

DRAVIDIAN UNIVERSITY
SRINIVASAVANAM
KUPPAM – 517 426
ANDHRA PRADESH
INDIA



M.Sc. BIOTECHNOLOGY
(SELF SUPPORTING)

CURRICULUM
(EFFECTIVE FROM THE ACADEMIC YEAR
2017-18)

DEPARTMENT OF BIOTECHNOLOGY
SCHOOL OF HERBAL STUDIES AND
NATURO SCIENCE

REGULATIONS FOR M.Sc. BIOTECHNOLOGY (2 YEARS)

Name of the Course: M.Sc. Biotechnology

A brief description of the course: This is full time course to impart knowledge and training in different fields of Biotechnology so as to equip them for higher studies in research and/or job orientation.

School offering the course: The School of Herbal Studies and nature sciences offer two years full time M. Sc programs in Biotechnology for the academic year 2013-2014.

Board of Studies: Board of Studies in Biotechnology approved course structure and CBCS syllabus of M. Sc Biotechnology 1st, 2nd, 3rd, and 4th semester on 25th and 26th February 2013.

Components of Course

- 1) Core courses – Compulsory
- 2) Internal Elective Courses – open for the students of the particular program in which they are admitted
- 3) External Elective Courses – open for the students from the other department
- 4) Soft Skill - open for the students from the other department.

Prerequisites: B. Sc Biotechnology or B.Sc Chemistry with the Combination of two life Science subject

Credits (Theory, Practicals, Core and Electives): 100 credits,

Core papers : 75 credits
Internal Electives (IE) : 15 credits
External Electives (EE): 6 credits (2 EE X 3= 06 credits)
Soft skills: 4 credits (2 SS X 2 = 4 credits)

.....
100 Credits

.....
Number of semesters, how the courses are distributed: 4

Distribution of courses: 1st Semester: 24 credits – 600 Max Marks
2nd Semester: 26 credits – 650 Max Marks
3rd Semester: 25 credits – 600 Max Marks
4th Semester: 25 credits – 650 Max Marks

.....
100 Credits 2500 Max Marks
.....

Duration:

- a) The minimum duration for completion of a two year master program in Biotechnology is 4 semesters. The maximum period for completion is ten semesters counting from first semester.
 - b) Even if a candidate earns the required number of credits in less than 4/6 semesters he/she has to necessary study for four semesters for the two years.
- A department shall offer a minimum two internal electives in a semester.
 - A course in external elective shall be offered by a department only when there is a minimum enrolment of five students for that particular course.
 - One credit shall mean one period of teaching for theory or two periods for laboratory per week in a semester for 90 working days (15 weeks).

Course Fees:

- Each student admitted to the M.Sc. Biotechnology degree course will pay a Tuition, Lab, Special, Stationery, Chemical and computer and other fees as decided by the University from time to time

Syllabus

From the academic year (2013-2014) Choice Based Credit System (CBCS) is introduced in all departments of the University. According to this system the M.Sc. Biotechnology Course requires a student to earn 100 credits in four semesters. The basic course structure and the scheme of examinations are given in tables that follow.

M.Sc. DEGREE EXAMINATION
External Assessment
.....Semester
Branch –Biotechnology
Paper I – Core paper (or) Internal Electives

Time: 3 Hours

Max. Marks: 70

SECTION - A
Answer any SIX questions
Write a brief account of the following

Marks: 6 x 5 = 30

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

SECTION – B
Answer ALL four questions

Marks: 4 x 10 = 40

11. (a) or
- (b)
12. (a) or
- (b)
13. (a) or
- (b)
14. (a) or
- (b)

M.Sc. DEGREE EXAMINATION
Internal Assessment
.....Semester
Branch –Biotechnology
Paper I – Core paper (or) Internal Electives

Time: 1.30 Hours

Max. Marks: 30

SECTION - A

Answer any FOUR questions

Marks: 4 x 5 = 20

Write a brief account of the following

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

SECTION – B

Answer ONE question

Marks: 1 x 10 = 10

7. (a)

or

(b)

**M.Sc., BIOTECHNOLOGY-- CBCS SEMESTER SYSTEM
(EFFECTIVE FROM THE ACADEMIC YEAR 2017-18)
COURSE STRUCTURE**

The two year M.Sc. Biotechnology program will have four semesters.

The Course structure will be as given below:

Paper No.	Title of the Paper	Type of Paper	Periods/Week	Duration of Exam (Hours)	IA	EA	Max. Marks	Credits
I Semester								
BT 101	Chemistry of Biomolecules	Core	4	3	30	70	100	4
BT 102	Biophysical and Biochemical Techniques	Core	4	3	30	70	100	4
BT 103	Molecular Microbiology	Core	4	3	30	70	100	4
BT 104	Biostatistics, Computer Applications and Bioinformatics	Core	4	3	30	70	100	4
Practical								
BTP 105	Chemistry of Biomolecules and Biophysical and Biochemical Techniques		8	4		100	100	4
BTP 106	Molecular Microbiology & Biostatistics, Computer Applications and Bioinformatics		8	4		100	100	4
Total Marks and Credits for I Semester							600	24
II Semester								
BT 201	Enzymology and Metabolism	Core	4	3	30	70	100	4
BT 202	Molecular Biology	Core	4	3	30	70	100	4
BT 203	Immunotechnology	Core	4	3	30	70	100	4
BT 204	Legal, Ethical and moral Implications of Biotechnology	EE	3	3	15	50	65	3
		SS	2	2	10	25	35	2
Practical								
BTP 205	Enzymology and Metabolism		8	4			100	4
BTP 206	Molecular Biology & Immunotechnology		8	4			100	4
BTS 207	Seminar		2	4			50	1
Total Marks and Credits for II Semester							650	26

Paper No.	Title of the Paper	Type of Paper	Periods/Week	Duration of Exam (Hours)	IA	EA	Max. Marks	Credits
III Semester								
BT 301	Genetic Engineering	Core	4	3	30	70	100	4
BT 302	Plant Biotechnology	Core	4	3	30	70	100	4
BT 303	Select any one from the following 1. Cell Biology 2. Bioprocess Engineering and Fermentation Technology	IE	4	3	30	70	100	4
BT 304	Role of Biotechnology in Human Welfare	EE	3	3	15	50	65	3
		SS	2	3	15	20	35	2
Practical								
BTP 305	Genetic Engineering & Plant Biotechnology		8	4			100	4
BTP-306	IE Practical		8	4			100	4
Total Marks and Credits for III Semester							600	25
IV Semester								
BT 401	Animal Biotechnology	Core	4	3	30	70	100	4
BT 402	Industrial Biotechnology	Core	4	3	30	70	100	4
BT 403	Phytomedicine	Core	4	3	30	70	100	4
BT 404	Select any one from the following 1. Environmental Biotechnology 2. Pharmaceutical Biotechnology	IE	4	3	30	70	100	4
Practical								
BTP 405	Animal Biotechnology & Industrial Biotechnology		8	4			100	4
BTP 406	IE Particles & Phytomedicine		8	4			100	4
BTS 407	Seminar Presentation		2	4	50		50	1
Total Marks and Credits for IV Semester							650	25
Grand Total Marks and Credits for 4 Semesters							2500	100

IA-Internal Assessment, EA – External Assessment, SS - Soft Skills

DRAVIDIAN UNIVERSITY
M.Sc. BIOTECHNOLOGY
SYLLABUS
UNDER CBCS
(With effect from 2017-2018)

FIRST SEMESTER

BT 101 – CHEMISTRY OF BIOMOLECULES

UNIT – I:

Chemical bonds – covalent, coordinate, electrostatic hydrogen, ionic bonds; Vander Wal forces; hydrophilic and hydrophobic interactions; functional groups. Chemistry of carbohydrates – Definition and classification of carbohydrates. Outlines of structures of important mono di, and polysaccharides. Chemical reactions of sugars..

UNIT – II:

Chemistry of proteins – classification of amino acids and proteins, structures of amino acids, chemical reaction of amino acids. Peptide bond. Composition and sequence of amino acids of proteins. Structural organization of proteins. Classification of Enzymes, and animal hormones (insulin and human growth hormone).

UNIT – III:

Chemistry of Nucleic acids – structure of purines and pyrimidines, modified bases nucleosides and nucleotides; structural polymorphism of DNA and RNA types. Identification of DNA and RNA molecules.

UNIT–IV:

Chemistry of lipids – classification of lipids, outline structures of saturated and unsaturated fatty acids, fats and waxes, phospholipids and glycolipids, cholesterol, prostaglandins. Outline structures and biological functions of penicillin, vincristine.

