

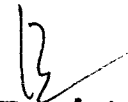


**UNIVERSITY OF RAJASTHAN**  
**JAIPUR**

**SYLLABUS**

**B.Sc. BIO-TECHNOLOGY**

<b>B.Sc. Part-I Examination</b>	<b>2018</b>
<b>B.Sc. Part-II Examination</b>	<b>2019</b>
<b>B.Sc. Part-III Examination</b>	<b>2020</b>

  
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JAIPUR

UNIVERSITY OF RAJASTHAN, JAIPUR

B.Sc. Biotechnology Integrated (Annual Scheme)

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**Concept**

Biotechnology is not a single subject as it being project all around. Biotechnology is a term of convenience for an integrated approach using a conglomerate of several disciplines such as botany, zoology, microbiology, biochemistry and chemistry, molecular biology, genetics, plant breeding, pharmacology medicine, information and computer science and others. Biotechnology, is a collection of tools, and is about problem- solving, where expert from different disciplines collaborate to find a solution to an identified problem, such as pest control, nutritional enhancement, an improved drug a vaccine or an antibody, and the like. While there can be a department of biotechnology with expertise in all relevant areas.

For bringing thrust to Biotechnology sector in Rajasthan it is imperative that-

1. State of Rajasthan is an attractive destination for the biotechnology Industry.
2. Create and upgrade biotechnology infrastructure.
3. Create a quality infrastructure for research and commercial activities.
4. Promote biotechnology education by devising suitable courses which are focused to meet the demand of biotech Industry in general and development in Rajasthan in particular.

Priority areas of Biotechnology declared in the Biotech Policy of Government of Rajasthan are:

1. Plant biotechnology,
2. Medical biotechnology,
3. Biodiversity and prospecting,
4. Animal Biotechnology,
5. Bioprocessing, and
6. Bioinformatics.

State government has taken care of every measure for promoting academia and industry in the state. The University on its part is proposing integrated course in B.Sc. Biotechnology Integrated M.Sc. Biotechnology Integrated or 5 Years M.Sc. Biotechnology integrated course with option


of taking a B.Sc. Biotechnology Integrated after three years or counting to obtain M.Sc. Biotechnology Integrated.

#### Prerequisites of laboratory-

Some basic minimum equipment required to run the course shall include as follows:

1. Well-equipped library facility with Internet connectivity.
2. Glassware, chemicals and reagents necessary to run the course.
3. Minimum equipment required:
  - a. Laminar Flow Hoods/clean benches.
  - b. Microscopes compound (8 no)
  - c. Centrifuges - one high speed, one microfuge
  - d. UV-visible spectrophotometer
  - e. Colorimeter
  - f. pH meter
  - g. BOD incubator
  - h. Micro- and regular balance
  - i. Autoclave
  - j. Glass distillation apparatus
  - k. Computers
  - l. Cold cabinet/ cold room.
  - m. Refrigerator and Deep freeze
  - n. DNA/RNA, protein electrophoresis apparatus.
  - o. Culture racks with light arrangements
  - p. Shakers
  - q. Incubators

Prerequisites of admission to the course:

  
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1. Candidates who have passed 12<sup>th</sup> standard examination under 10+2 system of Rajasthan State Higher Secondary Board, CBSE or any equivalent examination of any recognized Board with physics, Chemistry & Biology or Physics, Chemistry & mathematics in one and the same attempt with not less than 50% marks together.
2. Candidates who have appeared for and are expecting their result on or before 31<sup>st</sup> June of the respective final qualifying examinations are also eligible to apply.
3. The admission could be through entrance test or open merit.

### General

The B.Sc. - M.Sc. Integrated biotechnology shall be a 5 year course. However the candidate will have the possibility of obtaining degree of B.Sc. Integrated Biotechnology after completion of three year course or alternatively to continue for the M.Sc. Biotechnology Integrated proposed here.

Admission to the M.Sc. Biotechnology Integrated can be for a 5 years integrated course at once level of entry, where facilities and faculty shall exist for conducting such course. Admission for B.Sc. Biotechnology Integrated could be done separately where graduate level facilities are available and M.Sc. Biotechnology should only be run at the Institution fully equipped to the course.

Admission to M.Sc. Biotechnology Integrated shall be restricted to B.Sc. Biotechnology Integrated student. University may decide suitable admission process. Procedure for filling such seats by competitive examination or through merit could be decided. List of Practicals to be carried out is appended and these require some basic equipments which must be present in the institution, starting the course. It is imperative that that only such institutions which can run the practical prescribed should have the affiliation to open these courses.

Details of the equipment are appended which are essential to run course successfully and it is intended that due consideration is given while granting affiliation to run course of Integrated biotechnology or one continuous course of M.Sc. Biotechnology Integrated that such facilities exists in the institution(Appendix I). The University shall appoint head examiner for each practical proposed here, who will formulate a skeleton question paper as well as possible exercises to be given in the examination. There can be 50 percent choice of exercises to be given in each question but it will be compulsory to conduct the practical examination on the basis of question paper sent by the university. If the compliance of the University question paper and exercises proposed is not done, the matter shall be reported in the COC/BOS and Academic council and University may initiate appropriate action against such institutions who did not give prescribed exercise set by the head examiner appointed for setting the question paper for the practical. This is being proposed in order to maintain adequate level of study and examination in professional courses.

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The number of papers and maximum marks for each paper together with the minimum marks required for a pass are shown against each subject separately. It will be necessary for a candidate to pass in theory part as well as practical part of a subject/paper, wherever prescribed. Separately, classification of successful shall be as follows:

First Division 60% of the aggregate marks prescribed at (a) Part First Examination excluding those obtained in the Second division 48% compulsory subject, (b) part Second Examination (c) Part Third Examination taken together.

All the rest will be declared to have passed the examination if they obtain a minimum pass marks in each subject viz. 36%. No division shall be awarded at the First and the Second Year Examination

### **B.Sc. Biotechnology Integrated Programme:**

{B.Sc.: Bachelor of science/master of Science.}

Level: Biotechnology Undergraduate Course / Biotechnology two years or 4 semesters for postgraduate/ 5 years for complete course or 10 Semester

#### **Aims & Content:**

Candidates will be trained in the basic part biotechnology and in the skills of self-education, critical evaluation, problem recognition and problem solving in science. There is an emphasis on integrating theory with extensive practical training.

Candidates will have:


1. Excellent skills in the science of medical biotechnology.
2. Generic skills including teamwork, oral and written presentation.
3. An awareness of the social, economic and ethical aspects of biotechnology management.

#### **Objectives:**

- Understand modern biotechnology - practices and approaches with an emphasis in technology application in pharmaceutical, medical, industrial, environmental and agricultural areas.
- Become familiar with public policy, biosafety, and intellectual property rights issues related to biotechnology applications nationally and globally.
- Gain experience with standard molecular tools and approaches utilized: manipulate genes, gene products and organisms.
- Develop skills in international teamwork and research collaboration.

Skills that a biotechnology integrated student obtain by the time they have finished their undergraduate programme:

- Understanding of the fundamentals of chemistry and biology and the key principles of biochemistry and molecular biology
- Awareness of the major issues at the forefront of the discipline.
- Ability to access primary papers critically.
- Good "quantitative" skills such as the ability to accurately and reproducibly prepare reagents for experiments.
- Ability to dissect a problem into its key features.
- Ability to design experiments and understand the Limitations of the experimental approach.
- Ability to interpret experimental data and identify consistent and inconsistent components.
- Ability to design follow-up experiments.
- Ability to work safely and effectively in a laboratory.
- Awareness of the available resources and how to use them.
- Ability to use computers as information and research tools.
- Ability to collaborate with other researchers.
- Ability to use oral, written and visual presentations to present their work to both a science literate and a science non-literate audience.
- Ability to think in an integrated manner and look at problems from different perspectives.
- Awareness of the ethical issues in the molecular life sciences.

  
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## Scheme of Examination

### B.Sc. Biotechnology: Scheme of examination

1. Each theory paper shall carry 50 marks and will be of 3 hrs duration. Minimum passing marks shall be 17.
2. The theory question paper will be divided into two parts A and B. Part A of question paper shall be compulsory and contain 10 (ten) very short answer type questions of 20 words covering entire syllabus. Each carrying 1 (one) mark, with a total of 10 marks.
3. Part B of question paper will have 4 questions, one question with internal choice from each unit /section. Students are required to attempt four questions in all from Part B, selecting not more than one question from each section. Each question will carry 10 marks, with a total of 40 marks.

