MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI

UG COURSES – AFFILIATED COLLEGE
B.Sc in Biotechnology

(Choice Based Credit System)
(With effect from the academic year 2017 -2018)

Sem (1)	**Pt. I/II/III/IV/V** (2)	**Sub no.** (3)	**Subject status** (4)	**Subject Title** (5)	**Contact Hrs/ week** (6)	**L Hrs / week** (7)	**T Hrs / week** (8)	**P Hrs/ week** (9)	**C credits** (10)
III	I	17	Language	Tamil/ other languages	6	6	0	0	4
	II	18	Language	English	6	6	0	0	4
	III	19	Core-5	Microbiology	4	4	0	0	4
	III	20	Major practical-III	Lab in Microbiology	2	0	0	2	2
	III	21	Allied III	Biophysics	4	4	0	0	3
	III	22	Allied practical III	Lab in Biophysics	2	0	0	2	2
	IV	23	Skill based core-I	Clinical Biochemistry (or) Industrial Biotechnology	4	4	0	0	4
	IV	24	Non major elective	Nutritional biotechnology (or) Vector borne diseases	2	2	0	0	2
	IV	25	Common	Yoga^{+}	2^{+}	0	0	0	2^{+}
				Subtotal	**30**				**25**
IV	I	26	Language	Tamil/ other languages	6	6	0	0	4
	II	27	Language	English	6	6	0	0	4
	III	28	Core-6	Immunology	4	4	0	0	4
	III	29	Major practical IV	Lab in Immunology	2	0	0	2	2
	III	30	Allied IV	Biostatistics	4	4	0	0	3
	III	31	Allied practical IV	Lab in Biostatistics	2	0	0	2	2
	IV	32	Skill based core-II	Floriculture (or) Vermi and mushroom culture	4	4	0	0	4
	IV	33	Non major elective	Genetic diseases (or) Cancer biology	2	2	0	0	2
	IV	33	Common	Computers for Digital Era^{+}	2^{+}	0	0	0	2^{+}
	V	34	Extension activity	NCC, NSS, YRC, YWF	0	0	0	0	1
				Subtotal	**30**				**26**

V	I	35	Core-7	Genetic engineering	4	4	0	0	4
	II	36	Core-8	Plant biotechnology	4	4	0	0	4
	III	37	Elective	Basic bioinformatics (or) Nanobiotechnology (or) Genomics	4	4	0	0	4
	III	38	Major practical V	Lab in Genetic engineering	4	0	0	4	2
	III	39	Major practical VI	Lab in Plant biotechnology	3	0	0	3	2
	III	40	Major practical VII	Lab in Bioinformatics	3	0	0	3	2
	IV	41	Skill Based Common	Personality Development /Effective Communication/ Youth Leadership	2	2	0	0	2
		42		Mini Project-Group	6	0	0	6	3
				Subtotal	**30**				**23**
VI	III	43	Core-9	Animal biotechnology	4	4	0	0	4
	III	44	Core-10	Stem cell technology	4	4	0	0	4
	III	45	Core-11	Bioprocess technology	4	4	0	0	4
	III	46	Elective	Clinical Research (or) Biosafety & Bioethics (or) Developmental Biology	4	4	0	0	4
	III	47	Major practical VII	Lab in Animal biotechnology	3	0	0	3	2
	III	48	Major practical VIII	Lab in Stem cell technology	2	0	0	3	2
	III	49	Major practical IX	Lab in Bioprocess technology	3	0	0	3	2
	III	50		Project – Group	6				6
				Subtotal	**30**				**28**
				Total	**180**				**152**

\+ Excluding the 30 Contact hours

B.Sc. Biotechnology

Total Course Preamble:

The science of Biotechnology has tremendous potential for application in agriculture and medicine. The linkage between basic and applied research and new discoveries and innovations can find direct applications in agriculture and human health. The breakthroughs in modern biotechnology mainly include our ability to produce useful organisms through genetic engineering and cell fusion techniques and improve bioprocess technology to purify novel molecules generated by such processes. It also involves targeting drugs, development of delivery systems and vaccines. Considering this background, the syllabus document is essentially to be formulated which focused on diverse areas from Cell Biology, Biochemistry, Immunology, Plant Biotechnology, Animal Biotechnology, Genetic Engineering and Stem Cell technology with significant laboratory practices which will enable the students to have hands on experience in doing experiments themselves.

III SEMESTER
Major Paper 5: MICROBIOLOGY

L	T	P	C
4	0	0	4

Objective: To understand applications of microorganisms in different areas.

Unit I

General Microbiology- History and Scope of Microbiology- Major contributors in microbiology. Principle, operation and maintenance of microbiology - Future of microbiology – Role of microbes in biotechnology. **(14 L)**

Unit II

Microorganism – Classifications and Ultrastructure – Bacteria, Algae, Protozoa, Fungi, Viruses – Ultra structure and characteristics of microorganisms. Staining techniques. **(10 L)**

Unit III

Culture media – Types – Ingredients – Preparation and Sterilization – Isolation of pure cultures – Culture of microorganisms – Measurement of growth – Calculation of generation time – Preservation of microorganisms. **(12 L)**

Unit IV

Gram positive and gram negative organisms - Morphology, cultural characteristics, pathogenicity - Laboratory diagnosis – Treatments. Gram positive – *Staphylococcus, Streptococcus, Bacillus, Clostridium*, Gram - Negative – *Neisseria, E.coli, Klebsiella***.** **(12 L)**

Unit V

Microbial interaction – Plants – Rhizophere – Mycorrhiza – Plant pathogens – Nodules – Bacterial and viral diseases. Antibiotics and antifungal agents – Mode of action. Probiotics and applications. **(12 L)**

(Total: 60 L)

Outcome: This paper is devoted to study of diversity of microbial habitats, also involves exploiting these principles for economic purpose. Students were expected to master the major theoretical and practical expertise from this course.

References

1. General Microbiology, Stanier, R.Y., Inram, J.L.K., Wheelis, M.L. and Painter, P.R., The Macmillan Press Ltd.
2. Biology of Microorganisms, Brock, Madigan, M.T., Martinko, J.M. and Parker J. Prentice- Hall.
3. Microbiology, Pelczar, M.J.Jr., Chan, E.C.S. and Kreig N.R., Tata McGraw Hill.
4. Microbial Genetics, Maloy, S.R., Cronan, J.E.Jr. and Freifelder, D. Jones, Bartlett Publishers.
5. Chemical Microbiology, An introduction to Microbial Physiology – A.H. Rose, Butterworth, London.
6. Microbiology – A laboratory Manual, Cappucino, J.G and Sherman, N, Addison Wesley.

L	T	P	C
0	0	3	2

Major Practical III: MICROBIOLOGY

1. Preparation of liquid and solid media for growth of microorganism
2. Plating techniques - Spread, Streak and Pour plate
3. Storage of microorganism: slant and stab culture
4. Isolation of microorganism from soil
5. Growth : Growth curve – Measurement of growth by turbidometry method
6. Microscopic examination of bacteria and yeast
7. Counting of microrganisms using Hemocytometer
8. Assay of antibiotics and demonstration of antibiotic resistance
9. Biochemical characterization of selected microbes : IMViC, Oxidase, Catalase and Starch hydrolysis
10. One step growth curve of *Coliphage*

Allied Paper III – BIOPHYSICS

L	T	P	C
3	0	0	3

Objectives: To introduce the physical aspects and bioenergetics of the living system and to familiarize the principle and working of various instruments used in biotechnology experiments.