REFERENCE:

1. Biochemical Techniques: Theory and Practical. 1987. J.P. Robft and B.J. White, Waveland Press, Inc. Prospect Heights, IL, pp. 407.
2. Biochemistry. 1992. R.H. Abeles. Panima Publication. pp 894.
3. Principles of Biochemistry. 2nd ed. 1993. A.L. Lehninger, D.L. Nelson, M.Cox. Panima Publications. pp 1090.
4. Harper's biochemistry. 1988. R.K. Murray. D.K. Granner, P.A. Mayes. Printice Hall International.
5. Biochemistry. 1998. 2nd ed. Zubay. Addision – Wesley Publication.
6. Biochemistry. 1998. 3rd ed. Luber Stryer. Freeman International.
7. Biochemistry of the Nucleic acids. 1992. 11th ed. R.L.P. Adams, J.T. Knowler, D.P. Leader. Chapman and Hall.
8. Proteins: Structure, function and evolution. Dickerson & Geis, 2nd Edn. Banjamin / Cummings, Meulo park, Callf 1983.
9. The Proteins: Neurath and Hill, 3rd Edn. Academic New York.
10. Biochemistry, A problem approach, 2nd ed. Wood, W.B., Addison Wesley, 1981.
11. Biological Chemistry, Mahler & Cordes.
12. Text Book of Biochemistry West, E.S. Todd, Mason & Vanbruggen, Macmillian & Co.
13. Principles of Biochemistry – White – A, Handler, P and Smith E.L. Mc. Graw–Hill.
14. Biochemistry – Cantrow, A. Sehepartz. B. Sunders – Japan.
15. The Carbohydrates: Pigman & Hartman Vol. II – A & II – B.
16. Biochemistry Voet & Voet.
17. Comprehensive biochemistry – Florkin & Storz, Academic Press.
18. Organic Chemistry, T.L. Eeunar, ELBS.
19. Organic Chemistry, J.P.Cohen, Vol.3, Edward Arnold & Co.
20. Basic Principles of organic chemistry Roberts & Cashino (Benjamin).

Practical Course:

1. Biochemical techniques: Theory and Practice. 1987. J.E. Robyt and B.J. White, Waveland Press, Inc. Prospect Heights, IL. pp 407.
2. CRC Practical handbook of biochemistry and molecular biology, 1989. G.D. Fasman ed. CRC Press, Inc. Boca Raton F.L. pp 601.
3. Experimental biochemistry. 2nd ed. 1993. Rodeny F.Boyer. Addison-Wesley International Publication. pp 608.
4. An introduction Practical Biochemistry. 1987. D.T. Plummer. Tata McGraw – Hill.
5. Modern Experimental biochemistry, 1986, Boyer. The Benjamin / Cuming Publication Company.

Practicals:

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of lipids
3. Qualitative analysis of nucleic acids
4. Estimation of protein
5. Isolation of DNA
6. Isolation of RNA
7. Estimation of DNA
8. Estimation RNA

BT 102 – BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

UNIT – I :

Characterization of biological macromolecules, Hydrodynamic properties of biomolecules – viscosity, diffusion, osmosis and Donnan effect. Buffers and measurement of pH and pKa.

Microscopy – light, phase contrast, fluorescent and electron microscopy. Centrifugation – preparative and analytical centrifuges, rotors, rate-zonal and equilibrium density gradient centrifugation. Isolation of cell organelles.

Concentration of macromolecules – salting out with ammonium sulphate, flash evaporation, lyophilization, pressure dialysis, reverse dialysis.

UNIT – II :

Chromatography – paper, thin layer, gas-liquid, HPLC, molecular sieve and affinity chromatography techniques. Electrophoresis – types of electrophoresis, paper and gel (starch, acryl amide and agarose) electrophoresis, SDS-PAGE, 2-D PAGE, Isoelectric focusing, immuno-electrophoresis, blotting techniques.

UNIT – III :

Spectroscopy – Electromagnetic spectrum of light, simple theory of absorption of light by molecules, Beer-Lambert law, types of detectors. UV – visible spectrophotometry, infrared spectroscopy, Raman spectroscopy, flame photometry, atomic absorption, ESR and NMR spectrophotometry. Mass spectroscopy, X-ray diffraction and X-ray crystallography.

UNIT – IV :

Radioisotope tracer techniques – Nature and types of radioactivity, decay units, detection and measurement of radioactivity (GM counter, scintillation counter, auto radiography, gamma-ray counter), quench correction. Biological uses of radioisotopes, safety measures in handling radio-isotopes.

REFERENCE:

1. Biochemical techniques : Theory and Practical. 1987. J.F. Robft and B.J. White, Waveland Press, Inc. Prospect Heights, IL, pp 407.
2. Principles and Techniques of Practical Biochemistry, 1994. 4th ed. Eds. K. Wilson and J. Walker.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology. 2nd ed. David Freifelder. W.H. Freeman and Company, New York.
4. Affinity Chromatography: Bio selective adsorption on insert matrices. 1992. W.H. Scouten, John Wiley & Sons, New York, pp 348.
5. Applications of HPLC in Biochemistry : Laboratory Techniques in Biochemistry and Molecular Biology. 1987. A. Fallon, R.F.G. Booth and L.D. Bell, eds. Elsevier Science Publishers, Amsterdam, the Netherlands. pp 338.
6. Electron microscopy: Principles and Techniques for biologists. 1992. J.J. Bozola and L.D. Russel, Jones and Bartlett Publishers, Boston, M.A. pp 542.
7. Electrophoresis : Theory, techniques and biochemical applications. 2nd ed. 1986. A.T. Andrews, Oxford University Press, Oxford. pp 452.
8. Enzymatic analysis : A practical guide. 1993. Janet. V. Passonneau and Oliver. H. Lowry, Humana Press, Totowa, N.J. pp 400.
9. Enzyme assay : A Practical Approach. 1992. R. Eisenthal and M.J. Danson, Eds. IRL Press. pp 351.
10. Flow cytometry : A practical approach. 1990. M.G. Ormerod. Ed. IRL Press. pp 279.
11. Introduction to Biophysical methods for protein and Nucleic acid research. (1995). J.A. Glasel and Murray P. Deutscher. Academic Press. pp 505.
12. Special Analytical techniques in Nutritional Biochemistry 1991. Gopalakrishna and S.K. Ranjhan. Kalyani Publishers.
13. Methods in Non-radioactive deterction. 1993. Gary C Howard. Ed. Appleton & Lange Earwalk. CT. pp 342.
14. Preparative centrifugation : A Practical approach. 1992. D. Rickwood. Ed. IRL Press. pp 400.
15. Principles of Laboratory Instruments. 1993. L.E. Schoeff, R.H. Williams, Mosby year-book Inc. pp 473.

16. Radioisotopes in Biology : A Practical approach. 1990. R.J. Slater, Ed. IRL Press, pp 307.
17. Physical Chemistry. 1986. P.W. Atkins, W.H. freeman. Sanfrancisco Pub.
18. Principles and techniques of Practical Biochemistry, 1994 (4th ed.) by K. Wilson and J. Walker (eds).

PRACTICALS:

1. Preparation of buffers and measurement of pH.
2. Verification of Beer-Lamberts law.
3. Isolation and spectrophotometric determination of cyanobacterial pigments.
4. Salting out with PEG.
5. Separation of amino acids by paper-chromatography.
6. Separation of plant pigments / lipids by TLC.
7. Demonstration of Gel Filtration Chromatography.
8. Demonstration of Ion-exchange Chromatography.
9. Electrophoretic separation of DNA (Agarose gel electrophoresis).
10. Electrophoretic separation of Proteins (SDS-PAGE)
11. Immuno electrophoresis.
12. Isoelectric focusing.
13. Southern blotting.
14. Western blotting.

BT 103 – MOLECULAR MICROBIOLOGY

UNIT – I :

Discovering the microbial world. Classification of micro organisms up to order level – bacteria, algae, fungi, protozoa. Structure of prokaryotic and eukaryotic microorganisms. General and distinctive characteristics of the major groups of microorganism – bacteria, mycoplasma, chlamydiae, rickettsias, actinomycetes, fungi, algae, protozoa and viruses. Outlines of characterization and identification of common bacteria, fungi, algae and protozoa.

UNIT – II :

Nutritional requirements to microorganisms – mode of nutrition – phototrophy, chemotrophy – methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parasitic, Interaction of microbes. Sampling, Isolation, enumeration and maintenance of cultures. Growth of microorganism (bacteria) – normal and biphasic growth curve, batch and continuous cultures, chemostates, shift up and shift down. Growth determination.

UNIT – III :

Control of microorganisms – principles, physical and chemical agents, assay of antimicrobial action. Batch and continuous sterilization of media and air.

Viruses – nature, cultivation and assay methods, structure, physicochemical properties, classification, pathogenicity, replication of viruses. Biotechnological importance of – E.coli, Spirulina and baculovirus

UNIT – IV :

Gene transfer mechanisms in microbes

Plasmids : types, properties, detection, transfer.

Transposable elements and insertion sequences – types of transposons and transposition.

Bacterial transformation – biology, molecular mechanisms, mapping by transformation.

Bacterial conjugation – Hfr transfer, Rec proteins. Bacteriophages T4 and Lambda – Genome organization, replication, lytic and lysogenic cascades, recombination, generalized and specialized transduction, co– transduction. Eukaryotic viruses – recombination, assortment, complementation, phenotypic mixing and genetic reactivation, transduction of genes.

Mobile genetic elements.