Year: I Year

#### Theory

S.No.	Code	Subject I	T	L	MM
1.	BT-101	Microbiology	2	3	50
2.	BT-102	Cell Biology	2	3	50
3.	BT-103	Biostatistics & Computer Application	2	3	50
		Practical based on above subject	4	4	75
		Total			225

S.No.	Code	Subject II	T	L	MM
1.	BT-201	Developmental Biology	2	3	50
2.	BT-202	Immunology	2	3	50
3.	BT-203	Bioanalytical techniques and Instrumentation	2	3	50
		Practical based on above subjects	4	4	75
		Total			225

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S.No.	Code	Subject III	T	L	Exam	MM
1.	BT-301	Energy Resources & Utilization	2	3	50	
2.	BT-302	Biochemistry-I	2	3	50	
3.	BT-303	Plant and Animal Physiology	2	3	50	
		Practical based on above subjects	4	4	75	
		<b>Total</b>				<b>225</b>

**Year: II Year**

S.No.	Code	Subject I	T	L	Exam	MM
				Hrs.		
1.	BT-401	Molecular Genetics	2	3	50	
2.	BT-402	Food and Dairy Technology	2	3	50	
3.	BT-403	Bio resources and waste management	2	3	50	
		Practical based on above subjects	4	4	75	
		<b>Total</b>				<b>225</b>

S.No.	Code	Subject II	T	L	Exam	MM
				Hrs.		
1.	BT-501	Biochemistry II	2	3	50	
2.	BT-502	Plant Secondary metabolites	2	3	50	
3.	BT-503	Environmental biotechnology	2	3	50	
		Practical based on above subjects	4	4	75	



Total

225

S.No.	Code	Subject III	T	L Hrs.	Exam MM
1.	601	Industrial Biotechnology	2	3	50
2.	602	Recombinant DNA Technology	2	3	50
3.	603	Behavioral Sciences & Basic Communication Skills	2	3	50
		Practical based on above subjects	4	4	75
		Industrial training/project work in Institute itself* (It will be assessed by separate examiner)			75
		<b>Total</b>			<b>300</b>

Year: III Year


Theory

S.No.	Code	Subject I	T	L Hrs.	Exam MM
1.	701	Genomics & Proteomics	2	3	50
2.	702	Plant biotechnology	3	3	50
3.	703	Animal biotechnology	3	3	50
		Practical based on above subjects	4	4	75
		<b>Total</b>			<b>225</b>

Total

Code

Subject II

  
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1.	801	Medical biotechnology	3	3	50
2.	802	Fundamentals of bioinformatics and nanotechnology	2	3	50
3.	803	Bioethics and IPR	2	3	<del>50</del>
		Practical based on above subjects	4	4	75
4.	804	Industrial training/project work in Institute itself* (It will be assessed by separate examiner)			75
		<b>Total</b>			<b>300</b>

### Subject III

5.	805	Critical Reasoning, Scientific writing and presentation	2		50
6.	806	Industrial relations and entrepreneurship	2	4	50

Student shall study for two and half years and shall work in his own institute /elsewhere in an industry or institution of learning having adequate facilities on intensive training in any one of the branches of biotechnology . He/she will submit a dissertation of about 50 to 100 pages which will be evaluated by a separate external practical examiner.

807 Dissertation will have 200 marks 200

Distributed as below (1) 50 marks viva voce, (2) 150 Dissertation - its content

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quality style of presentation. Remuneration will be Rs. 35(Thirty five per student) and examiner will not examine more than 20 candidates per batch. only one external examiner will be appointed for each center

Total	300
Total marks for all the three years	2250

### BT 101: MICROBIOLOGY

**Section-A** A  
**General introduction:** Microbial diversity and taxonomy. Prokaryotes Types of Microorganisms.  
**Classification:** Haeckel's three kingdom concept, Whitakers five kingdom concept, Bergey's manual of determinative bacteriology, Basic Concept in Taxonomy  
**Characteristics and structure of microbes:**Algae, fungi,mycoplasma, Viruses Protozoans and Helminthes

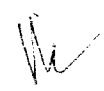
**Section-B** B  
**Bacteriology :**Morphology and ultra-structure of bacteria-morphological types, Cell Wall- Archaeobacteria, gram negative ,gram positive, Structure and function of cilia, chromosome,carboxysomes, plasmids, Bacterial spores, structure,formation and germination. Diversity of bacterial nutrition: Autotrophic,heterotrophic,bacterial genetics plasmids nonconjugative,metabolizable,resistant

**Section-C** C  
**Gene transfer in bacteria:** Conjugation, transformation, transduction.  
**Growth microbial population:** Batch culture of microbes, Simple continuous culture of microbes,growth curve aerobic and anaerobic growth,and effect of environment on microbial growth: temperature,pH, radiation and atmosphere.

**Enumeration of microbes:**Culture media, total cell count isolation,classification and identification of microbes,bacteria-selective culture techniques,funghi-culture techniques, virus-plaque assays,animalculture,and tissue culture.

#### Section -D

**Microbial Metabolism:** Metabolic pathways and bioenergetics, production of secondary metabolites and their application in industry microbial products.

  
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**Food Microbiology:** Overall general idea, spoilage & preservation.  
**Environmental Microbiology:** Recycling of biomaterials production of Biogas. Leaching ones by microorganisms, bio fertilizers, bio pesticide, pollution control through use of consortium of microorganisms.

**Books:**

1. Microbial Physiology, 4th ed. by Albert G. Moat & John W. Foster by Wiley
2. Microbiology by Pelczar, M.J. Chan ECS & Krieg NR-Tata McGraw Hill.
3. Foundation in Microbiology by Talaro K, Talaro A, Cassida Plezar and Reid W.C. Brown Pub.
4. Microbiology by nester
5. General Microbiology by R.Y. Stanier
6. General Microbiology by Prescott.
7. General Microbiology by Brock.
8. Food Microbiology by Frazier

**Other Books**

- Introductory Microbiology: F.C. Ross, Columbus Charles E. Mettrill.
- Modern Concept of Microbiology H.D. Kumar and S Kumar Vikas Publishing House, New Delhi.
- Microbiology. M.J. Pelczar, C.E.C. Sun and N.R. Krieg, Tata McGraw Hill, New Delhi
- Microbiology: K.L. Burdon and R.P Williams, McMillanworth Publishers
- Microbiology B.D. Davis et al. Harper and row Publishers.
- Microbiology E.W. Nester et al. Sunders International edition.
- Principles of fermentation Technology: P.F. Stanbury and A Whittaker, Pegamon Press.
- Fundamental Principles of Bacteriology: A.J. Salle, Tata McGraw Hill

**BT102: Cell Biology**

**Section A**

**The Cell structural Organization:** Development of cell theory, Eukaryotic cells, the nucleus and cell cycle (Mitosis and meiosis). The ultra-structure of the cytoplasm- Cytoskeleton

elements, Endoplasmic reticulum & Golgi complex, membrane organelles, mitochondria, chloroplast, lysosome, Ribosomes, vacuoles and peroxisomes.

#### Section B

**Transport Across Cell Membrane:** Molecular organization of cell membrane, passive and active transport, Na-K pump,  $\text{Ca}^{2+}$ ATPase pumps, Lysosomal and Vacuolar membrane ATP dependent proton pumps, Co-transport into prokaryotic cells, endocytosis and exocytosis, entry of viruses and toxins into cells. **Receptors and models of extra cellular signaling:** Cytosolic, nuclear and membrane bound receptors, examples of receptors, autocrine, paracrine and endocrine model of action.

#### Section C

**Signal Transduction:** Signal amplification, different model of signal amplifications, cyclic AMP, role of inositol phosphatase messengers, Biosynthesis of inositol triphosphates, cyclic GMP and Glycoproteins' in signal transduction, Calcium models of signal amplification, phosphorylation, of protein Kinases.

#### Section D

**Cell Culture:** Techniques of propagation of prokaryotic and eukaryotic cells, Cell lines, generation of cell lines, maintenance of stock cells, characterization of cells, immunochemistry, morphological analysis techniques in cell culture, primary cultures, contamination, differentiation, three dimensional cultures.

#### Books:

1. Cell & Molecular Biology by De Robertis, Lea and Fehiger
2. Cell & Molecular Biology by H. Baltimore, WH Freeman
3. Cell & Biology by Kimball T.W. Wesley Pub.

#### BT-103: Biostatistics & Computer Application

##### Section A

**Statistics as statistical data:** various types of data (Raw data, grouped data); Representation of data using frequency distribution diagram (Simple/Multiple/Subdivided bar diagram, Pie diagram), Graphs (Histogram, polygon, curve)

##### Section B

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Measure of central tendency: Mean (Definition & simple problems); Median, Quartiles (Definition, Graphical calculation); Mode (Definition, graphical calculation); Standard deviation; Standard errors, Students-T-Test, ANOVA 1) one way, 2) two way followed by t test (pair wise)

### Section C

**Introduction to computers:** Overview and functions of a computer system Input and output devices; Storage devices: Hard disk, Diskette, Magnetic tape, RAID, ZIP devices, Digital tape, CD-ROM, DVD (capacity and access time)

Main Circuit Board of a PC: Chips, Ports, Expansion; Slots; Memory: Register, buffer, RAM, ROM, PROM, EPROM, EEPROM (comparison); Types of Processing: Batch, Real-Time, Online and Offline.

