of purines & pyrimidines.

TEXT / REFERENCE BOOKS:

1. Lehninger: Principles of Biochemistry, 4th edition, by David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W.H. Freeman & Company.
2. Biochemistry (2004) by J.David Rawn, Panima Publishing Corporation, New Delhi.
3. Fundamentals of Biochemistry, 2nd ed., by Donald Voet, Judith G. Voet and Charlotte W. Pratt (2006) , John Wiley & Sons, INC.
4. Biochemistry: The chemical reactions of living cells, 2nd edition, Volumes I & II by David E. Metzler (2001), Harcourt Academic Press.
5. Principles of Peptide synthesis (1984), Miklos, Bodansky, Springer-Verlag Berlin, Heidelberg.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT– 505 MS MICROBIOLOGY-I

M. Sc. Semester - II (Biotechnology & Bioinformatics)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

UNIT-I: Introduction to Microbiology: History and scope of Microbiology, discovery of the microbial world, milestones of microbiology, microbes in human welfare and causation, applications of microbiology in biotechnology, future of microbiology.

UNIT-II: The Diversity of the Microbial World: Classification of microorganisms, major characteristics used in taxonomy, classification systems: phenetic classification, numerical taxonomy, phylogenetic taxonomy.
Structure and function of prokaryotic microbes: functional anatomy of bacteria, viruses, fungi: their major characteristics and classification, brief account of algae and protozoa.

UNIT-III: Microbial Nutrition and Growth: Growth requirements, culture medium, axenic cultures, isolation and preservation of pure cultures, growth curve, measurement of microbial growth, batch and continuous culture, chemostat and turbidostat, influence of environmental factors on growth, bacterial reproduction- transformation, transduction and conjugation.
Control of Microorganisms: Sterilization, disinfection, factors influencing effectiveness of antimicrobial agents, physical and chemical methods of control.

UNIT-IV: Applied Microbiology: Basic clinical microbiology, pathogenicity of microorganisms, important bacterial, viral and fungal diseases, food spoilage, food-borne diseases, major products of industrial microbiology, viz., antibiotics, amino acids, organic acids etc. biopolymers, biosensors and bioremediation.

TEXT / REFERENCE BOOKS:

1. General microbiology: Stanier, Adelberg and Ingraham
2. Microbiology, ed. Prescott et al., 2003, Mc Graw Hill, USA.
3. Microbiology, ed. Pelczar et al, Tata Mc Graw Hill, New Delhi.
4. Food Microbiology, ed. Adams & Moss, , C B S Publishers, New Delhi
5. Principles of Microbiology: R.M. Atlas et al

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT– 507 MS BIOSTATISTICS AND COMPUTER APPLICATIONS

M. Sc. Semester - I (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

UNIT-I: Brief description and tabulation of data and graphical representation. Measures of central tendency and dispersion: mean, median, mode, range, standard deviation, variance. Idea of two types of errors and level of significance, tests of significance (F and t-test); chi-square test.

UNIT-II: Simple linear regression and correlation. Introduction to digital computers: organizations; low level and high-level languages, the binary number system. Flow charts and programming techniques.

UNIT-III: Introduction to programming in Q basic and C. Introduction to data structures and database concepts, introduction to internet and its applications. Introduction to MS-Office software, covering word processing, spreadsheets and presentation software. Introduction to Harvard graphics/Sigma plotter.

UNIT-IV: Computer oriented statistical techniques: Frequency table of single discrete variable, bubble sort, computation of mean, variance and standard deviation; t-test, correlation coefficient. Bioinformatics and biotechnology.

TEXT / REFERENCE BOOKS:

1. Principles of Biostatistics- M. Pagano, Cengage Learning Publishers, 2nd Edition, 2008.
2. Schaum's outline of Probability and Statistics- Tata McGraw Hill, 2004.
3. Introduction to Biostatistics. Glover T. and Mitchell K. (2002). McGraw Hill, New York.
4. Fundamentals of Biostatistics. Rosner Bernard (1999), Duxbury Press.
5. Beginning Perl for bioinformatics- J. Tisdall; Wrox Press Ltd., 2000.
6. Genomic Perl- R.A. Dwyer, Cambridge University Press, 2003.
7. Programming Perl – Larry Wall, Tom Christiansen & John Orwant 3ed 2000- O'Reilly
8. MySQL and mSQL- Yarger O'Reilly Media Publishers, 1999.
9. Programming Perl - Tom Christiansen, Larry. Wall Orielly Publications.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT – 509 MS BIOTECHNOLOGY LAB- I

M. Sc. Semester - I (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of	: 6 Hours
			Examination		

List of Experiments/ Exercises

1. Principle and functioning of commonly used biotechnological instruments in the laboratory.
2. Microscopy: structure of prokaryotic and eukaryotic cells.
3. Histology of various organ systems (Nervous, Digestion, Reproductive, Respiratory, and Circulatory system).
4. To study cell division in onion root tip/ insect gonads cells.
5. Isolation of genomic DNA and to study its purity by spectrophotometric method.
6. Isolation of proteins from eukaryotic cells
7. Isolation of genomic DNA from prokaryotic cells.
8. Isolation of plasmid DNA from bacterial cells.
9. Separation of proteins by SDS-PAGE electrophoresis.
10. Restriction mapping of plasmid DNA, involving single & double digestion of the plasmid with restriction enzyme.
11. Gel extraction of DNA.
12. P.C.R. amplification of DNA: Visualisation by gel electrophoresis.

