

**APPENDIX - 8 (R)**

**UNIVERSITY OF MADRAS**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. DEGREE COURSE IN MICROBIOLOGY**  
 (for the candidates admitted from the academic year 2013-2014)

- I. That in the Regulations relating to B.Sc. Degree Course in Microbiology – under Regulation No. **6-Scheme of Examinations** be modified to read as follows.

**REVISED SCHEME OF EXAMINATIONS**

**FIRST SEMESTER**

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
I	Part – I	Language Paper – I	6	3	3	25	75	100
I	Part - II	English Paper – I	6	3	3	25	75	100
I	Part - III Core Paper I	General Microbiology and Microbial physiology	6	4	3	25	75	100
I	Core Paper II	Major practical I: (General Microbiology and Microbial physiology)	3	4	6	40	60	100
I	Allied I	Paper I -Biochemistry I	6	4	3	25	75	100
I	Practical	Paper II - Practical I (Biochemistry I)	3	4	3	40	60	100
I	Soft skill - I		2	2	3			100

## SECOND SEMESTER

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
II	Part – I	Language Paper – II	6	3	3	25	75	100
II	Part - II	English Paper – II	6	3	3	25	75	100
II	Part - III Core Paper III	Immunology & Microbial Genetics	6	4	3	25	75	100
II	Core Paper IV	Major practical II: (Immunology & Microbial Genetics)	3	4	6	40	60	100
II	Allied -I	Paper – III Biochemistry II	6	4	3	25	75	100
II	Practical	Paper – IV Practical II Biochemistry II	3	4	3	40	60	100
II	Soft skill - I		2	2	3			100

## THIRD SEMESTER

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
II	Part – I	Language Paper – III	6	3	3	25	75	100
II	Part - II	English Paper – III	6	3	3	25	75	100
III	Part - III Core Paper V	Molecular biology	6	4	3	25	75	100
III	Core Paper VI	Major practical III: Molecular biology	3	4	6	40	60	100
III	Allied - II	Paper -I Bioinstrumentation	6	4	3	25	75	100

III	Practical	Paper – II Practical - III (Bioinstrumentation)	3	4	3	40	60	100
III	Soft skill - I		2	2	3			100

#### FOURTH SEMESTER

Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
						CIA	External	Total
II	Part – I	Language Paper – IV	6	3	3	25	75	100
II	Part - II	English Paper – IV	6	3	3	25	75	100
I V	Part - III Core Paper VII	Soil & Agricultural Microbiology	6	4	3	25	75	100
I V	Core Paper VIII	Major practical IV: Soil Agricultural Microbiology	3	4	6	40	60	100
I V	Allied - II	Paper III - Biostatistics	6	4	3	25	75	100
I V	Allied Practical	Paper IV – Practical IV ( Biostatistics)	3	4	3	40	60	100
I V	Soft skill - I		2	2	3			100

### FIFTH SEMESTER

Sl. No.	Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
							CIA	External	Total
1	V	Core Paper IX	Medical Bacteriology	6	4	3	25	75	100
2	V	Core Paper X	Medical Mycology & Parasitology	6	4	3	25	75	100
3	V	Core Paper XI	Medical Virology	6	4	3	25	75	100
4	V	Core Paper XII	Major Practical V: Medical Bacteriology, Mycology, Parasitology & Virology	6	4	6	40	60	100
5	V	Elective-I	Genetic Engineering	6	3	3	25	75	100

### SIXTH SEMESTER

Sl. No.	Semester	Course Components	Name of the Subject	Inst. Hrs.	Credits	Exam Hours	Max. Marks		
							CIA	External	Total
1	VI	Core Paper XIII	Environmental Microbiology	6	4	3	25	75	100

2	VI	Core Paper XIV	Food & Dairy Microbiology	6	4	3	25	75	100
3	VI	Core Paper XV	Major Practical VI: Environmental, Food & Dairy Microbiology	6	4	6	40	60	100
4	VI	Elective II	Industrial and Pharmaceutical Microbiology	6	3	3	25	75	100
5	VI	Elective III	Biotechnology	6	3	25	75	100	25

**Part IV – Non-major –elective, EVS, Value education, Extension activity is applicable to B.Sc. Microbiology degree course as followed in the other Under-graduate / 5 year Integrated degree courses.**

II. The above amendment to the Regulations take effect from the academic year 2013-2014 and thereafter.

**AC.S'12**

**APPENDIX – 8 (S)**

**UNIVERSITY OF MADRAS**  
**CHOICE BASED CREDIT SYSTEM**  
**B.Sc. DEGREE COURSE IN MICROBIOLOGY**  
(for the candidates admitted from the  
academic year 2013-2014 onwards)

**REVISED SYLLABUS**

**SEMESTER - I**

**CORE: PAPER-I**

**GENERAL MICROBIOLOGY & MICROBIAL PHYSIOLOGY**

**UNIT I**

History of microbiology, microscopy including electron microscope; stains and staining methods. Anatomy of prokaryotic and eukaryotic cells.

**UNIT II**

Culture media and pure culture techniques. Anaerobic culture techniques. Sterilization and disinfection; Antimicrobial chemotherapy. Methods of bacterial identification- morphological, physiological, biochemical and serological properties.

**UNIT III**

Physiology of microbial growth and nutrition. Batch – continuous - synchronous cultures; Growth Curve. Nutritional requirements. Transport of nutrients by active and passive transport. Sporulation.

**UNIT IV**

Respiration. Fermentation. Photosynthesis - oxygenic and anoxygenic.; Bio-geo chemical cycles.