Unit I

Definition, scope and methods of biophysics, Physical quantities and their units, physics of atoms and molecules – atomic structure–relationship between atomic structure and chemical properties. Formation of molecules from atoms: bond different types – properties and strength – molecular orbital. **(10 L)**

Unit II

Bioenergetics, Laws of thermodynamics – Entropy – enthalpy – free energy of a system, living body as a thermodynamic system. Photosynthesis – Primary biophysical events. **(8 L)**

Unit III

Diffusion – Fick's law of diffusion, Viscosity: Theory of viscosity, capillary viscometers, rotational viscometers, Rheology – biological properties of plasma, viscosity of blood, Newtonian and non-Newtonian fluids. Osmosis: Osmotic pressure, osmometry, biological significance. **(9 L)**

Unit IV

Bioacoustics – sound and its characteristics, physical organization of ear, mechanism of hearing. Conduction of nerve impulses, recording of nerve impulses. Heart – echocardiography, Brain – EEG, CT-Scan, X-ray. **(9 L)**

Unit V

Radioactive substances: radioisotopes – α particles, β particles, γ particles, radioactivity – units of radioactivity, radioactive decay, half life, effect of radiations on biological systems, harmful effect of radiations, beneficial effects of radiations, measurement of radioactivity – Geiger-Muller Counter, Liquid Scintillation Counter, γ ray detector, Autoradiography. **(9 L)**

Total (45 L)

Outcome: The students will be able to understand the fundamentals of biophysics and the general instrumental techniques used in biotechnology.

References:

1. Physical Biochemistry, applications to Biochemistry and Molecular biology – D. Freifelder
2. General Biophysics, Vol I and II – H.V. Volkones
3. Molecular Biophysics – B. Pullman and M. Voino
4. Aspects of Biophysics, Hughe S.W, John Willy and Sons
5. Introduction of Biophysics by Pranab Kumar Banargy, S. Chand and Co.

Allied Practical III: BIOPHYSICS

L	T	P	C
0	0	2	2

1. Determination of the thermodynamic parameters; ΔH, ΔG, ΔS and CP of protein lysozyme
2. Agarose gel electrophoresis
3. SDS – PAGE
4. Estimation of DNA by DPA method
5. Estimation of RNA by orcinol method
6. ECG, EEG, CT scan, X-ray – demonstration
7. Estimation of protein by Barfoed's method
8. Determination of pH of a solution
9. Determination of the viscosity of different solutions using Ostwald Viscometer

SKILL BASED CORE (ANY ONE)

A. CLINICAL BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective: To give basic awareness about the concepts and physical aspects in Clinical biochemistry and to develop analytical skills in students in order to prepare them to use diagnosing instruments.

Unit I

Basic concepts of Clinical Biochemistry: Definition and scope of clinical Biochemistry in diagnostics, collection and preservation of biological fluids (blood, serum, plasma, urine and CSF), normal values of important constituents of blood, CSF, urine, etc. Biochemical principles of water and electrolyte imbalance, acid base homeostasis, preliminary concept of cardiovascular, liver and kidney disorders including laboratory test for respective markers. **(15 L)**

Unit II

Diseases related to carbohydrate metabolism: Regulation of blood sugar, Glycosuria – types of glycosuria. Oral glucose tolerance test in normal and diabetic condition, Diabetes mellitus and diabetes incipidus – hypoglycemia, hyperglycemia, ketonuria, ketosis. **(10 L)**

Unit III

Inborn errors of metabolism: Introduction – clinical importance, phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, galactosemia, albinism, tyrosinemia and haemophilia. **(10 L)**

Unit IV

Organ function test: Lipid and lipoproteins: Classifications, composition, mode of action – Cholesterol. Factors affecting blood cholesterol level. Dyslipoproteinemia, IHD, atherosclerosis, risk factor and fatty liver. Liver function test: Metabolism of Bilirubin, jaundice – types, differential diagnosis. Liver function test – Icteric test, Vandenberg test, plasma protein changes, PT. Renal function test: Clearance test – Urea, Creatinine, Inulin, PAH test, concentration and dilution test. Gastric function test: Collection of gastric contents, examination of gastric residuum, FTM, stimulation test, tubeless gastric analysis. **(15 L)**

Unit V

Clinical enzymology: Functional and non-functional plasma enzymes, Isoenzymes with examples, Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting. **(10 L)**

Total (60 L)

Outcome:

Create awareness about the various syndrome and their diagnosing test in Clinical biochemistry.

References

1. Text book of Clinical Biochemistry – Carl A. Bordis and Edward R. Ashwood
2. Text book of Medical Biochemistry – Dr. M.N. Chatterjee and Rane Shinde
3. Clinical Chemistry in diagnosis and treatment – Philip D. Mayne
4. Clinical chemistry – William Hoffman
5. Clinical Biochemistry with clinical correlation – Devin, Wiley
6. Practical Clinical Biochemistry – Harold Varley, CBS, New Delhi

B. INDUSTRIAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective: This paper explains production and processes of various microbial metabolites at industrial scale by use of microbes. Students should be trained to understand commercial importance of biotechnology through its industrial aspects.

Unit I

Biotechnological importance of microorganisms – Techniques of microbial culture – Growth media – Growth media, sources of nutrition, procedures for microbial cultures. **(10)**

Unit II

Microorganisms and their products – Isolation of microbial strains – Improvement of microbial strains– mutations, recombination, protoplast fusion and rDNA techniques. **(10)**

Unit III

Bioreactors/Fermentor: Types, features, operation: sterilization (Batch and Continuous), Innoculation and sampling. Control of bioprocess parameters. Types of Microbial culture – batch, fed batch, semi – continuous, continuous, Growth kinetics of microorganisms- Measurement of microbial growth. **(12)**

Unit IV

Downstream processing: Solid – liquid separation, flotation, flocculation, filtration, centrifugation, cell disruption, concentration, and evaporation, liquid – liquid extraction, membrane filtration, precipitation, adsorption, product purification by chromatography. **(13)**

Unit V

Industrial process of food and beverages, fermented food, vegetarian products, alcoholic beverages - vitamins (eg. Vitamin B12)– amino acid (eg. Glutamic acid) – organic acids (eg. citric acid) – organic solvents (eg. Ethanol) – antibiotics (eg. Penicillin) – single cell proteins – Mushrooms, Biotransformation – techniques, Biotransformation to produce commercial products. Production of yeast biomass. **(15)**

Total (60 L)

Outcome: This paper provides the knowledge of strain improvements & basic principle of fermentation process, which help students to design, develop and operate industrial level fermentation process. This fundamental knowledge is essential for the students to make their career in industry based on Fermentation.

References

1. Manual of industrial microbiology and Biotechnology, Demain A.L. Solomon, J.J., 1986. ASM press.
2. Industrial Microbiology, Reed C., Prescott and Dann's, 1982. Macmillan publishers. Fundamentals of Biotechnology, Prave. P. Faust, V. Sitih. W., Sukatsh, DA, 1987. ASM press.
3. Biotechnology, Satyanarayana, U., 2006. Books and Allied (P) Ltd.
4. An introduction to Genetic Engineering, Desmond, S.T., Nicholl, 1994. Cambridge press.
5. Principles of Gene Manipulation. 4th edition, Old R.W. and S.B. Primrose, 1994. Blackwell scientific publication London.
6. Fundamentals of Biotechnology, P.Prave, P.Faust, V. Sitting, Word Sukatasch D., 1987. VCH verlasgetell Schafor MBH, Weinhkeim.

NON MAJOR ELECTIVE (ANY ONE)

A. NUTRITIONAL BIOTECHNOLOGY

L	T	P	C
2	0	0	2

Objective: The course is intended to introduce the student to the basics of physiological aspects and to familiarize the students with the basics of human nutrition.