TEXT /REFERENCE BOOKS:

1. Principles & Techniques of Practical Biochemistry, ed. K. Wilson & J. Walker. Cambridge University Press, Cambridge. (1994).
2. Introductory Practical Biochemistry, ed., S.K. Sawhney & Randhir Singh. Narosa Publishing House, New Delhi. (2000).
3. An introduction to Practical Biochemistry by David T. Plummer. McGraw Hill, Book Company. U.K. (1998).
4. Molecular Cloning – A laboratory manual, ed. J. Sambrook and D.W. Russell, 2001, Cold Spring Harbor laboratory Press, New York

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT – 511 MS BIOTECHNOLOGY LAB- II

M. Sc. Semester - I (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of	: 6 Hours
			Examination		

List of Experiments/ Exercisess

1. Extraction of carbohydrates and total lipids from biological material.
2. Qualitative tests for carbohydrates.
3. Quantitative test for lipids.
4. Determination of total protein in a given sample.
5. Extraction and purification of proteins
6. Study of Protein fractions – albumin, globulin, glutelin, prolamin.
7. Total Fat analysis
8. Study of Free fatty acids/ saponification value/ iodine value.
9. Gel electrophoretic separation of proteins.
10. Analysis of blood / urine samples for sugars / urea / bile pigments.
11. Assay of enzyme activities – alkaline phosphatase /peroxidase /oxidase
12. Gel electrophoresis of DNA /RNA.

TEXT /REFERENCE BOOKS:

1. An Introduction to practical biochemistry, ed. S.K. Sawhney & Randhir Singh, 2002, Narosa Pub. House, N. Delhi

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT – 513 MS BIOTECHNOLOGY LAB- III

M. Sc. Semester - I (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of	: 6 Hours
			Examination		

List of Experiments/ Exercises

1. Microscopy: Use of microscopes, microscopic examination of microorganisms.
2. Micrometry: Microscopic measurement of microorganisms.
3. Staining methods: Gram, Spore, Capsule and Lactophenol cotton blue
4. Preparation of media for growth of various microbes; culturing and enumeration of microbes.
5. Isolation and characterization of microbes from soil, water and air.
6. Performance of biochemical tests for identification of microbes.
7. Pure culture techniques – Streak plate, Pour plate, Spread plate
8. Measurements of growth and study of effect of various factors on growth of
9. Microorganisms temp., pH, salt concentration, U.V. & R.H.
10. Biochemical tests useful in bacterial taxonomy.
11. Water microbiology – BOD, multiple tube fermentation tests.
12. Milk Microbiology –SPC, testing the quality of milk.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT- 502 MS BIOINSTRUMENTATION

M. Sc Semester -II (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

UNIT I: Microscopy: Light, electron (scanning & transmission), phase contrast, fluorescence microscopy, freeze – fracture techniques, specific staining of organelles or marker enzymes.

Ultracentrifugation: Sedimentation of macromolecules, centrifugation techniques and their applications, differential centrifugation, zonal, density gradient and ultracentrifugation techniques.

UNIT II: Gel Electrophoresis: Analysis of Proteins: Electrophoretic separation of proteins (single dimension, native and denaturing gels, 2D), Detection (staining, blotting and immunodetection, ELISA, RIA).Purification of proteins (ion-exchange, reverse phase, gel filtration, affinity, gas chromatography ,High pressure liquid chromatography (HPLC).

UNIT – III: Spectrophotometry: Basic concepts and brief description of application of U.V./ Visible, IR, NMR, ESR , Fluorescence , Raman , Mass spectroscopy ,X-ray diffraction (diffraction by fibrous proteins, globular proteins and molecular crystals), CD and ORD.

UNIT IV : Radioisotope Techniques: Nature of radioactivity, properties of α , β and γ rays, measurement of radioactivity, use of radioisotopes in research, in vivo and in vitro leveling techniques, double labelling, instruments for monitoring radioactivity , quenching , internal standard channel ratio, external standard ratio, emulsion counting radioactive decay, auto radiograph.

TEXT/ REFERENCE BOOKS:

1. Biological Spectroscopy: Campbell and Durek.
2. Physical Biochemistry, ed. by D. Friefelder, W.H. Freeman and company U.S.A.
3. Introduction to instrumental analysis, ed. Robert. D. Braun, 1987. McGraw Hill, U.K.
4. Analytical Chemistry for technicians, ed. John Kenkel, 1994, Lewis Publishers. Boca Raton, U.S.A.
5. Principles and Techniques of Practical Biochemistry, ed. K. Wilson and J. Walker, 1994, Cambridge University Press, Cambridge.
6. Bophysical Chemistry: Principle and Techniques, ed. A.Upadhyay, K.Upadhyay and N. Nath, 1998, Himalya Publication House, Delhi.
7. Physical Biochemistry, ed. K.E. Vanholde, 1985, Prentice Hall Inc., New Jersey.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT– 504 MS IMMUNOLOGY-I
M. Sc. Semester - II (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

- UNIT-I:** The Components of Immunity: Innate and Acquired Immunity. Cells and organs of immune System, phagocytosis, and inflammatory responses, hematopoiesis. Immunogens and Immunoglobulins: Antigens, haptens, superantigens, antigenic determinants, immunoglobulins- basic structure, classes and subclasses of immunoglobulins, biological effector functions mediated by antibody, genetic organization of immunoglobulin genes, generation of antibody diversity.
- UNIT-II:** Immune effector responses: Humoral immune responses, B cell receptor, B cell maturation, activation and differentiation, T- dependent and T- independent antigens, role of TH cells in humoral immune response, primary and secondary humoral immune response, T cell receptor, T cell development and activation, mechanism of cell mediated immune response, major histocompatibility complex, antigen processing and presentation, cytokines, complement system.
- UNIT-III:** Techniques in Immunology: Antigen-antibody reactions, affinity, avidity, immuno precipitation techniques, immunodiffusion, immunoelectrophoresis, rocket immunoelectrophoresis, counter current immuno electrophoresis, radio-immunoassay, ELISA, immunofluorescence, flow cytometry, monoclonal antibodies and hybridoma technology.
- UNIT-IV:** Clinical Immunology: Immunity to infection: Bacteria, viral and parasitic infections, vaccines, a brief account of: Hypersensitivity- Type I-IV, autoimmunity- types of autoimmune diseases, transplantation immunology, immunological basis of graft rejection, tumour immunology, cancer and the immune system Immunodeficiency diseases.