### Section D

Working Knowledge of window 1997 onwards, Windows 2003. MS Word, Excel, PowerPoint Presentations. Use of scanners for preparation of reports. Internet awareness. Conversant with e Journals and books. Retrieval of electronic resources through Internet.

### Texts/References:

1. Biostatistics, Daniel, W.W., 1987. New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press.
4. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.
5. The Principles of scientific research, Freedman, P. New York, Pergamon Press.
6. Statistics for Biologists, Campbell, R.C., 1998. Cambridge University Press.
7. Statistics for medicine, Colton, T., 1974. Little Brow, Boston
8. Introduction to Computers Data processing & Networking
9. Computer Fundamentals – P.K. Sinha

## BT-201: DEVELOPMENTAL BIOLOGY

### Section A

Plant development, plant versus animal development, development of plant embryo, development of seeding; shoot apex organization vegetative and floral apex, root, shoot, leaf and flower development Programmed cell death, ageing and senescence.

### Section B

Genes and their role in development, signal transduction in development, cell division cycle,

cytoskeleton, cell adhesion and the extracellular matrix:  
Unicellular models, sporulation in *Bacillus subtilis*, mating type switching in yeast aggregation  
and culmination in *Dictyostelium discoideum*

### Section C

~~Sex gametes and fertilization, germ line speciation, germ cell migration, gametogenesis,~~  
gastrulation in invertebrate and vertebrate, cell, lineage, Axis specification in vertebrates, fate  
of ectoderm, mesoderm and endoderm.

### Section D

Cell differentiation mechanism and factors affecting developmental gradient in *Hydra*, axial  
gradients in *Drosophila* development. Organogenesis in invertebrates and vertebrates.

### Books:

R M. Twyman 2001 Development Biology. Viva Books private Ltd. New Delhi  
Gilbert S. 1997 Development Biology, 6th edition, senior Associate  
Inc. Slack JMV 1991, From egg to embryo, Second edition Cambridge University Press U.K.  
Wolpert L. 1997 Principles of Development. Oxford University Press. Oxford University.

## BT 202: IMMUNOLOGY

### Section - A

**Historical Background:** Humoral and Cellular components of the immune  
system. Innate immunity. Skin and mucosal surface, Physiological Barriers, Phagocytic Barriers,  
Inflammation, Adaptive immunity. Immune Dysfunction and its consequences; Allergy and  
Asthma,

**Cells and Organs of Immune System:** Lymphoid cells: Stem cells, B and T Lymphocytes,  
Natural killer cells, mononuclear phagocytes. Granulocytic cells.  
Organs. Thymus Bone Marrow, Lymphatic System, Lymph nodes spleen

### Section -B

**Antigens-Antibody:** Antigens Structure, properties, types, Epitopes, Haptens, Antibodies:  
Structure and function, Antibody mediated functions,  
Antibody classes and biological Activities, Monoclonal Antibodies

**Antigen-Antibody Interaction:** Precipitation reaction, Agglutination,  
Radioimmunoassay; ELISA, Western Blotting  
Major Histocompatibility Complex, General Structure and function of MHC, MHC Molecules  
and genes, Antigen Processing and presentation, T-Cell receptors, T-Cell Maturation and  
Differentiation, B-Cell Generation, Activation & Differentiation

cytoskeleton, cell adhesion and the extracellular matrix:  
Unicellular models, sporulation in *Bacillus subtilis*, mating type switching in yeast aggregation  
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Structure and function, Antibody mediated functions,  
Antibody classes and biological Activities, Monoclonal Antibodies

**Antigen-Antibody Interaction:** Precipitation reaction, Agglutination,  
Radioimmunoassay; ELISA, Western Blotting  
Major Histocompatibility Complex, General Structure and function of MHC, MHC Molecules  
and genes, Antigen Processing and presentation, T-Cell receptors, T-Cell Maturation and  
Differentiation, B-Cell Generation, Activation & Differentiation

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Amino acids and protein: Introduction, Definition and properties of amino acids, Structure of 20 amino acid, Classification based on structure, polarity and nutritional requirement of amino acid, chemical reactions. Proteins: Classification, primary secondary tertiary and quaternary structure, protein sequencing, biological function, protein nucleic acid interactions, helix coil transitions, zipper model, protein folding, Ramchandran plot, Bonds involved in protein structure

### Section C

Lipids: Introduction, Classification, Fatty acids [Classification, Physical property, Chemical property, Sap value, acid value, iodine number, rancidity] phosphoglycerides (e.g., lecithin), sphingolipids (e.g., Cerebrosides), Steroids (Cholesterol), Bile acids, bile salts, plasma lipoproteins

Nucleic acids: Nucleic acid: Purine & pyrimidine bases, nucleosides & nucleotides, double helical structure of DNA, conformational parameters of nucleic acids & their constituents, nucleic acids geometrics, glycosides bond rotational isomers and those puckering backbone rotational isomers and ribose puckering forces stabilizing ordered forms, base pairing, base stacking, Chargaff's rule, DNA polymorphism, DNA supercoiling, hyperchromicity, circular DNA, Types & structure of RNA, m RNA, tRNA, rRNA & modified nucleotides, tertiary structure of nucleic acids.

### Section D

Enzymes: Nomenclature and classification, co-enzymes and co-factors, reaction and derivation of Michaelis-Menten equation kinetics and allosteric regulation of enzymes, isozymes; mode of catalysis.

Vitamins: Their structure, properties and biological structures.

### Suggested readings:

1. Lehninger, Albert L. 1978. Biochemistry. M/s Worth Publishers Inc. New York.
2. Lehninger, Albert L. 1978. Principles of Biochemistry. M/s Worth Publishers Inc., New York.
3. Matthews & Van Holde, 2nd Biochemistry. Benjamin Cummings Pub. Co.
4. Stayer, L., 4th Ed. Biochemistry
5. Rawn, 1989 Biochemistry
6. Voet & Voet, 1991 Biochemistry

### BT-303: Plant & Animal Physiology

#### Section A

Photosynthesis:

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Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways.

**Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

**Nitrogen metabolism:** Nitrate and ammonium assimilation; amino acid biosynthesis

**Plant hormones:** Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

**Sensory photobiology:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

## Section B

**Solute transport and photoassimilate translocation:** Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

**Secondary metabolites -** Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

**Stress physiology:** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress

## Section C

**Blood and circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

**Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

**Respiratory system:** Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

**Nervous system:** Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture

## Section D


**Sense organs:** Vision, hearing and tactile response.

**Excretory system:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

**Thermoregulation:** Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

**Stress and adaptation**

**Digestive system:** Digestion, absorption, energy balance, BMR

  
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**Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.

**Books:**


1. Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
4. Hooykaas, P.J.J., Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology (fourth edition). W.H. Freeman and Company, New York, USA.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA.
8. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
9. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
10. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee 1999., Concepts in Photobiology : Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
12. Thomas, B. and Vince-Prue, D. (1997) Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.
13. Westhoff, P. (1998) Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK.
14. Plant Secondary Metabolites by K.G. Ranawat
15. Eckert Animal Physiology Mechanisms and Adaptation. R. Eckert (ed), 5<sup>th</sup> Biochemical Adaptation. P.W. Hochachka and G.N. Somero (eds), Princeton Univ. Press, Princeton, New Jersey. edition, W.H. Freeman and Company, New York.
16. General and Comparative Animal Physiology, W.S. Hoar (ed), Prentice Hall of Indian.
17. Animal Physiology: Adaptation and Environment, K.S. Schiemdt Neilsen (ed), University Press, Cambridge, UK.
18. A regulatory Systems Approach. Strand, F.L. Physiology: Macmillan Publishing Co., New York.