REFERENCES:

1. Microbiology : Concepts and Applications. Michael J. Pelczar, Jr. E.C.S., Chan, Noel R. Krieg, 1993. Mc. Graw Hill, Inc.
2. Introductory Microbiology. 1995, by Trevor Gross.
3. Fundamentals of Microbiology. 4th ed. 1994. I.E. Alcamo. Scientific Publication.
4. Microbiology, 1990. 4th Ed. B.D. Davis, R. Dulbeco, H.N. Eisen and H.S. Ginsberg and J.B. Lippincott Company.
5. Fundamental Principles of Bacteriology. 1994. A.J. Sake. Tata McGraw Hill.
6. Laboratory Experiments in Microbiology. 3rd ed. Brief Version. 1992. T.R. Johnson and C.L. Case. Addison Wesley International Publications. pp 350.
7. Microbiological Applications : A laboratory Manual in General Microbiology. 5th ed. 1990. H.J. Benson. Panima Publications. pp 459.
8. Microbes in Action : A Laboratory manual of Microbiology. 4th ed. 1991. H.W. Seeley, Jr. P.I. Van Denmark and J.J. Lee., W.H. Freeman and Co. New York, pp 450.
9. Microbiology : Concepts and Applications. 1988. P.A. Ketchum. Wiley Publication, New York.
10. Manual of Clinical Microbiology. 5th ed. 1991. A. Balows. ed. American Society of Microbiology, pp 1, 364.

Practical Course:

1. Skerman, N.B.D. A guide to the identification of the General of Bacteria.
2. Bergey's Manual of Determinative Bacteriology.

PRACTICALS:

1. Isolation of Lactobacillus from Curds.
2. Isolation of spore forming Bacillus from the soil
3. Gram's staining of Bacillus (gr+) Pseudomonas (gram(-))
4. Bacterial spore staining
5. Isolation of methanotrophs from methanol
6. Isolation of methylotrophs from leaf surfaces and Cowdung
7. Observation of permanent slides / the micro preparation of selected algae. fungi, protozoa
8. Assay of Penicillin against a bacterium

BT 104 – BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS

UNIT – I :

Introduction and scope of biostatistics – variables and attribution, diagrammatic representation of biological data. Measures of location and dispersion and skewness, arithmetic mean, median and mode, standard deviation and co-efficient of variation. Curve fitting – fitting straight line, parabola exponential curve and power curve.

Probability : Various definitions of probability, addition theorem (without proof), conditional probability, multiplication theorem (without proof), Random variables (discrete and continuous), distribution function of a random variable and its properties, probability density function and frequency function, Binomial and normal distributions (their properties).

UNIT – II :

Correlation and regression – Scatter diagram, positive and negative correlation. Sample, sampling distribution, student's t, F and Chisquare distributions and their properties and uses. The concept of 'Statistical Hypothesis (simple and composite), Type-I and Type-II errors level of signification, power of the test. Analysis of variance (ANOVA), elements of probit analysis. Applications of Computers in statistics. Elements of statistical quality control.

UNIT – III :

Introduction of computers: Definition, various sub units of computer such as CPU, ROM, RAM etc, Classification of computers based on technology, usage and working principle, various peripheral devices such as input, output, storage – capabilities and limitations – communication with computers ; hard ware, system software and applications.

Programme development cycle: Various stages such as recognition of problem, algorithm, flowchart development. Selection of a language, compilation, execution and debugging. MS-Windows, MS-Office, Adobe Photoshop. Networking of computers, need and advantages, overview of Indian networks such as NICNET and INFLIBNET.

UNIT – IV :

Bioinformatics – sharing of scientific information / interaction through computer communication networking. Using of bioinformatics software, Medline search for literature, biological sequence and structural data bases (EMBL, NCBI, SWISS – PORT), Microbial and cellular data bases, sequence analysis, algorithms BLAST, FASTA, multiple sequence alignments, Data mining. Vector NT.

Principles of protein secondary structure prediction – structure prediction, internet based structure prediction, Secondary structure elements. Protein Data Bank (PDB), PIR, NRL – 3D, Protein visualization (RASMOL).

REFERENCE:

1. Statistical concepts and applications in Medicine Monographs on statistics and Applied Probability series. 1994. J. Aitchison.
2. Statistical methods sin Agriculture and Experimental biology. 2nd ed. 1993. R. Mead, R.N. Curnow, A.H. Hasted, Panima Publications, pp 415.
3. Introduction to Biostatistics. 1995. R.N. Forthafter and E.S. Lee. Academic Press. pp 656.
4. Biometrical interpretation, making sense of statistics in Biology. 1989. 2nd ed. Neil Gilbert. Oxford Science Publication.
5. Statistics with applications to the biological and health sciences. 1985. R.D. Remington and M.A. Schork. Prentice-Hall.
6. Zar, Jerrold. H., Biostatistical Analysis, Engel Wood Cliffs Prentice Hall, 1974.
7. Lewis, Alvin, E, Biostatistics, Affiliated East West Press (P) Ltd., New Delhi, 1971.
8. Daniel, Waynew, Biostatistics a foundation for analysis in the health sciences, John Wiley and Sons, New Delhi, 1983.
9. Goldstein, Avrom, Biostatistics an introductory text, New York, The Mac Millian Company, 1971.
10. Ingelfinger, Joseph A and Others : Biostatistics in Clinical Medicine, 1983.
11. Bemstein, L and Weatherall, M. Statistics for Medical and Other Biological; students, edenberg, E & S Livingstone, 1952.
12. Schefler, William C, Statistics for the Biological Sciences, Reading, Addission Wesley, 1969.
13. T.K. Attwood & D.J. Parry – Smith 199. Introduction to Bioinformatics. Pearson Education Asia.
14. Stephen Misener & S.A. Krawez 2000. Bioinformatics, Methods and Protocol.
15. R. Durbin, S. Eddy, A. Krogh & G Mitchson. Biological sequence analysis. Cambridge Univesity Press, 1998.
16. C.P. Freidman & J.C. Wyatt, Computers and machine, Evaluation methods in Medical information. Springer Verlag, New York, 1997.
17. M.J. Bishop & C.J. Wyatt, DNA and Protein structure analysis: A Practical approach. Oxford University Press, 1997.
18. S.B. Primrose. Principle of genome analysis. 2nd edition. Blackwell Science, 1998.

19. R.M. Kolodner, Computer in Health care: computerizing large integrated health networks. Springer – Verlag, New York, 1997.
20. P.N. Arora & P.K. Malhan, Biostatistics – Himalaya publishing house.

PRACTICALS:

1. Determination of Mean, Median and Mode.
2. Computation of Quartile Deviation and Standard deviation.
3. F – test for two variances.
4. Chi-square test for independence of attributes.
5. Computation of Karl Pearson's coefficient of correlation.
6. Computation of Rank coefficient of correlation.
7. Basics of computers and how to operate a computer.
8. Familiarization with Windows NT, MS–OFFICE.
9. Use of Internet, world wide web.
10. Management of computer viruses and debugging.
11. Programming in C language (4-5 programmes).
12. Searching of databases (web searching).
13. MEDLINE searches for literature on a given topic, locating related materials on Medline.
14. Web based biological sequence analysis protein coding regions.
15. Hands on experience on various sequence analysis programs, Multiple sequence alignment programming.

SECOND SEMESTER

BT 201 – ENZYMOLOGY AND METABOLISM

UNIT – I :

Mechanism of enzyme action – kinetics of enzyme catalyzed reactions (pH, temperature, incubation period, substrate and enzyme concentrations), assay of enzyme activities, activators and inhibitors, zymogen activation, isoenzymes, allosteric enzymes, regulation of enzyme activity, ribozymes and abzymes. Enzymes, regulation of enzyme activity, ribozymes and abzymes. Enzymes in industry – immobilized enzymes. Metabolism of carbohydrates – Glycolysis, TCA cycle,ETS and oxilative phosphorilation, glyoxalate cycle, gluconeogenesis, HMP shunt, interconversion of hexoses and pentoses, amylogenesis, glycogenesis, synthesis of cellulose and hemicellulose.

UNIT – II :

Metabolism of amino acids and proteins – Hydrolysis of proteins, proteases, synthesis of amino acids and their catabolism (deamination, decarboxylation and transamination) coordinated control of metabolism, formation of ammonia and urea. Inborn errors in metabolism – Phenylketonuria and Alkaptonuria.

Metabolism of lipids – lipid hydrolysis, lipases, biosynthesis of fatty acids and cholesterol, oxidation of fatty acids; synthesis of prostaglandin and leukotrienes, ketone bodies.

UNIT – III :

Metabolism of purines and pyrimidines – biosynthesis of bases. Nucleosides and nucleotides and their catabolism. DNases and RNases. Out lines of biosynthesis of porphyrins (Chlorophyll and haeme),

UNIT – IV :

Carbondioxide assimilation in plants – photosynthesis and energy transduction; photosynthesis in higher plants; chloroplast as an energy transducing organelle, photosystem I an II, electron flow through cyclic and non-cyclic and pseudo cyclic photophosphorylations pathways of CO₂ fixation, C₃ and C₄ photosynthesis, CAM pathway.

REFERENCE:

1. Principles of Biochemistry: White. A, Handler, P. and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of Physiological Chemistry: Harold A. Harper.
6. Outlines of Biochemistry, Conn and Stummf.
7. Text of Biochemistry, West and Todd.
8. Metabolic Pathways – Greenberg.
9. Mitochondria, Munn.
10. Biochemistry, 2nd Edition, G. Zubay (1998).
11. Plant Physiology – Sailsburry & Ross

Practical Course:

1. Practical Biochemistry – H. Varley.
2. Methods in Enzymology S.P. Colowick & N.O. Kaplan, Academic Press.
3. Methods in Biochemical analysis.
4. Oser: Hank's Physiological Chemistry.
5. Food analysis – Woodman.