TEXT / REFERENCE BOOKS

1. Immunology, ed. R.A. Goldsby ,T. J. Kindt, B.A. Osborne, W.H.Freeman & company, New.York.
2. Essential of Immunology, ed. Ivon Roitt, Peter Delves, Blackswell, Scientific Publications. Oxford.
3. Fundanental of immunology, ed. Paul W.E. Raven press, New York.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT– 506 MS GENETIC ENGINEERING-I

M. Sc. Semester - II (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration of Examination	:	3 Hours

UNIT-I:	Tools for Gene Cloning: Introduction, historical background, restriction enzymes, modifying enzymes, ligases, polymerases, linkers and adaptors, homopolymeric tailing, labelling of DNA, nick translation, random priming Cloning vectors: plasmids, bacteriophages, cosmids and phasmids, artificial chromosomes as vectors (YAC, BAC, MAC).
UNIT-II:	Cloning strategies and recombinant selection: Cloning strategy, methods of gene isolation, Chemical Synthesis of gene, construction of genomic and cDNA library. Chromosome walking, chromosome jumping, different screening methods: genetic, immunochemical, nucleic acid hybridization, HRT and HART.
UNIT-III:	Molecular probes and Polymerase Chain Reaction: Molecular probes, labeling (radioactive vs non-radioactive) and uses of probes, primer designing, PCR: principle, types; modified PCR (inverse PCR, anchored PCR, PCR for mutagenesis, RT-PCR, asymmetric PCR), cloning of PCR products. Applications of PCR. Expression of cloned genes: In bacteria, in yeast, expression in plants and in mammalian cells.
UNIT-IV:	Hybridization techniques , Molecular Mapping and Applications of Genetic Engineering: Southern, Northern, and Western Hybridization, DNase footprinting, gene silencing technologies, Molecular markers (RAPD, RFLP, AFLP, STS), Applications of Genetic engineering in microbial, plant and animal world

TEXT / REFERENCE BOOKS:

1. Primrose, S.B., Twyman, R.M. and Old, R.W. Principles of Gene Manipulation. 6th Edition, S.B. University Press. (2001).
2. Brown T.A. Genomes., 3rd ed. Garland Science. (2006).
3. Smita Rastogi and Neelam Pathak. Genetic Engineering (2009) Oxford University Press.
4. Sambrook, J. and Russel, D.W. Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL. (2001).
5. Selected papers from scientific journals.
6. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT– 508 MS INTRODUCTION TO BIOINFORMATICS

M. Sc. Semester - II (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

UNIT-I:	Introduction to operating and number systems: Windows, Unix, Linux; binary, octal and hexadecimal number systems. Basics of Networking and programming: Internet, Intranet, networking protocols, FTP, www., flow charts, algorithms, assemblers, interpreters, compilers. Databases and Databanks: Introduction, collecting and storing sequences in laboratory, structure databases: PDB, MMDB, NCBI databases: SEQ-IDs, Bio SEQs-SETS, SEQ- ANNOT, SEQ- DESCR, submitting DNA sequences to the databases.
UNIT-II:	Information retrieval from biological databases: Retrieving database entries, integrated information retrieval, ENTREZ system, sequence databases beyond NCBI, medical databases. Sequence alignment and database searching: Introduction, evolutionary basis of sequence alignment, optimal alignment methods, statistical significance of alignment, database similarity searching, FASTA, BLAST. Multiple sequence alignment: Exhaustive algorithms, heuristic algorithms, progressive alignment methods, iterative alignment, block-based alignment.
UNIT-III:	Phylogenetic analysis: Elements of phylogenetic models, identifying paralogs and orthologs, steps in phylogenetic data analysis: alignment, determining the substitution model, tree building, tree evaluation, forms of tree representation Distance based method: unweighted pair group method with arithmetic mean, neighbor joining and Fitch-Margoliash method, minimum evolution. Character- based methods: maximum parsimony and maximum likelihood, bootstrapping by jackknifing, phylogenetics software: PHYLIP and PAUP.
UNIT-IV:	Predictive methods using nucleotide sequences: framework, marking repetitive DNA, database search, codon bias detection, detecting function sites in the DM, integrated gene passing, finding tRNA genes. Predictive methods using protein sequences: protein identity based on composition, Propsearch, physical properties based on sequences, secondary structure and folding classes, Sspread Sopma, specialized structure of features, tertiary structure.

TEXT / REFERENCE BOOKS:

1. Bioinformatics – Concepts, Skills, Applications” .S.C. Rastogi, Namita Mendiratta, Parag Rastogi.
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Andréa’s D. Baxevanis, B.F. Francis Ouellette.
3. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Richard Durbin
4. Shanmughavel, P. 2005. Principles of Bioinformatics, Pointer Publishers, Jaipur, India.
5. DNA and Protein Sequence Analysis. A Practical approach. Bishop M.J. Rawlings C.J. (Eds.).
6. Introduction to Bioinformatics. Teresa. K. Atwood and David J. Parry-Smith.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT – 510 MS BIOTECHNOLOGY LAB- IV

M. Sc. Semester - II (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of	: 6 Hours
			Examination		

List of Experiments/Exercises

1. Routine techniques in handling laboratory animals: Feeding, cleaning & hygienic measures.
2. Inoculation and bleeding of laboratory animals (mice/ rabbit).
3. Preparation and administration of antigens.
4. Isolation and purification of immunoglobulins.
5. Quantification of immunoglobulins.
6. To perform single radial immunodiffusion test.
7. To perform double immunodiffusion test.
8. Latex agglutination test.
9. To perform different types of ELISA.
10. To perform immunoelectrophoresis with the given antigen-antibody sample.
11. To perform differential leukocyte count of the given blood sample.
12. To perform total leukocyte count of the given blood sample.