19. Practical Biochemistry, L. Lummer (ed), Tata McGraw Hill
20. Environmental and Metabolic Animal Physiology, C.L. Prosser (ed), Wiley-Liss Inc.,  
Animal physiology by guyton


### B.Sc. Biotechnology Part I

#### List of practical's based upon above syllabus

1. Study of Laboratory rules and safety regulations
2. Basic techniques of sterilization
3. Types of culture media and their preparations for microbes- Bacteria, Fungi, Algae, Protozoa
4. Isolation of microorganisms from air, water and soil
5. Isolation techniques
  - a. Spread plate
  - b. Streak plate
  - c. Pour plate
  - d. Serial dilution
6. Growth Curve
7. Study of mitosis stages by squash preparation of onion root.
8. Study of meiosis by squash preparation of *Datura* anthers/*Tradescentia* anthers/cockroach testis/grasshopper testis.
9. Study of permanent slides of various plant and animal tissues
10. Exercise based on statistical methods for biologists .
11. Computer – Getting familiar with the hardware, booting & operating
12. Tutorials operating systems: DOS, Windows 98/XP, UNIX etc.
13. File handling: copy, rename, delete, type etc. Directory structure: make, rename, move directory
14. Word Processing (Microsoft Word): Creating, Saving & Operating a document, Editing, Inserting, Deleting, Formatting, Moving & Copying Text, Find & Replace, Spell Checker & Grammar Checker, Document Enhancement (Borders, Shading, Header, Footer), Printing document (Page layout, Margins), Introduction to the use of Wizards & Templates, Working with Graphics (WordArt), Working with Tables & Charts, Inserting Files (Pictures, Databases, Spreadsheets)
15. Use of internet – Downloading & Installing software/plugins on Windows 98/XP (Acrobat Reader, Post Scripts Viewer, etc.) Searching/Surfing on the WWW
16. Study of various plant parts and their mode of development
17. Study of seed and its germination stages till the formation of seedling in monocot and dicot
18. Study of T.S. of dicot stem, monocot stem, root and leaf.
19. Dissection of flower to study its various parts
20. Permanent slides to study various developmental stages in *Drosophila* Life Cycle
21. Permanent slides to study various developmental stages in Chick (18 hrs., 21 hrs., 36 hrs., 48 hrs., 72 hrs., 96 hrs.,).

  
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22. Preparation of blood film and microscopic study of stained blood film for identification of cell types.
23. Total Leukocyte counting by Hemocytometer.
24. Radial immune-diffusion technique.
25. ELISA technique.
26. pH Meter: Standardization of pH meter, Preparation of Buffers.
27. Verification of Beer-Lambert's law-using UV-Vis spectrophotometer.
  - a. Change in absorbance with concentration of potassium permanganate.
  - b. Absorption maxima- change in absorbance in potassium permanganate with
    - a. wavelength
28. Principle of TLC and paper chromatography.
29. Column chromatography for protein /pigment.
30. Microscopy- Compound Light Microscope: Principle,Parts and Function.
31. Sterilization: Principles and Operations- Autoclave, Hot air oven, Filtration, Laminar Air Flow.
32. Principles and operations of Incubators and Shakers.
33. Principles and operations of Centrifuge.
34. Industrial visits- In Rajasthan Go sewa sangh and Project report Preparation.
35. Determination of  $\lambda$  (wavelength) maxima of given solution.
36. Qualitative estimation of Carbohydrates, Proteins and Lipids.
37. Determine the vitamin C content in citrus fruit by titration method.
38. Quantitative estimation of protein by Biuret method in serum sample.
39. Effect of substrate concentration on activity of any enzyme and determination of its  $K_m$  value.
40. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids.
41. To determine the chlorophyll a/ chlorophyll b ratio in C3 and C4 plants.
42. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry's or Bradford's method.
43. Determination of RBC in given blood sample.
44. Determination of packed cell volume in given blood sample.
45. Determination of the glucose in urine.
46. Study of permanent slides of Mammalian tissue.
47. Introduction to Microtomy

  
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## Second Year

### BT-401: MOLECULAR GENETICS

#### Section A

Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Codominance, incomplete dominance, gene interactions and pleiotropy.

Concept of gene: Allele, multiple alleles, pseudo allele, complementation tests. Genome; Basic structure of prokaryotic and eukaryotic genome and its organization

#### Section B

Macromolecular structure: Structure, types and function of DNA and RNA. Chromosome structure and nucleosome concept; DNA Repair mechanism.

Replication: Prokaryotic and eukaryotic DNA replication. Enzymes and factors required for replication.

#### Section C

Transcription: Prokaryotic and eukaryotic transcription. Post transcriptional modification of mRNA, rRNA, and tRNA. Reverse transcription

Translation: Concept of Genetic code and its feature Deciphering of Gene code. Prokaryotic and eukaryotic translation, post translational modification, inhibition of transcription and translation. Polymerase Chain Reaction (PCR) Types & Applications

#### Section D

Mechanism of genetic recombination: Homologous and Non homologous


Mutation elementary concept; types of mutations; Point mutations (Base pair change, frame shift, deletion, etc.) mutagens.

Regulation of gene expression with 'Lac' operon as model.

Gene cloning

#### Books:

1. Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness ASM Press, Washington, 1997.
2. Genetics by Goodenough U, Hold Saunders Inter-National, 1985.

  
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3. Principles of Genetics by Gardener ,E.j, Simmons M.J. Siustd DP.
4. Genes VIII by Benjamin Lewin, Oxford Univ. Press, Oxford, NY, 1994
5. Molecular Biology by Freirelder D. joners&Barilett Pub. Inc.

## BT - 402 : FOOD AND DAIRY TECHNOLOGY

### Section -A

Microbial role in food processes, operation and production new protein foods- mushroom, food yeasts, algal proteins

Fermentation as a method for preparing and preserving foods. Food additives like coloring flavors and vitamins.

Organisms and their use for production of fermented foods and beverages: pickling, alcoholic beverages, cheese, sauerkraut, idli, vinegar.

### Section -B

Deoxygenating and DE sugaring by glucose oxidase, beer mashing and chill proofing or cheese making by protease in and various other enzyme catalytic action in food processing  
Classification of fruit juice.

Post-harvest technology and process of food preservation.

### Section -C

Milk: Definition, composition, chemical and functional properties of milk components : physicochemical properties of milk protein, aggregation of Casein, micelles, factors affecting milk composition, milk secretion and lactation.


Micro-organisms: Importance in dairy science and technology. Microbial spoilage of milk, hydrolytic rancidity in milk and milk product, autoxidation of milk fats and effects on milk quality.

### Section -D

Milk processing operation: Milk pasteurization, Homogenization & Sterilization. Effect of processing of milk component and their functional properties.

Skimming of milk, Cream & Cream characteristics, manufacture of yoghurt and other fermented milk product Ice cream manufacture, Butter making technology, technology of cheese and processing of concentrated milks and dried milk powder. 5. Milk quality control, sanitation in the dairy plant, adulteration of milk, dairy equipment maintenance and waste disposal.

Books

  
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1. Frizer, Food Microbiology, THM Publications.
2. Heller. Genetic Engineering of food: Detection of Genetic Modifications, Wiley Publications.
3. Lel A. et. al. Microorganism & Fermentations - N.Y. Chemical. Rehm, Biotechnology set Wiley Publication
4. KeshavTrehan Biotechnology, 'New Age International Pvt Ltd.,2002

## **BT- 403: BIORESOURCE AND WASTE MANAGEMENT**

### **Section -A**

1. General:Bio resources: Biomass of food, fuels and chemical
2. Biodiversity and its characterization, use of Global positioning system in bio resource management.
3. Generation of Solid Waste: Goals and objectives of solid waste management, classification of solid waste. Solid waste generation factors influencing generation of solid waste. Characteristics of solid waste, analysis of solid waste, Problems associated with solid waste Disposal

### **Section -B**

4. Onsite Handling, Storage and Processing: Public Health and Aesthetics onsite Handling, onsite Storage, Dustbins. Community Containers, Container Locations, Onsite Processing Methods.
5. Solid waste collection, transfer and transport: Collection System equipment and labor requirement, collection routes, options for transfer and transport systems.


### **Section -C**

6. Processing and Disposal methods: Processing techniques and methods of disposal, sanitary land filling, composting and incineration, Bioremediation. Overview of methods of vermicomposting
7. Recovery of resources, conversion products and energy: Material, recovery, energy generation and recovery operation reuse in other industry

### **Section -D**

8. Industrial solid waste: Nature, treatment and disposal methods.
9. Bio waste including medical waste: Disposal and safety regulations.

### **Text/References:**

  
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### Books:

Principles of Biochemistry: Lehninger, 3rd ed. McMillan Biochemistry: G. Zubay

Biochemistry : Stryer, 5th ed., 2001, W.H. Freeman

Biochemistry : Garret and Grasirii Pub. Somders College

### BT -502: PLANT SECONDARY METABOLITES

#### Section -A

Introduction, secondary plant products in nature and their occurrence, type and uses. Basic tools and techniques used in isolation and separation.

#### Section -B

Production in vitro- optimization selection effect of metabolism on secondary metabolite-production, production under stress factors.

Production of alkaloids, steroids and saponins. Mechanism and control by different factors, detoxification of secondary metabolites.