**References:**

1. Bernard D. Davis. Renato Dulbecco. Herman N. Eisen. and Harold, S. Ginsberg. (1990). Microbiology (4th edition). J.B. Lippincott company, New York.
2. Alexopoulos C.J. and C W. Mims. (1993). Introductory Mycology (3rd edition). Wiley Eastern Ltd, New Delhi.

3. Elizabeth Moore - Landecker. (1996). Fundamentals of the fungi. (4th edition). Prentice Hall International, Inc, London.
4. Heritage, J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.
5. Holt, J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins, Baltimore.
6. John Webster (1993). Introduction to Fungi. (2nd edition). Cambridge University press, Cambridge.
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8. Larry Mc Kane and Judy Kandel (1996). Microbiology- Essentials and applications. (2nd edition). Mc Fraw Hill Inc, Newyork.
9. Madigan, M.T. Martinko.J.M and Parker J Brock T.D. (1997). Biology of Microorganisms.(8th edition).Prentice Hall International Inc, London.
10. Schaechter M and Leaderberg J (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California.
11. Nester, E.W., Roberts, C.V. and Nester, M.T. (1995). Microbiology, A human perspective. IWOA, U.S.A.
12. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York.
13. Salle, A.J. (1996). Fundamental principles of Bacteriology.(7th edition).Tata McGraw - Hill publishing company Ltd, New Delhi.
14. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, U.S.A.
15. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition). McGraw - Hill company, New York.
16. Moat, A.G. and Foster, J.W. (1988). Microbial Physiology (Second Edition). John Wiley & Sons, New York.

17. White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
18. Prescott, L.M., Harley, J.P. and Klein, D.A. (1999) Microbiology. McGraw Hill, New Delhi
19. Ketchum, P.A. (1984) Microbiology: Concepts and Applications. John Wiley and Sons, New York.
20. Mandelstam, J., McQuillen, K. and Dawes, L. (1992) Biochemistry of Bacterial Growth, 3rd Edn. Blackwell Scientific Publications, Oxford.
21. Doelle, H.W. (1975) Bacterial Metablism. 2nd Edn. Academic Press, London.
22. Moat, A.G. and Foster, J.W. (1995) Microbial Physiology, 3rd Edn. John Wiley and Sons, New York.
23. Rose, A.H. (1976) Chemical Microbiology: An Introduction to Microbial Physiology, 3rd Edn. Plenum, New York.
24. Gottschalk, G. (1986) Bacterial Metabolism, 2nd Edn. Springer-Verlag, New York.
25. Ingraham, J.L. and Ingraham, C.A. (2000) Introduction to Microbiology, 2nd Edn. Books / Cole Thomson Learning, UK.
26. Schelegel, H.G. (1993) General Microbiology, 7th Edn. Cambridge University Press, Cambridge.

**CORE PAPER II - Major Practical –I**  
**GENERAL MICROBIOLOGY AND MICROBIAL PHYSIOLOGY**

**UNIT I**

Cleaning of glass wares Sterilization principle and methods- moist heat- dry heat and filtration methods. Media preparation: liquid media, solid media, agar slants, agar plates, basal, enriched, selective media preparation- quality control of media, growth supporting properties, sterility check of media.

**UNIT-II**

Pure culture techniques: streak plate, pour plate, decimal dilution. Culture characteristics of microorganisms: growth on different media, growth characteristics and description. Demonstration of pigment production.



### **UNIT-III**

Microscopy: light microscopy, bright field microscopy, dark field microscopy. Motility demonstration: hanging drop, wet mount preparation, dark field microscopy, semi solid agar, Craigie's tube method. Staining techniques: smear preparation, simple staining, Gram's staining, acid fast staining, staining of Metachromatic granules.

### **UNIT-IV**

Morphology of microorganisms: morphological variations in algae, morphology of fungi, slide culture technique. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains. Micrometry: Demonstration of size of yeast and fungal filaments.

### **UNIT-V**

Physiology characteristics: IMViC test, H<sub>2</sub>S, Oxidase, catalase, urease test. Carbohydrate fermentation test, maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

## **ALLIED I - Paper I – BIOCHEMISTRY - I**

### **UNIT-I :**

Chemistry of Carbohydrates Definition and Classification of carbohydrates, linear and ring forms (Haworth formula) for monosaccharides for glucose and fructose. Disaccharides - sucrose and lactose. Physical properties - mutarotation and kiliani cynohydrin synthesis. Chemical properties-Oxidation, reduction, osazone formation. Disaccharide-sucrose and lactose - occurrence, structure; Physical and chemical properties. Polysaccharides: starch and cellulose-occurrence, structure, physical and chemical properties

### **UNIT-II :**

Chemistry of aminoacids: Definition and classification of aminoacids, common properties of aminoacids, amphoteric nature, isoelectric point, isoelectric pH and Zwitter ion. Reaction with ninhydrin, 1-fluoro-2, 4-dinitrobenzene (FDNB) and Siegfried's carbamino reaction.

### **UNIT-III :**

Chemistry of Proteins Classifications-shape and size, solubility and physical properties and functional properties. Physical properties: salting in and salting out, denaturation, peptide bond. Structure of protein: primary, secondary, tertiary and quaternary. N-terminal determination-Edman's and Dansyl chloride method. C-terminal determination-Van-Slyke reaction, Phosgene reaction

### **UNIT-IV :**

Chemistry of Lipids

Definition, classification and functions. Occurrence, chemistry and biological functions- simple lipids: tertiary compound lipids (e.g. phospholipids), derived lipids: steroids (e.g. cholesterol). Saturated fatty acids: Butyric, arachidic and stearic acid. Unsaturated fatty acids: Oleic, linoleic and linolenic acid. Physical property emulsification. Chemical properties-saponification, rancidity, definition of acid number, saponification number, iodine number and Reichert-Meissl number. Bile acid and bile salt functions.