TEXT /REFERENCE BOOKS:

1. Immunology, Kuby JWH Freeman and Company, New York
2. Practical Immunology (vol 1 & 2) by G.P.Talwar.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT – 512 MS BIOTECHNOLOGY LAB- V

M. Sc. Semester - II (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of	: 6 Hours
			Examination		

List of Experiments/Exercises

1. Isolation of plasmid DNA, construction of RE map, and restriction endonuclease profile analysis.
2. Construction of recombinant DNA and transformation of E.coli cells with rDNA.
3. Extraction of double stranded genomic RNA from viral samples.
4. Polyacrylamide gel electrophoresis (PAGE) for detection of segmented genomic RNA
5. Polymerase chain reaction for detection of pathogens in blood/and other clinical samples.
6. RT-PCR for detection of RNA.
7. Cloning of PCR products followed by nucleic acid sequencing.
8. Restriction endonuclease profile analysis.
9. RFLP and RAPD.
10. Southern hybridization/ Northern hybridization.

TEXT /REFERENCE BOOKS:

1. Sambrook J & Russel DW. 2001. Molecular Cloning: a LaboratoryManual. Cold Spring Harbour Lab. Press.
2. Twyman RM. 2003. Advanced Molecular Biology. Bios Scientific.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT – 514 MS BIOTECHNOLOGY LAB- VI

M. Sc. Semester -II (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of	6 Hours
			Examination		

List of Experiments/Exercises

1. Biological Databanks: biological sequence databases, structure databases, specialized databases.
2. Database file formats and Data retrieval tools: SRS, Entrez.
3. Similarity searching using NCBI, BLAST and multiple sequence alignment using Clustal.
4. Phylogenetic tree construction using PHYLIP package.
5. Molecular visualization tools: Swiss-Pdb Viewer and Rasmol.
6. Protein sequence analysis (ExPasy proteomic tools).
7. Gene structure and function prediction (using GenScan, GeneMark).
8. PERL Programming.
9. To tabulate statistical information given in descriptive form and use graphical techniques to interpret it.
10. To compute the correlation coefficient for bivariate data and interpret it.

TEXT /REFERENCE BOOKS:

1. Bioinformatics: A Practical Approach by K. Mani and N. Vijayaraj, Aparna Publications, Coimbatore.
2. Bioinformatics. Higgins & Taylor (2000). OUP.
3. Practical statistics for Experimental Biologists. Wardlaw, A.C. (1985). John Wiley and Sons.
4. Programming Perl – Larry Wall, Tom Christiansen & John Orwant 3ed 2000- O'Reilly
5. Programming Perl - Tom Christiansen, Larry. Wall Orielly Publications

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT-601 MS GENOMICS AND PROTEOMICS-I

M. Sc. Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	3 Hours
			Examination		

UNIT-I: Genome structure, organization and mapping: Structural organization of prokaryotic, eukaryotic and organellar genomes; genome content- gene distribution and arrangement in prokaryotes and eukaryotes; mapping genomes- genetic and physical mapping, DNA markers for genetic mapping, linkage analysis, restriction mapping, FISH, STS mapping.

UNIT-II: Genome sequencing, analysis and annotation: DNA sequencing- principle and technique, pyrosequencing; automated, whole genome, and shotgun sequencing, clone-contig assembly, human genome sequencing project- a brief account; analysis of sequence data- experimental and computational approaches for determining gene location and for functional analysis of individual genes; genome sequence annotation; comparative genomics; transcriptomics- studying transcriptome by sequence analysis and microarray analysis, SAGE, parallel signature sequencing.

UNIT-III: Proteomics: Protein profiling- two-dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots, MALDI-TOF for protein identification, protein characterization by mass spectrometry, protein expression analysis using microarrays; structural analysis of proteins- X-ray crystallography and NMR spectroscopy; protein-protein interactions- phage display, yeast two-hybrid system; analysis of protein complexes- affinity purification and mass spectrometry, metabolomics and systems biology.

UNIT-IV: Applications of genomics and proteomics: in research, human health care, and in agriculture, pharmacogenomics, high throughput screening in genome for drug discovery and identification of gene targets, comparative genomics, future perspectives and developments.

TEXT / REFERENCE BOOKS:

1. Brown TA, Genomes, 3rd Edition. Garland Science Pub (2006).
2. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Pearson Education (2007).
3. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell (2006).
4. Daniel C. Liebler, Introduction to Proteomics. Humana Press.
5. Twyman RM, Principle of Proteomics. BIOS Scientific Publishers. (2004).
6. Kamp RM, Methods in Proteome and Proteome Analysis. Springer. (2004).
7. Jolles P and Jornvall H, Proteomics in Functional Genomics: Protein Structure Analysis. Birkhauser (2000).

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT – 603 MS ENZYMOLOGY AND ENZYME TECHNOLOGY-I

M. Sc Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	3 Hours
			Examination		

UNIT-I: Introduction to enzyme: History, Nomenclature and classification of enzymes; Isoenzymes, enzyme specificity, monomeric and oligomeric enzymes, multienzyme complex, holoenzyme, apo-enzyme, Units of enzyme activity (definition of IU, Katal), specific activity of enzyme, measurement of enzyme activity, enzyme turnover. Ribozymes and abzymes– A brief account.

UNIT-II: Enzyme kinetics : Enzyme kinetics and its importance, Methods used for investigating the kinetics of enzyme catalyzed reactions; factors affecting the velocity of enzyme catalysed reaction; Michaelis-Menten equation, V_{max} , K_m and its significance; Lineweaver Burk plot- its advantages and limitations, Eadie- Hofstee and Hanes plots; enzyme inhibition, types of enzyme inhibitions- competitive, uncompetitive, noncompetitive. Bisubstrate reactions- brief introduction to sequential and pingpong mechanism with examples.