PRACTICALS:

1. Estimation of blood sugar by Nelson & Somogyi method.
2. Estimation of Serum proteins by Biuret method.
3. Estimation of cholesterol.
4. Determination of bilirubin.
5. Determination blood urea by Diacetyl monoxime method.
6. Determination of uric acid.
7. Determination of SGOT.
8. Determination of SGPT.
9. Determination of inorganic phosphate.
10. Determination of serum creatinine.

BT 202 – MOLECULAR BIOLOGY

UNIT – I :

Identification of genetic material as DNA or RNA. Organization of genetic material in prokaryotes and eukaryotes; chromosomes and types, molecular organization of DNA and histone proteins.

Classical genetics – Mendelian Laws of inheritance, variability and inheritance. Linkage and crossing over, genetics of sex chromosomes, chromosomal aberrations.

UNIT – II :

Replication of DNA – models for replication of DNA, molecular mechanism of replication, enzymology of replication, DNA replication and reverse transcriptase. DNA damage and repair mechanisms.

Mutagenesis – Types of mutations, mutagens, molecular mechanism of mutations, spontaneous and induced mutation, isolation and analysis of mutants, reversion, suppression, role of mutagenesis in evolution and in improving the beneficial organisms.

UNIT – III :

Transcription – types of RNA and their role, mechanisms of transcription of prokaryotes and eukaryotes, RNA polymerases, introns and exons, biosynthesis and processing of different RNAs. Promoters and enhancers and factors affecting transcription.

Translation – central dogma theory and flow of genetic information, genetic code and its elucidation, wobble hypothesis, structure and composition of prokaryotic and eukaryotic ribosomes, structures of mRNA and rRNA, events of protein synthesis in prokaryotes and eukaryotes, post-translation modification of proteins, inhibitors of translation.

UNIT – IV :

Types of genes – constitutive (house keeping) genes, luxury genes, pseudogenes, split genes, regulatory and structural genes. Regulation of gene expression: Operon, operator, promoter. lac, gal, trp operons.

REFERENCE:

1. Molecular Biology. 2nd ed. 1994. D. Freifelder, Springer.
2. Molecular Biology by G. Padmanabhan, K. Sivaram Sastry, C. Subramanyam, 1995, MacMillan.
3. Molecular Biology and Biotechnology 2nd ed. J.M. Walker and E.B. Gingold. Panima Publications. pp 434.
4. Dictionary of microbiology and molecular biology. 2nd ed. 1994. Sigleton. P. and Sainsbury, D. Sciential Publication.
5. Molecular Biology of the Gene, 1987. 4th Ed. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner, 2 Vol. Benjmin / Cummings.
6. Biochemistry of the Nucleic acids. 1992. 11th ed. R.L.P. Adams, J.T. Knowler, D.P. Leader. Chapman and Hall.

Practical Course:

1. Techniques in molecular biology. Vol.2. 1987. ed. J.M. Walker and Wim Gaestra. Panima Publications. pp 332.
2. Methods in Plant Molecular Biology. 1989. M.A. Schuler and R.E. Zielinski. Academic Press.
3. Methods for cloning and Analysis of eukaryotic genes. 1990. A Bothwell, G.D. Yancoponlos and F.W. Alt; Jones and Bartlett Publishers. pp 1990.
4. PCR: A Practical approach. 1991. M.J. McPherson. P. Quirke and G.R. Taylor. Eds. IRL press, pp 253.
5. Short Protocols in Molecular Biology. 1992. F.M. Ansubel et al., Academic Press, pp 800.
6. Essential molecular biology: A Practical approach. Vol. I, II, 1991. T.A. Brown. Ed. IRL Press, pp 318. pp 320.

PRACTICALS:

1. Extraction of RNA from dry yeast
2. Estimation of RNA by orcinol method
3. Isolation of chromosomal DNA
4. Estimation of DNA by DPA method
5. Extraction of protein from dry yeast by salt precipitation method
6. Estimation o protein by Lowry method
7. Determiation of melting temperature and base composition of DNA from thermal denaturation
8. Determiation of purity of DNA & RNA by UV method.
9. DNA extraction from blood using high salt method
10. Screening of gene libraries using colony hybridization technique
11. Determiation of phosphorous in nucleic acids

BT 203 – IMMUNOTECHNOLOGY

UNIT – I :

History of immunology : immunity – natural and acquired; specific and non-specific; Primary and Secondary organ of immune system – thymus, spleen, lymph nodes, bursa fabricus, other types of lymphoid tissues. Cells of the immune systems; B and T lymphocytes, neutrophils, macrophages, plasma cells, eosinophils and basophils. Natural body defense. Virulence factors in microbes – host relationships. Blood groups and isohaemagglutinins.

UNIT – II :

Antigen – definition, properties, specificity, cross reactivity, immunogenicity, antigenic determinants and haptens. Antibody: nature and formation, classification of immunoglobulins, types, diversity and production of antibody – primary and secondary responses, valency and avidity production of polyclonal antibodies and monoclonal antibodies – principles, production, advantages and disadvantages. Mechanism of antigen – antibody interaction.

UNIT – III :

In vitro serological tests : Principles and applications of serological tests used in identification of pathogenic agents and initial sources of inoculum–precipitation tests in liquid media, single and double diffusion tests using agar gel media, hemagglutination, bentonite and flocculation tests, complement fixation test, labeled antibody techniques (RIA and ELISA) immunodetection of viral antigens.

UNIT – IV :

Complement – nature, and physicochemical properties, complement cascade pathway, complement fixation. In vivo serological reactions – phagocytosis, opsonization, neutralization, protection tests. Cell mediated immunity (CMI): Induction and mechanism. Allergy: classification and details. The major histocompatibility complex. Immune tolerance, immune suppression. Transplantation and GVH reactions. Immunopathology – Autoimmune diseases; immunodeficiency diseases.

REFERENCE:

1. Advanced immunochemistry. 2nd ed. 1990. E.D. Day, Wiley Liss, Inc, New York. pp 633.
2. Basic and clinical immunology, 7th ed. 1991. D.P. Stites and A.I. Terr Eds, Appleton and Lange, Norwalk, CT, pp. 870.
3. Clinical immunology: A practical approach. 1990. H.C. Goo, and H. Chapel. Eds. IRL Pres, Oxford, pp 263.
4. Immunology: A short course, 2nd . 1991. B. Benjamin and S. Leskowitz, Wiley-Less, N.Y. pp 459.
5. Immunochemical protocols : Methods in Molecular biology. Vol. 10, 1992, M.M. Manson. Ed. Humanma Press. Totowa. NJ. pp 480.
6. Immunology, 1995, R.B. Gallagher, J. Gilder, G.J.V. Nossal and G. Salvatore. Ed. Academic Press. pp 300.
7. Cellular and Molecular Immunology. 1991. A.K. Abbas, A.K. Lichtman, J.S. Pober, Harcourt Brace. pp 480.
8. Hybridoma techniques : A Laboratory Course. 1986. Muthukkar Uppan, U.R. Bhaskar, S. and F. Singaglia. Macmillan India Ltd.,
9. Immunology, 1989, I. Riott, J. Bro Stoft and Daid Male. 2nd ed. Churchill Livingstone.
10. Essential immunology, 1988. 6th ed. I.M. Roitt. ELBS.
11. Fundamental immunology. 1992. 2nd ed. R.M. Coleman. M.F. Lombard and R.E. Sicard. Wm. C. Brown Publication.
12. Immunology. 1990. R.M. Hyde and R.A. Patnode. 2nd ed. John Wiley and Sons.
13. Immunology – An illustrated outline. 1986. David Male. Churchill Livingstone.
14. Serological methods for detection and identification of viral and bacterial plant pathogens. 1990. R. Hampton, E. Ball and S. De. Boer (eds). American Phytopathological Society.
15. Monoclonal antibodies. 1992. J.H. Peters and H. Baumgarten. Eds. Springer – Verlag. New York. pp 488.

Practical Course:

1. Clinical immunology : A Practical approach. 1990. H.C. Goo, and H. Chapel. Eds IRL Press. Oxford. pp 263.
2. Immunological Protocols: Methods in Molecular biology. Vol. 10. 1992. M.M. Manso, Ed. Humana Press. Totowa, NJ. pp 480.
3. Serological methods for detection and identification of viral and bacterial plant pathogens. 1990. R. Hampton, E. Ball and S. De. Boer (eds.) American Phytopathological Society.
4. Practical immunology. 1989. 3rd ed. Hudson and F.C. Horp. Blackwell Scientific Publication.
5. Antibodies: A Laboratory Manual. 1998. E. Harlow and D. Lane. Cold Springer Harbor Lab. NY. pp 726.

PRACTICALS:

1. Demonstration of lymphoid organs
2. Separation of serum and plasma
3. Purification of IgG from serum
4. Blood typing – A,B,O and Rh system
5. Enumeration of RBC and WBC
6. Lymphocyte separation and identification of viable lymphocytes.
7. Differential Leukocyte count
8. Antigen – antibody reactions – Precipitation test (Tube, VDRL) Agglutination
9. Immunodiffusion : Double immunodiffusion, Radial immuno diffusion
10. Rocket immunoelectrophoresis.
11. WIDAL test
12. ELISAs.

