



# **RANI CHANNAMMA UNIVERSITY**

# **BELAGAVI**

**THE COURSE STRUCTURE & SYLLABUS OF UNDER GRADUATE**

**BACHELOR OF SCIENCE**

**BIOTECHNOLOGY**

**1<sup>ST</sup> TO 6<sup>TH</sup> Semesters**

**w.e.f.**

**Academic Year 2020-21 and Onwards  
Under**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**CHOICE BASED CREDIT SYSTEM [CBCS]  
B.Sc. Program with Optional Subject: BIOTECHNOLOGY**

(With effect from the academic year 2020-21 onwards)								
Sem	Part	Paper Code	Title of the Paper	Hours/Week	Marks			Subject Credits
					IA	Exam	Total	
I	Part – 1 DSC	BTNDSCT 1.1	Cell Biology and Genetics	4	20	80	100	3
		BTNDSCP 1.1	Practicals-1	3	10	40	50	1
	<b>Total: Hours / Credits</b>			<b>7</b>			<b>150</b>	<b>4</b>
II	Part – 1 DSC	BTNDSCT 2.1	Biochemistry and Biogenetics	4	20	80	100	3
		BTNDSCP 2.1	Practicals-2	3	10	40	50	1
	<b>Total: Hours / Credits</b>			<b>7</b>			<b>150</b>	<b>4</b>

(With effect from the academic year 2021-22 onwards)

Sem	Part	Paper Code	Title of the Paper	Hours/Week	Marks			Subject Credits
					IA	Exam	Total	
III	Part – 1	BTNDSCT3.1	Microbiology and Immunology	4	20	80	100	3
	DSC	BTNDSCP3.1	Practicals-3	3	10	40	50	1
	Part – 2 SEC	BTNSECT3.2	Molecular Diagnostics	2	10	40	50	2
	Total: Hours / Credits			9			200	6
IV	Part – 1	BTNDSCT4.1	Molecular Biology.	4	20	80	100	3
	DSC	BTNDSCP4.1	Practicals-4	3	10	40	50	1
	Part – 2 SEC	BTNSECT4.2	Industrial Fermentations	2	10	40	50	2
	Total: Hours / Credits			9			200	6

(With effect from the academic year 2022-23 onwards)

Sem	Part	Paper Code	Title of Paper	Hours/Week	Marks			Subject Credits
					IA	Exam	Total	
V	Part – 1 DSE	BTNDSET 5.1	Plant and Animal cell Technology.	4	20	80	100	3
		BTNDSEP 5.1	Practicals 5	3	10	40	50	1
		BTNDSET 5.2A (Elective I)	Recombinant DNA Technology and Nanotechnology	4	20	80	100	3
		BTNDSEP 5.2A (Elective I)	Practicals-5A	3	10	40	50	1
		BTNDSET 5.2B (Elective II)	Bioinformatics.	4	20	80	100	3
		BTNDSEP 5.2B (Elective II)	Practicals-5B	3	10	40	50	1
	Part – 2 SEC	BTNSECT5.3	Industrial Fermentations	3	10	40	50	2
<b>Total: Hours / Credits</b>				<b>17</b>			<b>350</b>	<b>10</b>

Note: Students have to choose either Elective-I or Elective-II

VI	Part – 1 DSE	BTNDSET 6.1	Industrial and Environmental Biotechnology	4	20	80	100	3
		BTNDSEP 6.1	Practicals-6	3	10	40	50	1
		BTNDSET 6.2A (Elective III)	Agricultural and medical Biotechnology	4	20	80	100	3
		BTNDSEP 6.2A (Elective III)	Practicals-6A	3	10	40	50	1
		BTNDSET 6.2B (Elective IV)	Medical Microbiology	4	20	80	100	3
		BTNDSEP 6.2B (Elective IV)	Practicals 6B	3	10	40	50	1
	Part – 2 SEC	BTNSECT 6.3	Basics of Forensic Science	3	10	40	50	2
<b>Total: Hours / Credits</b>				<b>17</b>			<b>350</b>	<b>10</b>

Note: Students have to choose either Elective-III or Elective-IV

T: Theory, P: Practical, CC/EA: Co-curricular/Extension Activities. AECC: Ability Enhancement Compulsory Course, DSC: Discipline Specific Course. DSE: Discipline Specific Elective, SEC: Skill Enhancement Course).

Note: Duration of examinations is 03 h for 80 Marks theory and 02 h for 40 marks theory. For practicals, duration of examination is 03 h.

### Schema of Evaluation for Practical Examination

	<b>Particulars</b>	<b>Marks Allotted</b>
<b>1</b>	<b>Experimental preparation involving the following *</b>	<b>30</b>
<b>2</b>	<b>Journal (record) assessment</b>	<b>05</b>
<b>3</b>	<b>Oral performance (Viva-voce)</b>	<b>05</b>
<b>Total</b>		<b>40</b>
*	Brief description & tabulation	04
	Basic diagrams/specimen identification	04
	Preparation of required solutions and Experimental set-up	04
	Record of observation and performance of experiment	10
	Calculation including drawing graph	06
	Accuracy of result with unit	02

**Question Paper pattern**  
First Semester B.Sc. Degree Examination, December 2020  
(CBCS Scheme-2020-21: Regular)

**Biotechnology**  
**CHEDSCT 1.1: Cell Biology and Genetics**

Time: 3 Hours

Max. Marks: 80

Q. No. I. Answer any TEN of the following

2X10= 20 Marks

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)
- 12)

Q. NO. II. Answer the following questions

5X3=15 Marks

- a)
  - b)
  - c)
- OR
- d)

Q. No. III. Answer the following questions

5x3= 15 Marks

- a)
  - b)
  - c)
- OR
- d)

Q. No. IV. Answer the following questions

5x3=15 Marks

- a)
  - b)
  - c)
- OR
- d)

Q. No. V. Answer the following questions

5x3=15 Marks

- a)
  - b)
  - c)
- OR
- d)

**Question Paper pattern**  
First Semester B.Sc. Degree Examination, December 2020  
(CBCS Scheme-2020-21: Regular)  
**Biotechnology**

**CHESECT 3.2: Title of the Paper**

Time: 3 Hours

Max. Marks: 40

Q. No. I. Answer any **FIVE** of the following

2X5= 20 Marks

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)

Q. NO. II Answer the following questions

5X3=15 Marks

- a)
  - b)
  - c)
- OR
- d)

Q. No. III. Answer the following questions

5x3= 15 Marks

- a)
  - b)
  - c)
- OR
- d)

**Instruction to set the DSC/DSE question paper.**

- Question number 1 has 12 sub questions consisting of 3 questions from each unit. Each question carries two marks. Student has to answer any ten questions.
- Question number II are from unit I.
- Question number III are from unit II.
- Question number IV are from unit III
- Question number V are from unit IV.

**Instruction to set the SEC question paper.**

- Question number 1 has 6 sub questions consisting of 3 questions from each unit. Each question carries two marks. Student has to answer any five questions.
- Question number I is from unit I.
- Question number II is from unit II.