#### Section -C

Production of secondary metabolites by bioconversion genetic transformation for production of secondary metabolite. Large scale production in bioreactor. Commercial production of secondary metabolites using cell cultures. Use of bioreactors, immobilized cells. Biotransformation. Applications and limitations. Cryopreservation and ex situ conservation of germplasm. Microbial secondary metabolites, their occurrence types and uses.

#### Section -D

Sources and type of antitumor compounds, food additives and insecticides. Products obtained in traditional medicinal systems and their significance in plant biotechnology. Biotechnological approach on production of secondary metabolites e.g. ginkgolides from cell cultures of *Ginkgo biloba* L. Use of immobilized cell systems for the production of industrially important chemicals.

Genetic regulation of metabolic. Gene expression in response to environmental stimuli, Regulation of gene expression. Analysis of metabolic control and the structure metabolic.

#### BOOK RECOMMENDED:

Secondary Metabolites- K G. Ramawat .Oxford Press. Reprint 2000

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## **BT – 503: ENVIRONMENTAL BIOTECHNOLOGY**

### **Section -A**

1. Components of Environment – Hydrosphere, lithosphere, atmosphere
2. Energy transfer in an Ecosystem, Food chain, food web, Bio-geochemical cycles (N, C, and P cycles).
- 3 Environmental pollution and degradation – Pollution of air, water , land and noise with reference to their causes, nature of pollutions, impact and control strategies.
- 4 Global Environmental Problems – Greenhouse Effects, Acid rain, El Nino, Ozone depletion, Deforestation,, salinization, biodiversity loss; chemical and radiation hazards.

### **Section -B**


5. Waste water: communal, sewage and industrial effluents: type of wastes, properties and step involved in aerobic and anaerobic treatments
6. Principle and design aspects of various waste treatment methods, with advance bioreactor configuration: activated sludge process, trickling filter, fluidized expanded reactor, up flow anaerobic sludge blanket reactor, contract process, fixed/packed reactor, hybrid reactors, sequential batch reactors.

### **Section -C**

7. Kinetic models for biological waste treatment: Bioconversions of agricultural and of highly organic waste material into gainfully utilizable product, Biogas, H<sub>2</sub>, cellular and food and feed stocks.
8. Process strategies for Bioremediation through microbes and plant. Bioremediation by industries, impact for process in global Bioremediation industry, exploiting microbial metabolism Bioremediation of organic contaminants, heavy metals and nitrogenous wastes.

### **Section -D**

9. Environmental monitoring (Bio indications, Biomarkers, Biosensors) Environmental Protection Act
10. Waste disposal and management, legislation of environmental problems, microbiological and biochemical aspects of waste water treatment processes, microbial strain improvement with view to develop scavengers, bioremediation. Environmental laws, national movements on sustainable developments, environmental policies and conservation, IUCN role in environmental protection

  
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## References:

- 1 J. Winter, Environmental Processes I-III, 2nd Ed., Wiley Publications.
- 2 Metcalf Eddy - Waste water Biotechnology.
- 3 Ted Munn, Encyclopedia of Global Environmental Changes, 5 Vol. Set Wiley Publications.
- 4 Metcalf Eddy - Waste water Engineering - 3rd ed., THM publications.
- 5 R.S. Ramalho - Introduction to waste water treatment

## BT 601: INDUSTRIAL BIOTECHNOLOGY

### Section A

**Introduction to bioprocess technology**, basic principles of fermentation technology. Range of microbial fermentation processes. Recombinant DNA technology assisted products. Flow chart of typical industrial fermentation process. Concept of value addition shelf life improvement. Low volume high value and High volume low value products.

**Bioreactor/Fermenter** – types & operation of Bioreactors, Construction, Design & Operation Materials of Constructions, Components of the fermenters & their specifications

**Types of Bioprocess:** Bio-transformations (enzyme, whole cell), Batch fed batch, cell cycle and continuous fermentation processes. Monod model and constitutive equations used for expressing growth, substrate consumption and product formation, solid state fermentation

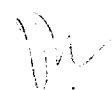
### Section B

**Technology of Microbial cell maintenance** – steps to maintain microbial culture in an aseptic & sterile environment (how to inoculate, preserve & maintain), Strain preservation, maintenance and strain improvement by mutation of gene transfer processes

**Industrial production** of Ethyl alcohol, Acetic Acid (Vinegar), Citric acid, lactic acid,  $\alpha$ -amylase, protease penicillin, tetracycline and vitamin B12, With reference to easily available raw materials, Production of herbal drugs. Antibiotics, amino acids, vitamins, ethanol, vaccines (FMD, DTP, New Castle disease), Single cell protein (Methanolic yeast, Spirulina).

### Section C

**Enzyme technology** nature of enzymes, application of enzymes, limitations of microbial cells used as catalysts in fermentation, multi enzyme reactors, genetic engineering & protein engineering of enzymes, cloning strategy for enzymes technology of enzyme production, use of

  
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immobilized cells and enzymes (Calcium alginate beads, polyacrylamide), industrial applications of immobilized enzymes.

Application of enzymes in Medical/pharmaceutical, and in food industry. Industrial applications of amylases and proteases. Production of amino acids and antibiotics by immobilised enzymes/cells. Use of microbial enzymes in leather, paper and dairy industry.

**Biological fuel generation** = photosynthesis, sources of biomass, ethanol from biomass, methane from biomass, hydrogen, microbial recovery of petroleum


#### Section D

**Biotechnology in specific medical & industrial applications** - Retting of jute, microbial process for immunization (Production of monoclonal antibodies), Deterioration of paper, textiles, painted surfaces and their prevention, Bio-films, microbial biopolymers, bio surfactants, Microbial culture selection with high yield potential.

**Fermented Foods:** Yoghurt, Buttermilk, Idli, Dosa, Cheese, Tempeh. Plant cell suspension culture for the production of food additives-Saffron and Capsaicin, Microbial polysaccharides and polyesters; production of xanthan gum and polyhydroxyalkanoates (PHA)

#### Books:

1. Harrison G. Roger, Paul Todd, Scott R. Rudge, Demetri P. Petrides, "Bio separation Science and Engineering" Oxford University press, 2003.(Unit I, II).
2. Treybal E. Robert, "Mass-Transfer Operations", 3rd ed., McGraw Hill International Edition, Singapore, 1980.(Unit IV).
3. Doran M. Pauline, "Bioprocess Engineering Principles", 8th ed., Academic press, New York, 2003.
4. (Unit V).
5. Belter A Paul and Cussler E. L, Wei-Shou Hu., " Bioseparations: Downstream Processing for Biotechnology ", A Wiley-Interscience Publication, John Wiley & sons, New York, 1988. (Unit III)
7. Ladisch, M.R., "Bioseparation Engineering: Principles, Practice and Economics", A Wiley-Interscience Publication, John Wiley & sons, New York, 2001.
8. McCabe L. Warren, Smith C. Julian and Peter Harriott, "Unit Operations of Chemical Engineering", 6th ed., McGraw Hill International Edition, New York, 2001.
9. Prescott, Dunn, "Industrial Microbiology", Agrobias (India), Jodhpur, 2002.
10. Casida L.E., "Industrial Microbiology", John Wiley & Sons, 1968.

  
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11. Biochemistry by Jeremy M. Berg, John L. Tymoczko, Lubert Styer, Fifth edition, W.H. Freeman and Company, 1514 pages.
12. Wulf Crueger, Anneliese Crueger, "Biotechnology: A Text Book of Industrial Microbiology", Panima publishing corporation, New Delhi, 2003. (Unit I, II: Vitamins, III, IV and V)
13. Stanbury, P.F., Allan Whitaker and S.J. Hall. 1997. Principles of Fermentation Technology. Adityabooks-private Ltd., New Delhi.

## BT 602: RECOMBINANT DNA TECHNOLOGY

### Section A

**Milestones of recombinant DNA Technology-** Introduction and Historical perspective and early experiments.

**Recombinant DNA Tools:** Enzymes (Restriction enzymes, DNA ligases, DNA Polymerase Reverse Transcriptase, Polynucleotide kinase, End labelling and other enzymes). Cloning hosts (bacteria fungi animal and plant cells).

**Gene transfer strategies:** DNA mediated gene transfer, vector mediated gene transfer (Plasmid vectors, cosmid, Phagemid, Phage vectors) and *Agrobacterium* mediated gene transfer.