BT 204 – LEGAL, ETHICAL & MORAL IMPLICATIONS OF BIOTECHNOLOGY

UNIT – I:

Intellectual property rights – Definition – types – patents – copy rights – trade marks: essential requirement for IPR, procedures of filling patents – provisional and complete specifications – Pan-Co-operation treaty (PCT)-application: GATT and IPR: WTO Act – Global and Indian Biodiversity Act-Indian Patent Act and their revised versions.

UNIT – II:

Legal and Ethical aspects of Biotechnology – Prenatal diagnosis – Genetic screening – Surrogate mothers and exploitation of women – designing of plants and animals – gene therapy – cloning – Manipulation of human genome – Technology transfer.

UNIT – III:

Social and Moral aspects of Biotechnology – Biotechnology and International trade – privatization and patenting of Biotechnology products – Role of Government, Industries and society in promoting, accepting and regulating the rDNA research.

UNIT – IV:

Environmental and Health aspects of Biotechnology – Generally engineered organisms – Introduction of novel species and natural equilibrium – Environmental security and safety – Precautionary measures – Genetically modified foods – health safety.

REFERENCES:

1. Gene cloning – Brown
2. Concepts in Biotechnology – Balasubramnayam.D
3. Basic Biotechnology – Coliln Rotledge and Kristainsen
4. Gene Biotechnology – Jogdand
5. From Genes to Clones, Introduction to Gene Technology-Winnacker, Ernst.L
6. Safety, Moral, Social and Ethical issues related to geneticalls modified foods – Smith J.E.
7. Molecular Biology and Biotechnology – Meyer R A
8. Environmental Biotechnology – Forster and wase
9. Biotechnological Innovations in Environmental Management – Leach and Van Dam-mieras
10. Industrial Microbiology and Biotechnology – Demain and Solomon.

THIRD SEMESTER

BT 301 – GENETIC ENGINEERING

UNIT – I:

Genetic engineering - Concepts, scope and importance. Genetic engineering tools: Enzymes- Restriction endonuclease (RE), different DNA and RNA polymerases, ligases, topoisomerases, phosphatases, kinases, nucleotidyl transferases, alkaline phosphatase and nucleases. Vectors-types, plasmids, cosmids, phage based vectors, bacterial and animal virus based vectors, bacterial and yeast artificial chromosomes, expression vectors. Oligonucleotides chemical synthesis of DNA, linkers, double-linkers, adaptors homopolymer tails, primers, promoters. Cloning and expression hosts- *E. coli*, *Bacillus*, *Agrobacterium*, and Yeast, plant and animal cell cultures.

UNIT- II:

Molecular cloning strategies: Generation of DNA fragments; Joining of DNA fragments to vectors; delivery of recombinant molecules into targeted host systems-physical, biological and chemical approaches; screening and methods for identification of positive clones, hybridization and PCR; Construction and screening of c DNA and genomic libraries. DNA sequencing- Chemical method of Maxam and Gilbert, Sanger's dideoxy chain termination, automated sequencing and DNA sequencing by capillary array electrophoresis. Outlines of human genome project.

UNIT-III:

Site directed mutagenesis- Different approaches and its potential in changing genes; protein engineering by mutagenesis and generation of novel proteins. Molecular Diagnostics- Preparation of DNA and RNA probes; nucleic acid hybridization and its applications; PCR-principles, factors affecting PCR, different types of PCR (RT-PCR, IC-RT-PCR, nested PCR, multiplex PCR, real-time or quantitative PCR) and their applications and limitations. Profiling of nucleic acids by DNA finger printing, RFLP, RAPD, RACE and AFLP.

UNIT-IV:

Microarray technology- DNA microarrays-Principles and applications. Protein microarrays- principles and its applications. Microbial synthesis of recombinant molecules- construction of expression cassettes; inducible expression systems; overexpression conditions, production of inclusion bodies. purification protocols and up-scaling; determination of purity and activity of over expressed proteins; experiments using model systems- *E.coli*, yeast and baculovirus. Genomics- Principles of structural, comparative and functional genomics and its applications. Proteomics-two-dimensional analysis of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy. Global expression profiling-global analysis of RNA and protein expression; Application and implications of genetic engineering in biology, agriculture, medicine and industry; Preparation of antisense molecules and its applications.

REFERENCES:

1. Old and Primrose Principles of Gene Manipulation: An introduction to genetic engineering. 6th ed. Blackwell Scientific Pub. 2001.
2. SB. Primrose and R.W. Twyman. Principles of genome analysis and genomics. 3rd edition. Blackwell Science. 2003.
3. D S T Nicholl. An introduction to genetic engineering. 2nd edition. Cambridge University Press. 2004.
4. Glick and Pasternak, Molecular Biotechnology, Panima Pub. 2003
5. J. Sam brook, E.F. Fritsch and T. Maniatis. Molecular Cloning: a Laboratory Manual, Cold Spring Harbor Laboratory Press, New York, 2000.
6. M.R. Walker and R. Rapley. Route Maps in Gene Technology, Blackwell Science Ltd., Oxford, 1997
7. M. Kingsman and A.J. Kingsman Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes, S, Balckwell Scientific Publications, Oxford, 1998.
8. S.P Hunt and R. Liveey. Functional Genomics: A practical Approach. Oxford University Press, 2000.
9. H. Kreuzer and A. Massey. Recombinant DNA and Biotechnology: A guide for Teachers: (2nd ed.) ASM Press, 2001. 10.H. Kreuzer and A. Massey. Recombinant DNA and Biotechnology: A guide for students: 2nd ed. ASM Press, 2001.

PRACTICALS:

1. Isolation of DNA from *E. coli*
2. Isolation of plasmids from bacteria
3. Restriction enzyme analysis of plasmids.
4. Construction of restriction map
5. Extraction of DNA from low melting agarose gels
6. Demonstration of Ligation
7. Demonstration of transformation
8. Demonstration of GFP cloning
9. Demonstration of Southern hybridization
10. Preparation of Dot-blot for hybridization
11. Demonstration of RAPD technique
12. Amplification of DNA by PCR
13. Problems related to recombinant DNA technology

BT 302 – PLANT BIOTECHNOLOGY

UNIT – I:

Introduction of plant tissue culture preparation techniques – cleaning, sterilization, sterile handling tissue culture lab requirements. Media composition, preparation and sterilization. Callus – growth pattern / characteristics, organogenesis and plant regeneration. Somatic embryogenesis, artificial and synthetic seeds. Anther, endosperm and pollen culture, significance and advantages of haploid plants. Production of virus-free plants by meristem tip and other tissue culture techniques.

UNIT – II :

Cell culture techniques for production of useful compounds – Hairy root cultures – transformed roots using *Agrobacterium rhizogenes* – production of secondary metabolites of commercial importance – elicitors factors affecting their yield, immobilized cell systems, bioreactors. Protoplast culture – isolation of protoplasts, culture and fusion methods, somatic hybrids and cybrids. Production of transgenic plants with improved yield and nutritional quality. Germplasm preservation by tissue culture technology and establishment of gene banks.

UNIT – III:

Agrobacterium mediated gene transfer Mechanism of gene transfer by Ti and Ri plasmids as vectors. Techniques of gene transfer into plants, Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection.

UNIT – IV:

Application of Plant Transformation for productivity and performance- Transgenic plants : herbicide resistance, insect resistance (Bt genes, non-Bt like protease inhibitors, alpha amylase inhibitor), viral resistance, fungal resistance (chitinase, 1-3 beta glucanase, RIP, antifungal proteins, thionins; PR proteins), abiotic stress, post harvest losses, extended shelf life of fruits and flowers (use of ACC synthase, polygalactouranase, ACC oxidase) male sterile lines (bar and barnase systems) ADP glucose pyrophosphorylase and advantages, Molecular genetics of nitrogen fixation (regulation of nif and nod genes), Nutritional quality improvement, terminator seeds. Chloroplast Transformation: advantages, vectors, success with tobacco and potato. Genetically modified foods – Biosafety.

REFERENCES:

1. Ray V. Herren, Introduction to Biotechnology an Agricultural Revolution Thomson Delmar Learning, 2005.
2. Maarten J. Chrispeels & David E. Sadava, Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers, 2003.
3. S. Narayana Swamy, Plant cell and Tissue Culture, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.
4. Kalyan Kumar De, An Introduction to Plant Tissue Culture, New Central Book Agency (P) Ltd, 2003.
5. Adrian Stator, Nigel Scott and Mark Fowler (Eds): Plant Biotechnology - The Genetic Manipulation of Plants, Oxford University Press, 2003.
6. H.S.Chawla : Biotechnology in Crop improvement, International Book Distributing Company, 1998.
7. P.K. Gupta: Biotechnology & Genomics, Rastogi Publishers Co. Meerut, 2004.
8. Metabolic Engineering of Plant Secondary Metabolism; R. Verpoorte &A. W. Alfermann; Kluwer Academic Publishers, 2000.
9. Plant Biochemistry & Molecular Biology, 2nd Ed., Edited by P.J.Lea & R.C. Leegood, 1999; John Wiley & Sons Ltd.,
10. J. Hammond, P. MCGarvey and V. Yusibov (Eds.): Plant Biotechnology. Springer Verlag, 2000.
11. T.J. Fu, G. Singh, and W.R. Curtis (Eds.): Plant Cell and Tissue Culture for the Production of Food Ingredients. Kluwer Academic/Plenum Press. 1999.
12. H.S. Chawla: Biotechnology in Crop Improvement. International Book Distributing Company. 1998.