## First Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCT 1.1  
**Teaching Hours:** 4 H / Week  
**Total hours:**60

**Paper Title:** Cell Biology and Genetics  
**Marks:** Th-80+IA-20  
**Credits :**3

### Unit: 1

**15 Hours**

**General Introduction and cell as a basic unit of life:** Introduction to Biotechnology, Scope and branches of Biotechnology. Historical perspectives, the cell theory, Ultra structure of animal and plant cells and their organelles: Cell wall, Plasma membrane, Mitochondria, Chloroplast, Ribosome, Golgi complex, Endoplasmic Reticulum, Nucleus, Lysosome, Peroxisomes, Vacuoles, Cytosol and Cytoskeleton structures, Cell –Cell interaction.

### Unit: 2

**15 Hours**

**Chromosomes and Cell division:** Discovery, morphology and structural organization: Number, size and types, Chromosomal Morphology, fine structure and models, heterochromatin and Euchromatin, **Cancer Biology:** Causes, symptoms, types of cancer and its prevention **Cell motility:** Amoeboid, ciliary and flagellar movements, Cell senescence and programmed cell **death** Cell Division: Cell cycle, Mitosis and Meiosis and its applications. **Transport across Cell Membrane:** Active and passive transport.

### Unit: 3

**15 Hours**

Introduction to genetics: History and scope and branches of Genetics  
Mendelianism: Mendel's work, Laws of heredity, back cross, Test-cross, Incomplete Dominance and simple problems  
**Supplementary factors:** Comb pattern in Fowls, Complementary factors: Flower color in sweet pea Multiple factors: Skin color in human beings Multiple allelism : Blood group in human beings ,Epistasis : Plumage color in Poultry **Sex determination in Plants and Animals:** Concept of allosomes and autosomes, XX-XY, XX-XO, ZW-ZZ, ZO-ZZ Types  
**(15 Hours)**

### Unit: 4

**15 Hours**

**Linkage and crossing over:** Coupling and repulsion hypothesis, Linkage in maize and Drosophila, Mechanism of crossing over and its importance, chromosomal mapping-Linkage map in maize

**Chromosomal Variation:** Structural and numerical aberrations, chromosomal evolution in wheat and cotton

**Mutations:** Types-Spontaneous and Induced; Mutagens – Physical and chemical mutagens, Induced Mutations in Plants, Animals and Microbes for economic benefit.

**Cytoplasmic inheritance:** Plastid inheritance in *Mirabilis*, Petite character in yeast and Kappa particles in *Paramecium*.

**Human Genetics:** Karyotype in man, Inherited disorders – Allosomal (Klinefelter's and Turner's syndrome), Autosomal (Downs and Cri-du-chat syndrome)

## First Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCP 1.1 **Paper Title:** Practicals-1

**Teaching Hours:** 3 H / Week

**Total hours:**45

**Marks:** Th-40+IA-10

**Credits :**1

### BTDSC P11: PRACTICALS I

**60Hours**

1. Study of fixatives and stains: Preparation of Formaldehyde (4-10%), Alcohol (70- 100%), Bouin's fixative, Carnoy's solution, Borax carmine (alcoholic), Eosin (alcoholic), Heamatoxylin, Acetocarmine, Aceto-orcein, Schiff's reagent (Feulgen method), Giemsa Stain.
2. Squash preparation: Onion root tip to study stages of mitosis.
3. Squash preparation: Grasshopper testis / onion flower bud/ Tradiscantia to study stages of meiosis.
4. Squash preparation of salivary gland chromosomes: Drosophila /Chironomous larva.
5. Karyotyping analysis.
6. Micrometry.
7. Buccal epithelial smear and Barr body.
8. Extraction of cellular materials in saline buffers, solvents and precipitation.
9. Demonstration of Laws of inheritance by using color beads
  - a. Law of segregation
  - b. Law of independent assortment
  - c. Solve genetic problems
10. Each student is required to submit 2 permanent slides of Mitosis and Meiosis:at least one from each.

### References:

#### CELL BIOLOGY:

1. Alberts, B.Bray, D. Lewis, J. Roff, M. Roberts, K, and Watson, J D 1994: 3rd edition, molecularbiology of "The Cell". Bolsover, S.R Hysams, J.E Jones, S. Shepherd, E.A and White, ,H.A.1997:Form genes to cells wileys-less .Inc New York.
2. Cambell, N.A. Mitchell, L .G. and Reece, J.B. 1996: General Biology. Benjamin cunning.
3. Cooper, GM. 1997 The Cell: A molecular approach, ASM press, USA.
4. De- Robertis, E.D.P. and Robertis, E.M.S. 1996: Cell and Molecular Biology, Holt Saunders International
5. Garrett, R.H. and Gresham, C.M. 1995: Molecular aspects of cellbiology, International edition, Saunders college publishing
6. P.K. Gupta Cell and molecular. Biology:
7. Gilbert and Raunio 1997: Embryology – constructing the organism
8. Holly Ahern 1992: Introduction to Experimental Cell biology, W.M.C. Brown publishers
9. Inder Singh, 1997: Text book of human Histology, Jaypee brothers Medical publishers, New Delhi.

10. Karp, G. 2000 Cell and Molecular Biology: Concepts and Experiments, John Willey and sons Inc. New York.
11. Lodish. H. Berk. A. Zipursky, S.L. Matsiduvarya. P. Baltimore, D. Darnell, J. 2000: Molecular cell Biology, Freeman W.H. and co. New York.
12. Singh, H.R. 2000: Animal Physiology and related Biochemistry, S. Lobanlal Nagin Chand and co. Educational publishers, New Delhi.
13. Smith and Wood 1992: Cell biology, Chapman and Hall.
14. Tobin and Morel 1997; Asking about “Cells “Saunders College Publishing.
15. Vasudev Rao, K. 1994: Developmental Biology – A modern Synthesis,
16. Oxford IBH publishing. Wilson, E.B.: Cells in Development and inheritance, Mac Millan, New York.

### **GENETICS :**

- 1 Daniel. L Hartl, “Basic Genetics”, Jones and Barlett Publishers USA.
- 2 Edgar Attenburg, “Genetics”, Oxford and IBH Publications.
- 3 Fairbanks, D.J.R. Anderson, W.R. 1999: Genetics, the continuity of life. Brooke and Cole Publication. Co. New York.
- 4 Lewin. B. 2000: Gene VII, Oxford University Press, New York.
- 5 Lewin, R 1999: Human Genetics: Concept and applications, 3<sup>rd</sup> edition WCB, Mc Graw Hills Dubuque, IA.
- 6 Miglani G.S. 2000, “Basic Genetics” Narosa publishing house. New Delhi.
- 7 Sandhya Mitra, “Genetics – Blue print of life” Tata Mc. Graw Hill publications
- 8 Snustad , P.D. and Simmons , M.J. 2000 : Principles of Genetics , 2<sup>nd</sup> Ed. John Wiley and Sons Inc. New York.
- 9 Stricberger, M.W. 1995: Genetics 3 Ed. Prentice Hall Inc. London.
- 10 Sturitevant, A. Hand Bredle, G.W. 1989: An Introduction to genetic W.B. Saunders Philadelphia.
- 11 Tamarin, R.M. 2000: Principles of genetics 6 Ed. WMC Publication co. London. Winchester Sinnott and Dorm, “Principles of Genetics”.