### Section B

**Experimental model systems:** *E. coli*, Yeast, Baculovirus and their applications

**DNA Libraries:** Making of genomic and c-DNA libraries, their screening strategies for recombinant molecules and major application

**Transposons:** Concept of prokaryotic and eukaryotic transposition

### Section C

**Transgenic Technology:** Production of transgenic Microbes transgenic Animals and transgenic Plant along with their application in Biotechnology

**Requirement of recombinant molecules:** in health, pharmaceutical, agriculture and industrial sectors in research laboratories, criteria of purity

### Section D

**Strategies for the production of recombinant molecule:** Rationale for the design of vectors for the over expression of recombinant proteins, selection of suitable promoter sequences, ribosome binding sites, transcription terminator, fusion protein tags, purification tags, protease cleavage sites and enzymes plasmid copy number, inducible expression system

**In vitro optimization of downstream processing:** Over expression conditions, production of inclusion bodies, solubilization insoluble proteins, Purification protocols and upscaling. Determination of purity and activity of over expressed protein

**Books:**

1. An introduction to Genetic Engineering –Desmond S T Nicholl ,Cambridge university press, 2nd Ed.
2. Ausbel S.M, Brent R, Current Protocols in Molecular Biology., Wiley International New York.
3. Bernard R Glick & Jack J Pasternak, ASM press.
4. D.M Glover, DNA cloning, A practical approach.
5. DNA Science by MicklosFreyer
6. Gene cloning and DNA analysis by T.A. Brown
7. Genes V –Benjamin Lewin
8. Maniatis I, FritchhE.F ,&Sambrook J, Molecular cloning.
9. Methods in Enzymology series, vol 152, 185, Academic press inc, Sandiego.
10. Molecular Biology of gene by Watson, Baker, Bell, Gann, Levine, Losick
11. Molecular Biotechnology Principles & Applications of Recombinant DNA, Bernard R Glick & Jack J Pasternak, ASM press.
12. Molecular Biotechnology: Principles and Applications of Recombinant DNA, B.R. Grick and J.J. Pasternak, ASM Press
13. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell Scientific publications.
14. Principles of Gene manipulation and Genomics by Primrose and Twyman
15. Principles of Gene Manipulation: An Introduction to Genetic Engineering, R.W. Old and S. B Primrose, Blackwell Science Inc
16. Recombinant DNA, J.D. Watson et al, W.H. Freeman and Company
17. Recombinant DNA: A short Course, Watson J.D, CSHL press Short course in Bacterial Genetics –J. H. Miller
18. Setlow& Hollander A, Genetic Engineering: Principles & Methods, Plenum Press.
19. WinnekeFrom Genes to Clones.

**BT 603: Behavioral Science and Basic communication skill**

**Section A**

**Behavioral Science : Self Analysis- SWOT Analysis, Self Confidence, Self Esteem**

**Attitude-Change Management, Perceptions- Ideas and Approach**

**Motivation- Internal and External Self Talk**

**Goal Setting- Time Management- Vision & Planning, Problem Solving**

**Creativity- Out of box Thinking – Lateral Thinking**


**Interpersonal Skill- Team Work- Networking,**

**Leadership Skill- Role Models- Leadership Style**

**Stress Management- Emotional Intelligence- Emotional Quotient**

**Section B**

**Conflict Resolution- Approaches- Solution**

  
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**Presentation Skill-** Analytical Thinking, Review  
**Assertiveness-** Stress Management – Quiz  
**Lateral Thinking ( Situational) Team Work , Impromptu (Text Analysis)**  
**Business Plan Presentation-** Plan I & Plan II, Chinese Whisper  
**Self Introduction-** GD, Mock Interview, Curriculum Vitae

## Section C

### Basic Communication Skills-


General Introduction of Communication, The process and importance of Communication, Principle and Benefits of Effective Communication,  
**Spoken English Communication-** Speech Drills, Pronunciation and Accent, Stress and Intonation, Developing Listening Skills, Developing Speaking Skills

## Section D

**Basic Methods in communication :** Developing Reading Skill, Developing Writing Skill, Progression of Thoughts/ Ideas, Structure of Paragraphs, Structure of Essays.


### Books Recommended:

Written communication in English- Sarah Freeman  
McMillan Grammar: A Handbook of “ Augustine and Joseph”- Orient Longman.  
Phil Loweb Kogee Page: Creativity and problem solving, New Delhi  
Organizational Behavior, Davis, K.  
Bates, A.P. and Julian, J.: Sociology- Understanding Social Behaviour  
Geoff Petty: How to be better at creativity; Kogan Page, New Delhi 1998  
Michael Steven: How to be a better problem solver, Kogan Page, New Delhi-1999  
Julia T. Wood, interpersonal Communication everyday encounter

  
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**B.Sc. Biotechnology Part II**  
**List of Practical**

1. Isolation of DNA from human cheek cells
2. Isolation and electrophoretic separation of DNA from prokaryote (bacteria)
3. Assessing the purity & Quantity of extracted DNA spectrophotometrically
4. Determination of absorbance maxima for DNA spectrophotometrically
5. Demonstration and handling of PCR
6. Prepare the mount for polytene and lampbrush chromosomes
7. Parameters for quality control analysis of milk
8. Biological characteristics such as Litmus milk test, MBRT test
9. Detection of adulterants, in milk
10. Isolation of protein from milk sample
11. Production of wine from grape juice
12. Educational tour to Dairy/food processing/fermentation industries
13. Field report on Biodiversity Park.
14. Shelf-life management of flowers of importance.
15. Study of Industrially important plants (specimens/products) morphology, botany and uses.
16. Study on disposal and treatment of biomedical waste
17. Waste Water Treatment
18. Preparation of standard curve
19. Quantitative estimation of sugar content in plant sample by Anthrone method
20. Quantitative estimation of protein content in plant sample by Lowry method
21. Quantitative estimation of phenolic content in plant sample by Folin-Ciocateu reagent method given by McDonald
22. Protein profiling by SDS PAGE
23. Isolation of secondary metabolites (aqueous or alcoholic)
24. Qualitative test for:
  - a. Alkaloids
  - b. Flavanoid
  - c. Tanins
  - d. Phenols
  - e. Saponin
25. Quantitative test for
  - a. Alkaloids
  - b. Flavanoid
  - c. Tanins
  - d. Phenols
  - e. Saponin
26. To estimate free CO<sub>2</sub> in given water sample
27. To determine BOD of given water sample
28. To determine total dissolved solids in water sample
29. MPN determination in water sample

  
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30. To determine organic content in soil sample
31. Isolation of microorganisms and Screening of industrially important microorganisms
32. Study of growth, substrate utilization and product formation kinetics in shake flask cultures
33. Cell disruption techniques Detergent and Enzyme
34. Membrane based filtration – Ultra Filtration and Micro Filtration
35. Centrifugation and Sedimentation
36. Measurements, micropipetting and sterile handling of the reagents
37. Electrophoretic separation of plasmid isolated by alkali lyses method
38. Restriction digestion of DNA (RFLP analysis)
39. Bacterial DNA ligation
40. Molecular characterization by RAPD marker Detection of a specific sequence using PCR

  
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## Third Year

### BT – 701: GENOMICS AND PROTEOMICS

#### Section -A

1. Basic structure of prokaryotic and eukaryotic genome.
2. Chromatin model, concept of gene, linkage and crossing over, linkage analysis in *Drosophila* and *Neurospora*.

#### Section -B

3. Pedigree analysis in human, Genetic mapping and its tools genetic mapping of complex character.
4. Multigene families in human genome and repetitive DNA, C-Value paradox and complexity of genome.

#### Section C

**Proteomics: Basic principles of protein structure: Protein Structure and Function. Structural and functional proteomics. Designing protein.**

**Analysis of Proteome: 2D – gel electrophoresis, mass spectroscopy. Modelling of three-dimensional structure of a protein from amino acid sequence. Modelling mutants.**

#### Section D

**Protein – protein interactions: Yeast- two hybrid method, GFP Tags, Proteome- wide interaction maps. Understanding of interactions and effects of internal (intracellular) milieu on the activity of the protein and its various complexes and interactions.**

**Designing genome and proteins: Analysis of nucleic acid / protein sequence and structure data, genome and proteome data using web-based tools.**

**Applications of mapping: Interrelations of genomics with proteomics. Genomics and proteomics their application to health, agriculture and industry.**

#### Books Recommended

1. Genetics: Griffith and Suzuki.
2. Principles of Genetics: Gardener 8th Ed., Pring, 2002, Jho.
3. Genes VIII: Benjamin Lewin 1st Ed., Pring, 2003 Oxford University
4. Genome: T.A. Brown, 1999, John Wiley & Sons.
5. Statistics Concept and application: H. Frank and S.C. Althoen Cambridge University Press.