UNIT-III: Strategies used for enzyme production, isolation and purification, method of calculating the purification fold; estimation of enzyme activity; characterization of an enzyme, criteria of enzyme purity, determination of the molecular weight, enzyme immobilization; protein engineering, enzyme reactors.

UNIT-IV: Industrial uses of enzymes: Enzyme used in detergents, use of proteases in food, leather and wool industries, production of glucose syrup from starch using starch hydrolyzing enzymes, production of syrup containing maltose, enzyme in sucrose industry, glucose from cellulose. Lactose in dairy industry, glucose oxidase and catalase in food industry and medical application of enzymes. Basic principles of biosensors and their applications.

TEXT / REFERENCE BOOKS:

1. Nature of Enzymology By RL Foster
2. A textbook of enzyme biotechnology By Alan Wiseman.
3. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry By Trevor Palmer.
4. Enzymes By M Dixon and EC Webb. EC Longmans, London.
5. Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins (Paperback)By Nicholas C. Price and Lewis Stevens. Oxford University Press.
6. Advances in Enzymology: v. 47 (Hardcover)By Alton Meister. John Wiley and Sons Inc.
7. Lehninger Principles of Biochemistry 4th EdBy David L. Nelson and Michael M. Cox,WH Freeman and Company.
8. Principles of Biochemistry (Hardcover)By Geoffrey Zubay. Publisher: McGraw Hill College.
9. Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) By D Voet. John Wiley and Sons.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT-605 MS INDUSTRIAL BIOTECHNOLOGY-I
M. Sc. Semester - IV (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

- UNIT I. Industrial Microbiology: Introduction, objectives and applications. Cultivation & Maintenance of Microorganisms: Different types of culture medium; C/ N/ P balance and design of culture medium. Substrates for industrial microbial processes, industrially important microbes: isolation, preservation and improvement of industrially important microorganisms, selection of mutants, and use of recombinant DNA technology.
- UNIT II. Production and Process technology for microbial products: Microbial growth kinetics, Primary metabolite: ethanol, citric acid, vinegar and amino acid, production of alcoholic beverages-wine and beer, microbial production of industrial enzymes
- UNIT III. Isolation and purification of enzymes: Extraction of enzymes, preparation of crude enzymes, purification of enzymes, processing of enzymes, applications of enzymes in various sectors.
- UNIT IV. Metabolic Engineering: Heterogenous gene Expression, complementing, transferring and engineering of metabolic pathways, redirecting metabolite flow, Metabolic engineering for carotenoid, polyhydroxy-alkanoates and alkaloid biosynthesis, pathway analysis, metabolic control analysis, metabolomics. Microbes and microbial genomics for industry: Microbial transformations, transformation of Steroids, sorbitol, sorbose and antibiotics, microbes in paper industry, biohydrometallurgy and biomineralization.

TEXT / REFERENCE BOOKS:

1. Casida, L.E. Industrial Microbiology. New Age International (P) Ltd. New Delhi. (1998).
2. Prescott & Dunn, Industrial Microbiology. Ed. E.G. Reed. CBS Publisher New Delhi. (1987).
3. Crueger, W. and Crueger, A. Biotechnology: A Textbook of Industrial Microbiology 2nd Edition. Panima Publishing Corporation, New Delhi. (2000).
4. Arnold L.D. and Julian E.D. Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. ASM Press Washington D.C. (1999).
5. Microbiology: Prescott et al., 5th edition, Mc Graw Hill, USA. (2003).
6. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.) Pergamon Press.
7. Brock, T.D. Biotechnology: A Text Book of Industrial Microbiology: Smaeur Associates. (1990).
8. Madigan M.T. and Martinko, J.M. Brock Biology of Microorganisms, 11th Edition, Pearson Prentice-Hall. (2006).

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT-607 MS PLANT BIOTECHNOLOGY-I

M. Sc. Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration of Examination	:	3 Hours

- UNIT-I: Plant Cell and Tissue Culture: Totipotency; Organogenesis; Somatic embryogenesis; Types of culture: seed, embryo, callus, organ, cell and protoplast culture, meristem and shoot tip culture, bud culture, organogenesis, embryogenesis
Micropropagation: Advantages and disadvantages of Micropropagation.
Cell Suspension cultures: types of suspension cultures: batch, continuous and semi-continuous.
- UNIT-II: Cryopreservation as a Germplasm storage method, cryoprotectants, pre-treatment, freezing, storage, thawing and its applications.
Protoplast isolation: Culture and usage; Somatic hybridization – Protoplast fusion: methods, identification and selection of hybrid cells, Cybrids : Applications.
In vitro production of Haploids: androgenesis, gynogenesis and their applications.
- UNIT-III: Gene transfer in plants: Plant gene structure as a discontinuous gene, Control sequences Transient and stable gene expression, Marker genes, selectable and scorable markers.
Direct gene transfer methods - PEG-mediated, electroporation, particle bombardment and alternative methods-Macroinjection, microinjection, liposome mediated, silicon carbide fiber mediated and chemical methods.
Indirect gene transfer methods, Genetic Transformation with Agrobacterium; Virulence; Ti and Ri plasmids; T-DNA transfer; Disarming the Ti plasmid. Agrobacterium-mediated gene delivery; Cointegrate and binary vectors
- UNIT-IV: Genetic modifications for crop improvement and Strategies for Introducing Biotic and Abiotic Stress Resistance/ Tolerance: Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; transgenics for flower color and shape, transgenics for male sterility, quality improvement:: modification for higher carbohydrate, protein and oil content; antisense gene approach, Flavr Savr tomato and Golden rice (as case studies); plant-derived vaccines. Plants as Biofactories: Concept of biofactories., commercial transgenic crops at global and national level.