## Second Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCT 2.1  
**Teaching Hours:** 4 H / Week  
**Total hours:** 60

**Paper Title:** Biochemistry and Biostatistics  
**Marks:** Th-80+IA-20  
**Credits:** 3

### Unit: 1

**15 Hours**

**Carbohydrates:** Structure, Properties, Classification and functions

**Lipids:** Structure, Properties, Classification and Functions

**Amino acids and Proteins:** Structure, Properties, Classification and functions of amino acids and proteins. Structural organizations of proteins (primary, secondary, tertiary and quaternary structures) reverse turns and Ramachandran plot.

**Enzymes:** Nomenclature, classification, properties, factors influencing enzyme catalyzed reactions, enzyme inhibition (reversible and irreversible), outline of purification, industrial application of enzymes.

**Vitamins & Hormones:** Dietary source and functions of Water soluble and Fat-soluble vitamins. Chemistry and functions of pituitary and gonadal hormones.

### Unit:2

**15 Hours**

**Bioenergetics:** Concept of free energy transformations, Redox potentials, Regulations of Glycolysis, Krebs's cycle and Electron Transport System.

**Principles and applications of Solutions, pH and buffers:** Theory of water ionization and its purity (KW), pKa & pKb acids and bases, Derivation of Henderson-Hasselbalch equation and its significance. Buffers: Criteria for selection of buffers, types of buffers, Buffers in Biological systems and their mechanism of action.

### Unit:3

**15 Hours**

**Nucleic acids:** Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

**Analytical techniques:** Principles and applications of Chromatography (Paper, thin-layer, column and GLC), Centrifugation (RPM and G, Ultracentrifugation), Spectroscopy (UV-Visible), Isotopes and Radioactivity: Radioactivity, decay laws, Isotopes in Biological studies.

### Unit: 4

**15 Hours**

**Biostatistics:** Data & its types, Tabulation and classification of data, Frequency distribution and Graphical representation of data, Measures of central tendencies: Mean, Median, Mode and their properties, Measures of Dispersion: Mean deviation, Variance, Standard deviation and coefficient of Variation, Different models of data presentation with special reference to biological samples, Chi square test, student T test, introduction to SPSS analysis with examples etc.

## Second Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCP 2.1  
**Teaching Hours:** 3 H / Week  
**Total hours:** 45

**Paper Title:** Practicals-2  
**Marks:** Th-40+IA-10  
**Credits:** 1

### BTDSC P21: PRACTICAL-II

**Total hours:** 60

1. Preparation of percent molarity, molality and normality of solution, Measurement of pH and buffer.
2. Qualitative analysis of Carbohydrates, Amino acids, Proteins and Lipids.
3. Paper Chromatography of amino acids and sugars.
4. Qualitative analysis of body fluids such as blood and urine.
5. Assay of amylase activity.
6. Colorimetric estimation of protein by Biuret method.
7. Colorimetric estimation of blood sugar.
8. Estimation of amino acids.
9. Estimation of creatinine in urine sample.
10. Testing of acid phosphates (Potato) and alkaline phosphates (milk) activity.
11. Demonstration of catalase activity.

### References:

1. Biomolecules and analytical techniques Boyer Rodney, 1999 "Concepts of biochemistry", Pacific Grove, Brooks/cole publishing company.
2. Deb, A.C. "Fundamental of Biochemistry", New Central Book Agency, Calcutta.
3. Jain, J.L. "Fundamentals of Biochemistry".S. Chand and Company. Keshav Trehan; "Biochemistry", wiley Eastern publication.
4. Lehninger, et.al., 1997: Principal of Biochemistry CBS publishers.Mathews and Van Horde:
5. Moron, L.A. sceimgeour, K.G. Hostan, H.R. Ochs, R.S. and Rawn, J.D. 2000: Biochemistry, 3rd edition
6. Biomolecule: Mohan P. Arora Biophysics: Mohan P. Arora
7. Biochemistry: A. C. Deb
8. Biophysics: Pattabh & Gautham Text book of Biochemistry (1997), Devlin, Thomas, M.
9. Biochemistry (1993) Zubay, G.
10. Biochemistry Fundamentals, Voet et al.
11. Biochemistry, Friedfider, D.
12. Practical Biochemistry, Plummer.
13. Physical Biochemistry: Application to Biochemistry and Molecular Biology – Freilder.
14. Principle of Instrumental Analysis – Skoog & West
15. Bliss, C.J.K. (1967) Statistics in Biology Vol 1. I Mc Graw hill. New York
16. Campbell R.C. (1974) Statistics for Biologists, Cambridge Univ, Press, Cambridge
17. Daniel (1999) Biostatistics (3<sup>rd</sup> Edition) Panima Publishing, Comotation
18. Sward law, A.C. (1985) Practical statistics for Exponents Biologists, Jhon Wiley and Sons, In
19. Khan (1999) Fundamentals of Biostatistics, Publishing Corporation

## Third Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCP 3.1  
**Teaching Hours:** 4 H / Week  
**Total hours:** 60

**Paper Title:** Microbiology and Immunology  
**Marks:** Th-80+IA-20  
**Credits:** 3

### PART A – MICROBIOLOGY

#### Unit:1

**15 Hours**

**Introduction and scope of Microbiology:** Historical perspective, importance and scope of microbiology as a modern Science and Branches of microbiology

#### **Microbial techniques:**

A) Sterilization: Physical, chemical and radiation method of sterilization.

B) Microscopy: Phase contrast, florescent and electron microscope. C) Stains and staining techniques: Principles of staining, types of staining- Simple, Differential and Structural staining concept.

#### **Ultra-structure of Viruses and Bacteria:**

A. VIRUSES – Structure and classification Plant Viruses – CaMV Animal Viruses – Hepatitis B Bacterial Viruses – Lambda phage B. BACTERIA – Ultra structure of a bacterial cell, cell wall, endospore and capsule.

#### Unit:2

**15 Hours**

**Culture of microorganisms:** Culture media, types of culture media, isolation of microorganisms by different methods, preservation and maintenance of culture.

**Microbial growth:** Nutritional requirements of microorganisms, Bacterial growth curve, Factors affecting bacterial growth.

**Pathogenic microorganism** a) Bacterial diseases of man- Tetanus, Tuberculosis and Cholera. b) Viral disease – AIDS (HIV).

### PART B – IMMUNOLOGY

#### Unit:3

**15 Hours**

**Introduction to immunology:** History and scope of Immunology.

**Immunity:** Types of immunity – Innate, Active, Passive and Acquired, Humoral and Cell mediated Immunity.

**Cells of immune system:** Lymphoid cells, T & B lymphocytes

**Organs of immune system:** Bone marrow, Thymus, Lymph node and spleen.

#### Unit:4

**15 Hours**

**Antigens:** Types: Haptenes, Epitopes, Paratopes, Effector Phase, and Blood group antigens.

**Antibodies (Immunoglobulins):** Structure, theory of antibody formation, types, properties and functions of Immunoglobulins and MHC.