6. Statistical Methods: G.W. snedecor and W.G. Cochran

7. Basic Statistics: B.L. Agarwal.

8. Principles and Procedure of Statistics: A Biometrical Approach, R.G.D. Steel and J.H. torrie.

## **BT- 702: PLANT BIOTECHNOLOGY**

### **Section A**

1. Historical background; Terminology used in cell & tissue culture; Basic techniques of cell and tissue culture; Surface sterilization; Aseptic tissue transfer. Concept of totipotency (Dedifferentiation, Redifferentiation).

2. Nutritional requirement of cell in vitro; Various types of nutrient media (Inorganic supplements, Organic supplements, PGR's, Gelling agents, Defined media).Development of explants (Somatic embryogenesis, Organogenesis).

3. Micro propagation and cloning of plants (Process, Limitation, Applications of micro propagation in agriculture, horticulture & forestry)

### **Section B**

4. Variability in tissue culture; Soma clonal and other variations (Process, Advantages, Limitation, Screening of soma clonal variants, Verification of soma clones)

5. Haploid production (Techniques, Androgenesis, Gynogenesis, Diplodization of haploids, Applications, Limitation).


6. Production of disease free plants by tissue culture methods (Process, Application, Limitation, and Virus indexing).

### **Section C**

7. Isolation of cells (From plant, From suspension culture, Mechanical method, Enzymatic method) Single cell cultures and cloning (Bergmann cell plating technique, Filter paper raft nurse technique, Micro culture chamber technique, Micro drop method, Feeder layer technique).

8. Protoplast isolation and hybridization: Protoplast isolation and culture, fusion of protoplast (Mechanical, enzymatic, Purification of protoplast, Checking the quality of protoplast); Somatic hybrids (Somatic hybridization- Chemical, Electrical), Fate of somatic hybridization, Verification of hybridity).

### **Section D**

  
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University of Rajasthan

9. Genetic transformation: *Agrobacterium tumefaciens* induced tumor formation and *A. rhizogenes* induced hairy root, features of TI and RI plasmid, mechanisms of DNA transfer in plants.

10. Genetic engineering: for increasing crop productivity (By manipulation of photosynthesis, Nitrogen fixation, Nutrient uptake efficiency); biotic stress tolerance- (Insects, Fungi, Bacteria, Viruses, Weeds); Abiotic stress (Drought, Flooding, Salt, Temperature); for quality improvement (Protein, Lipids, Carbohydrates, Vitamins, Mineral nutrients).

11. Germ plasm conservation, Identity conservation in genetically modified Crops.

#### Books /Reference:

1. Dodds. J.H. & Roberts L.W. (1985). Experiments in plant tissue culture, Cambridge Univ. Press.
2. Kumar A and S Roy (2006), Plant biotechnology and its applications in culture. I.K. International, New Delhi.
3. Beversdorf W.D. (1990) Progress in plant cellular & Mol. Boli. (Eds.) HJJ.Nijkamp, Kluwar Acad. Pub. Dordrecht.
4. Green D.A. & Somerspm (1987), Progress in PLant Cellular & Mol. Biol., Kluwar Academic Press Dordrecht.
5. Vasil, I.K. and Thorpe, T.A. 1994. Pliant Cell and Tissue Culture, Kluwer Academic Publishers, The Netherlands
6. Hall R.D. (Ed.) 1999 Plant Cell Culture Protocols. Human Press Inc. New Jersey, USA.
7. Molecular Bilyog of cell. Garland Pulishing Co., Inc. New York, USA.
8. Dixon R.A. (ED) 1987. Plant Cell Culture: A Practical Approach. IRL Press, Oxford.


#### BT – 703: ANIMAL BIOTECHNOLOGY

##### Section A

Introduction to animal tissue culture: Milestones in Animal tissue Culture, Concepts and Terminologies, Steps in Cell Culture.

Contamination and Aseptic techniques – Sources of Microbial Contamination, Washing & preparation of glassware, packing & sterilization, media sterilization, Filter sterilization, precautions to maintain aseptic conditions.

##### Section B

  
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M. S. University of Baroda

Laboratory Set up and Media Formulations: Setting up the laboratory , Hazards and safety in the cell culture laboratory, Animal cell culture media ,General cell culture media design ,Natural media, Synthetic media , Consideration in Media formulation, Nutritional components of media The Role of serum in cell culture, Choosing a medium for different cell types.

Key techniques in animal cell culture: Culturing and routine Maintenance of the culture, Tissue Disaggregation, Quantification of cells in cell culture, Cloning and selecting cell lines Physical methods of cell separation.

### Section C

Characterization of cell lines: Species verification, Intra-species contamination, Characterization of cell type and stage of differentiation.

Preservation of animal cell lines: Variation and instability in cell line, freezing of cells. Cell viability and Cytotoxicity assay, Cell banks.

Scale Up of animal cell culture: Culture parameters, Scale of anchorage- dependent cells. Suspension culture. Cell culture based vaccines.

### Section D

Monoclonal Antibody Production: The limitation of traditional antibody preparation , The basis of hybridoma technology The details of hybridoma technology , Long term storage of hybridoma cell lines ,Contamination , Hybridomas from different species Human hybridomas , Commercial scale production monoclonal antibodies.

The applications of animal cell culture, Stem cells and applications, Organ Culture and tissue Engineering.

### Book

Cell and tissue culture: Lab Procedures in Biotechnology, Alan Doyal (ed) J. Bryan Griffith (ed).

Freshney, R. I., 2000, Culture of Animal Cells: A Manual of Basic Technique, Published by Willey & Liss Publication.

Harrison & Rae, 1997, General Techniques of Cell Culture, Cambridge University Press.

## BT – 801: MEDICAL BIOTECHNOLOGY

### Section -A

Diseases: Introduction, types: Genetic; Chromosomal aberrations: numerical and structural autoimmune disorders, diseases caused by microbial sources. Mechanism of pathogenicity, pathogenic islands, Molecular basis of diseases. Antimicrobial compounds and their mode of action

Disease prevention: Gene therapy - *Ex-vivo*, *In vivo*, *In situ* gene therapy, Strategies of gene therapy: gene augmentation, Vectors used in gene therapy, Biological vectors – retrovirus, adenoviruses, Herpes. Synthetic vectors– liposomes, receptor mediated gene transfer

Characteristics of infectious diseases, Herd immunity. Disease cycle (Source of disease, reservoir, carriers). Transmission of pathogens (Air Borne. contact transmission and vector transmission).

### Section -B

- Characteristics of infectious diseases, Herd immunity.
- Disease cycle (Source of disease, reservoir, carriers).
- Transmission of pathogens (Air Borne. contact transmission and vector transmission).
- Bacterial Diseases: Epidemiology, Pathogenicity, Laboratory Diagnosis, Prevention & control of the following diseases: Anthrax, Tuberculosis, Typhoid, Whooping cough, Tetanus, Diphtheria, Leprosy

### Section -C

General account of fungal diseases: Mycosis, Subcutaneous and deep.

- General Account of viral & protozoan diseases: Pneumonia, mumps, Chickenpox, AIDS and Malaria, Leishmaniasis.
- Brief account of sexually transmitted diseases.

### Section -D

Disease prevention: Gene therapy - *Ex-vivo*, *In vivo*, *In situ* gene therapy, Strategies of gene therapy: gene augmentation, Vectors used in gene therapy, Biological vectors – retrovirus, adenoviruses, Herpes. Synthetic vectors liposomes, receptor mediated gene transfer.

Drug discovery and Tissue engineering: Introduction to drug discovery. Stem cell based drug discovery, drug screening and toxicology. Therapeutic applications – Parkinson disease - Neurological disorder – limb amputation – heart disease - spinal cord injuries – diabetes – burns - HLA typing- Alzheimer's disease. Ethical considerations.

Nano medicine: Immunotoxins, Targeted drug delivery approach and molecular motors. Antiviral therapy for AIDS, DNA/RNA based diagnosis Hepatitis, CML – bcr/abl, HIV - CD 4 receptor. Microarray technology- genomic and c DNA arrays, application to diseases.

### Books Recommended:

1. Text Book of Microbiology R. Ananthanarayanan and C.K. JayaramPaniker, Orient Longman, 1997.

2. Medical Microbiology ,Vol 1 ; Microbial infection : Mackie and MaCartny, Churchill Livingstone, 1996

3. Bailey and Scott's Diagnostic Microbiology : Baron EJ, Peterson LR and Finegold SM Mosby, 1990.

4. Broude A.I. (1981) : Medical " Microbiology" ; and Infectious Diseases, W.B. Saunders & Co. Philadelphia.

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5.J.T. Bushberg. J.A. Scibert, E.M. Leidholdt (JR), J.M. Boone : The Essential Physics of medical Imaging, Lippincott Williams and Wilkins, USA, 2002.

6.R.B. Buxton : Introduction to Functional Magnetic Resonance Imaging :Principle & Techniques, Cambridge Univ. Press, UK, 2002.