#### **UNIT-V :**

Chemistry of Nucleic acids Definition, nucleoside, nucleotide and polynucleotide. Double helical model of DNA and its biological functions. Structure of RNA: tRNA, mRNA and rRNA-occurrence, chemistry and its biological functions. Differences between DNA and RNA properties: cot curve and cot value, T<sub>m</sub>, hypo and hyper chromicity.

#### **References**

1. Lehninger Principles of Biochemistry-David L. Nelson, Michael M. Cox, Macmillan Worth Publishers.
2. Harper—s Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange Medical Books. 25th edition.
3. Fundamentals of Biochemistry-J.L. Jain, Sunjay Jain, Nitin Jain, S. Chand & Company.
4. Biochemistry-Dr. Amit Krishna De, S. Chand & Co., Ltd.
5. Biochemistry-Dr. Ambika Shanmugam, Published by Author.
6. Biomolecules-C. Kannan , MJP Publishers,Chennai-5.

### **ALLIED I – Paper II**

#### **PRACTICAL I - BIOCHEMISTRY - I**

##### **PRACTICAL I Volumetric Estimation**

1. Estimation of HCl using Na<sub>2</sub>CO<sub>3</sub> as link and NaOH as primary standard.
2. Estimation of Iron in Ferrous Ammonium Sulphate using potassium permanganate as link solution and oxalic acid as primary standard.
3. Estimation of Glucose by Benedict—s method.
4. Estimation of Glycine by formal titration.
5. Estimation of Ascorbic acid.

### **SEMESTER II**

#### **CORE PAPER – III IMMUNOLOGY AND MICROBIAL GENETICS**

##### **UNIT I**

History of immunology; Innate immunity, organs & cells in immune response. Humoral & cell mediated immunity. Complement. Antigens – properties, types. Vaccine. Immunoglobulins – types, structure and functions of different classes of IgG – theories of Antibody formation; Mechanism of immune response;

## **UNIT II**

MHC – structure & types ; Immuno haematology; Hypersensitivity reactions – types ; Transplantation Immunology (types & graft rejection) Immunological techniques – precipitation, agglutination, CFT, RIA, ELISA, IFT, Western blot.

## **UNIT III**

Molecular concept of gene. Bacterial plasmids – structures & properties; Bacteriophage – Lytic & Lysogenic cycle – phage  $\lambda$  . Structures of bacterial Transposons – Types of bacterial Transposons.

## **UNIT IV**

Gene transfer – transformation, Conjugation & transduction; Operon - Lac operon – trp operon. Mutations –types & mechanisms - Ames test, Role of mutation in evolution. Mechanism of Antibiotic resistance

### **References:**

1. Chapel, H. and Halbey, (1986). Essentials of Clinical Immunology. ELBS.
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3. Kuby, J. (1994) Immunology, 2nd Edn. H.W.Freeman and Company, New York.
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12. Roitt, I.M.(1988) Essential Immunology. Blackwell Scientific Publications,Oxford.
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20. Lewin, B, (2000). Genes VII. Oxford University Press.
21. Maloy, S.R., Cronan Jr. Je. Freifelder D (1998). Microbial genetics. Jones and Barlett Publishers
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23. Maloy, S.R., Cronan, J.R. Freifelder, D. (1994). Microbial Genetics, Jones and Bartlett Publishers
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27. Old, R. and Primrose, S.B. (1995) Principles of Gene Manipulation: An Introduction to Genetic Engineering, 5th Edn. Blackwell Scientific Publications, Oxford.
28. Freifelder, D. (1995) Molecular Biology. Narosa Publishing House, New Delhi.
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34. Talwar GP (ed). (1982) A handbook of Practical Immunology, Vikas Publishing House Pvt. Ltd.
35. Talwar GP (1983). Microscopic Immunoassays and Applications, Vikas International Students Edition, Vikas Publishing House Pvt. Ltd.
36. Brawshaw L.J. (1988). Laboratory Immunology, Sandders College Publishing.

**CORE PAPER -IV – MAJOR PRACTICAL-II**  
**(IMMUNOLOGY AND MICROBIAL GENETICS)**

**UNIT-I**

Blood groups and typing - Coombs's test. Precipitation reaction in

Gel-Diffusion, double diffusion, Single Radial Immuno diffusion. VDRL, RPR. Agglutination reactions: Slide and Tube methods RBC agglutination IHA, TPHA Bacterial.

#### **UNIT-II**

Complement fixation test. Titration of antibody and complement (demonstration only). Immunofluorescence, (Demonstration only), ELISA

#### **UNIT-III**

Isolation of Buffy coat, using heparin lymphocytes (T cells, B cells), Enumeration of different cell types, Peripheral blood cell counts, absolute cell counts.

#### **UNIT-IV**

Antibody production in rabbits against sheep RBC and its titration (Demonstration). Anaphylactic reactions in guinea pigs. Arthus reaction in rabbits, (Demonstration).

#### **UNIT-V**

Skin tests, both immediate and delayed hypersensitivity reactions to egg proteins, bacterial, fungal antigens.

### **ALLIED I – Paper III - BIOCHEMISTRY- II**

#### **UNIT-I :**

Metabolism Glycolysis, TCA cycle, HMP shunt and its energy yield. Deamination, transamination reaction, SGOT and SGPT. Urea cycle, Biosynthesis of fatty acids, beta oxidation.