**Antigen- Antibody reactions:** Mechanism of precipitation, Agglutination, Complement fixation.

**Immuno-blotting techniques:** Immuno-Fluorescence, RIA and ELISA.

### Third Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCP 3.1  
**Teaching Hours:** 3 H / Week  
**Total hours:** 45

**Paper Title:** Practicals-3  
**Marks:** Th-40+IA-10  
**Credits:** 1

#### MICROBIOLOGY AND IMMUNOLOGY

1. Safety measures in microbiology laboratory.
2. Cleaning and sterilization of glassware's.
3. Study of instruments: Compound microscope, Autoclave, pH, laminar airflow and centrifuge.
4. Media preparation: Nutrient agar, Nutrient broth and Potato dextrose agar.
5. Isolation of bacteria and fungi from soil, air and water-dilution and pour plate method.
6. Inoculation techniques: stab, point, streak, pour plate and spread plate.
7. Bacterial staining technique – Simple and Differential (Gram's).
8. Counting of microorganism – Total count (Haemocytometer).
9. Biochemical tests: Starch hydrolysis, Catalase, Gelatin liquification.
10. Antibiotic sensitivity test – Paper disc method.
11. Preparation of serum.
12. Total RBC and WBC count.
13. Estimation of hemoglobin content in blood.
14. Demonstration of ELISA and RIA.
15. Diagnosis of infectious disease by immunoassay Widal test for Typhoid and Wassermann Reaction for syphilis.
16. Rocket Electrophoresis.

#### References:

##### MICROBIOLOGY

1. Ananthanarayanan, R. Jakarta Panikar, C.K.1997: textbook of microbiology. Orient Longman Chennai
2. Aneja, K.R.1997: Experiments in Microbiology Plant Pathology and tissue culture.
3. Atlas, R.M. 1998: Microbiology, Fundamentals and applications 2nd Edition McMillan Publishing Co. New York.
4. Auro, P.T. Kapoor, K. K. Yadav, K.S. 1996: An introduction to Microbiology, New Age International Pvt. Ltd.
5. Gerharot, P. Murry, R.G Wood, W.A. and kreig, N.R 1994: Methods for general and molecular bacteriology, American Socitey for Microbiological Washington DC.
6. Kumar, H.D. and Swati kumar 1998: Modern Concept of Microbiology, Vikas Publishing House Pvt. Ltd, New Delhi
7. Pecleczar Jr., M., J. Chan, E.U. and kreig, , N.R 1993 : Microbiology McGraw Hill Inc. New York.
8. Prescott, L.M. Harley, J.P. and Kiein, D.A. 1996: Microbiology WMC Brown Publisher.
9. Purohit S.S.1997-98: Microbiology, Agrobotanica Bikaner.
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11. Sharma P.D.2001: microbiology, Rastogi Publication, Meerut.

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13. Sundarajan S.1999, College microbiology, Vardhanan Publication, Bangalore.
14. Modern concept of Microbiology: H.D. Kumar & Swati Kumar
15. A text book of Microbiology: Dubey & Maheshwari
16. Microbial ecology fundamentals and application: Atlas Bartha
17. Fundamentals of Microbiology & Immunology: A.K. Banerjee, Nirmalya Banerjee
18. General Microbiology Vol. I & II-Power & Dangiwal
19. Microbiology, Prescott, Harley & Klein.
20. Alcamo's Fundamental of Microbiology, (2004); Pommerville et al.
21. Microbiology (1996); Prescott, Harley & Klein
22. Microbiology (2004); Tortora, F.
23. Foundation in Microbiology (1996); Talaro & Talora.
24. Food Microbiology (2004); Adam, M.R.
25. Principles of Microbiology (1994); Atlas, R.M.
26. Pharmaceuticals Microbiology (2003); Purohit & Saluja.
27. Microbiology: A Lab Manual, Cappuccino et al.
28. Brock Biology of Microbiology, Martinko, M. T & Parker, J.
29. Microbial Biotechnology (1998) Glazer & Nikaido

#### **IMMUNOLOGY:**

1. Abbas A.K., Litchman A.H and Pber J.S.1994: Cellular and molecular immunology, 2<sup>nd</sup> edition, W.C. Brown Publishers.
2. Abdul. K. Abbas, Litchman A.H and Pber J.S.2000: Cellular and molecular immunology, 4<sup>th</sup> edition, W.C. Brown Publishers.
3. Charles A. Janeway, Paul Travers, Mark Walport,2001: Immunology, Garland publishing, New York.
4. Cobman. R.M., Lambard M.F., and Sieard R.E.1992: Fundamental immunology, 2<sup>nd</sup> Edition, W.C. Brown Publishers.
5. Eli Benjamin, Richard Coiro, Gerfferey Sunshine, Hyde R.m.1992, Immunology, 2<sup>nd</sup> edition, Willeans and Wilkins Baltimore.
6. Essentials of Immunology – Roitt
7. Immunology – a short course, 4<sup>th</sup> edn, Wiley liss.
8. Immunology 3<sup>rd</sup> Ed. (1997) – Kuby J.
9. Immunology – An Introduction (2004) –Tizard, I.R., Thompson Pub.
10. Immunology – Roitt.
11. Jack Chirikjiou 1995: Biotechnology, theory and techniques, Plant biotechnology, Animal cell culture,
12. Immuno biotechnology (Vol I) Jones and Barlet Publishers, 40 Tall Pine Driver, stadbury.
13. Joshi K.R. and Osama N.O. 1998 Immunology Agro Botanica Bikoner.
14. Richard A. Gldsby, Thomas J, Kindth Barbara 2000: Immunobiology, W.H. Freeman and company, NewYork.
15. Tiyard Fon R 1992: Immunology- an introduction, Philadelphia, Saunder college Publishing.



## Third Semester B.Sc. (Biotechnology) Skill Enhancement Course

**Paper Code:** BTNSEC 3.2

**Teaching Hours:** 3 H / Week

**Total hours:** 30

**Paper Title:** Molecular Diagnostics

**Marks:** Th-40+IA-10

**Credits:** 3

### UNIT I

**15 Hours**

#### **Enzyme Immunoassays:**

Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques

### UNIT II

**15 Hours**

**Molecular methods in clinical microbiology:** Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

**Laboratory tests in chemotherapy:** Susceptibility tests: Micro-dilution and macro-dilution broth procedures.

**Susceptibility tests:** Diffusion test procedures.

**Susceptibility tests:** Tests for bactericidal activity.

### REFERENCES:

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton- Century-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert

## Fourth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCT 4.1

**Teaching Hours:** 4 H / Week

**Total hours:** 60

**Paper Title:** Molecular Biology

**Marks:** Th-80+IA-20

**Credits:** 3

### **Unit:1**

**15 Hours**

**Molecular basis of life:** An introduction, Experimental proof of DNA and RNA as Genetic material.

**Nucleic acids:** Structure and types of DNA and RNA and their functions

**DNA replication:** Prokaryotic and Eukaryotic – enzymes and proteins involved in replication, Theta and Rolling circle model.

**DNA damage and repair:** Causes and mechanism- Photo reactivation, Excision repair, Mismatch Repair.

### **Unit:2**

**15 Hours**

**Recombination in Prokaryotes:** Transformation, Conjugation and Transduction **Structure of Prokaryotic and Eukaryotic gene:** Genetic code, properties and deciphering **Insertional elements and transposons:** Transposable elements in Maize and Drosophila.

