School of Biological and Chemical Sciences

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M.Sc. Biotechnology

Prog. Code: 0902BT

(Two year Full Time Post Graduate Course)

Semester Pattern

Syllabus M.Sc. Biotechnology (Prog Code: 0902BT)

GENERAL INTRODUCTION OF THE DEPARTMENT

MATS School of Biological and Chemical Sciences (MSBCS) was established with a vision to create technocrats in the applied branches of Biological and Chemical Sciences to convey updated scientific knowledge. In the school the performances of the students are constantly monitored by continuous assessment. The School believes in supplementing academic input of students with the help of regular Seminar, Guest Lectures, Industrial/Research Institute visits and encouraging the students to participate in National & International Seminars, Conferences and Workshops.

DEPARTMENT HIGHLIGHTS

- Research focus on frontier of Life Sciences and affordable healthcare
- Highly acclaimed scientists as faculty
- State-of-the-art Lab facilities
- Hand-on training on sophisticated equipments
- Academia – Industry interface
- Multidisciplinary research in affordable healthcare, Agriculture and Food

COURSEDESIGN

The department follows a unique course-design which is contemporary and cutting-edge. It includes modern and advanced papers/ subjects including the papers from Management / Science as given in the curriculum matrix

PEDAGOGY

- Chalk Board, LCD and Projector based teaching
- Research based teaching
- Project based learning
- Separate lab bench for each student

FACILITIES

State-of-the-art facilities include:

- Double beam UV- Visible Spectrophotometer, Cooling Centrifuge, Microfuge, Incubators, Microscopes, Laminar flow hoods, Colorimeter, Micro- and regular balance, Electronic Balance Autoclave, Glass distillation apparatus, Computers, Deep freeze, DNA/RNA & Protein Electrophoresis apparatus, Plant Tissue Culture racks with light arrangements, Shakers, BOD incubator & Orbital Shaking Incubator etc
- Microbial cell culture
- Plant tissue culture

FACULTIES

- Well experienced faculties from Academic Institutes and Industries
- Invited lectures by eminent scientists from different countries

M. SC. BIOTECHNOLOGY: SCOPE AND CONTENT

Biotechnology is the research-oriented science including a fusion of biology and technology. This study includes a large variety of subjects including Cell & Molecular Biology, General Microbiology, Biochemistry, Biostatistics & Instrumentation, Management in Practice, Immunology, Medical Biotechnology, Genetic Engineering, Computer Applications & Bioinformatics, Entrepreneurship, Plant Biotechnology, Industrial Biotechnology, Environmental Biotechnology, Animal Biotechnology, IPR Bioethics & Research Methodology, Dissertation etc. Biotechnology features the use of living cells and bacteria in the industrial process. Biotechnology can be applied in developing

various vaccines, medicines and diagnostics, improving energy production and conservation and increasing productivity.

OBJECTIVES OF THE M.Sc. BIOTECHNOLOGY PROGRAM

1. To impart knowledge and skills of various aspects of biotechnology.
2. To train the students for industrial need and to pursue further education.
3. To develop human resource and entrepreneurs in biotechnology with the ability to independently start their own ventures or small biotech units in the field of biotechnology.
4. Understand modern biotechnology - practices and approaches with an emphasis in technology application in pharmaceutical, medical, industrial, environmental and agricultural areas.
5. Become familiar with public policy, bio-safety, and intellectual property rights issues related to biotechnology applications nationally and globally
6. Gain experience with standard molecular tools and approaches utilized: manipulate genes, gene products and organisms.
7. Develop skills in international teamwork and research collaboration.

ELIGIBILITY FOR ADMISSION:

Interested aspirants for M.Sc. Biotechnology degree need to fulfill the below mentioned minimum eligibility criteria.

- Completion of UG (10+2+3) level of education.
- Biology as one of the subjects at UG level

Instead of biology, one may even have had any subject related to biological sciences as one of the main subject of study.

PROGRAM OUTCOME:

1. Post graduates will be able to apply knowledge, concepts to solve issues related to their course.
2. Post graduates will have ability to identify problems related to their subjects.
3. Post graduates will have ability to analyze and derive valid conclusions with fundamental knowledge in their respective subjects.
4. Post graduates upon the needs of environment and society, will be able to fulfill the same in the form of solutions within the safety limit of prevalent rules and guidelines.
5. Post graduates will have ability to design, conduct experiments, analyze and interpret data for investigating problems in their respective fields.
6. Post graduates will have ability to select and apply appropriate tools and techniques.
7. Post graduates will have knowledge for assessing societal, health, safety and legal aspects and the duties as responsible citizen of country.
8. Post graduates will have the knowledge for the need of sustainable development.
9. Post graduates will have the knowledge of ethics and regulatory norms of their respective course.
10. Post graduates will have oral, written communications skill along with team spirit.

PROGRAM SPECIFIC OUTCOMES:

1. Application of knowledge and techniques of basic sciences related to biological and chemical sciences.
2. Scale up of biochemical process after designing, optimization and analysis for developing products required for society.
3. Tabulation and interpretation of Biological data using computer software.

CAREER PROSPECTS:

The bio-technology Industry is constantly growing and in the past 10 years, human resources in the field have grown drastically. Today, Indian biotech sector comprises of lot many companies and bio suppliers, generating ample amounts of revenues. Indian biotech industry comprises of clinical research, new drug discovery, bioinformatics, R&D, biopharmaceuticals etc. Bio-tech industry has rapid growth rate per annum. As there is increasing popularity and explosive growth, there are plenty of opportunities available in Biotechnology field. One can be a Research Scientist, Teacher, Marketing manager, Science Writer, Bioinformatician, Quality Control Officer or Production in-charge in the Food, Chemical and Pharmaceutical industry, Analyst, Environmental / Safety Specialist.

THE MAIN JOB SECTORS ARE AS FOLLOWS:

Biotechnology companies, Health service organizations, Pharmaceutical companies, Universities and Research institute, Horticultural industries, Conservation organizations, Food and drink manufacturers, Water industry, Agricultural industry, Law Enforcement.

ATTENDANCE:

A candidate shall be deemed to have undergone a regular course of study in the University, if he/she has attended at least 60% of the lectures in each subject will be at least 75% in the aggregate of lectures, tutorials and practical in order to be eligible to appear at the Final Examination.

SCHEME OF EXAMINATION, EVALUATION AND DISTRIBUTION OF MARKS

1 The overall weightage of a course in the Syllabi and Scheme of Teaching & Examination shall be determined in terms of Marks assigned to the course.

2 The evaluation of students in a course shall have two components unless specifically stated otherwise in the Scheme of Teaching & Examination and Syllabi:
   (i) Evaluation through a semester-end examination (University Examination Marks)
   (ii) Continuous evaluation by the teacher(s) of the course.

3 Continuous Evaluation (Internal Marks)

i) Theory courses

The division of internal marks will of 50% marks for mid semester examination and 50% of marks for the internal class tests. There shall be three class tests held during each semester. The three class tests shall ordinarily be held after 4 weeks, 8 weeks and 12 weeks of teaching in accordance with the University Academic Calendar.

(ii) Practical/Laboratory courses

The total internal marks in practical /Laboratory courses shall be based on performance in the laboratory, regularity, practical exercises /assignments, quizzes, etc. The assessment shall be given at three nearly equi-spaced intervals.

Evaluation through a semester-end examination

The distribution of weightage for various components of evaluation shall be as given below:

		Bachelor's degree/ Under-graduate diploma	Master's degree/ Post-graduate diploma
A.	THEORY COURSES		
	(i) Semester-end examination	70%	70%
	(ii) Continuous evaluation by the teachers	30%	30%
B.	PRACTICAL/LABORATORY COURSES		
	(i) Semester-end examination	70%	70%
	(ii) Continuous evaluation by the teachers	30%	30%
C.	DISSERTATION/THESIS		
	(i) Assessment by External Examiner	70%	70%
	(ii) Assessment by Internal Examiner	30%	30%

PASSING MARKS:

For postgraduate students, obtaining a minimum of 45% marks in aggregate in each course shall be essential for passing the course and earning its assigned credits. A candidate, who secures less than 45% of marks in a course, shall be deemed to have failed in that course.

GRADING SYSTEM:

For UG:

80% and above – "10 Grade Point" and Letter Grade "O" (Outstanding)

40% and above but below 45% - "Grade Point 4" and Letter Grade "P" (Pass)

For PG:

80% and above – "10 Grade Point" and Letter Grade "O" (Outstanding)

45% and above but below 50% - "Grade Point 4" and Letter Grade "P" (Pass)

PROGRAM DURATION:

The maximum permissible period for completing a program for which the prescribed program duration is **n semesters**, shall be **(n+4)** semesters. All the program requirements shall have to be completed in (n+4) semesters.