Unit I

Nutrition –definition, Recommended Dietary Allowances (RDA) and balanced diet- factors affecting RDA, principles of deriving RDA. Carbohydrates – classification, functions, digestion and absorption maintenance of blood sugar level, sources. **(10L)**

Unit II

Dietary fibre, role of fibres, recommended dietary allowances and sources, Lipids – classification, chemical composition, functions, sources, digestion and absorption recommended dietary allowances, deficiency diseases **(5L)**

Unit III

Proteins**,** classification, functions, chemical composition, digestion and absorption, sources, recommended dietary allowances, deficiency diseases, factors affecting protein utilization. **(5L)**

Unit 1V

Vitamins- structure and biochemical roles, deficiency disorders of vitamin A, D, E,K, B_1, B_2, B_6, Folic acid, Panthothenic acid, Niacin and Vitamin C. **(5L)**

Unit V

Minerals- biochemical functions of Na, K, Ca, P, I, Fe and Se - Disorders related to hyper activity and deficiencies of these elements. Diseases related to nutritional deficiencies- Carbohydrates, Lipid, Proteins, Vitamins and Minerals. **(5L)**

Total (30L)

Outcome: This course is introduced the basics of physiological aspects and basics of human nutrition to the students.

References

1. Nutrition science – B.SriLakshmi,New age international (P) limited
2. Nutritional Biochemistry – M.S. Swaminathan
3. Nutritional Biochemistry, 2nd edition, Tom Brody, Academic Press
4. Nutrition – An integrated approach, 3rd edition, Ruth L. Pike and Myrtle L.Brown

B. VECTOR BORNE DISEASES

L	T	P	C
2	0	0	2

Objective: This course is designed to get an in-depth knowledge in Vector borne microbial diseases. This knowledge is very important as far as Biotechnology is concerned.

Unit I

Introduction to general entomology, insect morphology and classification insects and other arthropods of medical importance and their structures and functions. Methods for collecting these insects and arthropods, their preservation maintenance and transportation. **(5L)**

Unit II

Biology and ecology of mosquitoes, biology and life history of Aedes, Culex and Anopheles, their behaviour and ecology with special reference to dengue, chicken gunya, Biology and ecology of other blood sucking insects, ticks and mites, Biology and morphology of fleas, lice, culicodes. **(10L)**

Unit III

Communicable & infective disease control – definitions related to communicable diseases, infection, contamination, decontamination, disinfection, transmission (direct and indirect) **(5L)**

Unit IV

Vector borne diseases- a brief account of insect vectors affecting the health of man and domestic animals. Epidemiology and control of vectors and vector borne diseases like dengue, plaque, malaria, filariasis, tuberculosis, MMR, chicken pox, pertussis, chickengunya and mite borne diseases. **(6L)**

Unit V

Various control strategies and environmental management. Control in urban settings, control at aquatic stages, adult population, personal protection, insecticide resistance mechanism and control dynamics. **(4L)**

Total (30L)

Outcome: The students are expected to master all microbial related techniques to pursue studies in biotechnology.

References

1. Gordon R.M., Lavoipierre M.M.J., (1962). Entomology for Students of Medicine. Blackwell Scientific Publishers.
2. Service M.W., (1966) Medical entomology for students. Chapman and Hall.
3. Kettle D.S., (1984) Medical and Veterinary Entomolgy. CAB International.
4. Bates M (1949) Natural History of Mosquitoes. The Macmillan Co.
5. Baker R.H and Wharton R. (1952) Introduction to Acarology. The Macmillan Co.

SEMESTER - IV

2017-18/MSU/46th SCAA/ Affiliated coll./UG/B.Sc Biotechnology/Sem-IV/ Core/Ppr-6

MAJOR PAPER 6 – IMMUNOLOGY

L	T	P	C
4	0	0	4

Objective:

To give a basic training to the students of Biotechnology on immune system, immunology and immunology related techniques.

Unit 1

Introduction – History & Scope - Developments – Immunity - Cells of immune system – B and T lymphocytes, cell surface markers – TCR – BCR. Lymphocyte traffic – Primary and Secondary lymphoid organs - Structure and functions.**(12L)**

Unit II

Immunity - Types – Innate and Acquired - Immune response - Humoral and Cell Mediated. Vaccines – types, production and uses, Antigens – Properties - Types – Immunogenicity, antigenicity - Epitopes - Haptens - Adjuvants. **(11L)**

Unit III

Immunoglobulins - Structure – Types - Properties and functions - Antigen antibody interactions - Precipitation – Agglutination - Cross reactivity – Cytolysis. Complement systems - Classical and alternative pathways. Major Histocompatibility Complex - structure and functions. **(11L)**

Unit IV

Antigen processing and presentation – Exogenous and endogenous pathways – Cytokines – Hypersensitivity reactions - Immediate and Delayed, Autoimmune diseases, Immuno deficiency diseases, Transplantation Immunology – specificity of graft, mechanism of graft rejection, Tumour Immunology, Immunoregulation. **(14L)**

Unit V

Immunological techniques – WIDAL, VDRL, Pregnancy and Rheumatoid factor tests, Principle and applications of RIA – ELISA. Immunodiffusion – Immunoelectrophorosis – Immunofluorescence - Monoclonal antibody – Production and applications. **(12L)**

Total (60L)

Outcome:

This course will create an interest in immunology and is essential for further studies in Biotechnology. It also throws light on its use in the field of therapeutics.

References:

1. Ivan, M. Roit, Jonathan and Brostof and David Male (1998): Immunology – 5th Edition. (Churchil Livingstone Publishers).
2. Janis Kuby (1998): Imunology – 3rd and 4th Edition (W.H.Freeman).
3. Weir, D.N (1997): Immunology (8th Edition, Churchil Livingstone Publishers).
4. Nandini Shetti: Immunology Introductory Text Books.
5. Essential Immunology by Roit, I, Blackwell Science, Oxford.

Major Practicals IV – IMMUNOLOGY

L	T	P	C
0	0	3	2

1. Identification of human blood groups – A, B, AB, O and Rh factor.
2. Total leucocyte count on the given blood sample.
3. Total RBC count on the given blood sample.
4. Identify different cells of the blood sample.
5. Differential count of the given blood sample
6. Immunodiffusion by Ouchterlony method - Demonstration.
7. Immunoelectrophoresis with a given antigen – antibody system - Demonstration.
8. Rocket Immunoelectrophoresis – Demonstration.
9. Perform DOT ELISA.

Allied Paper IV: BIOSTATISTICS

L	T	P	C
3	0	0	3

Objectives: The overall aim of the course is to develop skills of Mathematics, Statistics and Computers in the field of biology.

Unit I

Definition and scope of biostatistics and their limitations. Collection, classification, tabulation of statistical data, Frequency table – univariate and bivariate frequency table, diagrammatic and graphical representation of data.**(9L)**

Unit II

Measure of central tendency – mean, median, mode (individual, discrete and continuous series) and their merits and demerits. **(8L)**

Unit III

Measure of dispersion – range, quartile deviation, mean deviation, standard deviation (individual, discrete and continuous series) and their merits and demerits. Coefficient of variation, standard error, Skewness – Karl Pearson's and Bowley's coefficient of Skewness, Kurtosis. **(11L)**

Unit IV

Correlation Analysis – Scatter diagram – Karl Pearson's Correlation Coefficient, Spearman's Rank Correlation, Regression analysis – Regression lines – fitting of straight lines using method of Least Squares. **(9L)**

Unit V

Test of significance – ANOVA (one way and two way), Student's t test and Chi square test. Concept of probability – Addition and multiplication theorem of probability, conditional probability. **(8L)**

Total (45L)

Outcome: Study of Biostatistics in this section of the course is to deepen knowledge to students and understanding of how to use a quantitative approach. Course content includes the formulating quantitative study and statistics.