#### **UNIT-II :**

Metabolic Disorders Jaundice, hypoxia, glycogen storage diseases, pentosuria, ketosis, lipidosis, edema, gout. Dehydration: definition, causes, symptom and prevention.

#### **UNIT-III :**

Enzymes Definition, classification of enzymes with one example. Mechanism of enzyme action. Lock and key mechanism, induced fit theory. Property: specificity. Isoenzyme: Definition with one example. Factors affecting enzyme activity: pH, temperature and substrate concentration. Michaelis-Menten equation. Enzyme inhibition: competitive, uncompetitive and non competitive. Biological functions of enzymes.

#### **UNIT-IV :**

Molecular Biology Replication: Definition, types, mode of action of replication, mechanism of replication. General mechanism of transcription and translation. Genetic code. DNA and RNA act as genetic material.

#### **UNIT-V :**

Vitamins and Minerals A brief outline of occurrence and biological function of Vitamins and minerals (Na, K, Cl, Ca, P, I , Fe, Mg & S)

#### **References**

1. Lehninger Principles of Biochemistry-David L. Nelson, Michael M. Cox, Macmillan Worth Publishers.
2. Harper—s Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange Medical Books. 25th edition.
3. Fundamentals of Biochemistry-J.L. Jain, Sunjay Jain, Nitin Jain, S. Chand & Company.
4. Biochemistry-Dr. Amit Krishna De, S. Chand & Co., Ltd.
5. Biochemistry-Dr. Ambika Shanmugam, Published by Author.
6. Biomolecules-C. Kannan , MJP Publishers,Chennai-5.

### **ALLIED I – Paper IV**

### **PRACTICAL II - BIOCHEMISTRY - II**

#### **PRACTICAL II Qualitative analysis**

1. Carbohydrates: Glucose, fructose, galactose, mannose, maltose, lactose and arabinose and xylulose.
2. Amino acids: Arginine, cysteine, tryptophan and tyrosine.

Colorimetric analysis (only for demonstration)

1. Estimation of protein by Biuret method.
2. Estimation of DNA using diphenyl amine.
3. Estimation of glucose by O -Toluidine.

#### **References:**

1. Practical Clinical Biochemistry - Harold Varley, CBS, New Delhi.
2. Medical Laboratory Technology-Kanai L. Mukherjee, Tata McGraw Hill., Vol. I, II, III.
3. Clinical Chemistry - Ranjana Chawla.

4. Laboratory manual in Biochemistry - Jayaraman.
5. Biochemical methods - S.Sadasivan and Manickam.
6. Introduction to Practical Biochemistry - David T. Plummer

## **SEMESTER - III**

### **CORE PAPER V - MOLECULAR BIOLOGY**

#### **UNIT I**

DNA structure, various forms (A, B, Z & H), Stability of nucleic acid structures; prokaryotic and eukaryotic genome organizations.

#### **UNIT II**

**DNA replication, repair and recombination:** Enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

#### **UNIT III**

**RNA synthesis and processing:** Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA,

#### **UNIT IV**

**Protein synthesis:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA,

#### **UNIT V**

**Control of gene expression at transcription and translation level:** Regulation of, prokaryotic and eukaryotic gene expression, role of chromatinin regulating gene expression and gene silencing.

#### **References:**

1. Brown, T.A. (199). Gene Cloning. 3rd edition. Chapman and Hall Publications, U.S.A.
2. Burrell, M.M. (1993). Enzymes of Molecular Biology, Humana Press.
3. Chirikjian, J.G. (1995). Biotechnology – Theory and Techniques, Vol. II, Jones and Burtlett Publishers.



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6. Blackburn, G.M. and Gait, M.J. (1996). Nucleic acids in chemistry and biology. Oxford University Press.
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16. Geoffrey L. Zubay (1998). Biochemistry. Wm. C. Brown Publishers, 4th Edition.
17. Lewin, B. (2000) Genes VII. Oxford University Press.
18. George M. Malacinski, David Freifelder. (1998). Essentials of Molecular Biology. Jones and Bartlett Publsiherers.

19. Maloy, S.R., Cronan, J.R. Freifelder, D. (1994). Microbial Genetics, Jones and Bartlett Publishers. M.Sc. Applied Microbiology: Syllabus (CBCS) 60
20. Macinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology, 3rd Edition, John and Bartlett Publishers.
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22. Patki, L.R., Bhalchandra, L. and Jeevaji, I.H., 1989, An introduction to microtechniques, S. Chand and Company Ltd., New Delhi.
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24. Dharmalingam K. (1986). Experiments with M13, Macmillan India Ltd. Chennai.
25. Harwod AJ. (1994). Protocols for Gene Analysis. Humana Press.
26. Surzyeki S (2000). Basic Techniques in Molecular Biology. Springer.
27. Miyamoto MM, Cracraft JL. Phylogenetic Analysis of DNA sequences. Oxford University Press. Oxford.
28. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH (2002). Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH Freeman and Company, New York.
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35. Balows A, Hansler Jr K.L, Isenberg H.D, Shalomy H.J (1991). Manual of Clinical Microbiology, American Society for
36. Microbiology, Washington DC.

## **CORE PAPER VI**

### **MAJOR PRACTICAL III (MOLECULAR BIOLOGY)**

#### **UNIT I**

Estimation of DNA by diphenylamine method. Estimation of RNA by orcinol method.

#### **UNIT II**

Isolation of Plasmid DNA by Alkalysis method.

Isolation of Chromosomal DNA from Eukaryotic cells. Eg. Leaves,.

#### **UNIT III**

Isolation of RNA from yeast.

Isolation of antibiotic resistant mutants.