ATKT criteria:

ATKT Candidate means a candidate who failed in not more than forty percent of the total number of Core and Core bracket papers, excluding the Practical Examination / Project Work / Viva Voce Examination in the Semester Examination and is appearing in the Examination of same semester again which is organized with the next Semester Examination. Forty percent (of the total number of Core and Core bracket papers) will be rounded off to higher side in case it is not a whole number. In case a Students fails or was absent in Practical Examination / Project Work / Viva Voce Examination, he/she may be allowed to have ATKT exam on his/her own expenses.

Curriculum Matrix M.Sc. Biotechnology (Prog. Code 0902BT)

Semester I					Marks Distribution		
	Code	**Subject**	**Hours/ week**	**Credit (L+T+P)**	**External**	**Internal**	**Total**
Core Course	02BT1101	Cell and Molecular Biology	4	4 (4+0+0)	70	30	100
	02BT1102	General Microbiology	4	4 (4+0+0)	70	30	100
	02BT1103	Biochemistry	4	4 (4+0+0)	70	30	100
	02BT1104	Instrumentation	4	4 (4+0+0)	70	30	100
Laboratory	02BT1205	Lab Course I	4	2 (0+0+2)	35	15	50
	02BT1206	Lab Course II	4	2 (0+0+2)	35	15	50
Open Elective	09OE1307 OR 09OE1308	Food and Nutrition (09OE1307) **OR** Management in Practice (09OE1308)	4	4 (4+0+0)	70	30	100
		Total	**28**	**24 (20+0+4)**	**420**	**180**	**600**
Semester II							
Core Course	02BT2101	Immunology	4	4 (4+0+0)	70	30	100
	02BT2102	Biostatistics & Research Methodology	4	4 (4+0+0)	70	30	100
	02BT2103	Computer Application & Bioinformatics	4	4 (4+0+0)	70	30	100
	02BT2104	Genetic Engineering	4	4 (4+0+0)	70	30	100
Laboratory	02BT2205	Lab Course III	4	2 (0+0+2)	35	15	50
	02BT2206	Lab Course IV	4	2 (0+0+2)	35	15	50
Open Elective	09OE2307 OR 09OE2308	Vaccines and Antibiotics (09OE2307) **OR** Nanobiotechnology (09OE2308)	4	4 (4+0+0)	70	30	100
		Total	**28**	**24 (20+0+4)**	**420**	**180**	**600**
Senester III							
Core Course	02BT3101	Medical Biotechnology	4	4 (4+0+0)	70	30	100
	02BT3102	IPR & Bioethics	4	4 (4+0+0)	70	30	100
Core/ Discipline Based Elective	02BT3103 OR 02BT3104	Plant Biotechnology (02BT3103) **OR** Animal Biotechnology (02BT3104)	4	4 (4+0+0)	70	30	100
	02BT3105 OR 02BT3106	Environmental Biotechnology (02BT3105) **OR** Industrial Biotechnology (02BT3106)	4	4 (4+0+0)	70	30	100

Laboratory	02BT3207	Lab Course V	4	2 (0+0+2)	35	15	50
	02BT3208	Lab Course VI	4	2 (0+0+2)	35	15	50
Open Elective	09OE3309 OR 09OE3310	Medicinal and Pharmaceutical Chemistry (09OE3309) **OR** Entrepreneurship (09OE3310)	4	4 (4+0+0)	70	30	100
		Total	**28**	**24 (20+0+4)**	**420**	**180**	**600**
Semester IV							
Core Course	02BT4101	Dissertation		16	280	120	400
	02BT4102	Dissertation Seminar		2	35	15	50
	02BT4103	Viva Voce		2	35	15	50
		Total		**20**	**350**	**150**	**500**
L = Lecture, T = Tutorial, P = Practical			**Grand Total**	**92**	**1610**	**690**	**2300**
1 credit = 1 hour of teaching/week or 2 hours of Lab/week							
SGPA and CGPA will be calculated by the Examination Cell							
Coding Pattern : 1st digit denote semester; 2nd digit for type of paper [1-Core/Discipline based Elective, 2-Lab/Practical, 3-For others such as Open Elective]; 3rd & 4th digit for Paper Number							

M.Sc. Biotechnology
Semester I: Theory
Cell and Molecular Biology
Code: 02BT1101

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Cell and Molecular Biology.
2. To train the students to pursue further education.
3. To be familiar with molecular biology tools.
4. To gain experience of standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Cell and Molecular Biology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Cell Theory. Cell organization and functions: Structure of prokaryotic cells (bacteria, fungi, virus, cyanobacteria, mycoplasma etc.). General organization of eukaryotic cells; The cell cycle and its regulation; Cell division: Mitosis and Meiosis.

Module II

DNA REPLICATION: Enzymes and accessory protein involved in DNA replication. DNA replication in prokaryotes and eukaryotes. Repair of DNA;
Recombination and Transposition of DNA.

Module III

TRANSCRIPTION: In Prokaryotes and Eukaryotes; Mechanism of transcription.
Enzymology of transcription. Post-transcriptional modifications; Transcription in eukaryotes, RNA editing.

Module IV

TRANSLATION: In Prokaryotes and Eukaryotes; t-RNA and its function; Ribosome: Types and composition. Protein biosynthesis.

Module V

GENETIC CODE: Salient features of genetic code.
REGULATION OF GENE EXPRESSION: Basic elements in the control of gene expression, structural and regulatory genes, mechanism of activation of gene expression, operon model.

Suggested Readings:

- Molecular Biology of Cell, Alberts, B et. al
- Molecular Cell Biology, Darnell, Lodish, Baltimore, Scientific American Books Inc.1994.

- Molecular Biology LabFax, I.A.Brown (Ed), Bios Scientific Publishers Ltd., Oxford, 1991.
- Cell & Molecular Biology : Gerald Karp
- Cell Biology : C.B. Powar
- Essential Cell Biology : An introduction: Bruce, Alberts, Dennis
- The Cell: A Molecular Approach: Geoffrey M. Cooper
- Cell & Molecular Biology: SC Rastogi
- Molecular Cell Biology: Lodish
- Benjamin Lewin (1999) Genes VII, Oxford University Press, Oxford.
- Weaver R. F. (1999) Molecular biology, WCB McGraw-Hill Companies, Inc, New York.
- Brown T A (1995) Essential molecular biology, Vol. I, A practical approach, IRL press, Oxford.

M.Sc. Biotechnology
Semester I: Theory
General Microbiology
Code: 02BT1102

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of microbiology.
2. To train the students to pursue further education.
3. To be familiar with microbiological tools.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Microbiology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
4. Ability to dissect a problem in to its key features.

Module I

Introduction to Microbiology: Historical background, Major Landmarks and Scope, Difference between Prokaryotic and Eukaryotic organisms.

Methods of Microbiology: Sterilization techniques, Pure culture techniques, Preservation and Maintenance of Microbial cultures, Principle of Microbial Nutrition, Perpetration of culture media, Enrichment culture, Different techniques for Isolation of Microbes.

Module II

Classification of Bacteria: Basic principle and techniques used in bacterial classification, Phylogenetic and numerical taxonomy. Bergy's manual and its importance, A brief account of Bacterial Classification. Ultra structure of Bacteria, A brief account of Rickettsiae, Mycoplasma and Chlamydiae.

Microbial Growth: The definition of growth, bacterial generation time, specific growth rate and yield measurement, Monoauxic, Diauxic and synchronized growth curve. Factor affecting microbial growth. Culture collection and maintenance of culture. Sporulation in bacteria.

Module III

Viruses: General characteristics, Morphology, Reproduction, Classification and structure of plant, animal and bacterial viruses. Cultivation of viruses, A brief account of TMV, Adenoviruses, Herpes, Retrovirus, HIV, Viroids and Prions

Module IV

Actinomycete: Distribution of actinomycetes, General characteristics, Economic importance.

Algae: Distribution of algae, Biochemical classification, Thallus organization, Reproduction, Products of algae and their Importance.

Fungi: General Characteristics, Classification, Vegetative body, Reproduction, Nutritional groups and Habitat relationships, Economic importance of fungi.

Module V

Microbial Ecology: Microbial flora of soil, Interaction among soil microorganisms. Nitrogen fixation (a brief account), Symbiotic association-types, functions and establishment of symbiosis.

Control of Microorganism by physical and chemical agents: Antimicrobial agents, Sulfa drugs, Antibiotics (penicillin and cephalosporin), Broad Spectrum antibiotics, antibiotics from prokaryotes. Anti fungal antibiotics, Mode of action, resistance of antibiotics.