References

1. Statistical Methods by S.P. Gupta – Sultan Chand & Sons
2. An introduction to Biostatistics by Sundar Rao and Richard J, PHI publications
3. Fundamentals of Biostatistics by Veer Bala Rastogi
4. Statistics by R.S. N. Pillai and Bhagavathi, S. Chand & Sons
5. Biostatistics by P.N. Arora and P.K. Malhan, HPH Publications
6. Biostatistics by Gurumani

Allied Practical IV – BIOSTATISTICS

L	T	P	C
0	0	2	2

1. Diagrammatic representation of data – bar (simple, multiple), pie diagram using MS EXCEL
2. Computation of measures of central tendency using MS EXCEL
3. Computation of measures of dispersion using MS EXCEL
4. Computation of skewness and kurtosis using MS EXCEL
5. Computation of correlation using MS EXCEL
6. Computation of regression equation using MS EXCEL
7. Calculation ANOVA – one way and two way using MS EXCEL
8. Computation of Student's t test using MS EXCEL
9. Computation of Chi square test using MS EXCEL

SKILL BASED SUBJECTS (ANY ONE PAPER)

A. FLORICULTURE

L	T	P	C
4	0	0	4

Objective: This course will give an idea about the application of biological science, particularly plant science in business generations and self employment. This focuses on the horticulture, Floriculture, its marketing and depended economy and its impact on society.

Unit I

Avenues and scope of floriculture, emerging trends in floriculture biotechnology, Floriculture in the era of WTO, National and International status of Floriculture Industry. **(9L)**

Unit II

Cultivation of floriculture crops: Anthurium, Bird of Paradise, Carnation, Chrysanthemum, Gladiolus, Gloriosa, Iris, jasmine, Lily, Marigold, Orchids, Rose, Tulip. Nutritional aspects of floriculture crops. **(11L)**

Unit III

Package of practices for management of pest and disease for floricultural crops, Role of Green house in improving the quality and productivity of floricultural plants. Eco-friendly cultivation of floricultural crops, Compatibility for Inter cropping of floricultural crops with other agricultural crops. **(15L)**

Unit IV

Research and development in Floriculture: Modern Floriculture Industries, Improvement of aesthetic values, Genetic Improvement programmes through biotechnological approaches, Production of F1 hybrids, rapid propagation methods. Role of tissue culture in Floriculture Industry. **(14L)**

Unit V

Floriculture Industries (National and International status). Harvesting, Packing, Marketing, Revenues, Avenues for employments in Floriculture Industries, Socio economical aspects of Floriculture Industry. Sustainability. **(11L)**

Total (60L)

Outcome: After the course students will have an idea about the Floriculture, this focuses on the Floriculture, its marketing and depended economy.

References

1. Floriculture Technology, Trades and Trends by Prakash J and Bhandary K.R. New Delhi, Oxford and IBH publication
2. The Principles of Floriculture by Edward A. White Forgotten Book publication
3. Floriculture Fundamentals and Practices by Alex Laurie & Victor H. Ries The Ohio State University Second Edithion New McGRAW-HILL Book company

VERMI AND MUSHROOM CULTURE

L	T	P	C
4	0	0	4

Objective:

This course will give an idea about the application of biological science, particularly plant science in business generations and self employment. This focuses on the Vermicompost and Mushroom cultivation, its marketing and also in Agriculture depended economy and its impact on society.

Unit I

Vermi composting - Definition, introduction and scope: Ecological classification: Humus feeders, Humus formers leaf, mold, top soil and sub soil types. Physical, chemical and biological changes brought by earthworm in soil-burrows- drilosphere - earthworm casts. **(11L)**

Unit II

Optimal conditions for vermi culture-temperature, moisture, pH, soil type, organic matter, protection from sunlight, rain, predators-food preference. Basic components for vermi culture-culture practices- Home- School-Industries-Vermi wash. **(12L)**

Unit III

Composting- vermi composting-Required conditions-Requirements-Methods-Hep-Pot-Tray-changes during Vermi compost-Advantages-Cost-Benefit analysis of vermi composting-Role of Earthworms in soil fertility–Use of Vermicompost for crop production –Use of earthworms in land improvement and land reclamation, Economics of Vermicompost and vermiwash production.. **(13L)**

Unit IV

Introduction and Importance of mushrooms; History of mushrooms cultivation; resent status of mushroom industry in India cultivable edible mushrooms; Biology of mushrooms: food value of edible mushrooms; uses of mushrooms; Poisonous mushrooms and Medicinal mushrooms. **(10L)**

Unit V

Mushrooms farm structure; design and layout; Spawn principles and techniques of spawn production; Principle and techniques of compost and composting; Cultivation techniques of white button mushroom, oyster mushroom ;Management of fungal bacterial and viral diseases in mushroom; Competitors, pests and nematodes in mushrooms; Post harvesting techniques and Economics of mushroom cultivation. **(14L)**

Total (60L)

Outcome:

After this course, it gave an idea about the self employment. This focuses on the Vermicompost and Mushroom cultivation, its marketing and also in Agriculture depended economy definitely helps to students.

References

1. Sultan Ahmed Ismail, 2005, The Earthworm Book, second revised Edition, Mother India Press, Goa.
2. Edwards C.A. and Bohlen, P.J 1996, Ecology of earthworms – 3rd Edition, Chapman and Hall.
3. Jsmail, S.A., 1970, Vermicology, The Biology of earth worms, Orient Longman, London.
4. Lee, K.E., 1985. Earthworms – Their ecology and relationship with soil and land use, Academic Press, Sydney

NON MAJOR ELECTIVE (ANYONE PAPER)

A. GENETIC DISEASES

L	T	P	C
2	0	0	2

Objective: This course for non biology or non biotechnology students, who are interested to know about the methods and application of microbial genetics, and microbial diseases.

Unit I

The origin of medical genetics, classification of genetic diseases- definition and impact of genetic diseases, human chromosomes – structure and organization of DNA – Normal human karyotype, chromosomes abnormalities, disorder of autosomes and sex chromosome. **(7L)**

Unit II

Metabolic disorders and inherited disease- Diabetes, Hypertension, Alzheimer disease, Duchene's muscular dystrophy, Urolithiasis, Parkinson's disease, Schizophrenia, Hemophilia, Sickle cell anemia. **(6L)**

Unit III

Carcinogenesis and mutation, phenotype of cancerous cells, Tumor suppressor oncogene, cancer stem cell theory, Radiotherapy, chemotherapy and immune therapy. **(6L)**

Unit IV

Diagnostic and therapeutic protocol: antiviral drugs, antifertility drugs, anticancerous agents, anti inflammatory drugs, diagnostic kit and probes, Vaccines. **(6L)**

Unit V

Genetic counselling, prenatal diagnosis technique, treatment, methods of tracking diseased genes, diagnosis of genetic disorders. **(5L)**

Total (30L)

Outcome: The students are expected to master all microbial related techniques.

References:

1. Genetics – Strickberger, M.W, Printice Hall Edition 4, 1997.
2. Genes VII by Benjamin Lewin.
3. Cell and Molecular Biology – Robertis et al. Waverly publication, edition 8, 1995.
4. Molecular Biology of the Cell – Alberts, Garland Publication, edition 4 , 2002.
5. Principles of Genetics - E. J.Gardener, M.J. Simmons and D.P. Snustad, John Wiley and Sons publications.
6. The science of Genetics by Alen G. Atherly, Jack. R, Girton, Jhon. F, Mc Donald, Sounders college publishers.
7. Human Genetics, A. Gardener, R.T. Howell and T. Davies, published by Vinod Vasishtha for Viva Books private Ltd.