PRACTICALS:

1. Preparation of media.
2. Surface sterilization.
3. Micropropagation of tree species or elite plants.
4. Organ culture.
5. Callus propagation.
6. Induction of shoots or roots (organogenesis).
7. Induction of somatic embryogenesis.
8. Synthetic seed preparation.
9. Protoplast isolation and culture.
10. Anther culture, production of haploids.
11. Induction of cell suspension cultures.
12. Production of secondary metabolites in cell suspension culture.
13. Cytological examination of regenerated plants.
14. Agro bacterium culture, selection of transformation.
15. Reporter gene (GUS) assays.
16. Isolation of DNA from plant material and quantitative analysis.
17. Molecular weight determination of DNA extracted from different plant samples.

BT 303 – CELL BIOLOGY

UNIT – I:

Organization of prokaryotic and eukaryotic cell. Plasma membrane – molecular organization, current model and function. Cytoskeleton – microtubules, cilia and flagella, Structure and function of cytoskeleton. Structure and function of endoplasmic reticulum Golgi apparatus, lysosomes, peroxisomes.

UNIT – II:

Structure and functions of mitochondria and chloroplast Nucleus – structure and function of nuclear membrane, nucleolus, structure and role of ribosomes. Eukaryotic chromosome – chromatin, its chemical nature, nucleosome structure, polytene and lamp brush chromosomes.

UNIT – III:

Mechanism of cell division – mitotic apparatus, cytokinesis, chromosome movement. Regulation of eukaryotic cell cycle. Mutation causing cell cycle control. Meiotic process – stages, chromosome pairing, chiasma formation molecular mechanisms of recombination, synaptonemal complex.

Tumor biology – cell to cell interaction, cell adhesion, cell transformation mechanism and oncogenesis. Biology of Cancer: Oncogenes and tumor Suppressor Genes. Structure, function and mechanism of pRB and p53.

UNIT – IV:

Cell – cell signaling: cell surface receptors, second messengers and their role in signal transduction (cAMP, IP3 and Calcium as second messenger)

Cell cycle – General strategy of cell cycle, components in cell cycle control – cyclin, CDK's. Check points in cell cycle, Regulation and control cell cycle, Cellular basis of differentiation and development. Cell death pathway: Apoptosis – Definition, Important components in apoptosis. Mechanisms of cell death (Internal and external). Morphological & biochemical difference between apoptosis & necrosis.

REFERENCE:

1. Cell Biology – De Robertes & De Robertes
2. Cell and Molecular Biology – Baltimore. L
3. The cell – Hooper
4. Cell and Molecular Biology – P.K. Gupta
5. Cell Biology – Verma and Agarwal
6. Cell Biology – Rastogi
7. Cell Biology – Twyn
8. B. Alberts, D. Bray, J. Lewis, M. Raf, K. Roberts and J.D. Watson. Molecular Biology of the Cell , Garland publishing, Inc. New work, 1994.
9. E.D.P. De Robertics and E.M.F. De Robertics, Cell and Molecular biology, Jr-8th edition, B.I. Publication Pvt. Ltd. 2005.
10. Philip Sheeler and Donald E. Bianchi, Cell and Molecular biology, III rd Edition.
11. J. Darnell, H. Lodish and D. Baltimore, Molecular Cell Biology, Scientific American Books, Inc., USA, 1998.
12. Benjamin Lewin, Gene VII, Oxford University Press, U.K. 2000.
13. William H Elliott and D.C. Elliolt, Biochemistry & Molecular biology, Oxford University Press. 2000.
14. Watson, Baker, Bell, Gann, Levine, Losick., Molecular biology of Gene, 5th edition, Pearson Education, 2004.
15. SF Gilbert, Developmental Biology, Sinamer Associates Inc, 2004.
16. Gerald Karp, Cell and Molecular Biology, 4th edition, John Wiley & Sons, Inc. 2004.
17. Thomas D. Pollard, William C. Earnshaw, Cell Biology (Revised Reprint) Saunders, 2004.

PRACTICALS:

1. Mounting of cell cycle
2. Microtomy
3. Measurement of microorganisms by the use of ocular micrometer
4. Staining of nuclear material by toulidene blue
5. Flagellar staining
6. Staining of nuclear material with giemsa stain
7. Hanging drop method
8. Cell fractionation
9. Isolation of Mitochondria
10. Isolation of Ribosomes
11. Isolation of Chloroplast
12. Isolation of membrane proteins
13. Squash preparation to study mitotic cell division
14. Squash preparation to study meiotic cell division
15. Isolation of salivary gland chromosomes

BT 303 – BIOPROCESS ENGINEERING AND FERMENTATION TECHNOLOGY

UNIT-I:

Introduction to Bioprocess Engineering: Basic concepts and applications of chemical Engineering to Biological systems. Comparison of chemical reaction and bioprocessing. Flow sheets. Material and energy balances. Stoichiometry: Yield concepts. Biological rate equations for cell growth, death, lysis, endogeneous metabolism, maintenance energy, product formation and substrate uptake. Bioprocess control measurements: Physical and chemical measurements and control of bioprocess parameters. Methods for off-line and on-line monitoring of bioreactors.

UNIT-II:

Bioreactors: Definition of bioreactor, basic principles of bioreactor. Design construction of Bioreactor. Types and analysis of bioreactors and other specialized bioreactors. Scale-up of microbial bioreactors: Various approaches to scale-up including regime analysis and scale-down, scaleup methods by Constant P/V, KLa etc. Fermentation process: General requirements of fermentation process. Fermentation and its Types- Aerobic, anaerobic and solid state fermentations. Analysis of batch, fedbatch and continuous fermentations. Kinetic considerations: Growth of micro organisms and thermal death kinetics. Immobilized enzymes, methods and applications in industry.

UNIT-III:

Downstream Processing and product recovery: Introduction, Removal of microbial cells and solid matter, foam separation, precipitation, filtration (plate filters, rotary vacuum filters, membrane filtration, ultra filtration) centrifugation (continuous centrifugation, basket centrifugation, bowl centrifugation) cell disruptions, liquid-liquid extraction, chromatography, Drying (spray driers, drum driers, freeze driers) and Crystallization.

UNIT-IV:

Microorganisms as source of food and feed supplement: Mass cultivation of commercially valuable algae like *Spirulina* and edible Mushrooms. Cultivation of marine macro-algae for agar, alginates and other products of commercial importance. Role of microorganisms in production of fermented foods: Fermented & non fermented foods. Sterilization and Pasteurization of food products. Food spoilage and preservation techniques. Fermented foods, dairy & non dairy products - Yogurt, cheese, meat, fish & Food safety.

REFERENCES:

1. Biotechnical Engineering Fundamentals, J.E. Baily, and D.F. Ollis. McGraw Hill Book Co. New York. 1986.
2. M.L. Shuler and F. Kargi. Bioprocess Engineering: Basic Concepts, Prentice Hall, Engelwood Cliffs. 2004.
3. P.F. Stanbury, A. Whitaker, and S. J. Hall. Principles of Fermentation Technology, Pergamon Press, Oxford. 1997.
4. Wulf Crueger and Anneliese Crueger. Biotechnology- A Text book of Industrial Microbiology. 2nd edition. Panima Publishing Co. 2004.
5. M. Moo-Young. Comprehensive Biotechnology-Volume 2, 3 and 4. Pergamon Press. 2004.
6. D.G. Rao. Introduction to Biochemical Engineering. Tata McGraw-Hill Publishing Company Limited. New Delhi. 2002.
7. William C. Frazier and Dennis C. Westhoff. Food Microbiology. Tata Mc Graw-Hill Publishing. C. Ltd. 2006.
8. J. M. Asenjo. Separation processes in Biotechnology. Marcel Dkker Inc. 1993.

PRACTICALS:

1. Bacterial growth in different media.
2. Bacterial growth at different pH and temperatures.
3. Determination of thermal death point (TDP) of microorganism for design of a sterilizer.
4. Determination of thermal death time (TDT) of microorganism for design of a sterilizer.
5. Typical fermentation (shake flask).
6. Bacterial examination of milk by dye reduction.
7. Principles of bread making
8. Cultivation of *spirulina*, Mushroom cultivation.

BT 304 – ROLE OF BIOTECHNOLOGY IN HUMAN WELFARE

UNIT – I:

History and scope of Biotechnology, Definition of Biotechnology. Old & Modern Biotechnology, Different areas of Biotechnology,

UNIT – II:

Biotechnology and Agricultural, Micro propagation, (Cell and Tissue culture) Transgenic plants, Biofertilization, organic farming, Biopesticides.

UNIT – III:

Application of Biotechnology in Animal sciences, Animal cell and tissue culture production of transgenic animals, cloning of animal (IVF & ET) cryopreservation somatic production of animals, application of human vaccines in improving productivity.