Suggested Readings:

- General Microbiology-Roger. Y. Stainer, et al. 1986; Macmillan Press Ltd., Hampshire.
- Microbiology-An introduction: Gerald. J. Tortora, Berdell R.Funke,
- Christine.L.Case,Vth edition, 1995: The Benjamin/Cummings Publishing Co.Inc., USA.
- Microbiology: Essentials and Applications: Larry McKane, Judy Kandel, 2nd edition;1996; McGraw Hill Inc.
- Microbiology- Prescott, Harley, Klein, 4th edition, 1999; McGraw Hill Inc.
- Microbiology: Brock and Madigan
- Microbiology: Pelczar, Chan and Krieg
- Microbiology: Powar and Daginawala
- General Microbiology: R. Y. Ingraham
- Microbiology: Katherine Black

M.Sc. Biotechnology
Semester I: Theory
Biochemistry
Code: 02BT1103

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of biochemistry.
2. To train the students to pursue further education.
3. Become familiar with biochemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Biochemistry and key principles of Biochemistry.
2. Awareness of the major issue at the forefront of the discipline.
3. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
4. Ability to dissect a problem in to its key features.

Module I

Carbohydrates: Chemical Properties, Classification and Biological Importance**.**

Stereochemistry: Stereochemistry of Sugars, Ring Structure (Aldose & Ketose) and Anomeric forms, Mutarotation.

Mono and Oligosccharides: Structure and Biochemical Roles of Mono and Oligosccharides.

Polysaccharides: Structure and Biochemical Roles of Homo and Heteropolysaccharides, Proteoglycans, Peptidoglycan, Glycosaminoglycans, Glycoconjugates, Glycoproteins.

Module II

Lipids: Classification, Fatty acids, Properties of Fatty acids, Triglycerides, Phospholipids and Sphingolipids; Biological Significance of Lipids.

Membrane Lipid: Lipid Bilayers, Formation of Lipid Bilayers, Membrane Fluidity, Fluid Mosaic Model.

Module III

Amino acids: Physical and Chemical Properties, Titration of amino acids, Separation and Identification of amino acids,

Peptide bond: Primary structure, Determination of amino acid sequencing, Ramachandran plot, Secondary structure of α-helix, β-strand, β-sheet, turns and loops. Tertiary structure, Quaternary Structure, Globular and Fibrous Protein, Protein Sequencing.

Membrane Protein: Integral, Lipid-linked and Peripheral Membrane Proteins.

Module IV

Purine and Pyrimidine Bases: Structure and Types, Composition of DNA and RNA, Phosphodiester bond, Nucleosides and Nucleotides.

Nucleic Acid: Watson - Crick Model of Double helix, Chargaff's rule. Different forms of DNA structure (A, B & Z), RNA, Primary, Secondary and Tertiary of RNA, Denaturation and Annealing of DNA, Cot Value and Super coiling of DNA. Protein-Nucleic Acid Interaction

Nucleic Acid Sequencing: By Restriction Endonucleases, By Chain Terminator Method.

Module V

Enzymes: Classification and Nomenclature, Co-enzyme, Cofactor and Prosthetic group, Turnover of Enzymes, Enzyme-substrate Interaction. Activation energy, Catalytic mechanism of Enzymes.

Enzyme Kinetics: Michaelis-Menten equation, Double reciprocal plot, Activator, Inhibitors, Inhibition reactions (Competitive, Uncompetitive and Non-competitive) and their kinetics. Allosteric and Feedback Inhibition.

Suggested Readings:

1. Biochemistry: J M Berg, J L Tymoczko and L Stryer.
2. Principles of Biochemistry: David L. Nelson, Albert L. Lehninger, Michael M. Cox.
3. Biochemistry: D Voet, J Voet and C W Pratt.
4. Biochemistry: U Satyanarayana and U Chakrapani.
5. Textbook of Biochemistry: Edward S West.
6. Harper's Illustrated Biochemistry: Robert K Murray, Daryl K Garner and Peter A Mayes
7. The Enzyme: Dixon and Webb.
8. Text Book of Biochemistry with Clinical Correlations: Thomas M Devlin
9. Medical Biochemistry: N Mallikarjuna Rao
10. Introduction to Enzyme and Coenzyme Chemistry: Tim Bugg

M.Sc. Biotechnology
Semester I: Theory
Instrumentation
Code: 02BT1104

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of instrumentation.
2. Become familiar with working principle of different instruments.
3. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals instrumentation and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
4. Ability to dissect a problem in to its key features.

Module I

Centrifugation techniques: Basic Principles of Sedimentation.
Centrifuge and Rotor: Types, Instrumentation and Applications.
Microscopy: Principles of Microscopy;
Types: Bright field, Dark field, Phase contrast, Confocal and Fluorescent, Electron Microscopes (SEM and TEM).

Module II

Radioisotopes Techniques: Radioactive decay.
Detection and different methods of measurement of radioactivity.
Use of radioactive isotopes in biology; Safety aspects.
Mass Spectrometry: Principles, Techniques and Applications;
Mass spectrometer, MALDI-TOF.

Module III

Spectrophotometric Techniques: - Basic principles;
Lambert Beer's Law, Absorbance, Transmittance and Extinction Coefficient.
UV, Visible and Infrared Spectroscopy: Theory, Instrumentation and Applications;
Atomic Spectroscopy and Nuclear Magnetic Resonance (NMR) Spectroscopy: Theory, Instrumentation and Application

Module IV

Chromatography Techniques: Basic Principles, Instrumentation and Applications;
Plane Chromatography: Paper and Thin Layer Chromatography (TLC).
Column chromatography: Adsorption, Partition, Gel filtration, Ion exchange, Affinity chromatography, High Performance Liquid chromatography (HPLC).

Module V

Electrophoretic Techniques: Theory, Instrumentation and Applications;
Types: Paper, Gel electrophoresis, Isoelectric Focusing, Pulse Field Gel Electrophoresis, Immuno-electrophoresis, Electroblotting techniques.

Suggested Readings:

1. Biophysical Chemistry Principles and Techniques: Upadhyay, Upadhyay and Nath.
2. Biotechniques Theory and Practice: S V S Rana; Rastogi Publications.
3. Principles and Techniques of Biochemistry and Molecular Biology: K Wilson and J Walkar.
4. Physical Biochemistry Principles and Application: D Sheehan; Wiley
5. Physical Biochemistry and Molecular Biology: Freifelder D.
6. Principles of instrumental analysis: Skoog and West.
7. Biochemical Techniques: Theory and Practice-Robyt and White.
8. Principles and Techniques of Practical Biochemistry: Williams and Wilson.

M.Sc. Biotechnology
Semester I: Practical
Lab Course I
Code: 02BT1205

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with tools.
4. Gain experience with standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. Introduction to microbiological techniques, washing of glasswares & sterilization.
2. Different media composition and preparation used in Microbiology
3. Preparation of Slants and Plate Culture.
4. Different inoculation techniques.
5. Isolation and enumeration of microbes from air, water, soil and sewage.
6. Maintenance of pure culture.
7. Staining of microbes: Gram staining, Acid-fast staining, Cotton blue staining.
8. Hanging drop technique for motility of bacteria.
9. Study of Mitosis and Meiosis.
10. Effect of pH, temperature, light and nutrient source on the growth of microorganisms.
11. Bacterial growth curve by measuring the turbidity.

M.Sc. Biotechnology
Semester I: Practical
Lab Course II
Code: 02BT1206

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with tools.
4. Gain experience with standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. Estimation of sugar by Anthrone reagent.
2. Estimation of sugar by Folin-Wu method.
3. Estimation of Amino acids by Ninhydrin method.
4. Estimation of Total protein by Biuret and Lowry's method.
5. Quantitative estimation of Iodine number and Acid value of oil.
6. Estimation of DNA by DPA method.
7. Estimation of RNA by Orcinol method.
8. Determination of Optimum pH and Temperature of enzyme Peroxidase extracted from germinating seeds.
9. Paper chromatography of Amino acids.
10. Verification of Lambert Beer's Law.
11. Gel chromatography for separation of a mixture of molecules.

M.Sc. Biotechnology
Semester I: Theory
Food and Nutrition
Code: 09OE1307

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Food and Nutrition.
2. To train the students to pursue further education.
3. To be familiar with dietetics and nutritional requirements.

Course Outcome:

Skills that students obtain after completion of the course:
1. Understanding of the fundamentals Food and Nutrition and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Cereal: Types, Structure and composition, Nutritional value, Storage and Care.
Pulses: Types, Composition and Nutritional Value.
Nuts and Oil seeds: Classification, Nutritional value and Importance.

Module II

Milk and Milk Products: Composition of Milk, Properties, Effect of Heat and Nutritional value.
Fruits and Vegetables: Composition, Classifications, Nutritional value and Storage.
Flesh Foods: Meat, Fish and Poultry uses, Nutritional value and Storage.

Module III

Nutrition: Food as Nutrients, Types of Nutrients, Functions of Food.
Carbohydrates: Classification, Source and Functions.
Fats and Oils: Classification, Source and Functions.
Protein: Sources, Functions, Essential and Non-essential Amino acids.