B. CANCER BIOLOGY

L	T	P	C
2	0	0	2

Objective: This course for non biology or non biotechnology students, who are interested to know about the Biology of Cancer.

Unit I

Fundamentals of Cancer biology- regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumour markers, molecular tools for early diagnosis of cancer. **(7L)**

Unit II

Principles of carcinogenesis – Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, X –ray radiation - mechanisms of radiation carcinogenesis. **(5L)**

Unit III

Principles of Molecular Cell Biology of Cancer – Signal targets and cancer, activation of kinases, Oncogenes, Identification of oncogenes, retroviruses and oncogenes, Oncogenes/proto oncogene activity. Growth factors related to transformation, telomerases. **(7L)**

Unit IV

Principles of cancer metastasis - Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion. **(6L)**

Unit V

New Molecules for Cancer Therapy – Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, advances in cancer detection. Use of signal targets towards therapy of cancer, Gene therapy. **(5L)**

Total (30L)

Outcome: This course creates knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

References

1. Maly B.W.J, “Virology a Practical Approach”, IRLI Press, Oxford, 1987.
2. Dunmock N.J and Primrose S.B., “Introduction to Molecular Virology”, Blacwell Scientific Publications, oxford, 1988.
3. “An Introduction To Cellular and Molecular Biology of Cancer”, Oxford Medocal Publications, 1991.

SEMESTER V

2017-18/MSU/46th SCAA/ Affiliated coll./UG/B.Sc Biotechnology/Sem-V/Core/Ppr-7

Major Paper 7- GENETIC ENGINEERING

L	T	P	C
4	0	0	4

Objective: To give a basic Knowledge to the students of Biotechnology on recombinant DNA and related techniques.

Unit I

History and scope of genetic engineering, restriction enzymes, ligases, alkaline phosphatase , polynucleotidekinase, terminal nucleotidyl transferase, DNA polymerases, Taq DNA polymerase, RNAse, reverse transcriptase, linkers, adapters, oligonucleotide primers and homopolymer tailing. **(11L)**

Unit II

Gene cloning vectors-Plasmids, construction of PBR ^{322}, Bacteriophage vectors, phagemids, cosmids, yeast vectors and expression vectors in prokaryotic and eukaryotics, cloning strategies- gene library construction , screening of gene library. **(13L)**

Unit III

Analyzing DNA and protein sequences, polymerase chain reaction, inverse PCR, RT-PCR, changing genes-site directed mutagenesis, phage display, nucleic acid microarrays, northern blot, uses of online tools-web cutters and vector NT1, SAGE (serial analysis of gene expression). **(12L)**

Unit IV

Expression strategies for heterologous genes- expression in bacteria, yeast, insect, and insect celllines, mammalian cell lines and in plants. Processing of recombinant proteins, purification and re-folding, characterization of recombinant proteins, stabilization of proteins. **(12L)**

Unit V

Transposon tagging, Role of gene tagging in gene analysis, transgenic animals (mice, cattle, fish), transgenic plants (herbicide tolerance, delayed ripening) antisense RNA technology, human gene therapy. **(12L)**

Total (60L)

Outcome: This course will create an interest in genetic engineering and is essential for further studies in Biotechnology.

References

1. Primrose, S B, 1994, Molecular Biotechnology (2nd ED) Blackwell Scientific Publishers, Oxford.
2. James D. Watson. Recombinant DNA (2001). Scientific American Books. USA
3. Benjamin Lewin, Genes-V111, Oxford University press.
4. Glover, D.M and B.D Hames, DNA cloning1-4 (2006) Oxford University press.

Major Paper 8 - PLANT BIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective:

This course is designed to impart basic knowledge in the applied aspects of plant biotechnology for the improvement of agriculture and plant based industries. It will give an outline of plant tissue culture cell culture and plant genetic transformation methods.

Unit I

Plant tissue culture – History – Concept of totipotency – Principle - Laboratory organization – Sterilization techniques – Media preparation – Types of media – MS media, Nitsh media and Gamborgs media – Plant growth regulators. **(11L)**

Unit II

Callus culture – Suspension culture - Organogenesis. Plant micro propagation, Single cell culture, Virus elimination and Shoot tip cultures. Role of tissues culture in agriculture, forestry – Horticulture – Haploid plant production – Virus free plants. **(12L)**

Unit III

Embryo culture - Isolation, culture and fusion of plant protoplasts. Somaclonal variation, Somatic embryogenesis – Molecular markers – Types and uses – Plant genome projects – Arabidopsis - Cryopreservation and germplasm conservation. **(11L)**

Unit IV

Plant genome organization, Gene silencing in crop plants, Gene transfer methods. Current status of plant transformation technologies. Production of therapeutic antibodies and vaccines in plants – Agrobacterium tumefaciens and Rhizogenes transformation – Secondary metabolites – Types and uses - Invitro productions. **(12L)**

Unit V

Genetic engineering of crop plant for insect resistance (Bt –cotton), fungus resistance, virus resistance, drought, cold and saline resistance. Improvements of crop yield, quality and nutritions - Transposable elements - Procedures involved in commercialization of transgenic crops. **(14L)**

Total (60L)

Outcome:

This course will equip the students to understand the plant breeding via tissue culture, which is needed as a student of biology and can supplement in understanding and pursuing studies in Biotechnology.

References

1. J. Hammond, P McGarvey and V. Yasibov (Eds). Plant Biotechnology Springer Verlag 2000.
2. T.J. Fu, G. Singh and W. R. Curtis (Eds). Plant Cell and Tissue culture for the production of food ingredients. Kluwer Academic / Plenum press. 1999.
3. H.S. Chawla: Biotechnology in crop improvement. International Book distributing company 1998.
4. R. J. Henry: Practical Application of Plant Molecular Biology. Chapman and hall. 1997.
5. P.K. Guptha. Elements of BiotechnologyRastogi and Co, Meerut, 1996.
6. U. Sathyanarayanan, Biotechnology, Books and allied (P) Ltd.2005.
7. S.S. Bhojwani and M.K. Razdan, Tissue culture Theory and Practice, 2004.
8. Paul Christou and Harry Klee (2004) Hand book of Plant Biotechnology. Vol. I & II John Wiley & Sons.

MAJOR ELECTIVE (Select any one)
A. BASIC BIOINFORMATICS

L	T	P	C
4	0	0	4

Objective: This course is for biotechnology students, who are interested to know about the methods and application of bioinformatics, databases, tools and software of bioinformatics at the elementary levels.

Unit I

Bioinformatics - an overview, Scope and applications. Introduction to computers, file management, Algorithm- definition and examples- Types of Algorithm-iterative, recursive, fast and slow algorithms. **(11L)**

Unit II

DNA databank--the EMBL nucleotide sequence data bank, The protein sequence database-the NBRI-PIR database macro molecular structures-hierarchy in structure, Ramachandran map – peptide data bank, enzyme databases-cloning vector data bases. **(12L)**

Unit III

In Data mining, Data ware housing, BLAST, FASTA algorithm to analysis sequence data. Pair-wise alignment and Mutiple alignment of nucleic acids and protein sequences, CLUSTALW. **(11L)**

Unit IV

Primer Designing, degenerative primers, calculation of annealing temperature, Cytochrome C oxidase gene sequencing, 16S RNA sequencing, complementary& reverse complementry strands. **(12L)**

Unit V

Structure prediction of RNA and Protein, RASMOL, Concepts of structure modeling and stability computation-combinational, Drug design, modeling and threading. Access of web based bioinformatics tools. Principle and types of Molecular docking. **(14L)**

Total (60L)

Outcome: This course create knowledge to the students of biology about the importance of the bioinformatics, databases, tools and software of bioinformatics at the elementary levels.