Texts/References:

1. H.S Chawla: Introduction to Plant Biotechnology, 2004, Oxford and IBH Publishers, New Delhi,
2. Christou and Lee: Volume I and Volume II : Handbook of Plant Biotechnology, 2002
3. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 2003: 1st Edition, Oxford University Press,
4. Chrispeels, MJ and Sadava, DE, Plants, Genes and Crop Biotechnology, 2003: 2nd edition, American Society of Plant Biologists, Jones and Bartlett Publishers, USA
5. Arie Altman, Marcel Dekker, Inc. 2001 Agricultural Biotechnology
6. Biochemistry and Molecular Biology of Plants; Edited by Buchanan, Gruissem and Jones 2000, American Society of Plant Biologists, USA
7. Specific journals and published references

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT-609 MS BIOTECHNOLOGY LAB- VII

M. Sc Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of :	3 Hours
			Examination		

1. Verification of Beer Lambert Law.
2. Separation of amino acids / sugars by paper chromatography.
3. Partial purification of an enzyme by ammonium sulphate fractionation
4. Separation of proteins by SDS-PAGE.
5. Assay of enzyme catalysed reaction.
6. To study time course of the reaction catalyzed by alkaline phosphatase.
7. To examine the effect of enzyme concentration on the rate of an enzyme catalyzed reaction.
8. To determine temperature optima for alkaline phosphatase.
9. To examine the effect of pH on activity of alkaline phosphatase.
10. To study the effect of substrate concentration on activity of alkaline phosphatase and determine K_m and V_{max} of the reaction.

TEXT /REFERENCE BOOKS

1. Principles & Techniques of Practical Biochemistry, ed. K. Wilson & J. Walker, 1994, Cambridge University Press, Cambridge.
2. Introductory Practical Biochemistry, ed., S.K. Sawhney & Randhir Singh, 2000, Narosa Publishing House, New Delhi.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw Hill, Book Company. U.K.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT-611 MS BIOTECHNOLOGY LAB- VIII

M. Sc Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	4	2	Examination	:	50 Marks
			Total	:	100 Marks
			Duration	of :	3 Hours
			Examination		

1. Isolation and screening of microorganisms for cellulase production
2. Isolation and screening of microorganism for amylase production
3. Microbial production of glutamic acid.
4. Microbial production of single cell protein by algae/bacteria/yeast.
5. Microbial Growth Kinetics
6. Creation and selection of mutants.
7. Ames test to test mutagenicity and carcinogenicity of a compound.
8. To check the antimicrobial activity of chemical compound.
9. Recombinant DNA technology for the production of microbial products.
10. Production technology for Bt-based biopesticides.
11. Ethanol fermentation using yeast
12. Microbial production of antibiotics (penicillin, streptomycin etc).
13. Production technology of citric acid.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT- 613 MS BIOTECHNOLOGY LAB – IX

M. Sc. Semester - III (Biotechnology)

L	P	Credits	Class Work	: 50 Marks
--	4	2	Examination	: 50 Marks
			Total	: 100 Marks
			Duration of Exam	: 3 hours

List of Experiments/Exercises

1. Sterilization techniques in a plant tissue culture lab.
2. Preparation of liquid and solid plant tissue culture media
3. Callus propagation and organogenesis.
4. Regeneration of plantlets from different explants.
5. Transplantation: Transfer of plants from lab conditions to greenhouse / field.
6. Protoplast isolation, culture and fusion.
7. Anther culture and production of haploids.
8. Cryopreservation and thawing.
9. Preparation of LB and AB media for agro-infection of explants of any plant species using *Agrobacterium tumefaciens*.
10. Demonstration of transformation of explants of any plant species using *Agrobacterium tumefaciens*.
11. Isolation of genomic DNA/RNA from seed grown /potted plants.
12. Isolation of DNA / RNA from in vitro/regenerated plantlets.

TEXT/REFERENCE BOOKS:

1. J.H. Dodde and I.W. Robert : Experiments in Plant Tissue Culture, 1998.
2. H.S. Chawla Practicals in Plant Biotechnology, ed., Oxford & IBH Publications, New Delhi 2004
3. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press,2003
4. Chrispeels , MJ and Sadava, DE, Plants, Genes and Crop Biotechnology 2nd edition, American Society of Plant Biologists, Jones and Bartlett Publishers, USA,2003
5. Arie Altman, Marcel Dekker, Agricultural Biotechnology,2001

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory courses.

BT-615 MS TRAINING REPORT PRESENTATION
M.Sc. Semester – III (Biotechnology)

L	T	P	Credits	Class Work	: 50 Marks
-	-	2	2	Total	: 50 Marks

At the end of semester II each student would undergo four weeks Professional Training in an Industry/ Institute/ Professional Organization/ Research Laboratory etc and submit in the department a typed report along with a certificate from the organization.

The typed report should be in a prescribed format.

The report will be evaluated in the III Semester by a Committee consisting of three teachers from different specialization to be constituted by the Chairperson of the department. The basis of evaluation will primarily be the knowledge and exposure of the student towards different processes and the functioning of the organization.

The student will interact with the committee through presentation to demonstrate his/ her learning. Teachers associated with evaluation work will be assigned two periods per week load.

BT – 602 MS MEDICAL BIOTECHNOLOGY

MSc. Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	: 3 Hours
			Examination		

UNIT-I: Microbial Pathogenesis: Classification of medically important microorganisms; Normal microbial flora of human body; role of the resident flora; Infection and its types, sources of infection. Transmission of diseases anti-phagocytic factors; mechanism of bacterial adhesion. Role of aggressins, depolymerising enzymes, organotropisms, virulence and virulence factors Exotoxins and endotoxins Organs and cells of immune system and Basic immune response , Cell mediated and Humoral immunity.