Module IV

Vitamins: Definition, Types, Source, Functions and Deficiency.
Minerals: Source, Functions and Deficiency.
Balance Diet: Definition, Composition, Balance Diet for Adult Man, Woman and Young Children.
RDA: Definition, RDA for Average Indians,

Module V

Energy: Definition, Unit of Energy, Body's need for Energy, BMR
Malnutrition: Protein-Energy Malnutrition, Malnutrition and Infection, Malnutrition and Behaviour.
Nutrition and Fitness: Diet and Aerobic Fitness, Fitness Plan.
Nutrition and Disease: Obesity, Diabetes and Heart Disease.

Suggested Readings:

1. Food and Nutrition: Don Ross; Oxford Book Company.
2. Nutritional Biochemistry: Tom Brody; Academic Press.
3. Nutrition Now: Judith E Brown; Wadsworth Cengage Learning.
4. A Text Book of Foods, Nutrition & Dietetics: M R Begum; Sterling Publishers Pvt. Ltd.
5. Nutrition and Dietetics: Subhangini A Joshi; Tata McGraw Hill Education Pvt. Ltd.

M.Sc. Biotechnology
Semester I: Theory
Management in Practice
Code: 09OE1308

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To understand the basic functions of management.
2. To know the basic qualities of a manager so that they can be utilized in practical situation.
3. To develop understanding of basic know-how of industrial planning, market assessment, future projections, etc.

Course Outcome:

Skills that students obtain after completion of the course:

1. To prepare business plan and its execution according to market available.
2. Ability to dissect a problem in to its key features.
3. Apply the basic concepts of management to different situations.

Module I

Introduction to Management: - Meaning, nature and importance. Evolution of Management-Classical, Neo-classical, Scientific Theory, Administrative Theory; Functions of a Manager. Qualities of a manager. Social Responsibilities of a Manager, Management as a Process-Planning-Meaning and Importance. Organizing-Meaning and Importance. Staffing- Meaning and Importance. Directing – Meaning and Function.

Module II

Human Resource Management-Meaning. Importance of Human Resource management. Manpower Planning- Meaning and Importance. Difference between Human Resource Development and Human Resource Planning. Recruitment-Meaning and Importance. Selection- Meaning and Methods Training Meaning. and Types. Performance Appraisal- Meaning and Types.

Module III

Organization Behavior- Introduction to Organization Behavior- Meaning, Importance and scope. Motivation- Meaning, Process and Importance. Motivational Theories- Maslow, Herzberg and McClelland. Attitude- Meaning and Importance, Components of attitude in Organization Behavior. Perception- Meaning and Importance in the context of Organization Behavior.

Module IV

Marketing Management- Meaning, Importance and Implications. Marketing Mix- Product- Meaning, types and Importance. Place- Meaning and Importance. Price- Meaning. Methods and Importance; Promotion- meaning. Instruments and Importance to make a marketing decision.

Module V

Financial Management- Meaning and Importance. Relationship with other managerial functions. Financial Analysis- Meaning and Importance; Tools of financial management, Fund Flow – Meaning, Process; Fixed and Working Capital- Meaning and Importance.

Suggested Readings:

- Principles of Management: L. M. Prasad
- Management by Robbins.
- Marketing Management-Raja Gopal.
- Financial Management for Non-Finance Executives by Dr. Prasanna Chandra
- Human Resource Management by C. V. Mamoria
- Organizational Behavior by S. Robbins
- Management by Stoner
- Financial Management by Khan and Jain
- Financial Management by Dr. Prasanna Chandra
- Marketing Management by Philip. A. Kotler
- Human Resource Management by Edward Flipo

M.Sc. Biotechnology
Semester II: Theory
Immunology
Code: 02BT2101

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart through knowledge of Immunology.
2. To train the students to pursue further education.
3. To be familiar with Immunological tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Immunology and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Introduction; Cells of the Immune system; Innate and Acquired immunity; Organs and cells involved in immune system and Primary and Secondary immune response; Nature of antigens; Chemical and molecular basis of antigenecity; superantigen, Immunogenicity; Epitopes, Haptens, Adjuvant, Freund's adjuvants and its significance. Immune Responses; Theory of Clonal selection.

Module II

B-lymphocytes, their subpopulation and activation; Structure and function of Immunoglobulin; Antigenic determinants on immunoglobulin; Antigen-Antibody interactions; Antibody affinity, avidity; Agglutination; Precipitation; Idiotypic antibodies; Theories of antibody formation, hybridoma technology for monoclonal antibodies and designer monoclonal antibodies. Multiple mylomas and structural basis of antibody diversity; Antibody engineering; Generation of antibody diversity; Major Histocompatibility Complex.

Module III

Biology of T lymphocyte; Classification of T lymphocytes; Structure of T Cell Receptor (TCR); TCR diversity and genetics, Antigen processing and presentation; Cytokines; Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis; Hypersensitivity. Non-specific immune mechanism: Surface defenses, Tissue defenses, Opsonization, Inflamatory reaction, and Hormone balance. Tissue metabolites with bactericidal properties (lysozyme, nuclein, histone, protamine, basic peptides of tissues – leukins, phagocytins, lecterins, haemocompounds).

Module IV

Expressions and Regulation of Immune Response: Antigen processing and presentation, Generation of humoral and cell mediated immune response, Activation of B and T lymphocytes, Cytokines and their role in immune regulation, T cell regulation, MHC restriction, Immunological tolerance. Cell mediated cytotoxicity: Mechanism of T cells and NK mediated lysis, antibody dependent cell mediated cytotoxicity,

and macrophage mediated cytotoxicity. Complement system, Regulation of complement activation. Transplantation immunology: MHC, Types of grafts, Grafts rejection, GVH reactions, Mechanism of graft rejection and prevention of graft rejection.

Module V

Immunity and Immunoassays Defense against bacteria, viruses, fungi and parasites including Immunodiagnostics and immunotherapy. Immuno-assays: SRID, ELISA, ELISA-PCR, RIA, Western Blotting, FACS, Immunofluorescence, Flow cytometry, Immunodiffusion and Immunoelectrophoresis; Hemagglutination; Immunofluroscens and their application.

Suggested Readings:

- Immunology: Kubey
- Immunology: A short Course; Eli Benjamin, Richard Coico
- Fundamentals of Immunology: William Paul
- Essentials of Immunology (6th Edition): Ivan Riot- Blackwell Scientific Publications, Oxford, 1988.
- Antibodies- A laboratory Manual: Harlow and David Lane (1988), Old Spring harbor Laboratory.
- Immunology: Roitt, Brostoff and Male
- Immunology: C.A. Janeway and Paul Travers.
- Immunology: Weir, D.M. 1992.
- Immunological techniques: I. R. Tizard, Immunology, An Introduction, 1995, 4th edition – Saunder's.

M.Sc. Biotechnology
Semester II: Theory
Biostatistics and Research Methodology
Code: 02BT2102

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Statistics and Research Methodology
2. To be familiar with biostatistics and its application.
3. Become familiar with statistical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of statistics & research methodology and key principles of it.
2. Awareness of its major application.
3. Ability to use Computer for biostatistics or related problems.

Module I

Introduction to biostatistics; Kinds of biological data, Frequency distribution, Cumulative frequency distributions. Descriptive Statistics – Measures of Central tendency, Arithmetic Mean, Median, and Mode. Measures of dispersion – Standard deviation and Coefficient of Variations. Random Variable: Expectation and variance. Probability distribution, Mean Variance, Binomial, Poisson, Mean, Variance.

Module II

Normal distribution and standard normal distribution: Area properties, mean, variance, Testing of Hypothesis, Types of Hypothesis, Types of errors; z-test, t-test, F-test; Testing goodness of fit, Chi Square (χ^2) test.

Module III

Technique for analyzing Variance and Covariance, Principle of ANOVA, One-way ANOVA, Two-way ANOVA; Non Parametric tests: Sign test, Wilcoxon matched pairs test, Wilcoxon-Mann-Whitney test, Kruskal –Wallis test, Runs test (Test for randomness). Spearman's Rank Correlation, Kendall's coefficient.

Module IV

Research Methodology: Introduction, Meaning, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Research Methodology, Research & Scientific Method, Significance of knowledge of Research Methodology, Process of Research, Criteria of Good Research, Limitations of Research, Research Problem, Selecting a Problem, Necessity of defining the Problem, Techniques involved in defining a Problem, Hypothesis-Meaning & Characteristics, Research Design – Meaning, Need for Research Design, Features of good design, Developing a Research Plan Information sources for Literature search.

Module V

Interpretation and Report writing: Meaning of Interpretation, Techniques of Interpretation, Precaution in Interpretation, Significance of Report writing, Different steps in writing report, Layout of the Research Report, Types of Reports, Mechanics of writing a Research report, Precautions for writing Research Reports, Conclusions, Oral presentation.