References

1. Introduction to computers – Balaguruswamy
2. Vittal R. Srinivas, " BIOINFORMATICS : A MODERN APPROACH" , 2005, ISBN : 978-81-203-2858-7, published by PHI Learning Private Limited, New Delhi.
3. Andreas D.Baxevanis, B.F. Francis Ouellette, "Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins", Third Edition, 2005-2006, ISBN: 978-81-265-2192-0, published by John Wiley & Sons INC., U.K.

B. NANOBIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective:

This course is for biotechnology students, who are interested to know about the methods and application of modern Nanobiomolecules and their contribution in the various fields of biotechnology and healthcare.

Unit I

Fabrication and characterization of nanostructures **-** Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nanosystem, Chemical methods, Physical methods, Microbial production of inorganic nanoparticles, Characterization: UV Spectroscopy, FTIR, SEM, TEM, AFM.**(13L)**

Unit II

Nano materials - Classification based on dimensionality-Quantum Dots, Wells and Wires- Carbon- based nano materials (buckyballs, nanotubes, graphene)– Metal based nano materials (nanogold, nanosilver and metal oxides) - Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics. **(12L)**

Unit III

Biology inspired concepts **-** Protein based nanostructures building blocks and templates, DNA based nanostructures – Topographic and Electrostatic properties of DNA and proteins, Use of DNA molecules in nanomechanics and nanocomputing. **(11L)**

Unit 1V

Application of Nanoparticles **-** Introduction to bio sensors and tissue engineering , Targetted nanoparticles for drug delivery, Nanotechnology in agriculture – Fertilizer and pesticides, food, electronics, fabric, solar cells, fabric Future of Bionanotechnology. **(12L)**

Unit V

Biomaterials - Classification of biomaterials – Comparison of properties of some common biomaterials - Effects of physiological fluid on the properties of biomaterials – Biological responses (extra and intra vascular system) – Metallic, Ceramic and Polymeric implant materials. **(12L)**

Total (60L)

Outcome:

This course create knowledge to biotechnology students, about the methods and application of modern Nanobiomolecules and their contribution in the various fields of biotechnology and healthcare.

References

1. Nabok A., “Organic and Inorganic Nanostructures”, Artech House, 2005.
2. Dupas C., Houdy P., Lahmani M., “Nanoscience: Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. Rolf E. Hummel, “Electronic Properties of Materials”, 4th Ed., Springer, New York, 2011.
4. Silver F. and Dillion C., “Biocompatibility: Interactions of Biological and Implantable Materials”, VCH Publishers, New York, 1989

C. GENOMICS

L	T	P	C
4	0	0	4

Objective: This course is for biotechnology students, who are interested to know about the methods and application of genomics and proteomics, tools and software of bioinformatics at the elementary levels.

Unit I

Genome – overview of genome, sequence of genome acquisition and analysis – homologies – SNPs – Genetic analysis, Linkage mapping, High Resolution Chromosome mapping and analysis – Physical mapping, YAC, Hybrid mapping, strategies, Sequence Specific Tags (SST), Sequence Tagged Sites (STS), ISH, FISH, RFLP, RAPD. **(13L)**

Unit II

DNA sequencing – methods, Maxam and Gilbert method, ladder, Fluorescent, Shot gun, Mass Spectrometry, automation sequencing – Find gene mutations, implications of DNA – Sequencing and sequencing genomes. **(12L)**

Unit III

Genome Data Bank, metabolic pathway data – construction and screening of cDNA, libraries and microarrays – Applications of DNA arrays – PCR – Variations in PCR – Gene Disruptions – Sage and Sade, Pharmacogenomics. **(12L)**

Unit IV

Protein sequence Analysis – introduction – sequence data banks – WBRF – PIR – SWISSPROT – databases, data mining – algorithms of Proteomics and its applications - Protein Expression profiling – Protein protein interactions – Protein modifications. Automation - nucleic acid data bank – EMBL Nucleotide sequence data bank – AIDS virus sequence data bank – RNA data bank. **(12L)**

Unit V

Tools for data bank – pairwise alignment – Needleman and Wusch algorithm - Smithj waterman – Multiple alignment – CLUSTRAL – PRAS –BLAST – FAST, Algorithms to analyse sequence data – PDB, Cambridge structure data base (ISD), 2d electrophoresis, IEF, HPLC, Protein digestion technique, Mass spectrometry, MALDI, TOF, peptides, mass fingerprinting. **(11L)**

Total (60L)

Outcome: This paper create knowledge about rapidly growing branches of highthroughput, large scale biology & maturing discipline like Genomics and Proteomics. This paper includes genome analysis, proteome analysis, and structural & functional proteomics.

REFERENCE

1. Principles of Proteomics, R.M. Twyman
2. Handbook of Proteomic Method, P. Michael Conn
3. Proteomics – Introduction to methods and applications, A. Kraj and J. Silberring
4. Genomics, Cantor and Smith
5. Biochemistry, L. Stryer
6. Bioinformatics computing, Bergeron
7. Computational Molecular Biology, P. Clote and R. Backofen
8. Bioinformatics, Biocomputing and Perl: An introduction to Bioinformatics computing skills, Michad Moorhiase and Paul Barry John

Major Practical V: GENETIC ENGINEERING

L	T	P	C
0	0	4	2

1. DNA isolation - from Plant cell, Animal cell (goat liver), & Microbes
2. Isolation of RNA from Yeast
3. Plasmid DNA isolation
4. Gel electrophoresis
5. Digestion of plasmid DNA with restriction digestion
6. Ligation of DNA fragment
7. Elution of DNA from agarose gel electrophoresis
8. Polymerase Chain Reaction
9. Gel documentation & photography
10. Bacterial transformation
11. RFLP and RAPD mapping
12. Southern blotting technique

Major Practical VI: PLANT BIOTECHNOLOGY

L	T	P	C
0	0	3	2

1. Organization of tissue culture laboratory
2. Sterilization of plant materials
3. Preparation of media
4. Micropropogation
5. Callus establishment
6. Isolation of chloroplast from plant cells
7. Isolation of single cells from intact plant organs
8. Synthetic seeds
9. Isolation of protoplast from plant cells
10. Cell suspension culture
11. Acclimatisation

Major Elective Practical VII: BIOINFORMATICS

L	T	P	C
0	0	3	2

1. Retrieval of nucleotide sequence
2. Retrieval of protein sequence
3. BLAST – pairwise sequence alignment
4. FASTA – pairwise sequence alignment
5. Clustal omega/W
6. Multiple sequence alignment of nucleotide and phylogenetic analysis
7. Primer designing
8. Multiple sequence alignment of protein and phylogenetic analysis
9. Visualization of structure database- RASMOL, PDB VIEWER
10. Submitting DNA sequence in the database

SEMESTER-VI

2017-18/MSU/46th SCAA/ Affiliated coll./UG/B.Sc Biotechnology/sem-VI/Core/Ppr-9

Major Paper 9 - ANIMAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective: To introduce the basics of the subject of animal biotechnology and its applications to the students in an attractive and simple manner.