UNIT – IV:

Biotechnology and Environment: Microbial agents and Biochemical methods of xenobiotic degradation, OEMs, Waste water and solid waste management .

REFERENCES:

1. Gene cloning – Brown
2. Concepts in Biotechnology – Balasubramanayam.D
3. Basic Biotechnology – Colin Rotledge and Kristainsen
4. Gene Biotechnology – Jogdan
5. From Genes to Clones, Introduction to Gene
6. Technology – Winnacker, Ernst. L
7. Safety, Moral, Social and Ethical issues related to geneticalls modified foods – Smith J.E.
8. Molecular Biology and Biotechnology – Meyer RA
9. Environmental Biotechnology – Forster and wase
10. Biotechnological Innovations in Environmental
11. Management – Leach and Van Dam-mieras
12. Industrial Microbiology and Biotechnology – Damain and Solomon.

FOURTH SEMESTER

BT 401 – ANIMAL BIOTECHNOLOGY

UNIT – I:

Animal cell culture: Defined media and their applications, balanced salt solutions and simple growth media. Serum-free and Protein-free media. Role of carbondioxide, serum, growth factors, glutamine in cell culture. Types of cell culture: Primary and established culture, Disaggregation of tissue and primary cell culture. Three dimensional culture - Organ culture and Histotypic culture, Stem cell culture. Biology and characterization of cultured cells. Measuring parameters of growth, measuring cell death, Scaling up of animal cells.

UNIT – II:

Molecular Techniques in cell culture: Cell transformation; Physical, Chemical and Biological methods. Manipulation of genes – Hybridoma technology and its applications. Artificial insemination, Pregnancy diagnosis, in vitro fertilization, Embryo transfer technology and superovulation, Cryopreservation Artificial womb, Somatic cell genetics.

UNIT – III:

Biotechnological applications of Aquaculture and Transgenesis: Ploidy manipulations in fishes- gynogenesis, androgenesis sex reversal in fish. Pearl culture. Induced breeding in fishes. Transgenic animals - Microinjection and electroporation in Transgenesis; Production of transgenic fish, birds, mice, pigs, sheep, goat and cows,;

UNIT – IV:

Biotechnology applications of Biocontrol, Animal health and Gene therapy: Baculoviruses in biocontrol and foreign gene expression; pest management using juvenile hormone analogues. Animal health and disease diagnosis- Development of kits and their application in disease diagnosis. Gene therapy: Vector engineering, gene replacement, augmentation, gene correction, gene editing, generegulation and silencing.

REFERENCES:

1. R. Ian Freshney, "Culture of animal cells - A manual of basic techniques" 4th edition, John Wiley & Sons, Inc, publication, New York. 2000.
2. Daniel R. Marshak, Richard L.Gardner, David Gottlieb "Stem cell Biology" edited by Daniel Cold Spring Harbour Laboratory press, New York, 2001.
3. M.M. Ranga, Animal Biotechnology; Agrobios (India), 2006.
4. Butterworth "*In vitro* cultivation of Animal Cells" – Heinemann publishers Open Universities. Nederland, 1994.
5. J. Kruzer, "Recombinant DNA & Biotechnology for Teachers", 2nd Edition, Adrienne Massey, A.Massey & Association.
6. John R. W. Master "Animal Cell culture", University college London, Oxford University press, 2000.
7. Ann A. Kiessling, Scoot Anderson, Human Embryonic Stem Cells, Jones & Bartlett Publishers, Sudbury, Massachusetts, Boston, Toronto, London, 2003.

8. A.J. Thomson, Gene Targeting & embryonic Stem Cells, Bios Scientific Publishers, Taylor & Francis Group London & New York.
9. B.D. Singh, Biotechnology, Kalyani Publishers, Udhiana, New Delhi, Noida (U.P) 2003.
10. P.K. Gupta, Biotechnology and Genomics, Rostogi Publications, Shivaji Road, Meerut, India. 2005.

Websites: <http://www.nortonhealthcare.com>

<http://colostomu.future.easyspace>

PRACTICALS:

1. Preparation of tissue culture medium and membrane filtration.
2. Preparation of single cell suspension from lymphoid organs.
3. Cell counting using Hemocytometer
4. Cell viability testing.
5. Cold and warm Trypsinization.
6. Monolayer culture
7. Cryopreservation using liquid nitrogen and thawing.
8. Measurement of cell doubling time.
9. Preparation of metaphase chromosomes from animal cells.
10. Cell fusion with PEG
11. Pregnancy diagnosis.
12. Extraction of DNA from animal cells
13. Molecular weight determination of DNA extracted from different animal samples using electrophoresis
14. Glycogenesis
15. Androgenesis
16. Sex-reversal using hormones
17. Demonstration of action of Eye-Stalk Peptides on molting in Crustacean
18. Induction of breeding using Pituitary hormones.
19. Establishment of primary cultures from chick embryonic liver
20. Establishment of primary cultures from chick embryonic heart
21. Establishment of primary cultures from spleen cells
22. Culturing of lymphocytes
23. Culturing of HeLa cells
24. Subculturing of primary cultures

BT 402 – INDUSTRIAL BIOTECHNOLOGY

UNIT – I:

Selection of Microorganisms: Isolation, screening, preservation and maintenance of industrially important microorganisms. Media formulation and antifoam agents for industrial Fermentation. Air and Media Sterilization. Strain improvement methods - Conventional and rDNA methods.

UNIT – II:

Microbial Production of Alcohols & beverages: ethanol, acetone, butanol, wine and beer. Organic acids: citric acid, acetic acid (Vinegar), lactic acid. Amino acids: Lysine, Aspartic acid, glutamic acid. Antibiotics: Penicillin, tetracycline, streptomycin, Vitamins: B2, B12.

UNIT – III:

Enzyme technology: Isolation and purification of enzymes from microbial, plant and animal sources. Production of industrially important enzymes amylases, proteases, lipases & pectinases. Application of enzymes in Pharmaceutical and other industries. Application of immobilized enzymes. Methods involved in immobilization techniques of enzymes and whole cells.

UNIT – IV:

Instruments and equipment validation: Validation of autoclaves, dry heat sterilizers, washing devices, incubators, fermentors, and analytical instruments. Process validation: Clean area operations, washing, drying, sterilization, filling, sealing, critical process variables, cause and effect of process deviations, production protocols, standard operating procedures and validation protocols and in-house standards. Quality control concepts. Intellectual property rights - Definition - types - patents- copy rights - trade marks; Essential requirements for IPR, procedures of filing patents - provisional and complete specifications - Pan - Co - operation treaty (PCT) application; GATT and IPR; WTO Act - Global and Indian Biodiversity Act - Indian Patent Act and their revised versions.

REFERENCES:

1. L. E. Casida Jr. Industrial Microbiology. 1997.
2. P .F. Stanbury, A. Whitaker, and S. J. Hall. Principles of Fermentation Technology, Pergamon Press, Oxford. 1997.
3. W ulf Crueger and Anneliese Crueger. Biotechnology- A Text book of Industrial Microbiology. 2nd edition. Panima Publishing Co. 2004.
4. E. M. T. EL- Mansi and C. F. A. Bryce. Fermentation Microbiology and Biotechnology. 1999.
5. M. Moo-Young. Comprehensive biotechnology-Volume 2, 3 and 4. Pergamon Press, 2004.
6. P. K. Gupta. Biotechnology and Genomics. Rastogi Publications, 2004.
7. D.G. Rao. Introduction to Biochemical Engineering. Tata McGraw-Hill Publishing Company limited, New Delhi. 2002.

8. Gerald Reed, Prescott and Dunn's. Industrial Microbiology. 4th edition. CBS Publishers and Distributors. 2004.

PRACTICALS:

1. Isolation of industrially important microorganisms.
2. Screening techniques - crowded plate technique.
3. Production and assay of amylase producing microorganisms.
4. Estimation of penicillin and streptomycin.
5. Microbial production of citric acid using *Aspergillus niger*.
6. Estimation of citric acid by titrimetry method.
7. Fermentative production of ethanol by yeast
8. Estimation of ethanol by colorimetric method.
9. Production of wine from grapes.

BT 403 – PHYTOMEDICINE

UNIT – I:

Origin, scope and source of plant medicines: Brief history of origin and scope of plant medicines. Ayurveda, Unani and Homeopathy. Study of Medicinal plants from the following groups: Gymnosperms, Angiosperms (Ranunculaceae, Leguminaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Liliaceae, Zingiberaceae. Phytochemical extraction methods, medicinal plants based research centre in India.

UNIT – II:

Cultivation, Multiplication, Collection, Processing and Marketing: Macro and Micro Propagation and cultivation of medicinal plants; Multiplication of medicinal plants and production of specific biologically active molecules through tissue culture; Methods of collection, processing and storage of plant Medicines; Drying of medicinal plants – Drying methods, natural drying, artificial drying (freeze drying, microwave drying). Effects of drying factors, influence of drying air temp, influence of drying air humidity, influence of drying air velocity, influence of drying time. Physiological effects: influence of pre-treatments, influence of drying on volatile oil content. Plant Medicines and their trade: Adoption of GATT, patent rights and market potential for the plant medicines.