Suggested Readings:

- Biostatistical Analysis: Jerrold H Zar
- Principles of Biostatistics: Mercelo Pagano
- Fundamentals of Biostatistics: Khan and Khanum
- Fundamentals of Biostatistics- Practical Approach: Naren Kumar Dutta
- Fundamentals of Mathematical Statistics : S C Gupta and V K Kapoor
- Statistical Methods: Snedecor and Cochran
- Research Methodology- Methods and Techniques: C. R. Kothari
- Research Methodology- A Step-by-Step Guide for Beginners: Ranjit Kumar

M.Sc. Biotechnology
Semester II: Theory
Computer Application and Bioinformatics
Code: 02BT2103

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Computer Application and Bioinformatics
2. To be familiar with computer hardware and software.
3. To have experience of virtual world and databases.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Computer Application & Bioinformatics and key principles of it.
2. Awareness of its major application.
3. Ability to use Computer for biological applications or related problems.

Module I

Computer Basics, Introduction to computer networks, LAN, MAN, WAN & Internet, Internet applications. Introduction to MS office, working with documents, worksheets and presentations.

Module II

Concepts of Programming languages, Introduction to 'C' language, flowcharts and algorithms, introduction to data structure and database concepts, Object oriented concepts.

Module III

Database concepts: Introduction, Key features, History; Database management systems, Types of database management systems, Structured Query language; Index: Introduction and forms;
Biological Database: Introduction and Types; Sequence Database: Introduction and Types

Module IV

Bioinformatics: Introduction, Bioinformatics databases, Importance of Bioinformatics; Analytical approaches, Components of Bioinformatics, Useful sites for researchers, Commercial use of bioinformatics; Bioinformatics in Life Sciences, Biocomputing, Bioinformatics in the area of genomics, Technical and legal issues, Role of Bioinformatician.

Module V

DNA sequence analysis: Gene structure and DNA sequences, Features of DNA structure analysis, DNA libraries and ESTs, Effect of EST data on DNA databases; Pair wise and multiple sequence alignment techniques; Phylogenetics; Analysis of Gene expression: Overview of microarray analysis, Micro arrays as tools for Gene expression analysis

References:

- Let us learn C : Yashwant Kanetkar
- Mastering C: Venugopal
- Bioinformatics: C. S. V. Murthy

- Introduction to Bioinformatics: Indian Institute of Bioinformatics, New Delhi
- Bioinformatics: Baxavanis
- Bioinformatics: Higgins and Taylors.
- Fundamentals Concepts of Bioinformatics: Dan E. Krane and Michael L. Raymer.

M.Sc. Biotechnology
Semester II: Theory
Genetic Engineering
Code: 02BT2104

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Genetic Engineering.
2. To be familiar with genetic engineering tools.
3. To train the students to pursue further education.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Genetic Engineering and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Recombinant DNA technology: Enzymology: restriction endonucleases, ligases, polymerases, phosphatases. Steps involved in the Gene cloning, Gene Cloning Vectors: Plasmids, Bacteriophages, Phagemids, Cosmids and Artificial Chromosomes.

Module II

Gene libraries: Construction and Screening of DNA libraries. Gene amplification; Polymerase Chain Reaction (PCR): types and applications. Basic techniques: Dot Blots, Colony hybridization; Probes: preparation and labeling; Blotting techniques: Southern, Northern and Western blotting.

Module III

Genome Maps: Genetic markers – DNA, RNA and protein markers. Linkage mapping: RFLP, RAPD, AFLP, STSs. Physical Mapping; Pulsed Field Gel Electrophoresis (PFGE), Nucleic acid microarray.

Module IV

Site directed mutagenesis, Screening recombinant clones for site-directed mutagenesis; Protein Engineering; Recombinant proteins: Processing, Purification and Stabilization; Role of tagging in gene analysis, T-DNA and transposon.

Module V

DNA Fingerprinting and its applications; Gene Therapy: Strategies, Augmentation and targeted gene therapy for inherited diseases, Somatic Cell Gene therapy. Gene Augmentation, Gene Correction / Gene editing, Gene regulation and Silencing

Suggested readings:

- Gene Cloning and DNA Analysis: TA Brown.
- Principles of Gene Manipulation: Old and Primrose.
- Biotechnology: An Expanding Horizons: B D Singh.
- Genes IX: Benjamin Lewin.
- Recombinant DNA: Genes and Genomes: James D Watson, Richard M. Myers, Amy A. Caudy and Jan A. Witkowski.

M.Sc. Biotechnology
Semester II: Practical
Lab Course III
Code: 02BT2205

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with tools.
4. Gain experience with standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. Precipitation reaction: antigen-antibody interaction.
2. Agglutination reaction.
3. Radial Immunodiffusion.
4. ELISA.
5. Purification of IgG from the serum by ammonium sulphate, acetone precipitation and dialysis.
6. SDS-PAGE of denatured protein samples and determination of molecular weight of unknown proteins.
7. Poly Acrylamide Gel Electrophoresis of native proteins.
8. Estimation of acid and alkaline phosphate from serum.
9. Western Blotting of proteins.
10. Analysis of urine sample.
11. Antibiotic sensitivity test of blood and urine culture.
12. VDRL test.
13. HBs-AG test.
14. Estimation of Hemoglobin.
15. Perform an experiment based on probability distribution function.
16. Perform an experiment to correlate median class and standard deviation.
17. Calculate regression and correlation use excel

M.Sc. Biotechnology
Semester II: Practical
Lab Course IV
Code: 02BT2206

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with tools.
4. Gain experience with standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. Creation of presentation using MS power point presentation 2007.
2. To insert picture, music, animation in a presentation using MS PowerPoint presentation 2007.
3. To create word file by using paragraph and alignment.
4. To work with spreadsheet using MS Excel.
5. Writing a program in C language, to print "Hello World".
6. Searching scientific information using Google Scholar, NCBI or any other search engine
7. Pair wise alignment of DNA/ Protein using BLAST
8. Identification of gene using gene scan
9. Retrieval of 3d structure of protein from PDB
10. Prediction of protein secondary structure using J-pred
11. Multiple sequence alignment of protein using clustal –W
12. Agarose gel electrophoresis.
13. Isolation of Genomic DNA from Bacteria species
14. Isolation of Plasmid DNA.
15. Molecular size determination of DNA.
16. Restriction digestion and ligation of DNA
17. Polymerase Chain Reaction.
18. Preparation of competent cells

M.Sc. Biotechnology
Semester II: Theory
Vaccines and Antibiotics
(Open Elective)
Code: 09OE2307

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Vaccines and Antibiotics.
2. To be familiar with different tools of Vaccines and Antibiotics
3. To train the students to pursue further education.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Vaccines and Antibiotics and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Vaccines: History and Nature; Types of Vaccines with examples: Simple and Mixed Vaccines, Univalent and Polyvalent Vaccines, Inactivated vaccine, Attenuated Vaccine, Live Vector Vaccine, Recombinant Vaccines, Subunit Vaccines, Conjugate Vaccines, Peptide Vaccines, DNA Vaccines, Cell Culture Vaccine.

Module II

Preparation, Standardization and Storage of Vaccines; Multivaccine System; Principles of vaccination, passive and active immunization, immunization programs and role of WHO in immunization programs.

Module III

Hybridoma Technology: Theory; Monoclonal antibodies, Production and applications; Monoclonal Antibodies as Vaccines.

Module IV

Historical background of Antibiotics; Classification of antibiotics: On the basis of Source, Mode of Action and Chemical structure with examples; Antibiotic resistance; Toxicity of antibiotics.

Module V

Broad Spectrum antibiotics: General Structure and Mode of action of Streptomycin, Penicillin, Tetracycline, Chloramphenicol, Quinolone, Sulfonamide, Fusidic acids; Applications of antibiotics.

Suggested Readings:

1. An instruction to industrial Microbiology by Dr. P. K. Sivakumaar, Dr. M. M. Joe, Dr. K. Sukesh.
2. Biotechnology, by Mohan P. Arora.
3. Medical Microbiology and Immunology by Warren Levinson and Ernest Jawetz.
4. Biotechnology by Wufl Crueger and Anneliese Crueger.
5. Microbiology: Principles and Explorations by Jacquelyn G. Black.
6. Microbiology by Prescott, Harley and Klein.
7. Medicinal Chemistry by Ashutosh Kar.

M.Sc. Biotechnology
Semester II: Theory
Nanobiotechnology
(Open Elective)
Code: 09OE2308

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Nanobiotechnology.
2. To be familiar with different tools of Nanotechnology
3. To train the students to pursue further education.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Nanobiotechnology and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module-I

Introduction to Nanotechnology: The Nanoscale Dimension and Paradigm; Definition, History and Current practices; Types of Nanomaterials and their Classifications; Over view of Physical and Chemical Fundamentals of Nanomaterials.