UNIT-II: Microbial Diseases Caused by Bacteria: Medically important pathogenic bacteria: Staphylococcus, Streptococcus, Clostridium, Enterobacteriaceae, Haemophilus, Mycobacteria, Spirochaetes A detailed account of Pathogenesis, virulence & treatment.

UNIT-III: Microbial Diseases Caused by Viruses and Fungi: Medically important pathogenic Viruses: Orthomyxoviruses, Hepatitisviruses, Oncogenicviruses, HIV viruses: Medically important pathogenic Fungi: Dermatophytic & Dimorphic fungi, Opportunistic fungal Pathogens A brief account of Pathogenesis, virulence & treatment.

UNIT-IV: Antimicrobial Chemotherapy: Anti- bacterial Chemotherapy using various inhibitors. Anti-viral & Anti-fungal Chemotherapy, Drug resistance , Gene therapy, Vaccines, Antisense therapy, Enzyme and hormone therapy, RNA based therapeutics.

TEXT / REFERENCE BOOKS:

1. Ananthanarayanan, R. and Jayaram Panicker C.K. Text of Microbiology, Orient Longman. (1997).
2. Mackie and McCartney, Medical Microbiology Vol.1: Microbial Infection Vol.2: Practical Medical Microbiology Churchill Livingstone. (1996).
3. Shanson D.C., Microbiology in Clinical Practice. Wright PSG. (1982).
4. Baron E.J., Peterson L.R. and Finegold S.M. Mos, Bailey and Scott's Diagnostic Microbiology. (1990).
5. Jawetz et. al. Medical Microbiology.
6. Davis Harper, Microbiology, Row publisher.
7. Kuby, Immunology
8. Roitt, Brostoff, Male, Immunology.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT- 604 MS ANIMAL BIOTECHNOLOGY-I

M. Sc. Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	3 Hours
			Examination		

UNIT-I:	Basic in Animal Biotechnology: Animal cell lines, organ cell culture and its applications. Animal tissue culture - Plasma clot method, Raft method, Agar-gel method, Grid method, etc. - Cyclic exposure to Medium and Gas phase, Advantages, Risk in animal cell culture laboratory-Biohazards
UNIT-II:	Animal cell culture media: Preparation and Sterilization of cell culture media and reagents. Introduction to the balance salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Facilities for animal cell culture-infrastructure, equipment, culture vessels equipment, culture vessels
UNIT-III:	Isolation, maintenance and preservation of cell lines: Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells - manipulation of cell line selection - types of cell lines -maintenance of cell lines - immobilization of cells and its application - synchronization of cell cultures and cell division - production of secondary metabolites-biotransformation - Induction of cell line mutants and mutations - cryopreservation-germplasm conservation and establishment of gene banks.
UNIT-IV:	Gene cloning and transgenic techniques: Techniques for mammalian cells, establishment of immortal cell lines, cloning in mammalian cells, expression of mammalian genes in prokaryotic and eukaryotic systems, extinction of gene function by antisense RNA and DNA. Transfection methods, Embryonic Stem Cell Transfer, Targetted Gene Transfer. - Transgene integration, Detection of Transgenics through Transgene function. Transgenic animals:-Mice, Rabbits, Cattle, Goat, Sheep, Pigs and Fish.

TEXT / REFERENCE BOOKS

1. Molecular Biotechnology, ed. Old and Primrose.
2. Molecular Biotechnology: Principles and Applications of recombinant DNA, ed. Bernard R. Glick, Jack. J. Pasternak, ASM press Washington DC.
3. Animal Cell biotechnology, ed. R.E. Spier and J.D Griffiths, 1988, Academic press, U.S.A.
4. Living resources for Biotechnology of Animal cells, ed. A. Doyle, R. Hay and B.E. Kirsop, 1990, Cambridge University Press, Cambridge, U.K.
5. Animal Biotechnology, ed. Murray Moo-Young, 1989, Pergamon Press, Oxford.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT-606 MS ENVIRONMENT BIOTECHNOLOGY-I

M. Sc. Semester - IV (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	3 Hours
			Examination		

UNIT-I: Basic Ecological Concepts and Principles: Our Environment: Geological Consideration; Scope of Ecology; Principles and concepts of ecosystem; Types of ecosystem; Cybernetics and Homeostasis; Energy transfer in an ecosystem; Energy budget; Ecological efficiencies; Trophic structure and energy pyramids; Ecological energetics; Biogeochemical cycles (N, C, P cycles).
Microbes and Environment: Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Microbes and Nutrient cycles; Organic farming and reforestation applications

UNIT-II: Ecotoxicology: Definition; classification of toxicants in environment; Factors affecting toxicity; Bio-transformation of toxicants; Bio-accumulation.
Biodiversity: Definition; Historical and geographical causes for diversity; Types of diversity; Biodiversity hot spots in India; Methods of biodiversity conservation; Gene banks; Cryopreservation; Vulnerability and extinction of biodiversity; Introduction to biodiversity database: endangered animals, endemism and Red data books.
Bioremediation and Bioaugmentation; Definition; Types; Future prospects with applications

UNIT-III: Environmental Pollution: Concept of Environmental Pollution; Origin of pollution; Classification and nature of Environmental Pollutants; Major air pollutants and their sources; Particulate matter; Formation of fog and photochemical smog and acid rain; Types, sources and consequences of water pollution, ecological and biochemical aspects of water pollution ; water pollution control.; Types and possible hazards of radioactive substances; Effects of radioactive waste pollution on environment and impact of radiation on life; Concept of soil pollution; Control of soil pollution; Concept of solid waste; Major sources of solid wastes; Technical approach for solid waste management.