#### **UNIT IV**

Preparation of competent cells.

#### **UNIT V**

Transformation of E.coli.

### **ALLIED II - Paper I - BIOINSTRUMENTATION**

#### **Unit –1 Basic laboratory Instruments**

Common laboratory equipment –anaerobic incubator – Biosafety Cabinet -

Principle and working of pH meter, Laminar-air flow. Centrifugation: Types & principles

and their applications- Lyophilizer - Flow cytometry.

### **Unit – 2 Chromatographic techniques**

Theory, principles and applications of paper, thin layer, gel filtration, ion exchange,

### **Unit – 3 Electrophoretic techniques**

Basic principles of electrophoresis, theory and application of paper, agarose,

### **Unit – 4 Spectroscopy**

Spectroscopic techniques, theory and applications of UV, Visible, IR, NMR, Fluorescence,

Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy.

### **Unit – 5 Radioisotopic techniques**

Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer

techniques, detection and measurement of radioactivity using ionization chamber, proportional

chamber, Geiger- Muller and Scintillation counters, autoradiography and its applications.

## **ALLIED II – Paper II**

### **PRACTICAL III (BIOINSTRUMENTATION)**

1. Studies on pH titration curves of amino acids/ acetic acid and determination of pKa values and Handerson-Hasselbach equation.
2. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
3. Separation of serum protein by horizontal submerged gel electrophoresis.
4. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
5. Quantitative estimation of hydrocarbons/pesticides/organic Solvents /methane by Gas chromatography.
6. Demonstration of PCR, DNA sequencer, Fermenter, Flow cytometry

## References

### Laboratory / online

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2. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S.Himalaya Publishing House, Mumbai.
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.
4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
5. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.
6. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons.Inc., New York.
7. Analytical Biochemistry by Holme.
8. Introduction to High Performance Liquid Chromatography by R R. J. Hamilton and P. A. Sewell.
9. Spectroscopy by B.P. Straughan and S. Walker.
10. John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.

## SEMESTER - IV

### CORE PAPER VII - SOIL AND AGRICULTURAL MICROBIOLOGY

#### UNIT I

Soil microbiology - quantitative and qualitative micro flora of different soils-role of microbes in soil fertility-tests for soil fertility - soil structure, soil formation - characterization of soil types and importance.

#### UNIT II

Biogeochemical cycles-role of micro organisms in carbon, phosphorus. sulphur and iron cycles. Methods of studying ecology of soil micro organisms-microbial gas metabolism-carbon dioxide, hydrogen, and methane and hydrogen sulphide.

### **UNIT III**

Microbial interactions between microorganisms, plant and soil. Rhizoplane, rhizosphere, phyllosphere, spermosphere, mycorrhizae. Microbial association with insects-gut micro flora - symbiosis between microbes and insects; organic matter decomposition.

### **UNIT IV**

Nitrogen cycle; ammonification- nitrification- de-nitrification- nitrogen fixation- Bio-fertilizers (bacterial, cyanobacteria and azolla) and crop response-bio-pesticides (bacterial, viral and fungal) saprophytes for pathogen suppression.

### **UNIT V**

Principles of plant infection and defense mechanisms. Symptoms, Etiology, Epidemiology and Management of the following plant diseases: Mosaic disease of tobacco; Bunchy top of banana; Leaf roll of potato; Bacterial blight of paddy; Angular leaf spot of cotton, Late blight of potato; Damping off of tobacco, downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Blight of maize/sorghum; Leafspot of paddy, Grassy shoot of sugar cane; Root knot of mulberry.

### **References:**

1. Cambell, R. (1983) Microbial Ecology, 2nd Edn. Blackwell Scientific Publications, London.
2. Lynch, J.M. and Poole, N.J.(1979) Microbial Ecology: A. Conceptual Approach. Blackwell Scientific Publications, London.
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21. Data, S.C. (1989) Plant Physiology. Central Book Depot, Allahabad.
22. Hall, D.V. and Rao, K.K. Photosynthesis. Arnold, London.
23. Jacob, W.P. (1979). Plant Hormones and Plant Development. Cambridge University Press, Cambridge.
24. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology. Wassworth Publication. Co.. Belmont.
25. Ting, I.P. (1982) Plant Physiology. Addison Wesley Publication, Phillipines

26. Postgate, J. (1987) Nitrogen Fixation, 2nd Edn. Cassel, London.
27. Bonner, J. and Varner, J.E. (1979) Plant Physiology. Macmillan, New Delhi.

### **CORE PAPER VIII - MAJOR PRACTICAL IV** **(SOIL AND AGRICULTURAL MICROBIOLOGY)**

#### **UNIT I**

Methods to study soil microorganisms - Isolation and enumeration of Bacteria, Fungi, Bacterio-phages, Algae, Protozoa etc., Microbiological test for fertility - Bacterial and Fungal

#### **UNIT II**

Microbiological demonstration of soil enzymes – Amylase, Protease, Lipase, Gelatinase etc.

#### **UNIT III**

Isolation and identification of root nodule bacteria- Rhizobium(symbiotic), demonstration of rhizobium in the root nodule(CS of root nodule) Isolation and identification of Azotobacter (Asymbiotic).

#### **UNIT IV**

Isolation and identification of nitrogen fixing Cyanobacteria- Anabaena, Nostoc etc., Demonstration of Azolla Demonstration of antagonistic activity –bacterial and fungal.

#### **UNIT V**

Study of the following diseases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Leaf spot of paddy, Red rot of sugar cane, Root knot of mulberry.

### **ALLIED – II PAPER III - BIOSTATISTICS**

#### **UNIT I**

##### **Introduction:**

Types of biological data; frequency distributions; cumulative frequency distributions.