Module-II

Properties and Characterizations: Optical (UV-Vis/Fluorescence); X-ray diffraction; Imaging and size (Electron microscopy, Light scattering, Zetapotential).

Methods of Preparation of Nanomaterials: Top down and bottom up approaches-emulsifiers, Homogenizers, Sonicator; Over view of Biological Synthesis of Nanoparticles.

Module-III

Nanomedicine: Nano carriers for Drug delivery, Nanoparticle mediated Drug delivery, Nanotechnology in Drug discovery, Nano-formulation of Herbal Medicine; Nanoscafolds and their use in Cell culture, Organ culture and Tissue Engineering, Regulatory aspects in the approval of Nano medicine, Nano-Cosmetics and other use.

Module-IV

Nanomaterials and Toxicity Evaluation: Cyto-toxicity, Geno-toxicity, in vivo tests/assays etc.; Toxicological considerations in Nano medicine and Nano-delivery system.

Module-V

Environmental Applications: Nano clays, Nano adsorbents, Zeolites, Release of Nutrients and Pesticides, Biosensors - Green Technologies - Molecular biomimetic; Nano remediation: Identification and characterization of Hazardous waste; Nano pollution: air - water - soil contaminants; Treatment waters using nano-particles.

Suggested Readings:

1. Nanoscience: Nanobiotechnology and Nanobiology: Boissaeu, Houdy & Lehmani.
2. A-Z Nanobiology: Albert Shawn.
3. Nanotechnology in Biology and Medicine: Methods, Devices and Application, 2007, Tuan Vo-Dinh. CRC press
4. Nanoscience : Nanobiotechnology and Nanobiology (2009) P. Boisseau, P. Houdy and M.Lahmani, (Eds.) Springer, Heidelberg

M.Sc. Biotechnology
Semester III: Theory
Medical Biotechnology
Code: 02BT3101

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Medical Biotechnology.
2. To train the students to pursue further education.
3. To be familiar with Medical biotechnology tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Medical biotechnology and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Introduction to medical Biotechnology

History. Host-Parasite Relationship. Normal Flora of human body, Skin, Nose, Nasopharynx, Accessory sinuses, Normal flora of mouth. Upper respiratory tract, Genitourinary tract, Blood and Tissues. Process of infection.

Module II

Bacterial and Viral Diseases

Diseases-Concept of Diseases. Types of Diseases. Bacterial Origin- Clostridium, Enterobacteraccae, family, Mycobacterium.

Viral Origin-Pox Viruses, Rhabdo Viruses, Hepatitis, AIDS. Fungal Diseases-General Classification of Diseases caused by fungus – Mycoses Disease – Candidiasis, Systemic Mycosis, Aspergillosis, Cutaneous, subcutaneous Mycosis and Opportunistic Mycosis. Protozoal Diseases – Amoebiosis, Malaria.

Module III

Antimicrobial Drugs

Mechanism of Action. Resistance. Bacterial Vaccines, Nature of Vaccines, living organisms with attenuated virulence as vaccines. Dead organisms as vaccines, Bacterial Toxins, Toxoids as Vaccines, Immunizing sera as vaccines. Vaccines of defined chemical nature, preparations of active immunization product. Bacterial vaccines and viral vaccines.

Antibiotics – Mechanism of action, Production, Target Cells, Resistance.

Module IV

Gene Therapy

Evolution of cure, Types, Treatment Mechanism. Gene Vectors. Ex-Vivo, In-Vivo Gene Targetting. Sites of GT against Cancer, Tumors. Encourage Immuno Response. Future of GT

Module V

Biosensors

Conventional, Microbial Urea Sensor, Alcohol Sensor, Biosensors using Amorphous Silicon ISFET, Hypoxanthine and Inosine Sensors, Micro- Oxygen Electrode, Glucose and CO2 Sensors, Novel Biosensors, Biochips, Biofilms and Biosurfactents.

Suggested Readings:

- A text book of Medical Parasitology: Jayaram Panicker
- A text book of Microbiology: Chakraborty
- Medical Microbiology Vol I and II –Mackie and Mc Carthy
- A text book of Microbiology; R. Ananthnarayanan

M.Sc. Biotechnology
Semester III: Theory
Intellectual Property Rights and Bioethics
Code: 02BT3102

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Intellectual Property Rights and Bioethics
2. To be familiar with laws and application of IPR and Bioethics
3. Become familiar with IPR rules and regulation.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of IPR and Bioethics and key principles of it.
2. Awareness of its major application.
3. Ability to use or apply IPR related guidelines.

Module I

Introduction to Intellectual Property; Types of IP; Importance of IPR; Patents, Trademarks, Copyright and Related rights, Industrial Design; Traditional knowledge; Geographical indications; Patent life, Legal protection of biotechnological inventions; World Intellectual Property Rights Organization (WIPO); Protection of GMOs; Relevance of IP in Biotechnology.

Module II

History of Indian Patent System and Law; Patent file procedures; Types of Patent; Status of the patent applications; Precautions during patenting; Patentable and Non-Patentable items; Patent cooperation treaty (PCT); Patent and compulsory licensing. Indian Patent Act 1970 and Recent Amendments; GATT and TRIPS agreement; WIPO Treaties.

Module III

Introduction to Bioethics; Biotechnology and ethics; Ethical aspects of Genetic Engineering: Genetically modified food and crops, possible health outcomes, Regulation of GM foods; Stem cell research: Hematopoietic stem cell and Embryonic stem cell, Applications, stem cell in gene therapy, Ethical issues and biosafety.

Module IV

Cloning: Animal and Human Cloning, Reproductive and Therapeutic cloning, Problems and applications, Ethical and legal aspects of cloning; Testing of Drugs: Clinical trials, Benefits and risks, Ethical issues involving human participation; Organ transplant: Types and Sources, Problems due to clinical experimentation, Ethical and social issues, Legislation. Ethical implications of Human Genome project.

Module V

Biosafety: Introduction, Biosafety issues in biotechnology, Biosafety levels, Biosafety levels of microorganisms, Biosafety guidelines and regulations framework in India; International guidelines; Cartagena Protocol on Biosafety: Risk analysis and management; Roles of institutional biosafety committee.

Suggested Readings:

- Bioethics and Biosafety: M K Satheesh
- Biotechnology and Patent Protection: Beier FK, Crespi RS and Straus
- Intellectual Property Rights on Biotechnology: Singh K
- Regulatory Framework for GMOs in India: Ministry of Environment and Forest, Govt. of India
- Cartagena Protocol on Biosafety: Ministry of Environment and Forest, Govt. of Inida
- Bioethics: Shaleesha A Stanley

M.Sc. Biotechnology
Semester III: Theory
Plant Biotechnology
Code: 02BT3103

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Plant Biotechnology.
2. To train the students to pursue further education.
3. To be familiar with plant biotechnology tools.
4. To gain experience of standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Plant Biotechnology and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Plant tissue culture: History of Tissue Culture technique. Requirements for a Cell Tissue Culture . Nutrient media: Composition of commonly used nutrient culture media. Concept of cellular totipotency, single cell culture, micro propagation, somoclonal variation and its application for plant improvement, somatic embryogenesis, anther culture (Haploid Production)

Module II

Protoplast culture: Isolation ,fusion and culture, somatic hybridization, selection system for hybrids , cybrid production , cryobiology of plant cell culture and establishment of gene banks.

Module III

Plant cloning vectors: Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors). Mechanism of DNA transfer, role of virulence genes, use of 35S promoters, genetic markers, use of reporter genes, methods of nuclear transfer, particle bombardment, electroporation, microinjection; Plant DNA fingerprinting - Hybridization and PCR based markers (RFLP, SSRs, RAPD, QTLS , SCARS, AFLP etc.)

Module IV

Biological nitrogen fixation and biofertilizer, molecular mechanism of nitrogen fixation, genetics of *nif* gene. biopesticides, , plant cell culture for the production of useful secondary metabolites

Module V

Transgenic plants, Bio-safety guidelines for research involving GMO's, benefits and risks. Socio economic impact and ecological consideration of GMO's, IPR and IPP.