UNIT-IV: Environment Quality control: Quality of environment for life on earth and man; Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality; Concept of Remote sensing; Application of remote sensing in environmental studies; Concept of Geographical Information System; Types of Geographical Data; Importance of GIS in environmental studies

TEXT / REFERENCE BOOKS:

1. E.P. Odum: fundamentals of Ecology
2. Amann, R.I. Stromley, J. Stahl: Applied and Environmental microbiology
3. Dash: Concepts of Ecology
4. Varma and Agarwal: Environmental Biology
5. B.K. Sharma: Environmental Chemistry
6. Peavy and Rowe: Environmental Pollution
7. Asthana and Asthana: Environment Problems and Solutions
8. Saigo, Canninham: Environmental Science
9. M. Eisendbud, Environmental radioactivity, Academic Press
10. E.D.Enger, B.E. Smith, Environmental Science- A study of Inter relationships, WCB Publication.

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT- 608 MS BIOETHICS, BIOSAFETY AND IPR

M. Sc. Semester -IV (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
4	--	4	Examination	:	100 Marks
			Total	:	150 Marks
			Duration	of	3 Hours
			Examination		

- UNIT-I:** Bioethics: Ethical issues related to biotechnology and biomedical research and their impact to living system, Public education of the processes of biotechnology involved in generating new forms of life for informed decision making.
- UNIT-II:** Socioeconomic Impacts of Biotechnology: Beneficial applications and development of research focus to the need of the poor, identification of directions for yield effect in agriculture, bioremediation and environmental impacts of release of GMOs, social issues to biotechnology.
- UNIT-III:** Intellectual Property Rights: Intellectual property rights, and Intellectual Property protection, patents and methods of application of patents, Trade secret, copy rights, trade mark, legal implications, farmers rights, plant breeder's rights. International and National conventions on Biotechnology and related areas. GATT, TRIPS, Biodiversity convention, etc.
- UNIT-IV:** Biosafety: Introduction; Historical Background; 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; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

TEXT / REFERENCE BOOKS:

1. Thomas, J.A. and Fuch, R.L. Biotechnology and Safety Assessment. Academic Press. (2002).
2. Fleming, D.A., Hunt, D.L., Biological safety Principles and practices. ASM Press. (2000).
3. Sateesh, M.K. Bioethics & Biosafety, IK Publishers. (2008).
4. Sassaon A. Biotechnologies and development. UNESCO Publications. (1988).
5. Sassaon A. Biotechnologies in developing countries, UNESCO Publishers, (1993).
6. Singh K., Intellectual Property Rights on Biotechnology BCIL, New Delhi. (2008).

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>

NOTE: In the semester examination, the examiner will set eight questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

BT – 610 MS BIOTECHNOLOGY LAB – X

M. Sc. Semester - IV (Biotechnology)

L	P	Credits	Class Work	: 50 Marks
--	4	2	Examination	: 50 Marks
			Total	: 100 Marks
			Duration of Exam	: 3 hours

List of Experiments/Exercises

1. Sterilization of plastic ware and glass ware used in animal cell culture.
2. To demonstrate the principle and functioning of commonly used instruments in animal biotechnology lab.
3. Preparation of various media used for animal cell culturing.
4. Trypsinization of monolayer and subculturing.
5. To perform SRID, DID for disease diagnosis.
6. Immunoelectrophoresis for detection of pathogens.
7. To perform biochemical tests for identification of pathogens.
8. To detect blood groups of the given samples.
9. To perform TLC, DLC of the given blood samples.
10. To study the microbial flora of skin.
11. To determine the microbial content of dental cavities.
12. To perform widal for diagnosis of typhoid.
13. To perform VDRL for diagnosis of syphilis.
14. To demonstrate the effect of different antibiotics on bacterial pathogens.

TEXT /REFERENCE BOOKS

1. Practical microbiology cappuccino & Sherman .
2. Practical immunology by GP Talwar.
3. Practical technology by Hudson & Hay.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the related theory course.

BT – 612 MS BIOTECHNOLOGY LAB – XI

M. Sc. Semester - IV (Biotechnology)

L	P	Credits	Class Work	: 50 Marks
--	4	2	Examination	: 50 Marks
			Total	: 100 Marks
			Duration of Exam	: 3 hours

List of Experiments/Exercises

1. Isolation and screening of microorganisms involved in degradation of xenobiotics.
2. Laboratory scale production of biofertilizers (Nitrogen fixers/ phosphate solubilizers).
3. Wastewater analysis for physico-chemical characteristics such as pH, conductivity, TDS, DO, BOD, COD, CO₂, alkalinity, nutrients, chlorides, hardness, settlability of solids.
4. Estimation of halides in water samples by potentiometry.
5. Estimation of Co²⁺ and Ni²⁺ by colorimetry/spectrophotometry.
6. Vermicomposting: collection, preparation and analysis of composted material for NPK, moisture holding and microbial load.
7. Microorganisms from polluted environment/soil /water resources/ air.
8. Microbial degradation of textile dyes/pesticides/hydrocarbons and oil.
9. Pollutant removal using microorganisms from industrial effluent.
10. Effect of heavy metals on microbial growth.
11. Effect of pesticides on soil microbes.

NOTE: The students will be required to perform the experiments/exercises from the above list and any two experiments designed by the department based on the theory course.

BT – 614 MS INDEPENDENT STUDY SEMINAR

M. Sc. Semester - IV (Biotechnology)

L	P	Credits	Class Work	: 50 Marks
--	2	2	Total	: 50 Marks

The objectives of the course remain

- To learn how to carry out literature search.
- To learn the art of technical report writing.
- To learn the art of verbal communication with the help of modern presentation techniques.

A student will select a topic in emerging areas of Biotechnology and will carry out the task under the supervision of a teacher assigned by the department. He/ She will give a seminar talk on the same before a committee constituted by the Chairperson of the department. The committee should comprise of 2 or 3 faculty members from different specializations. The teacher(s) associated in the committee will each be assigned 2 hours teaching load per week. However, supervision of seminar topic will be in addition to regular teaching load.