### **Unit: 3**

**15 Hours**

**Transcription:** Process of transcription, Transcription factors, post transcriptional Modifications.

**Translation:** Initiation, elongation and termination of protein synthesis, translation Factors.

### **Unit: 4**

**15 Hours**

**Regulation of gene expression:** Regulation of gene expression in Prokaryotes – Operon concept Regulation of gene expression in Eukaryotes – Transcriptional activation, Galactose metabolism in yeast. Gene organization and expression in mitochondria and chloroplasts. Regulation of gene expression during development in Drosophila.

## Fourth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSCP 4.1

**Teaching Hours:** 3 H / Week

**Total hours:** 45

**Paper Title:** Practicals-4

**Marks:** Th-40+IA-10

**Credits:** 1

1. Preparation of DNA model.
2. Estimation of RNA by Orcinol method.
3. Estimation of DNA by DPA method and determination of T<sub>m</sub> value and purity of DNA.
4. Detergent lysis of RNA.
5. Osmotic lysis of RNA.
6. Extraction of protein from Animal (goat) liver / muscle source by salt precipitation and organic solvent method and estimation of protein by Lowry's method.
7. Extraction of protein from plant source (Green gram / Pea) by salt precipitation and organic solvent method and estimation of protein by Lowry's method.
8. Protein separation by polyacrylamide gel electrophoresis.
9. Demonstration of Conjugation, transformation and transduction by charts

### **References:**

1. Darnell J., Lodish H., and Baltimore D.1990: molecular cell biology, Scientific American books inc., New York.
2. De Roberties, E.P.D. and De Roberties, E.M.S. 1988: cell and molecular biology. Lea and Jeliger. Philadelphians K.M. Varghese company.
3. Freifelder D and Malacinski G.M 1993, Essentials of molecular biology, Jones and Barklett Publishers Inc.
4. GerogeM. Malacinski 1998: Essentials of molecular biology, Jones and Barklett Publishers Inc.
5. Glick B.R. and Pasternak, J.J.1994: Molecular biotechnology, principles and applications of recombinant DNA, American Society for microbiology, Washington DC
6. Griffith A.J.F, Miller, J.H. Suzuki, 2000: An introduction to genetic analysis, 7th Ed. W.H. Freeman, NewYork
7. Howe C 1995: Gene cloning and manipulation, Cambridge university press, USA.
8. Karp G 1996: Cell and Molecular biology concept and experiment, John Wiley and sons Inc. New York
9. Roger L.P. Adams, John T and David P. Leader Biochemistry of Nucleic acid, Chapman and Holl publications
10. Sandhya Mitra 1988: Elements of Molecular Biology, MacMilan Publications.
11. Smith, Molecular Biology, Faber and Faber publications.
12. Walker J.M and Gingold E.B.1983 Molecular Biology and Biotechnology, Indian edition Royal society of chemistry UK
13. Watson J.D., Hopkins, N.H. Robert and Weiner A.M.1987, Molecular Biology of Gene 4th Ed., Benjamin Publ Co. New York.
14. Biotechnology &Genomics: P.K. Gupta
15. Molecular biology: Avinash & Kakoli Upadhyay
16. Cell & Molecular biology: S.C. Rastogy

## Fourth Semester B.Sc. (Biotechnology) Skill Enhancement Course

**Paper Code:** BTNSECT 4.2 **Paper Title:** Industrial Fermentations

**Teaching Hours:** 3 H / Week

**Marks:** Th-40+IA-40

**Total hours:** 30

**Credits:** 2

### UNIT I

**15 Hours**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti-cancer agents, amino acids.

### UNIT II

**15 Hours**

Microbial products of pharmacological interest, steroid fermentations and transformations. Overproduction of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing

### References:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2<sup>nd</sup> edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

## Fifth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSET 5.1

**Paper Title:** Plant and Animal Cell Technology

**Teaching Hours:** 4 H / Week

**Marks:** Th-80+IA-20

**Total hours:** 60

**Credits:** 3

### Unit 1.

**15 Hours**

**Plant tissue culture:** In vitro methods in plant tissue culture, aseptic Techniques. Types of nutrient media and use of growth regulators (Auxins, Cytokinins and Gibberellins). In vitro fertilization – Ovary and Ovule culture. Micropropagation of elite species. Organ Culture – Anther, Embryo and Endosperm culture and their applications.

### Unit 2.

**15 Hours**

**Protoplast Culture:** Isolation, regeneration and viability test, somatic hybridization, methods of protoplast fusion – chemical and electro fusion, practical application of somatic hybridization and cybridization. Somaclonal variation and their significance. In vitro production of secondary metabolites – Techniques and significance. Transgenic plants: Technique of transformation – biological (Agrobacterium mediated), physical and chemical methods.

### Unit 3.

**15 Hours**

**Animal cell culture:** Media and its components - Primary Culture – Cell lines, and cloning disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. Secondary Culture – transformed animal cells and continuous cell lines. Growth factors – Promoting proliferation of animal cells EGF, FGF, PDGF, IL-1, IL-2, NGF and erythropoietin.

### Unit 4.

**15 Hours**

**Transgenic animals:** Transfection of animal cell lines. Selectable Markers and Transplantation of Cultural Cells. Expression of Cloned proteins in animal cell – Expression vector, over production and downstream processing of the expressed proteins. **Biotechnology and Intellectual property rights:** Patents, trade secrets, copyright, trademark, Geographical indications, WIPO, TRIPS. Procedure involved in patenting biotechnological inventions.

## Fifth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSEP 5.1

**Teaching Hours:** 3 H / Week

**Total hours:** 45

**Paper Title:** Practicals-5

**Marks:** Th-40+IA-10

**Credits:** 1

1. Preparation of culture media (plant and animal)
2. Production of Callus and suspension Culture
3. Plant Protoplast Isolation
4. Plant propagation through Tissue culture (shoot tip and Nodal culture)
5. Planting and Maintenance of Medicinally important plants and its medicinal importance (1 student, 2 Plants compulsory)
6. Preparation of Synthesis seeds
7. Anther Culture
8. Trypsinization of animal tissue
9. Animal cell culture of trypsinized cells
10. Preparation of balanced salt solutions :( Hank and Earl)
11. Extraction of serum (chicken / mammalian).
12. Chick embryo extract (10-11 days embryos).
13. Culture of animal cells (chick embryo cells) by following techniques.  
a) Plasma clot. b) Single slide method / hanging drop technique. c) Range method.  
d) Grid method.

### Reference:

1. Ravishankar G.A and Venkataraman L.V(1997) Biotechnology applications of Plant Tissue & cell culture. Oxford & IBH Publishing co., Pvt Ltd.
2. Bhan (1998) tissue Culture, Mittal Publications, New Delhi.
3. Islan A.C (1996) Plant Tissue Culture, Oxford & IBH Publishing Co., Pvt. Ltd.
4. LydianeKyte& John Kleyn (1996) Plants from test tubes. An introduction to Micropropagation (3rd Edition) timber Press, Partland.
5. Kumar H.D (1991) A test book book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
6. Chrispeel M.J. and Sdava D.E. (1994) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
7. Reinert J. and Bajaj y.P.S (1997) Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture, NarosaPublishing House.
8. .Bhan 1998.'Tissue culture', mittal publication. New Delhi.