Suggested Readings:

- Plant Cell Culture ,A practical approach; R. A. Dixson and Gonzalez

- Plant Molecular Biology; Donal, Grieson
- Elements of Biotechnology; P. K. Gupta and Rastogi
- Plant Biotechnology; J. Hammond, P. McGarvey and V. Yusibov
- Introduction to Plant Tissue Culture; Kalyan Kumar De
- Plant Tissue Culture; S. S. Bhojwani
- Plant Cell Culture; D. E. Evans.
- R. A. Dixon and R. A. Gonzales, 1994. Plant cell culture. A practical approach. Second Edition.
- Monica. A. Hughes, 1999, Plant Molecular Genetics. Pearson Education Ltd. England.
- Mantell, S. H. and Smith, H. 1983, Plant biotechnology. Cambridge University Press.
- M. J. Chrispeels and D.F. Sadava. 2000, Plants genes agriculture. The American
- Scientific Publishers.. R. J. Henry, 1997 Practical application of plant molecular biology.
- H. S. Chawla. 1998, Biotechnology in crop improvement. International Book Distributor.
- Plant Tissue Culture: Theory & practice a revised edition(2004) Bhojwani & Rajdan

M.Sc. Biotechnology
Semester III: Theory
Animal Biotechnology
Code: 02BT3104

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Animal Biotechnology.
2. To train the students to pursue further education.
3. To be familiar with animal biotechnology tools.
4. To gain experience of standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Animal Biotechnology and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Structure and Organization of Animal cell, Equipments and Materials for Animal Cell culture, Laboratory Conditions, Primary and Established cell line culture.

Module II

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, Serum and Supplements.

Module III

Basic Techniques of Mammalian Cell Culture *in vitro*, Desegregation of Tissue and Primary Culture. Measurement of Viability and Cytotoxicity. Maintenance of Cell Culture, Cell Separation, Scaling up of Animal Cell Culture.

Module IV

Cell Synchronization, Application of Animal Cell Culture. Cell Cloning and Micromanipulation. Cell Transformation. Stem Cell Culture, Embryonic Stem Cells and their Applications.

Module V

Cell Culture based Vaccines, Organ and Histotypic Culture. Measurement of cell Death, Three Dimensional Culture, Transgenic Animals and Tissue Engineering.

Suggested Readings:

- Animal cell culture: A practical approach: R.I Freshney
- Methods in cell biology- Volume 57 Animal cell culture methods Mather & David Barnes

- Principles of genetic manipulation: Old & Primrose
- Animal cell culture techniques- Martin Clynes
- Recombination DNA technology: Glick
- Jennie Mather, David Barnes, Methods in cell biology; volume 57.Animal cell culture methods, Academic press.
- M. Butler, Mammalian cell biotechnology; A practical approach, Oxford university press.
- Maxine Singer and Paul Berg, Exploring Genetic Mechanism,

M.Sc. Biotechnology
Semester III: Theory
Environmental Biotechnology
Code: 02BT3105

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge related to environmental biotechnology
2. Become familiar with the environment.
3. To train the students to pursue further education.
4. Gain experience with standard tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Environmental Biotechnology and key principles of its.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Environment: Basic concepts and issues. Environmental pollution: types of pollution, methods for measurement of pollution, methodology of environmental management- the problem solving approach, its limitations. Air pollution and its control through biotechnology.

Module II

Water Pollution and its control: water as a natural scarce resource, need for water management, measurement of water pollution, waste water collection, waste water treatment- physical, chemical and biological treatment processes.

Microbiology of waste water treatment, Aerobic Processes – activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds.

Anaerobic Processes – Anaerobic digestion, anaerobic filters, up-flow anaerobic sludge, blanket reactors.

Module III

Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.

Microbiology of degradation of xenobiotics in environment; Ecological considerations, decay behaviour and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, and pesticides. Bioremediation of contaminated oils and waste lands.

Module IV

Bio-pesticides in integrated pest management.

Solid waste: sources and management (composting, vermiculture and methane production).

Global environmental problem: Ozone depletion, UV-B, green house effect and acid rain, their impact, and biotechnological approaches for management.

Module V

Role of international and national organizations in Biotechnology; Cooperative efforts, government programs for biotechnology developments and applications, patenting biotechnical processes and production in different countries, regulation for biohazardous products.

Suggested Readings:

- Comprehensive Biotechnology (Vol. 1-4): M.Y. Young (Eds.), Pergamon Press, Oxford.
- Environmental Microbiology: W.D. Grant & P.E. Long, Blakie, Glassgow and London.
- Microbial Gene Technology: H. Polasa (ED.) South Asian Publishers, New Delhi.
- Bio-treatment Systems, Vol. 22, D. L. Wise (Ed.), CRC Press, INC.
- Environmental Biotechnology: Alan and Scragg; Pearson Education Ltd. England.
- Environmental Biotechnology: S.N. Jogdand; Himlaya Publishing House Bombay.
- Waste Water Engineering – Treatment, Disposal and reuse: Metcalf and Eddy.
- A.K.De, Environmental Chemistry Willey Eastern Ltd. New Delhi.
- Introduction to Biodeterioration: D. Allsopp and K.J. Seal, ELBS/Edward Arnold.

M.Sc. Biotechnology
Semester III: Theory
Industrial Biotechnology
Code: 02BT3106

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Industrial Biotechnology.
2. To train the students to pursue further education.
3. To be familiar with industrial biotechnology tools.
4. To gain experience of standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Industrial Biotechnology and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Bioprocess Technology:

Development of Bioprocess Technology; Overview of Traditional and Modern Applications of Biotechnological Processes; Outline of Integrated Bioprocess and Various (Upstream and Downstream) Unit Operation involved in the Bioprocess; Generalized Process Flow Sheets

Module II

Fermentation Process:

Requirements of Fermentation Processes; Basic Design and Construction of Fermenter and Ancillaries; Types of Fermenter; Major Parameters to be Monitored and Controlled in Fermentation Process; Overview of Aerobic and Anaerobic Fermentation Processes and their Applications in the Biotechnological Industry; Solid State Fermenters: Applications, Techniques of Enzyme Immobilization, Basic Design and Configuration of Immobilized Enzyme Reactors.

Module III

Media Design and Sterilization for Fermentation Process:

Medium Requirements for Fermentation Process; Carbon, Nitrogen, Minerals, Vitamins and other Complex Nutrients; Oxygen Requirements; Medium Formulation for Optimum Growth and Product Formation; Examples of Simple and Complex Media; Design and Usage of Various Commercial Media for Industrial Fermentation; Preparation of Liquid Media and its sterilization.

Module IV

Types of Fermentation Processes:

Different Types of Bioreactor & its Design and Applications; Specialized Bioreactors

Down Stream processing:

Removal of Microbial Cells, Extraction & Separation of Microbial Cells by Different Techniques; Effluent Disposal and Treatment; Advantages & Disadvantages; Application in the Field of Industry.

Module V

Industrial Production of Chemicals and Food Products:

Production of Alcohol, Acids, Antibiotics, Amino Acids; Technology of Typical Food Products; Sterilization and Pasteurization of Food Products; Food Preservation.

Suggested Readings:

1. Bioprocess Engineering: Shuler & Kargi
2. Principles of Fermentation Technology: Stanbury et al.
3. Industrial Microbiology: A. H. Patel
4. Comprehensive Biotechnology(Vol 1- 4): M.Y. Young (Eds.), Pergamon Press.
5. Biotechnology: A Text Book of Industrial Microbiology: T. D. Brock.
6. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd.
7. Industrial Microbiology: Prescott & Dunn, CBS Publishers.
8. Bioprocess Technology- Fundamentals and Applications, S O Enfors & L Hagstrom.
9. Biotechnology: Economic & Social Aspects: E.J. Dasilva, C. Ratledge & A. Sasson.
10. Biotechnology - A Hand Book of Industrial Microbiology: W. Crueger and A. Crueger.
11. Microbial Biotechnology: A. N. Glazer and H. Nikaids.
12. Biochemical Engineering, Aiba, S., Humprey, A.E., and Millis, N.F.
13. Biochemical Reactors. Atkinson, B.
14. Biochemical Engineering Fundamentals: Baily, J. E., and Ollis, D. F., McGraw – Hill
15. Book Co. New York.
16. Process Engineering in Biotechnology: Jackson, A.T., Prentice Hall, Engelwood Cliffs.
17. Bioprocess Engineering:- Basic Concepts, Shuler, M.L., and Kargi, F., Prentice Hall.

M.Sc. Biotechnology
Semester III: Practical
Lab Course V
Code: 02BT3207

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge.
2. To train the students to pursue further education.
3. Become familiar with biotechnological tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.

1. Demonstration of Bacterial flora of skin.
2. Demonstration of Gram staining of Bacterial flora of skin.
3. Staining techniques – Acid Fast staining, Negative staining
4. Demonstration of catalase test by bacterial flora of skin.
5. Isolation and Gram staining of Microbial flora of mouth-teeth crevices.
6. Determination of dental caries susceptibility.
7. Isolation and examination of dermatophytes from skin.
8. Slide agglutination reaction: Blood group determination.
9. Slide agglutination reaction: Rh factor determination.
10. Slide agglutination technique for pathogens: The Widal test.
11. Antibiotic sensitivity test.
12. VDRL test/ RPR serological test for syphilis.
13. HBs-Ag test.
14. Estimation of Hemoglobin contents of human blood.
15. Purification of IgG from the serum by ammonium sulphate, acetone precipitation.