Unit 1

Introduction to animal biotechnology, Animal cell production and culture of animal cells, Development and maintenance of cell lines, continuous cell lines, culture media, preparation of various culture media and sterilization, storage, suspension culture Embryo culture, teratogenesis, teratomas. Cell culture in laboratory, large scale cultures, applications of animal cell cultures. **(13L)**

Unit II

Genetic engineering in animals-transformation of animal cells, cloning vectors and expression vectors and animal viral vectors. Transgenic animals-improving important genes, production of recombinant proteins, immunotoxins, vaccines, hybridoma technology, Molecular and cellular biology of fertilization. **(10L)**

Unit III

Integrated pest management- pest management using juvenile hormone analogues, pheromones and genetic manipulation- silkworm and fish as bioreactors, Baculoviruses in biocontrol and foreign gene expression-therapeutic, reproductive cloning. **(12L)**

Unit IV

Biotechnology in aquaculture (Ploidy induction, Gynogenesis, Androgenesis and Transgenic fishes). Animal husbandry (*In vitro* fertilization, gamete selection, embryonic sex selection, embryo manipulation, Demi embryos and embryo transfer). Animal cloning- Cryobiology, Stem cell –Isolation, culture and its applications. **(13L)**

Unit V

Mammalian embryo fusion- Allopheny, Use of nucleic acid probes and antibodies in clinical diagnosis and tissue typing. Mapping of human genome, Role of RFLP, DNA fingerprinting and PCR in forensic science, gene therapy types and their applications, Social, ethical and legal issues in biotechnology.**(12L)**

Total (60L)

Outcome: This course create knowledge in the basic techniques and applications of Animal cell culture

References

1. Biotechnology- Sathyanarayana U, (2008), Books and Allied (P) Ltd
2. Animal Biotechnology- R.Sasidhara, MJP publishers, 2006
3. Animal Biotechnology-M.Ranga, Studam publishers, 2006.
4. A text book of Biotechnology. R.C Dubey: S.Chand Co Ltd.

Major Paper 10- STEM CELL TECHNOLOGY

L	T	P	C
4	0	0	4

Objective: The primary objective of the Stem Cell Technology is to develop awareness and enhance expertise within basic and clinical level research on stem cells.

Unit I

Stem cell basics- stem cells, embryonic stem cells, embryonic germ cell, bone marrow stem cell, adult stem cell- Differentiation- Introduction to concept in stem cell biology (renewal, potency etc) – Stem cell characterization – isolation and characterizations – markers and their identifications- Growth factors, requirements and maintenance in culture. **(13L)**

Unit II

Hematopoietic stem cell- Induced pluripotent stem cell – Epigenetic memory of IPS cells- Early embryonic development- lymphoid cell maturation and differentiation – Cell cycle regulators in stem cells – Molecular mechanisms of self renewal- pluri / multipotency and lineage differentiation- Molecular basis of pluripotency and Stem cell niche. **(13L)**

Unit III

The Human Umbilical cord- a source of stem cells- Isolation of mesenchymal stem cell – *in vivo* application of UCSC- cord blood stem cells transplantation- Advantages and disadvantages – Cord blood banking. **(11L)**

Unit: IV

Generation and manipulation of mouse embryonic stem cells- Generation and manipulation of human embryonic stem cell – Animal models of regeneration (Hydra, planarian, earthworm, zebra fish). **(11L)**

Unit V

Cancer stem cell- origin of cancer stem cell, impact of cancer stem cell, concept of cancer therapy- Epigenetics and reprogramming in stem cell biology- Stem cell gene therapy- Stem cell therapy for neurodegenerative diseases- Stem cell therapy for cardiac regeneration- clinical cell transplantation for leukemia- Ethical issues of stem cell biology. **(12L)**

Total (60L)

Outcome: This course create knowledge in field of Stem Cell Technology and further development of induced pluripotent stem cells (iPS cells), many other diseases associated with aging.

References

1. T.J. Kindt, R.A. Goldsby and B.A. Osborne, Kuby, Immunology, 2007, W.H. Freeman and Company.
2. P. Delves, S. Martin, D. Burton and I. Roitt, Roitt's Essential Immunology, Latest Edition, 2006, Wiley – Blackwell.
3. A.K.Abbas, A. Lichtman and J.S. Pober, Cellular and Molecular Immunology, 2000, W.B. Saunders Company.
4. C.A. Janeway, Jr. P. Travers, M. Walport and M.J. Sclommmchik, immunology, 2001. Garland S

Major Paper 11-BIOPROCESS TECHNOLOGY

L	T	P	C
4	0	0	4

Objective: To introduced the industrial application of Bioprocess technology through this course. Students should be trained to understand commercial importance of biotechnology through its industrial aspects.

Unit I

Fundamentals of Bioprocess engineering: Introduction of bioprocess, Media design and usage in fermentation, Types of media, composition of media – carbon sources, nitrogen sources, vitamins, mineral, inducer, precursors and inhibitors. Microbial growth, isolation and preservation and maintenance of industrial microorganism, Inoculums development: Development of inoculums for yeast, bacteria, mycelia and fungal processes, Aseptic inoculation of the fermentor. **(12L)**

Unit II

Sterilization methods: Moist, heat, dry heat, flame, filter, gas, HTST, Treatment: continuous, pasteurization, batch sterilization, continuous sterilization, filter sterilization. Microbial growth kinetics: Factors affecting microbial growth, fermentation kinetics. **(11L)**

Unit III

Bioreactor : Introduction to bioreactor, Batch and fed batch reactor, continuous reactor, solid state and submerged, aerobic and anaerobic fermentation, mixed microbial population, immobilization of cells and co immobilization, immobilized reactor, Design of bioreactor: construction of material, Basic components – Agitator, aerator, valves, seals, stirrer, glands, measurement and control of parameters, pH ,Do, gas, analysis, control pathway, computer in controlling, Air lift, stirred tank, tower, fluidized bed, packed bed, pulsed filed, Photoreactor. **(13L)**

Unit IV

Downstream processing: Biomass removal, separation of microbial cells and solid matters, centrifugation, sedimentation, flocculation, microfiltration, Disintegration of microorganism : Sonification, bead mills, homogenizers, chemical lysis, enzymatic lysis, membrane based purification, ultrafiltration, reverse osmosis, dialysis, Chromatography: size , charge, shape, hydrophobic interaction, Drying :spray driers, drum driers, freeze dries. **(12L)**

Unit V

Microbial products in pharma, food and agri, production and harvest , recovery and use, enzymes, antibiotics : (Pencillin, tetracycline, streptomycin) Vitamin (B2 & B12) Aminoacid (Lysine, glutamic acid, arginine, threonine) Organic solvents (acetone, butanol, ethanol, glycerol) Organic acid (acetic acid, citric acid, latic acid) use of microbes in mineral beneficiation recovery. **(12L)**

Total (60L)

Outcome: This course is improving the principles of fermentation, rheological behavior of fluids and mass transfer. Further the students are enriched to apply these principles to bioprocessing units.

References

1. Principles of Fermentation Technology by P.F. Stanbury and A. Whitaker, Pergamon Press, 2nd Edition, 2005.
2. Industrial Microbiology by presscott anf Dunns 4th edition edited by Gerald reed, Chapman and Hall Publications, 2007.
3. Introduction to Biochemical engineering by D.G. Rao, McGraw- Hill Publications, 1st Edition, 2007.

MAJOR ELECTIVE (Select any one)

A. CLINICAL RESEACH

L	T	P	C
4	0	0	4

Objective: To understand the basic steps in the drug research, toxicological, pre-clinical and clinical studies.