**Populations and samples:**

Populations; samples from populations; random sampling; parameters and statistics.

**UNIT II****Measures of Central Tendency:**

Mean; median; mode; geometric mean; harmonic mean.

**Measures of Dispersion:**

Range; variance; standard deviation, coefficient of variation; standard error.

**UNIT III****Probability:**

Mathematical probability and statistical probability; Laws of probability; addition law and multiplication law; conditional probability.

**Probability Distribution:**

Normal distribution; binomial distribution and poisson distribution.

**UNIT IV****Testing for goodness of fit:**

Chi-square test for goodness of fit; statistical significance; statistical errors in hypothesis testing; chi-square test for contingency tables; heterogeneity chi-square test.

**Test of hypothesis:**

Normal deviation test, tests for proportions, t-test.

**UNIT V****Simple linear regression and correlations:**

Simple linear regression; testing the significance of a regression; comparison of two slopes; correlation coefficient – hypothesis testing about correlation coefficients; comparison of two correlation coefficients; rank correlation; intraclass correlation.

**Analysis of variance:**

One-way classification; two-way classification.

## **ALLIED- II Paper IV**

### **PRACTICAL IV - BIOSTATISTICS**

#### **UNIT I**

Frequency distribution – Univariate – Bivariate; Measure of central tendency

#### **UNIT II**

Measure of dispersion; Correlation, Regression

#### **UNIT III**

Fitting distribution – Binomial – Poisson – Method of least squares

#### **UNIT IV**

Tests of significance – T – F; Tests of significance – Chi-square – Attributes

#### **UNIT V**

ANOVA; Design of experiments – CRO, RBD, LSD

#### **References:**

1. Arora, P.N. and Malhon P.K., (1996) Biostatistics. Imalaya Publishing House, Mumbai.
2. Sokal and Rohif, (1973) Introduction to Biostatistics - Toppan Co. Japan.
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5. Stanton, A and Clantz, Primer of Biostatistics - The McGraw Hill Inc., New York.

## **SEMESTER - V**

### **CORE PAPER IX - MEDICAL BACTERIOLOGY**

#### **UNIT I**

Classification and general properties of medically important bacteria. Recommendation for collection, transport of specimens, isolation of bacteria from clinical specimens.

## **UNIT II**

Primary media for isolation and their quality control - Antibiotic sensitivity discs, testing procedures and their quality control.

## **UNIT III**

Staphylococcus; streptococci and related catalase negative Gram-positive cocci; Neisseria and Branhamella Corynebacterium and related organisms. Mycobacterium - typical and atypical. Aerobic pathogenic actinomycetes.

## **UNIT IV**

Bacillus, B.anthraxis, Vibrios, Aeromonas Helicobacter  
Pseudomonas, Brucella, Haemophilus, Bordetella.  
Enterobacteriaceae, Salmonella, Shigella, Proteus, Escherichia,  
Klebsiella.

## **UNIT V**

Clostridia, Mycoplasma, Rickettsiae, Spirochetes, Trepenema, Leptospira and Borrelia.

### **References:**

1. Gerhardt, P. Murray, R.G., Wood, W.A., and Kreig, N.R. (1994). Methods for General and Molecular Bacteriology, ASM Press, Washington D.C.
2. Ronald M. Atlas, Lawrence C. Papis (1993) Hand book of Microbiological Media. Ed. LC. CRC Press, London.
3. Balows, A., Hauser Jr K.L., Isenberg, H.D., Shalomy, H.J. (1991). Manual of Clinical Microbiology, ASM, Washington D.C.
4. Lorian, V. (1991) Antibiotics in laboratory medicine, 3rd edition, Williams and Wilkins, Baltimore.
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19. Jeyaram Paniker, C.K. (2006) Text Book of Parasitology. Jay Pee Brothers, New Delhi.

### **CORE PAPER X - MEDICAL MYCOLOGY AND PARASITOLOGY**

#### **UNIT I**

Morphology, Taxonomy, Classification of fungi. Characteristics of Zygomycetes, Ascomycetes, Basidiomycetes and Duteromycetes.

#### **UNIT II**

Dermatophytes and agents of superficial mycoses. Trichophyton, Epidermophyton and Microsporum. Opportunistic mycoses- Candidiasis, Cryptococcosis, Aspergillosis. Systemic mycoses- Histoplasmosis, Coccidioidomycosis, Blastomycosis. Subcutaneous mycoses- Sporotrichosis, Mycetoma.

### **UNIT III**

ollection, transport of specimens, isolation of fungi from clinical specimens. Newer methods in diagnostic mycology. Mycotoxins, Antifungal agents, testing methods and quality control.

### **UNIT IV**

Introduction to medical Parasitology – Classification, Protozoa – Entameoba – Plasmodium, Leishmania – Trypanosoma –Giardia – Trichomonas – Balantidium.

### **UNIT V**

Platyhelminthes – Taenia – Fasciola – Paragonimus – Schistosoma. Nematihelminthes – Ascaris – Ankylostoma – Enterobius – Trichuris – Trichinella – Wuchereria – Dracanculus. Laboratory techniques in parasitology. Examination of faeces for ova and cysts – Concentration methods. Blood smear examination for parasites. Cultivation of protozoan parasites.

#### **References:**

1. Alexopoulos CJ and C W. Mims.(1993).Introductory Mycology (3rd edition) WileyEastern Ltd, New Delhi.
2. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi.(4th edition). PrenticeHall International, Inc, London
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## **CORE PAPER XI - MEDICAL VIROLOGY**

### **UNIT I**

General Properties of viruses – Detection of viruses and antigens in clinical specimens – Serological diagnosis of virus infections. Cultivation of Viruses.