UNIT – III:

Macroscopy and microscopy, adulteration, identification and substitutions and pharmaceutical uses of plant medicines and dosage: Medicinally useful plant parts such as leaves, stems, underground parts, flowers, fruits and seeds (Senna, Datura, cinnamomum, Cinchona, Ginger, Clove and Nux-vomica). Plant Medicines adulteration, identification and substitutions. Abuse of plant Medicines and repercussions.

UNIT – IV:

Formulations, diagnostic features and Biological activity of plant medicines: Formulations and dosage forms of plant medicines; Pharmacology and pharmacognosy; Study of the important diagnostic features of active constituents, quality, purity; and pharmaceutical uses of important plant medicines. Herbal cosmetics and Dietetics. Biological active principles established herbal medicines.

REFERENCES:

1. Kokate, C.K. Purohit, A.P. Gauchely, S.B. 1990. Pharmacognosy, (Narial Prakashan).
2. Wallis, T.E. 1999. Text Book of Pharmacognosy, 5th ed. CBS publishers & Distributions, New Delhi.
3. Harborne, J.B. 1948. phytochemical methods (ed) Chapman and Hall, London.
4. Khare, C.P. 2000. Indian herbal therapies. Delhi Book Co., MConnaught, Circus, New Delhi-11 0 001.
5. Trease, G.E. and Evans, W.C. 1983. Pharmacognosy, 12th ed. Bailine, London.
6. Anton. R & Haag Berrurier. M. (1980). Therapeutic use of Natural Anthraquinone for other than laxative Actions Pharmacology.
7. Abdul Kareem. M. 1997. Plants I Ayurveda (A compendion of Botanical & Sanskrit names) published by foundation for Revitalization of Local Health traditions, Bangalore.
8. Anna Bonar, 1992. Herbs. A complete guide to their cultivation and use. London.

PRACTICALS:

1. Identification of important medicinal plants of different taxa covered in theory including the study of important morphological features of the Medicinal plant part.
2. Field trip to study and identify locally occurring Medicinal plant.
3. Practical Methods of Cultivation, propagation, conservation and protection (visual) of important Medicinal plants to develop familiarity.
4. Micropropagation of medicinal plants and production of callus from different explants for specific biologically active ingredients of Plant Medicines.
5. Microscopic study of locally available Medicinal plant parts such as leaves, stems, underground parts, flowers, fruits and seeds (Senna, Datura, Cinnamon, Cinchona, Ginger, Clove, Nux-vomica).
6. Demonstration of drug adulteration, identification of locally available Plant Medicines.
7. Antibiotic sensitive test of crude drugs.
8. Demonstration of drug Formulation and Herbal cosmetics.
9. Visit to nearest pharmaceutical industry.

BT 404 – ENVIRONMENTAL BIOTECHNOLOGY

UNIT – I:

Environmental Management and Pollution: Types of pollution. Air pollution and its Control- Sources of Air pollution, Methods for the measurement of Air pollution. Air pollution control through Biotechnology- biofilters, bioscrubbers, and biotrickling filters. Environmental monitoring using Biosensors. Methodology of environmental management - the problem solving approach, its limitations.

UNIT – II:

Water management and Water Pollution: Need for Water management. Sources of water pollution, Measurement of water pollution. Waste water treatment - Physical, chemical and biological treatment processes. Aerobic Process: Trickling filter, rotating discs, rotating drums, oxidation ponds, Anaerobic Processes: Anaerobic digestion, anaerobic filters. Treatment schemes for waste waters of dairy, distillery, sugar, antibiotic, paper. Use of immobilize enzymes for waste water treatment.

UNIT – III:

Bioremediation: Concepts and principles of bioremediation, in-situ & exsitu bioremediation Bioremediation of heavy metal ions - biosorption & bioaccumulation principles. Concepts and Types of phytoremediation. Role of genetically engineered microbes in the Bioremediation. Role of oxygenases in microbial metabolism of hydrocarbons, oil pollution, surfactants (MEOR), pesticides. Applications of microbes in mining industry. Influence of transgenic plants on environment, Global Environmental Problems:

UNIT – IV:

Biofuels, Biodiversity, Biofertilizers and Biopesticides: Biogas-Hydrogen, methane, Microbial groups involved in biogas production and interactions among them. Factors affecting biogas production, Design of digestors, feed stock, uses of spent slurry. Biodiversity- levels of biodiversity, reasons for loss of biodiversity, Biodiversity Conservation (in-situ & ex-situ). Role of biotechnology in conservation of biodiversity. Biofertilizers - Rhizobium, Azotobacter, Azospirillum, Vermiculture. Biopesticides.

REFERENCES:

1. Michael T. Madigan, John M. Martinko & Jock Parker, Brock Biology of Microorganisms, Pearson Education, International Prentice Hall, 2003.
2. Michael J. Pelczar, JR, E.C.S. Chan & Noel R. Krieg, Microbiology, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
3. K. Vijaya Ramesh, Environmental Microbiology, MJP Publishers, Chennai, 2004.
4. A.G. Murugesan, C. Raja Kumari, Environmental Science & Biotechnology - Theory & Techniques, MJP Publishers, 2005.
5. Raina M.Maier Ian L.Pepper & Charles P.Gerba, Environmental microbiology, Academic press, 2000.
6. A.K. De., Environmental Chemistry, Wiley Eastern ltd., New Delhi. 7. D. Allsopp and K.J. Seal, Introduction of Biodeterioration, ELBS/Edward Arnold.
8. Atlas R.M., Bartha R., Microbial Ecology - "Fundamentals and applications", Benjamin/ cummings publishing company, Inc. 4th edition. 1998.
9. Ford, T.E. (ed.) Aquatic Microbiology: An Ecological Approach, Blackwell, Boston. 1993.
10. Power un seen: How microbes rule the world. Freeman/ Spectrum, Oxford. 1994.
11. Mitchell. R., Environmental Microbiology. Wiley, New York. 1992.
12. Y. Anjaneyulu, Introduction to Environmental Sciences, - BS Publications, 2004.

PRACTICALS:

1. Isolation of microorganisms from air
2. Determination of biochemical oxygen demand (BOD) of water
3. Determination of chemical oxygen demand (COD) of water
4. Metal tolerance in bacteria isolated from polluted and non polluted water
5. Ammonification
6. Denitrification
7. Nitrification
8. Antagonism
9. Synergism
10. Estimation of chlorides from polluted and non polluted water
11. Estimation of carbonates from polluted and non polluted water
12. Estimation of Ammonia content in water samples.
13. Total dissolved solids and conductivity relation.

BT 404 – PHARMACEUTICAL BIOTECHNOLOGY

UNIT – I:

Definition – History of development of Pharmaceutical Products by biotechnological methods like genetic recombinant vaccines, microbial and non-microbial products – scope of biotech products and biochemical in pharmaceutical industry. Need to design a drug, drug receptor interactions, antagonisms, biological activity, efficacy and stimulus, receptors and ion channels, ion gating co-operatively effect of solvent on drug – receptor interactions, drug docking.

UNIT – II:

In vitro development of drugs and pharmaceutical : Methods of testing products for anti-microbial potentials, pharmacological activities and biopesticidal properties – conventional and rapid enzyme inhibitor techniques; *in vivo* methods – use of animals model for confirmation of *in vitro* properties – transgenic systems – preclinical, toxicological studies, Acute, subacute, chronic studies. Clinical trails – definition – design – specific objectives – types of clinical trials – phase I, II & III – randomized controlled clinical trails – multicentric double blind clinical trails – pharmaceutical/drug regulations for commercializing new biotech products for human use – FDA and Indian regulations.

UNIT – III:

Biotech products as medicines and pharmaceutical products: Biochemicals – enzymes like proteases – chemical like ethanol, vinegar, citric acid and glutamic acid; vitamins like B12; drugs for infection and metabolic, immunomodulatory – insulin – interferons, B-cell growth factors, Tissue plasminogen activator, r-DNA based production of regulatory proteins, blood products, hormones, vaccines, Application of RFLP in forensic diseases prognosis, genetic counseling, pedigree, variation.

UNIT – IV:

Vaccines – cell culture based vaccines – genetic recombinant vaccines – recombinant vector based vaccines – live and subunit – their production model - fermentation technology – expression systems – guideline for the production of genetic recombinant vaccines – Eg. Hepatitis B vaccine, HIV vaccine and other vaccines in pipeline. Application of biotechnology to Animal health and disease diagnosis. Development of kits and their application in disease diagnosis. Gene therapy, vector engineering, strategies of gene delivery, gene replacement, augmentation, gene correction, gene regulation and silencing safety and bioethical issues in biotechnology.

REFERENCES:

1. Biopharmaceuticals –Walsh, John Willey and Sons, New York 1998.
2. Pharmaceutical Biotechnology – Daan J.A.Crommelin, RobestD. Sindelar, Daan JACrommelianAmazon.
3. Physical Methods to characterize Pharmaceutical Protines – James, N.Herron, Wim Jiskoor and Daan J.A.Crommelin Amazon. Wm From clone to clinic (Developments in Biotherapy) –Daan J.A.Crommelin and H.Schellekom Amazon. Wm.
4. Hand Book of Pharmaceutical Biotechnology – Jay P.Rho, Star4lonie The Haworth press.
5. Alice Sr. Bringhamton, NY13904, US Drug discovery, Tamas bartifai, Harold L.Dorn's The Scientific world Ltd., Newburry, U.K.