Unit I

Introduction to drug discovery and drug development, basic pharmacology and clinical research. Basic knowledge about receptors, drugs, pharmacodynamic, pharmacokinetic (ADME), drug interactions, clinical research. Introduction to pharmacoeconomics. **(12L)**

Unit II

New drug discovery process – purpose, main steps involved in new drug discovery process, timelines for each steps, advantages and purpose of each steps, ethics in clinical research, unethical trials, thalidomide tragedy. **(11L)**

Unit III

Clinical trials - phase I, II, III, IV trials, Post marketing surveillance-methods – principles of sampling – inclusion and exclusion criteria – methods of allocation and randomization – informed consent process (in brief) – monitoring treatment outcome – termination of trial – safety monitoring in clinical trials. **(13L)**

Unit IV

Preclinical toxicology: General principles, systemic toxicology (single dose and repeated dose toxicity studies), carcinogenicity, mutagenicity, teratogenicity, reproductive toxicity, local toxicity, genotoxicity, animal toxicity requirements.**(12L)**

Unit V

Basic terminology used in clinical research, Types of clinical trials – single binding, double binding, randomized trials, cross over design and their examples, interventional study, ethical committee and its members, Institutional ethical committee/Independent ethical committee, Data management in clinical trials. **(12L)**

Total (60L)

Outcome: Students acquire a basic understanding about the drug research.

References:

1. Basic and Clinical Pharmacology, Prentice Hall, International, katzung, B.G.
2. Clinical Pharmacology. Scientific book agency, Laurence, D.R and Bennet P.N.
3. Clinical Pharmacy and Therapeutics. Herfindal E.T., Hirschman J.L., Williams and Wilkins.
4. Drug Interaction, Kven Stockley, Hamsten.

B. BIOSAFETY AND BIOETHICS

L	T	P	C
4	0	0	4

Objective: To introduce Biosafety regulations and ethical practices in biotechnology

Unit I

Biotechnology – Society, Risks, Ethics and Patenting. Benefits of biotechnology,ELSI of Biotechnology, Recombinant therapeutic products for human and health care. Genetic modifications, recombinant foods, safety of GM foods. Release of genetically engineered organisms- Human embryonic stem cell research – cloning. Social issues – Public opinions against the molecular technologies. **(13L)**

Unit II

Patents – Basic of Patentability-Non Patentable Inventions- Patent Application – Producer in India – Treaties and conventions of patents – Patent Cooperation Treaty – TRIPS and Pharmaceutical Industry- issuses and prospects. Other Forms of IPR : Copyright- Trade Mark – designs – Know how – Patenting of biotechnology products and processes. **(14L)**

Unit III

Biosafety – definitions- biosaftey level, framework of biosafety regulation I India, structure and functions of committees, DBT guidelines on biosafety in conducting research in biology/biotechnology- Regulation of Genetically modified Organism in India- Biosafety regulation fortransgenicplants and animals – labeling of GM foods. **(12L)**

Unit IV

Bioethics – definition – Bioethics of IPR- ethical in biotechnology-animal ethics Guidelines for use of lab animals in medical colleges- Licensing of animal house- Human cloning- ethical issuses- Ethical clearance norms. **(10L)**

Unit V

Ethical issues – ethical issues against the molecular technologies, Bioethics-Necessity of Bioethics, different paradigms of bioethics – National & International. Legal issues- Legal actions taken by countries for use of the molecular technologies. **(11L)**

Total (60L)

Outcome: Create Indepth Knowledge on biosafety regulatory frame work for GMO's. Exposure to legal and socio economic impacts of biotechnology, Exposure to ethical concerns of biotechnology research.

References

1. Biosafety, Traylor,Fredric&Koch , 2002 . Michigsn state University Pub., USA
2. Contemporary issuses in Bioethics, Beauchamp& Leory, 1999.Wardsworth Pub. Co.Belmont, California
3. Manual of patent practice and procedure. IRP India, 2005. Ministry of commerce and industry, NewDelhi . PP 163.
4. Biotechnolgy and safety assessment, John A. Thomas, 2004.pp 333.

C. DEVELOPMENTAL BIOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES: To understand the sequential changes from single cell organization to organ level of organization in the development of multicellular organisms.

Unit I

Gametogenesis & Fertilization: Spermatogenesis – definition **-** Development and structure of mammalian sperm. Mechanism and significance of Oogenesis, Vitellogenesis Types of eggs and egg membranes. Reproduction: Structure of human testis and ovary, Graafian follicle, Menstrual cycle and its hormonal control. **(11L)**

Unit II

Cleavage: Definition-Cleavage, types of cleavage, factors affecting cleavage, molecular changes, Cleavage in Frog, and Chick, Amphibians, Mammals, Morula and Blastulation. Fertilization: Pre and Post fertilization events -significance; Parthenogenesis **(12L)**

Unit III

Fate maps &_Gastrulation**:** Natural and Artificial Marking in eggs. Gastrulation Definition and process in Frog, Amphibians, Mammals, Chick and chick embryo gastrulation. Test tube babies –Twins Amniocentosis, Nuclear Transplantation in Acetabularia **(12L)**

Unit IV

Organogenesis & Regeneration: Development of brain and heart in Chick. Foetal membranes in chick, Organizer, Placenta in mammals. Regeneration – Definition, Types –Regeneration in Amphibians –Regeneration in Planaria. Birth control : Contraceptive devices: urgical method –Hormonal methods **(13L)**

Unit V

Metamorphosis: Definition and Significance. Hormonal control of metamorphosis in amphibians. Insect metamorphosis**.** Environmental Influences on Development **(12L)**

Total (60L)

Outcome: understands the students about sequential changes from single cell organization to organ level in the development of multicellular organisms.

References:

1. Modern Embryology, Saunders International student edition,
2. Philadelphia.3rd Edition 1981. Eli Benjamini et al., (1991)
3. Developmental biology Gilbert, Scott's. (1985). Sinauer Association, Inc., Publishers.
4. Chordate embryology, Verma , P.S., V.K. Agarwal and Tyagi, 1995. S. Chand & Co., New Delhi.
5. Chordate Embryology, S.Chand and Co. Ltd., New Delhi (1998). Bodmer,

Major Practical VIII: ANIMAL BIOTECHNOLOGY

L	T	P	C
0	0	3	2

1. Animal tissue culture
2. Preparation of tissue culture medium and membrane filtration
3. Cell counting and cell viability
4. Measurement of doubling time
5. Preparation of metaphase chromosomes from cultured cells
6. Isolation of DNA from animal cells
7. Demonstration of apoptosis by DNA laddering
8. Handling of lab animals

Major Practical IX: STEM CELL TECHNOLOGY

L	T	P	C
0	0	2	2

1. Culturing of Earthworm.
2. Dissection of earthworm and observation of internal organs.
3. Identification of different cells in the celomic fluid of earthworm.
4. Identification of different cells in the skin of earthworm.
5. Anterior regeneration- amputation at 8th segment, observation and image documentation of regeneration kinetics for 10 days minimum.
6. Posterior regeneration- amputation at 30th segment, observation and image documentation of regeneration kinetics for 10 days minimum.

Major Practical X: BIOPROCESS TECHNOLOGY

L	T	P	C
0	0	3	2

1. Isolation of useful microorganism from natural source
2. Pure culture and mixed culture
3. Production of Enzymes
4. Production of antibiotics
5. Optimization of media for enzyme production
6. Immobilization of microbial enzymes
7. Wine and Alcohol production
8. Down streaming processing: product recovery, centrifugation, chromatography – Thin layer chromatography, crystallization

Total Course Outcome:

The overall course aims at training students in the areas of modern Biotechnology. The graduates are expected to carry out both basic and applied research in the areas of Biotechnology having academic and/or industrial relevance. The students would also be trained to assist industry in developing and/or solving problems of Biotechnology. In addition, the programal so aims at generating manpower capable of teaching Biotechnology at postgraduate and undergraduate level.