### **UNIT II**

Arthropod borne and rodent borne virus diseases – Picorna viruses and diseases. Hepatitis viruses: Rabies and other neuro viruses: Orthomyxo and Paramyxoviruses.

### **UNIT III**

Pox, Adeno, Herpes, Reo, Rota and HIV Viruses, Oncogenic viruses, Viral vaccines, their Preparation and their immunization schedules.

### **UNIT IV**

Viruses of importance to bacteria – Bacteriophages – Their Structure, types – Uses in Microbiology.

### **UNIT V**

Applied virology – Viral diseases, epidemiology diagnosis, prevention and treatment. Vaccines and interferons – Antiviral agents.

#### **References:**

1. Jewetz, E., Melnic, J.L. and Adelberg, E.A. (2000) Review of Medical Microbiology, 19th Edn. Lange Medical Publications, U.S.A.
2. Ananthanarayan, R. and Jeyaram Paniker, C.K. (1994) Text Book of Microbiology, 6th Edn. Orient Longman, Chennai

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13. Calendar, R. (1988) Bacteriophages Vols. I, II and III. Plenum Press.

### **CORE PAPER XII – MAJOR PRACTICAL V**

#### **(Medical Bacteriology, Mycology, Parasitology and Virology)**

#### **UNIT I**

GENERAL requirements of collections, transport of clinical Specimens – Methods of enriched, selective and enrichment culture techniques used to isolate organisms from clinical materials. Simple, differential and Special staining of clinical materials viz: Throat swab, Pus, Urine, Sputum, Stool etc. Enumeration of Bacteria in Urine, Quantitative Urine Culture.

## **UNIT II**

Isolation and identification of bacterial pathogens from clinical specimens their biological reactions. Antimicrobial Sensitivity testing by disc-diffusion technique and determination of MIC.

## **UNIT III**

Identification of pathogenic viruses in Slides/ Smears / Spotters. Isolation of phage from natural sources.

## **UNIT IV**

KOH and Lactophenol preparations for skin scrapings for dermatophytes. Microscopic identification and cultural characteristics of medically important fungi and lab contaminants. Germ tube, carbohydrate assimilation and fermentation tests for yeasts.

## **UNIT V**

Direct examination of faeces- wet mount and Lugol's iodine method- demonstration of protozoan cysts and helminthes eggs. Concentration techniques of stool specimen- floatation and sedimentation methods. Examination of blood for malarial parasites- thin and thick smear preparation. Identification of pathogenic parasites in slides/ specimens as spotters.

## **ELECTIVE I - GENETIC ENGINEERING**

### **UNIT I**

Vectors: Plasmid vectors: pSC101, pBR322, pUC series and Ti plasmids based vectors; Bacteriophage vectors: Lambda phage based vectors, phagemids, cosmids, and M13 based vectors; Viral vectors: Vaccinia, Retroviral, SV40 and Baculoviral system;

### **UNIT II**

Principles and methods in genetic engineering: Host cell restriction; Restriction modification; Restriction enzymes: Types and applications;; DNA finger printing; RFLP Nucleases, Ribonucleases, DNA ligases, Tag DNA Polymerases, Methylases, Topoisomerases, Gyases, and Reverse Transcriptases.

### **UNIT III**

Basic steps of cloning techniques; Genomic DNA and cDNA library Construction; Screening methods; Cloning in *E. coli*, Expression systems; Gene fusion and Reporter genes; Gene targeting; Methods of Gene transfer – transformation, transfection, Electroporation, microinjection and biolistics.



#### **UNIT IV**

Analysis of Recombinant DNA; Polymerase chain reaction; Principles and techniques of nucleic acid hybridization; Southern, Northern, Western blotting techniques; Microarray technique.

#### **UNIT V**

DNA and protein sequencing; Applications of genetic engineering in agriculture; health and industry.

#### **References:**

1. Winnacker, E.L. (1987). From genes to Clones: Introduction to Gene technology. VCH Publications, Federal Republic of Germany
2. Glover, D.M. (1984) Gene Cloning: The Mechanism of DNA Manipulation. Chapman and Hall, London.
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14. Lewin B 2003. Genes VII. Oxford University press, New York
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18. Gerd Gellissen - 2005. Production of Recombinant Proteins: Novel Microbial and Eukaryotic Expression Systems . Viley VCH Publishers, 426 pages.

**SEMESTER – VI**  
**CORE PAPER XIII - ENVIRONMENTAL MICROBIOLOGY**

**UNIT I**

Introduction: Organization of the biosphere and components of ecosystem, Natural habitats of microorganisms, Microbial communities in aquatic and terrestrial habitats, Microorganisms as components of ecosystem-as producers and decomposers.

**UNIT II**

Microbial life in extreme environments: Effect of temperature, pH, Pressure, salt and heavy metals such as As, Sb, Hg, Pb and Cd, Microbial life in conditions of high irradiation, Radiosensitivity; mechanism of damage and recovery, Growth in nutrient limited environment – mechanism of adaptations, Microbes in space.

**UNIT III**

Microbes in aquatic environments: The nature of aquatic habitats, Methods used in the study of aquatic (fresh and marine water) microbial community, Pollution of aquatic habitats, Water quality criteria, Water-borne diseases, Microbiological analysis of water purity, Indicator organisms, ground water quality and home treatment system.