9. Chatwal.G.R.1995: Text Book of Biotechnology, Anmol Publ.Pvt.Ltd.
10. Chawla H.S. Introduction to Plant Biotechnology , 2007, Oxford and IBM publishing Co Ltd., New Delhi.
11. Chadha K.L. Hand book of Horticulture, 2007, Indian Courses of Agri research, New Delhi
12. Crueger.W.andCrueger.A:Biotechnology – A textbook of Industrial Microbiology.2nd Ed.
13. Gamborg and Phillips .1996 Plant cell, tissue and Organ Culture:Fundamentalmethods.NarosaPubl,
14. Gupta P.K.1996: Elements of biotechnology; Rastogi and Company.
15. Harrison,Maureen,A.,Rac.Ian.F. 1997: General Technique of cell culture.Cambridge University Press. York
16. Freshney R.L. 1987: Cultures of animal cells: A manual of basic techniques.IanR.Freshney: Wiley-Liss (3rd Ed) culture of Animal cells
17. John.R.W: Animal cell culture-practical approach, oxford
18. Pulher A. 1993: Genetic Engineering of animals, VCH publishers, Weinheim FRG.
19. Ravi Shankar G.A and Venkataram L.V. 1997, Recent advances in biotechnology, oxford and IBH Publishing company.
20. Sateesh M.K.2003 Biotechnology-5, New age international publishers
21. Spier R.E.and Griffith T.B.1987: Modern approaches to animal cell technology, Somerset,
22. Butterworth and company

## Fifth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSET 5.2A

**Paper Title:** Recombinant DNA and Nano-Technology

**Teaching Hours:** 4 H / Week

**Marks:** Th-80+IA-20

**Total hours:** 60

**Credits:** 3

### Unit: 1

**15 Hours**

#### **Introduction to Genetic Engineering Tools of Genetic engineering:**

**Enzymes- Restriction endonucleases:** Classification, Nomenclature, Their application in recombinant DNA technology.

**Ligases:** DNA ligases and their application, enzymes to modify DNA molecules.

**Vectors/Vehicle DNA:** Plasmid and their features, some common Vectors-PBR 322, PUC9, vector from bacteriophage  $\lambda$  (lamda) Phage M-13. cosmids.

### Unit:2

**15 Hours**

**Gene cloning:** Methods of introducing gene in prokaryotes and eukaryotes (E.coli and yeast cells as cloning host). **Detection of the right clone** Direct screening, direct selection, indirect screening technique, nucleic acid Probe.

**Cells for cloning:** *E.coli*, *Bacillus subtilis*, *Saccharomyces cerevisiae*

**Gene libraries:** Genomic library, cDNA library and phase lamda Vs cosmid For Gene libraries.

**Mapping the DNA:** Restriction mapping, DNA finger printing.

### Unit:3

**15 Hours**

**DNA sequencing:** Maxam-Gillbert's method. Sanger and Coulson's method Primer, template, the dideoxy nucleotide terminators and deoxynucleotides and polymerase. Using computers for sequencing and analyzing DNA Sequence Molecular biology techniques Electrophoretic techniques- Proteins and nucleic acids. Polymerase chain reaction (PCR). Site directed mutagenesis (SDM). Blotting techniques-Southern, Western and Northern blot. Applications of r-DNA technology in human health Production of recombinant vaccines- Hepatitis B Production of human growth hormone. Human genome project and its implication.

### Unit 4

**15 Hours**

Introduction to Nano-world, The nanoscale dimension and paradigm, Definitions and historical evolution (colloids etc.) and current practice. Nanoscience and Nanotechnology - Physical and Chemical Fundamentals of Nanomaterials, Applications in nanotechnology viz. Biosensors, separation of cells and cell organelles, drug delivery, gene therapy etc. Synthesis of nanostructures: Natural in inorganic, Natural in organism, chemical and physical methods -Sol Process, Micelle, Chemical Precipitation, Hydrothermal Method, Pyrolysis, Bio-based Protocol, Chemical Vapor Deposition, Sputtering etc. Applications in various fields viz. Physical and Chemical, Materials, Life Sciences.



## Fifth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSEP 5.2A

**Teaching Hours:** 3 H / Week

**Total hours:** 45

**Paper Title:** Practicals-6A

**Marks:** Th-40+IA-10

**Credits:** 1

1. Isolation / extraction of genomic DNA from bacteria, yeast, plant and animal Tissues.
2. Study of denaturation and renaturation of DNA.
3. Quantification of extracted DNA by spectrophotometer.
4. Isolation of plasmid DNA (E.coli).
5. Agarose gel electrophoresis of DNA..
6. Study of transformation by kits.
7. Isolation of phages by sewage sample.
8. Restriction digestion.
9. DNA finger printing: Comparison of two plates of monomorphic and dimorphic bands (Photographs).
10. Study of gene cloning through charts.
11. Study of principles of genetic engineering equipments.
  - A) PCR machine
  - B) Laminar air flow cabinet.
  - C) Refrigerated centrifuge.
  - D) CO<sub>2</sub> incubator.
  - E) ELISA reader.
  - F) Incubator shaker.
12. Synthesis of Al<sub>2</sub>O<sub>3</sub> nanoparticles using sol gel method.
13. Synthesis of Fe<sub>2</sub>O<sub>3</sub>, AuCl<sub>2</sub> and AgO<sub>2</sub> nanoparticles by chemical method.
14. Synthesis of semiconductor (ZnS, CdS etc.) nanoparticles by chemical method.
15. Synthesis of nanoparticles using biological process – (2-3 methods).
16. Detection of nanoparticles in colloidal solutions using UV-Vis absorption Technique

## Fifth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSET 5.2B

**Teaching Hours:** 4 H / Week

**Total hours:** 60

**Paper Title:** Bioinformatics

**Marks:** Th-80+IA-20

**Credits:** 3

### UNIT I

**15 Hours**

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

### UNIT II

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

### UNIT III

**15 Hours**

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

### UNIT IV

**15 Hours**

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools.

### **BTDSE T52B: PRACTICAL-VB**

**Total hours: 60**

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.

### **References:**

1. Ghosh Z. and Bibek anand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

## Fifth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSET 5.2B

**Teaching Hours:** 3 H / Week

**Total hours:**45

**Paper Title:** Practicals-5B

**Marks:** Th-40+IA-10

**Credits:** 1

1. Isolation / extraction of genomic DNA from bacteria, yeast, plant and animal Tissues.
2. Study of denaturation and renaturation of DNA.
3. Quantification of extracted DNA by spectrophotometer.
4. Isolation of plasmid DNA (E. coli).
5. Agarose gel electrophoresis of DNA.
6. Study of transformation by kits.
7. Isolation of phages by sewage sample.
8. Restriction digestion.
9. DNA finger printing: Comparison of two plates of monomorphic and dimorphic bands (Photographs).
10. Study of gene cloning through charts.
11. Study of principles of genetic engineering equipments.
  - A) PCR machine
  - B) Laminar air flow cabinet.
  - C) Refrigerated centrifuge.
  - D) CO<sub>2</sub> incubator.
  - E) ELISA reader.
  - F) Incubator shaker.
12. Synthesis of Al<sub>2</sub>O<sub>3</sub> nanoparticles using sol gel method.
13. Synthesis of Fe<sub>2</sub>O<sub>3</sub>, AuCl<sub>2</sub> and AgO<sub>2</sub> nanoparticles by chemical method.
14. Synthesis of semiconductor (ZnS, CdS etc.) nanoparticles by chemical method.
15. Synthesis of nanoparticles using biological process – (2-3 methods).
16. Detection of nanoparticles in colloidal solutions using UV-Vis absorption Technique