M.Sc. Biotechnology
Semester III: Practical
Lab Course VI
Code: 02BT3207

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge.
2. To train the students to pursue further education.
3. Become familiar with biotechnological tools.

Course Outcome:

Skills that students obtain after completion of the course:

4. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
5. Ability to dissect a problem in to its key features.
6. Ability to design experiments and understand the limitations of the experimental approach.

Plant Biotechnology OR Animal Biotechnology

1. Sterilization of Plant material.
2. Preparation of tissue culture media and its sterilization.
3. Study of equipments and glassware used in plant tissue culture.
4. Surface disinfection of different explants.
5. Culture initiation from seeds.
6. Culture establishment from nodal segments.
7. Culture establishment from bulbous plants.
8. Sub culturing and propagule proliferation.
9. In vitro rooting.
10. Acclimatization of regenerated plants.
11. Initiation of callus from various explants
12. Organogenesis and somatic embryogenesis studies.
13. Isolation of DNA from Spleen and electrophoresis of Spleen DNA.
14. Isolation of RNA from Yeast and electrophoresis of Yeast RNA
15. Estimation of DNA.
16. Estimation of RNA.
17. Fractionation of Liver.
18. Preparation of tissue culture medium and membrane filtration.
19. Cell viability test of given source.
20. Desegregation of given tissue sample.

Industrial Biotechnology OR Environmental Biotechnology

1. Isolation of Cynobacteria from paddy field.
2. Prepare wine from grape juice.
3. Isolation of *Rhizobium* from root nodule.
4. Determine the effect of chemical disinfectant on the growth of microorganism.
5. Estimation of citric acid from *Aspergillus* culture.
6. Isolation and screening of cellulose degrading microorganisms.
7. Isolation of starch degrading organism.

8. Determination of B.O.D. of water.
9. Analysis of water for pH, turbidity, colour, total dissolved solids.
10. Identification and estimation of nitrate, arsenic, iron and alkalinity in water.
11. Effect of cleaning and sweeping of floor on microbial population of laboratory.
12. Bacterial Examination of water by Coliform and MPN.
13. Isolation of cellulose degrading organism.
14. Microscopic studies of fresh water algae and protozoans.
15. To check the pollution levels by collection of particulate settled on leaves at various places in the city.

M.Sc. Biotechnology
Semester III: Theory
Medicinal and Pharmaceutical Chemistry
Code: 09OE3105

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Medicinal and Pharmaceuticals Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Medicinal and Pharmaceuticals Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Local Anti Infective Drugs: Introduction and general mode of action, synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole and griseofulvin.

Module II

Antimalarials: Synthesis and properties of the following Anti malarial, 8-amino quinoline derivatives-pamaquine, primaquine, pentaquine, isopentaquine, 4-amino quinoline, derivatives- santoquine, camaquine, acridine derivatives-mepacrine, azacrin, pyrimidine and biquanide, derivatives-paludrine, pyremethamine.

Module III

Cardiovascular Drugs: Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators synthesis of amylnitrate, quindine methylopa, sorbitrate and atenolol.

Antineoplastic Drugs: - Introduction, cancer chemotherapy, special problems, role of alkylating agents and anti metabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards and 6-mercaptopurine.

Module IV

Drug Design: Development of new drugs, procedure followed in drug design, concept of lead compound and lead modification, concept of prodrug and soft drug, Structure activity relationship (SAR), factors affecting bioactivity, Quantitative structure activity relationship (QSAR), Concept of drug receptors, Physico-chemical parameter, lipophylicity, partition coefficient, Free-Wilson analysis, Hansch analysis, relationship between Free-Wilson and Hansch analysis, LD-50, ED-50 (Mathematical derivation of equations. excluded).

Module V

Pharmacokinetics: Introduction to drug adsorption, disposition, elimination using pharmacokinetics, important pharmacokinetic, parameter in defining drug disposition and in therapeutics', Mention of uses of pharmacokinetics in drug development process.

Pharmacodynamics: Introduction, elementary, treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry

Suggested Readings:

- Natural Products Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs.
- Organic Chemistry, D.V. Banthrope, Longman Essex, J. B. Harbrone.
- Streoselective Synthesis, M.Nogradi and CHV. Odds Chemistry of Carbon Compounds, ED.S. Coffey, Elsevier.
- Biological and Pharmacological Properties of Medicinal Plants from Americans, M. P. Gupta and A. Marston, Harwood Academic Publishers.
- Introduction to Flavonoids, B. A. Bohm. Harwood Academic Publishers.
- New Trends in Natural Products, Rahman and M.I. Choudhary.
- Insecticides of Natural Origin, Sukh Dev.
- Text Book of organic Medicinal and Pharmaceutical Chemistry, Robert F. Dorde.
- An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock.
- Berger's Medicinal Chemistry and Drug Discovery, Vol-I (Chapter-9 and Ch-14). Goodman and Gillman's Pharmacological Basis of Therapeutics, Mc Graw Hill.
- The Organic Chemistry of Drug Design and drug Action, R.B. Silverman. Strategies for Organic Synthesis and Design, D. Lednicer, John Wiley.
- Burger. Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley (1994).
- Goodman & Gilman. Pharmacological Basis of Therapeutics, McGraw-Hill (2005).
- S. S. Pandeya & J. R. Dimmock.Introduction to Drug Design, New Age International.(2000).
- D. Lednicer. Strategies for Organic Drug Synthesis and Design, John Wiley (1998).
- Graham & Patrick. Introduction to Medicinal Chemistry (3rd edn.), OUP (2005)

M.Sc. Biotechnology
Semester III: Theory
Entrepreneurship
(Open Elective)
Code: 09OE3310

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To learn basics of Entrepreneurship.
2. To understand statutory requirements on Entrepreneurship.
3. To develop understanding of basic know-how of industrial planning, market assessment, future projections, etc.

Course Outcome:

Skills that students obtain after completion of the course:

1. Implementation of entrepreneurship values
2. Ability to dissect a problem in to its key features.
3. To prepare business plan and its execution according to market available.

Module I

Entrepreneur-entrepreneurship-and-enterprise: conceptual issues. Entrepreneurship versus Management. Entrepreneurship versus Intrapreneurship. Qualities of an entrepreneur. Role of entrepreneurship in economic development. Role and functions of entrepreneur in relation to new venture creation. especially in the developing country context. Small business as the seedbed of entrepreneurship-contemporary discourse on small and medium enterprises.

Module II

Economic, Sociological and Psychological Perspectives. Entrepreneurial competencies, motivations, performance and rewards: The concept, metrics and role in entrepreneurial manifestation and sustenance entrepreneurship as a creative and dynamic process. Innovation and entrepreneurial orientation in a developing economy.

Module III

Global Entrepreneurship Monitor (GEM) Project, Total Entrepreneurship Index (TEI), India's rank and the issues facing Indian Entrepreneurship: Prominent business families and communities; Issues involved in family business. Especially those pertaining to accessing support for one's business ideas, assuming and asserting one's role in family business, and, leadership succession. The contemporary role models in Indian business: their values, business philosophy and behavioural orientations.

Module IV

Entrepreneurial Development Programmes: role, relevance and achievements. Role of Government in organizing EDPs. Critical Evaluation; Problems and Constraints. Reach of the various promotional programmes, evaluation of their effectiveness and the ways and means of accessing the available help. Role of industries/entrepreneur's associations and self-help groups.

Module-V

The idea of business and sources of business ideas. Opportunity sensing via personal observation, vicarious experience, primary surveys and secondary data analysis. Role of business

consultants/mentors, entrepreneurship trainers, and, family-and community networks in identifying business opportunities. Compatibility of the business idea with the personal profile of the entrepreneur. Tools and techniques of Economy-Sector- Industry analysis and projections.

Suggested Readings:

1) Harell (1995), 'For Entrepreneurs Only', New Jersey Career pub.
2) Vikram Sarabhai, (1974), 'Management for development', Vikas publications.
3) Rajagopal, Entrepreneurship and Rural Markets
4) Dr. Varshini, Fundamentals of Entrepreneurship
5) Ovmerod A, (1992), 'Textile, Project Management', The Textile Institute.
6) Rerry and Franklin, (2002), 'Principals of Management'. AITBS.
7) Acharya B.K. and Gonekan P.B. (1985) 'Marketing and Sale Management', Bombay, Himalaya Publication House

M.Sc. Biotechnology
Semester IV

Semester IV is entirely based on the dissertation work as per the details below

Total Credits-20

1. Dissertation (Code: 02BT4101)
2. Dissertation Seminar (Code: 02BT4102)
3. Viva Voce (Code: 02BT4103)