#### **UNIT IV**

Microbes in air: Composition of Air; Number and kinds of organisms in air; Distribution and sources of air borne organisms; Droplet and droplet nuclei; Assessment of air quality; Air sanitation; Airborne diseases;

#### **UNIT V**

Environmental application: Waste –types; Treatment of solid wastes –composting, Vermiform composting, silage, Pyrolysis and scarification; Treatment of liquid wastes, degradation of liquid industrial wastes; Degradation of pesticides and detergents; Degradation of lignin; synthetic polymers; Xenobiotic compounds; Alkyl benzyl sulphonates; Petroleum and hydrocarbon degradation.

#### **References:**

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition. Benjamin/Cummings Publishing Company, California.
2. Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.
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16. Mitchell, R. (1974) *Introduction to Environmental Microbiology*. Prentice – Hall. Inc. New Jersey.
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23. Clesceri L.S, Greenberg A.E, Eaton AD. (1998) *Standard methods for examination of water & waste water* American Public Health Association.

## **CORE PAPER XIV FOOD AND DAIRY MICROBIOLOGY**

### **UNIT I**

Food as a substrate for microorganisms–Microorganisms important in food microbiology; Molds, yeasts and bacteria–General Characteristics–Classification and importance.

### **UNIT II**

Principles of food preservation – Asepsis – Removal of microorganisms, anaerobic conditions – High temperature – Low temperature- Drying –Food additives.

### **UNIT III**

Contamination and spoilage- Cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products – Fish and sea foods – poultry, spoilage of canned foods.

### **UNIT IV**

Food borne infections and intoxications – bacterial, non-bacterial – Food borne disease outbreaks – Laboratory testing – preventing measures – Food sanitation – plant sanitation – Employees' health standards – waste treatment and disposal –quality control.

### **UNIT V**

Food fermentation: Bread cheese, vinegar, fermented vegetables, fermented dairy products. Spoilage and defects of fermented dairy products – oriental fermented foods.

### **References:**

1. Adams MR and Moss MO. (1995). Food Microbiology, The Royal Society of Chemistry, Cambridge.
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### **CORE PAPER XV - MAJOR PRACTICAL VI**

#### **(ENVIRONMENTAL, FOOD AND DAIRY MICROBIOLOGY)**

##### **UNIT I**

Detection of number of Bacteria in milk by breed count. Detection of number of bacteria in milk by standard plant count.

##### **UNIT II**

Determination of quality of milk sample by methylene blue reductase test and Resorzurin method.

##### **UNIT III**

Isolation of yeast and molds from spoiled nuts, fruits, and vegetables. Bacteriological examination of specific food a) Curd b) Raw meat c) Fish d) Ice cream.

##### **UNIT IV**

Determination of BOD and COD of wastewater. Water analysis

a) MPN method b) Memberane filter method.

## **UNIT V**

Quantification of microorganisms in air by settle plate and air sampler methods. Detection of aflatoxin B<sub>1</sub> from moldy grains using thin layer chromatography.

## **ELECTIVE II - INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY**

### **UNIT I**

General introduction to fermentation process. Microbial growth kinetics-batch, continuous and fed batch culture. Large scale cultivation of industrially important microbes (Streptomyces, Saccharomyces, Hansenella, Spirulina and Penicillium) Fermentation media-desired qualities- media formulation strategies- carbon, nitrogen, vitamin, mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams.

### **UNIT II**

Types of fermentation-fermentors-basic functions, design and components, asepsis and containment requirement. Specifications of fermentors- sterilization of fermentors- aseptic inoculation methods. Brief idea on monitoring control device.

### **UNIT III**

Microbial products of commercial use-penicillin, ethanol, vinegar, vitamin B12, protease, citric acid and glutamic acid.

### **UNIT IV**

Down stream processing - objective and criteria, foam separation, precipitation methods, filtration, industrial scale centrifugation and cell disruption methods. Liquid-liquid extraction, solvent recovery-chromatography. Two phase aqueous extraction, super – critical fluid extraction, ultra filtration, drying device, crystallization and whole broth processing.

### **UNIT V**

Ecology of microorganisms affecting pharmaceutical industries-atmosphere-water- raw materials- packaging- equipment. Factors affecting microbial spoilage of pharmaceutical products - Control of contamination during manufacture- good pharmaceutical manufacturing process. Quality control of pharmaceutical products. Manufacture of sterile pharmaceutical products- injections and ophthalmic preparations.

### References:

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9. Handa, S.S. and Kapoor, V.K. Pharamcognosy by 2nd Edition, Vallabh Prakashan Publishers, New Delhi.
10. Jain, S.K (1980) Indian Medicinal plants.
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## **ELECTIVE III - BIOTECHNOLOGY**

### **UNIT I**

Biotechnology–definition & history; Microbial production of industrial enzymes; methods for immobilization of enzymes; kinetics of soluble and immobilized enzymes; application of soluble and immobilized enzymes; enzyme-based sensors.

### **UNIT II**

Principles and application of genetic recombinant technology and strain improvement (mutational, rDNA technologies). Production of biotechnological products: Food –SCP (algae, yeast, mushroom). Biofertilizer (BGA, VAM) Biopesticides (Bacillus thuringiensis). Fuel – ethanol; Pharmaceuticals – antigens, interferons, vaccines, insulin, gene-therapy methods.

### **UNIT III**

Architecture of plant genome; plant tissue culture techniques; methods of gene transfer into plant cells; production of secondary metabolites using suspension/immobilized cell culture;

### **UNIT IV**

Methods for plant micro propagation; crop improvement and development of transgenic plants.

### **UNIT V**

Animal cell metabolism and regulation; cell cycle; primary cell culture; nutritional requirements for animal cell culture; techniques for the mass culture of animal cell lines; transgenic animals.

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