## Fifth Semester B.Sc. (Biotechnology) **Skill Enhancement Course**

**Paper Code:** BTNSECT 5.3  
**Teaching Hours:** 3 H / Week  
**Total hours:** 30

**Paper Title:**  
**Marks:** Th-40+IA-10  
**Credits:** 2

### **UNIT I**

**15 Hours**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti-cancer agents, amino acids.

### **UNIT II**

**15 Hours**

Microbial products of pharmacological interest, steroid fermentations and transformations. Overproduction of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

### **SUGGESTED READING**

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2<sup>nd</sup> edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

## Sixth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSET 6.1

**Paper Title:** Industrial and Environmental Biotechnology

**Teaching Hours:** 4 H / Week

**Marks:** Th-80+IA-20

**Total hours:** 60

**Credits:** 3

### PART A: INDUSTRIAL BIOTECHNOLOGY

#### Unit:1

**15 Hours**

Introduction to industrial biotechnology, Basic principle of fermentation technology.

**Design of fermenter and types:** Introduction, aseptic operation of fermenter, control and measurement Equipment & fermenter, pH, impeller, sparger, batch, aeration, Agitation, temperature control & foam control, types of fermenters – typical, airlift, Bubble up fermenter. Screening & isolation of industrially important microorganisms

**Downstream process:** Introduction, removal of microbial & other solid matter, Foam separation, filtration, centrifugation and application

**Fermentation media:** Natural and synthetic media, Sterilization techniques- Heat, Radiation, and filtration methods.

**Production of microbial products:** Lactic acid, Alcohol, penicillin & amylase.

#### Unit:2

**15 Hours**

**Fermented foods:** Fermented Foods-Yoghurt, Buttermilk, Dosa, cheese, Tempeh Microbial Foods-Single cell protein (SCP) and single cell oils (SCO). **Plant cell suspension culture for the production of food additives:** Saffron and capsaicin and shikonin.

**Technique of mass culture of algae:** *Spirulina*. Microbial polysaccharides and polyesters; production of xanthan gum and Polyhydroxy alkanoids (PHA).

### PART B: ENVIRONMENTAL BIOTECHNOLOGY: (30 Hours)

#### Unit:3

**15 Hours**

Renewable and non-renewable resources of energy. Impact of conventional and non-conventional fuels on environment. Biodegradation (xenobiotic compounds –simple, aromatic and petroleum products) and bioremediation. **Solid waste management:** Biogas production and its advantage.

#### UNIT:4

**15 Hours**

**Microbial ore leaching and recovery:** Biomining. Treatment of municipal waste and industrial effluents Study of Vermicomposting. Study of Air, water and Soil pollution. Environmental protection Act and related issues. Concept of global warming, ozone depletion (greenhouse effect, acid rain & Eco farming).

## Sixth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSEP 6.1

**Teaching Hours:** 4 H / Week

**Total hours:** 45

**Paper Title:** Practicals-6A

**Marks:** Th-40+IA-10

**Credits:** 3

1. Identification of industrially important microorganisms; *E.coli*, *Saccharomyces Cereviceae*, *Spirulina*.
2. Algal and Fungal culture – *Spirulina*, *Agaricus*, *Yeast* and *Aspergillus*.
3. Study of sugar fermentation by microorganisms by acid and gas production.
4. Preparation of wine from Grape, Banana / sweet potato.
5. Study of Bio gas plant.
6. Production of Biofertilizers, Vermi composting.
7. Estimation of Lactic acid.
8. Estimation of Lactose.
9. Bacteriological examination of water by MPN method.
10. Analysis of water samples for BOD, O<sub>2</sub>, toxic chemicals and microbial flora.
11. Determination of quality of water by MPN test.
12. Estimation of solids in sewage.
13. Visit to research centers / institutions / Industries.

**NOTE:** A report on the visit should be written and submitted along with Practical record.

### **References:**

#### **Industrial microbiology:**

1. Caside, LE 1968: Industrial microbiology, Wiley Eastern Ltd., New Delhi
2. Dubey, A.R.C.1995: A text book of Biotechnology.
3. Glazer A.N and Nikaido H-1995: Microbiology Biotechnology W.H. Freemanans co.
4. Harrison, Maureen. A, Ral, Ian F 1997: General Techniques of cell culture, Cambridge University Press.
5. Jay James M – 1996: Modern food microbiology CBS Publishers, New Delhi
6. Mallik. V.S and Sridhar P 1992 : Industrial microbiology
7. Patel A H. 1984: Industrial Biotechnology
8. Prakash M and Arora C.K.1998: Cell and Tissue Culture, New Delhi.

9. Prescott S.C and Dunn C 1984: Industrial microbiology, McGraw Hill, New York
10. Purohit S.S., Mathur S.K.1996: Biotechnology-fundamentals and applications. Agro botanical Publishers, New Delhi
11. Singh B D.2000: Biotechnology, kalyani publishers, Ludhiana.
12. Spier, R.E. and Griffith J.B.1987: Modern approaches to animal cell technology, Somerset, Butterworth and company ltd.
13. Stanbury P.F., Whitaker H . 1997: Principle of fermentation technology, Adity book limited.
14. Sullia S.B and Shantaram S. 1998: General Microbiology, Oxford and IBM publishing Co.
15. Singh B D.2006: Biotechnology, kalyani publishers, Ludhiana.
16. Wulfer Cruger and Annelier: Biotechnology. A text book of Industrial Microbiology. Cruger- Panima Publishing corporation, New Delhi

### **Environmental Biotechnology:**

1. A.K.D.E.: Environmental Chemistry, Wiley Eastern Ltd., New Delhi.
2. Agarwal K.C. 1996: Biodiversity. Agro-botanical publishers, New Delhi.
3. Alexander N. Glazer, Hiroshi Nikaida, 1995 Microbial biotechnology, Freeman and co.
4. Allosopp D and Seal K.J.: introduction to biodeteriation, EL 85/Edward Arnold
5. Baker. K.H. and Herson D.S.1994: Bioremediation McGraw Hill Inc., New York
6. Chatterji A.K 2002, introduction to environmental biotechnology, Prentice Hall of India, New Delhi
7. Christon J, Harst 1997, Manual of Environmental Microbiology, ASM Press, Washington DC
8. D.P.Singh and S.K.Dwivedi, Environmental Microbiology and Biotechnology, New age International Publishers
9. Dicastri F and Younes T, 1996, Biodiversity Science and development CAB International, Walfinhfords UK
10. Foster C.F. John WAe D.A Environmental Biotechnology, Ellis Horword Limited.
11. Grabiell Baston 1994: Waste Water Microbiology, willey-Lissinc., New York.
12. Lehinger T et.al Microbiology Degradation of Xenobiotics and Recalcitrant compounds, Academic Press, New York.
13. Metcalt and Eddy Inc., Waste Water Engineering- Treatment disposal and Reuse, Tata McGraw Hill, Delhi.
14. Mitchell R. Water Pollution Microbiology Vol I and II, Wiley inter science, New York.
15. Sinha R.K. 1997: Global Biodiversity, INA, Shree Publishers, Jaipur.