7. J.Enderle, S. Blancechard& J. Bronzino (Eds) : Introduction to Biomedical Engineering, Academic Press, 2000.

8. John G. Webster(Ed): Medical Instrumentation - Application and Design, 3rd Ed, John Wiley & Sons, 1989.

9. J.B. West. (Ed) Best and Taylor's Physiological basis of Medical Practice, 11th Ed., Williams and Wilkins, Baltimore 1985

10. Y.C. Fung: Biomechanics, Springer and Verlag, New York, 1981.

11. S. Oka: Cardiovascular Hemorheology, Cambridge University Press, 1981.

#### **BT - 802 : Fundamentals of Bio information and Nanotechnology**

##### **Section A**

1. Introduction to Bioinformatics: Nature of Biological data, Bioinformatics and its multidisciplinary approach, Definition of Bioinformatics, History of Bioinformatics, Search engines.

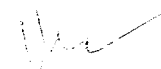
2. Biological databases: Primary, secondary and composite databases. Nucleotide sequence and Protein sequence databases, Structural Databases.

##### **Section B**

3 Aspects of Bioinformatics: Types of Alignment- Pairwise, Multiple, Global, Local, Heuristic Methods for sequence alignment- FASTA and BLAST, Multiple Sequence alignment

4 Applications of Bioinformatics, Bioinformatics in India (BTIS net).

##### **Section C**

  
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5 Introduction to Nanotechnology: Nano scale and Richard Feynman's idea of Nanotechnology, Definition and Historical perspective

6 Characterization and properties of nano-material: Structural characterization, Chemical characterization and Properties: Mechanical, optical, electrical and magnetic

#### Section D

7 Nano materials and applications: Definition, properties and uses of Carbon nanomaterials, Bucky ball, CNT, Dendrimers, quantum Dots, Nanocomposites, Nanocones, Nanotubes, Nanohorns and Nanowires.

8 Applications of Nanotechnology: Nanotechnology in Environment and energy, Medical nanotechnology and Drug Development, Recent advancements in nanotechnology

9 Impact of nanotechnology: Associated Risks and regulations for Society, Health, Environment and Industry.

#### List of Books:

1. Text book for Bioinformatics by Shankar and Munjal
2. Bioinformatics by Prakash S lohar
3. Fundamentals and applications of Nanotechnology by Mansi Karkare
4. Nanotechnology by Er. Rakesh Rathi

#### BT – 803: Bioethics and IPR

##### Section A

Regulatory Aspects: Direct Non Target effects on beneficial and native organisms, indirect effects, Regulating Recombinant DNA technology, Biohazards

Environmental and Regulatory aspects of using genetically modified plants.

**Section B** Microorganisms; monitoring of introduced microorganisms, Ecological impacts of GMM released

Biological Weapons, Risk Assessment, Ethics, Biosafety Regulations in INDIA and international activities.

##### Section C

Intellectual property rights and protection (IPR & IPP): Forms of IPR (copy Right, Patent, Trade Secrets, Trademark, Other rights), Choice of IPP.



## Section D

Patents in Biotechnology: Genes and DNA sequences, Life forms, General Agreement on Tariffs and trade (GATT) Trade related intellectual property rights (TRIPRS); Plant Breeders rights, International conventions, bio piracy, World intellectual property organization:

### Text & References:

The Law & Strategy of Biotechnology Patents, Sibley Kenneth,

Safety Considerations for Biotechnology, Paris, OECD, 1992 and latest publications.

Biological Warfare in the 21st century, by M.R. Dano, Brassies London, 1994.

Biosafety Management by P.L. Traynor, Virginia polytechnic Institute Publication, 2000.

Cartagena Protocol on Biosafety, January 2000.

## BT - 805: Critical Reasoning, Scientific Writing and Presentation

### Section A

**Introduction to Critical Reasoning-** Critical Thinking and its benefits, understand the Barriers to critical thinking, learn the feature of arguments, Get acquainted with social influences on critical thinking.

**Language of Critical Thinking-** to understand the language of critical thinking,

**Characteristics of Critical Discourses-** Clarity, Accuracy, Precision, Relevance, Depth, Breadth,

### Section B

**Scientific Writing:** Introduction to writing skills, effective Writing Skills, Avoiding Common Error, Paragraph Writing , Note taking, Writing assignments,

**Letter Writing-** Letter writing , Types of Letter, Types of Letter format

Memo, Agenda and Minutes, Notice and Circulars

### Section C

**Report Writing-** Purpose and Scope of a Report , Fundamental Principles of Report Writing, Project Report Writing, Summer Internship Reports Writing, Writing E-Mails, Brochure, leaflets,

### Section D

**Presentation and Professional Skills-** Presentation, Meetings, Planning and Getting started, Design and Layout of Presentation, Information Packaging, Making the presentation

### Text & References:

Michael Steven: How to be a better problem solver, Kogan Page, New Delhi. 1999

Geoff Petty: How to be better at creativity; Kogan Page, New Delhi, 1999  
Phil Lowe Koge Page: Creativity and Problem Solving, New Delhi, 1996  
Bensley, Alan D.: Critical Thinking in Psychology A Unified Skills Approach, (1998),  
Brooks/Cole  
Publishing Company.  
Business Communication, Raman -Prakash, Oxford  
Creative English for Communication, Krishnaswamy N, Macmillan  
Textbook of Business Communication, Ramaswami S, Macmillan  
Effective Writing, Withrow, Cambridge  
Writing Skills, Coe/Rycroft/Ernest, Cambridge

## **BT - 806: INDUSTRIALIZATION AND ENTREPRENEURSHIP**

### **Section -A**

Principle of Management - The topic mentioned below are to be covered with respect to Bio industries and Bio products.

Management - meaning and importance, evolution of management thoughts.

Function of management:

- i. Planning - meaning and importance, steps in the process of planning, Decision making.
- ii. Organizing - process of organizing, types of organizational structures, informal organizations

### **Section -B**

iii. Directing - Communication process barriers to effective Communication, Mediation - theories of Motivation, Leadership style.

iv. Controlling - Control techniques.

Personnel Management: Manpower planning, source of recruitment, selection and training of staff, job evaluation, merit rating, performance appraisal, wage administration and system of wage payment, incentive, trade unions and industrial relation.

### **Section -C**

Purchases and Stores Management : Concepts of quotations, tenders and comparative statement, inspection and quality control, inventory - Carrying cost and fixed cost of inventors, BEP analysis stores management, functions of storekeeper, methods of inventory - LIFO, FIFO.

Marketing, Management : Concept of selling, marketing, market research, Pricing-methods, penetration and Skimming pricing, Physical distribution methods, advertising and Sales promotion.

## Section -D

Export and Import Management: Concept of international trade, duties and antidumping duty, cost involved in exporting a product, pricing of export product. Government assistance for export promotion, export house, export promotion counsel, MODVAT, patent and patent rights.

Management Laws: Concept of Contract act, offer and acceptance, type of Contract, Void Contract, Concept of Guarantee and warranty, introduction of MRTP and FERA.

Work Study: Work Measurement time and motion study, flow process chart, flow diagram, Sio chart, string Chart therbligs.

Quality Management: TQM, quality management, ISO Systems.

### Reference Books:


1. Management for Business and Industry - C.S. George Jr.
2. Principles of Management - Koontz and O' Donnell.
3. Business Organization and Management \_ M.C. Shukla.
4. Basic Biotechnology, Colin and Bjorn Kristiansen, Cambridge University press.

The above syllabus is to be taught keeping in mind the aspect of Commercialization.

Marketing and Management of Biotechnological product. Term work - Minimum five case studies based on the above Syllabus.

### BT - 807 : Dissertation Based on Lab and Field Work


Dissertation will have 200 marks distributed a below: (1) 50 marks viva voce (2) 150marks  
Dissertation

  
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## B.Sc. Biotechnology Part III

### List of Practical

1. Electrophoretic separation of plasmid DNA.
2. Gene finding tools and genome-annotation- Gen Scan, Net Gene, Hmm gene.
3. Comparison of two given genomes- Mummer.
4. Preparation of stock solutions and Murashige & Skoog media
5. Micro-propagation by adventitious buds
6. Culture of anthers to raise haploids
7. Development of virus free plants from meristematic tips
8. Cell culture in bioreactor suspension
9. Basic set up of Animal tissue culture laboratory
10. Preparation of media, sterilization and practices in tissue culture laboratory
11. To Isolate Cells from whole Blood and its primary culture
12. To Study Cryopreservation
13. WIDAL test
14. Acid Fast Bacilli (AFB) staining
15. To perform BLAST
16. To perform FASTA
17. To study Protein Sequence Database
18. Primer Designing

  
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