## Sixth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSET 6.2A **Paper Title:** Agricultural and Medical Biotechnology

**Total Teaching Hours:** 4 H / Week

**Marks:** Th-80+IA-20

**Total hours:** 60

**Credits:** 3

### **PART A - AGRICULTURAL BIOTECHNOLOGY :30 Hours**

#### **Unit:1**

**15 Hours**

Introduction to agricultural biotechnology. Crop improvement, hybridization and plant breeding techniques Plant tissue culture application in agriculture, horticulture and cryopreservation Study of biopesticides used in agriculture (Neem as example), Integrated Pest Management.

#### **Unit:2**

**15 Hours**

Mechanism of biological nitrogen fixation process, study of nif, nod and hup genes in Biological nitrogen fixation

**Biofertilizers:** Mechanism of growth promotion by microbial inoculants- *Rhizobium*, *Bradyrhizobium*, *Azospirillum*, *Azotobactor* and *Mycorrhizae*. Use of plant growth regulators in Agriculture and Horticulture.

**Transgenic plants:** Techniques and application (Bt. Cotton and Golden Rice).

### **PART B- MEDICAL BIOTECHNOLOGY: 30 Hours**

#### **Unit:3**

**15 Hours**

Introduction and scope of medical biotechnology.

**Vaccine:** Production of Bacterial and Viral vaccines, recombinant vaccines and its Production (FMDV) and gene vaccines.

**Enzymes used in Diagnosis:** Immobilized enzymes.

**Enzymes in Therapy:** Important enzymes and their therapeutic applications. Insulin production by recombinant DNA technology.

**Antisense Technology:** Principles and applications.

#### **UNIT:4**

**15 Hours**

**Therapeutic proteins:** Important proteins and their therapeutic applications- Somatotropin, Cytokines, Interleukin, Interferon, Human Factor-VIII and IX. **Hybridoma Technology** Production of monoclonal antibodies and their applications. **Human Gene Therapy** Somatic and Germline therapy. In vivo and in vitro gene therapy with an example each, scope of Human Gene Therapy.



## Sixth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSEP 6.2A

**Teaching Hours:** 3 H / Week

**Total hours:** 45

**Paper Title:** Practicals-6A

**Marks:** Th-40+IA-10

**Credits:** 1

### **BTDSE P62A: PRACTICAL VIA**

1. Isolation of soil microorganisms – *rhizobium, azotobacter and mycorrhiza*
  2. Estimation of Soil alkalinity
  3. Estimation of soil organic matter
  4. Effect of bio-pesticides on the growth of microorganisms.
  5. Isolation of rhizobium from root nodules.
  6. Study of R:S ratio (Rhizosphere : Non rhizosphere samples)
  7. Culturing microorganisms from vermi compost.
  8. Seed inoculation with rhizobium culture and observation for root nodulation.
  9. Photographic demonstration of transgenic crop plants / animals and agricultural
1. Biotechnology innovations.
  2. Preparation of biocontrol formulation.
  3. Biofertilizer Formulations
  4. Culturing of antibiotic resistant strains of bacteria and verification of resistance.
  5. Demonstration of PCR for diagnosis of a disease.
  6. Study of life cycle of Honeybee and Silkworm.

### **Reference:**

#### **Agricultural Biotechnology:**

1. Chatwal G.R.1995: Text Book of Biotechnology, Anmol Pub. Pvt.Ltd.
2. Chrispeel M.J. and Sdava D.E.1994, Plant Genes and Agriculture, Jones and BarlettPublishers, Boston.
3. Cruger W and Cruger A.: Biotechnology- A text book of Industrial Microbiology, 2nd edn.
4. Gamborg and Phillips 1996: Plant Cell, tissue and organ culture: Fundamental methods,Narosa Pub.
5. Gupta .P.K.1996: Elements of Biotechnology, Rasotagi and company.
6. Ignacimuthu S. 1996: Applied Plant Biotechnology.
7. Natesh S, Chopra. V.L and Ramachandra S. 1994: Biotechnology in Agriculture, Oxford and IBM Publ Co. Pvt. Ltd., New Delhi.
8. Prakash M and Arora C.K.1998: Cell and Tissue Culture, New Delhi
9. Razdan M.K.1993: An introduction to Plant Biotechnology.
10. Singh B D.2006: Biotechnology, kalyani publishers, Ludhiana.
11. Plant Biotechnology & Molecular Markers (2004) Shrivastava *et al*
12. Agricultural Biotechnology (1998) Altman, A.
13. Plant Biotechnology: The Genetic Manipulation of Plant (2004) Adrianstateret Legal Aspect of Gene Technology (2004) Brian, C.
14. The GMO Hand Book: Genetically Modified Animals, Microbes & Plant (2004) Sarad, R.P.

## Sixth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSET 6.2B

**Teaching Hours:** 4 H / Week

**Total hours:** 60

**Paper Title:** Medical Biology

**Marks:** Th-80+IA-20

**Credits:** 3

### UNIT I

(15 Hrs)

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels. Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram-positive bacteria: *S. aureus*, *S. pyogenes*, *B. anthracis*, *C. perferinges*, *C. tetani*, *C. botulinum*, *C. diphtheriae* *M. tuberculosis*, *M. leprae*.

### UNIT II

(15 Hrs)

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli*, *N. gonorrhoea*, *N. meningitidis*, *P.aeruginosa*, *S. typhi*, *S. dysenteriae*, *Y. pestis*, *B. abortus*, *H. influenzae*, *V. cholerae*, *M.pneumoniae*, *T. pallidum* *M. pneumoniae*, *Rickettsiaceae*, *Chlamydiae*.

### UNIT III

(15 Hrs)

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

### UNIT IV

(15 Hrs)

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton*, *Microsporun* and *Epidermophyton*) Subcutaneous infection (*Sporothrix*, *Cryptococcus*), systemic infection (*Histoplasma*, *Coccidoides*) and opportunistic fungal infections (*Candidiasis*, *Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

## Sixth Semester B.Sc. (Biotechnology)

**Paper Code:** BTNDSEP 6.2B

**Teaching Hours:** 3 H / Week

**Total hours:** 45

**Paper Title:** Practicals-6B

**Marks:** Th-40+IA-10

**Credits:** 1

### **BTDSE P62B: PRACTICAL-VIB**

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
2. Growth curve of a bacterium.
3. To perform antibacterial testing by Kirby-Bauer method.
4. To prepare temporary mounts of *Aspergillus* and *Candida* by appropriate staining.
5. Staining methods: Gram's staining permanent slides showing Acid fast staining, Capsule staining and spore staining.

#### **References:**

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott

## Sixth Semester B.Sc. (Biotechnology) Skill Enhancement Course

**Paper Code:** BTNSEC 6.3

**Paper Title:** Basics of Forensic Science

**Teaching Hours:** 3 H / Week

**Marks:** Th-40+IA-10

**Total hours:** 30

**Credits:** 2

### Unit I

(15 hours)

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

### Unit II

(15 hours)

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of hand writing, examination and comparison of handwritings and analysis of ink various samples.

### SUGGESTED READING

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: A n Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G.Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).