

NORTH MAHARASHTRA UNIVERSITY
JALGAON



'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS FOR
Master of Science
in
Biochemistry

PART- II
(Semester III and IV)

w.e.f. Academic Year 2016 - 2017

NORTH MAHARASHTRA UNIVERSITY, JALGAON
M.Sc. Biochemistry
Part-II
(w.e.f. Academic Year 2016 - 17)

Course Structure at a Glance

Semester III

BC-301 :	Molecular Biology
BC-302 :	Plant Biochemistry and Biotechnology
BC-303 :	Environmental Toxicology
BC-304 :	Laboratory Course - V
BC-305 :	Laboratory Course - VI

Semester IV

BC-401 :	Genetic Engineering
BC-402 :	Fermentation Technology
BC-403 :	Industrial Biotechnology and Animal Tissue Culture
BC-404 :	Laboratory Course - VII
BC-405 :	Laboratory Course - VIII

- Semester III and IV will have 03 theory courses and 02 practical courses each.
- Practical examination for each semester will be held at the end of the respective semester.
- Each course will have a weightage of 100 marks.
(40 marks internal and 60 university examination)
- Each theory course is divided into five units and is to be completed in 50 lectures of 60 minutes duration each.

BC - 301 : Molecular Biology

Unit I : DNA: Structure - current concept, triple helix DNA , melting of DNA. Replication- general principles, isolation and properties of DNA polymerases, proof reading, continuous and discontinuous synthesis. Asymmetric and dimeric nature of DNA polymerase I, II & III, exonuclease activity in eukaryotic DNA polymerases.

DNA: Superhelicity, linking number, topological properties, mechanism of action of topoisomerases. DNA damage and repair: Types of DNA damage, repair pathways– methyl directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, SOS repair mechanism.

Unit II : Transcription: General principles, basic apparatus, steps in RNA synthesis, inhibitor of transcription, control of transcription by interaction between RNA polymerase & promoter region, sigma factor, attenuation & anti termination.

Maturation & processing of RNA: Methylation, cutting and trimming of rRNA, capping, polyadenylation and splicing of mRNA, catalytic RNA, group I & group II intron splicing.

Protein Biosynthesis: Steps in translation, role of various factors, various steps of translation, post translational modification, inhibitors of protein synthesis.

Unit III : Regulation of gene expression: Operon concept, *lac* operon, catabolite repression , instability of bacterial RNA, positive & negative regulation with example, inducers & co-repressors, regulation by attenuation- trp and arabinose operon.

Lambda phage regulation, lytic and lysogenic pathway, autogenous regulation, stringent response.

Unit IV : Eukaryotic chromosome and gene expression, histone proteins, nucleosome, DNA packing, DNA replication, DNA polymerases, telomers, mitochondrial and chloroplast DNA, repeating sequences, Cot_{1/2} values, transcriptionally active regions, transcription regulatory proteins, leucine zipper and zinc finger, DNA binding protein.

Unit V: Protein Targeting: Synthesis of exported protein on membrane bound ribosome, signal hypothesis, SRP & its role , chaperon proteins, targeting of proteins to organelles (lysosomes, mitochondria, chloroplast, ER, nucleus, and plasma membrane. protein destruction.

Recommended Books:

- Genes: B. Lewin (Oxford University Press).
- Lewin's Genes XI : J. E. Krebs, S. T. Kilpatrick, E. S. Goldstein (Jones and Bartlett Publishers, Inc).
- Biochemistry: L. Stryer (W.H. Freeman & co.).
- Lehninger Principles of Biochemistry: D. L. Nelson & M. M. Cox (Macmillan Worth Publishers).
- Molecular Cell Biology: J. Darnell, H. Lodish & D. Baltimore (Scientific American Books).
- Fundamentals of Biochemistry: D. Voet, J. Voet & C. Prati (John Wiley & Sons).
- Molecular Biology of Genes: J. Watson, N. H. Hopkin, J. W. Roberts, J. P. Stertz & M. Weiner (Freeman Co.)

- The Biochemistry of the Nucleic Acids: R. L. P. Adams, J. T. Knowler & D. P. Leader (Chapman & Hall).
- Biotechnology – An Introduction: S. R. Barnum (Thomson Brooks/Cole).
- Cell and Molecular Biology: E. D. P. De Robertis, E. M. F. De Robertis, Jr. (Lea & Febiger International Edition, Info Med).
- Principles of Genetics: E. J. Gardner, M. J. Simmons, D. P. Snustad (John Wiley & sons Inc.).
- A History of Molecular Biology: M. Morange (Oxford University Press).
- Molecular Biology : R. F. Weaver (McGraw-Hill)
- Cell and Molecular Biology: P. Sheeler, D. E. Blanche (John Wiley & sons Inc.).
- Molecular Biology and Microbes: S. Srivastava and V. Singhal (Anmol publications Pvt. Ltd.).
- Concepts in Molecular Biology: S. C. Rastogi, V. N. Sharma & A. Tandon (Wiley Eastern Ltd.).
- Molecular biology: P. K. Gupta (Rastogi Publications).

BC - 302 : Plant Biochemistry and Biotechnology

Unit I : Photosynthesis: Structure of chloroplast, photosynthetic pigments, excitation of chlorophyll molecule, photosystem I & II – location, mechanism of quantum capture & energy transfer between photosystems, photolysis of water, photoprotective mechanisms.

CO₂ fixation: C₃, C₄ and CAM pathways, bacterial photosynthesis, photorespiration.

Unit II : Nitrogen fixation: Symbiotic & non-symbiotic nitrogen fixation.

Plant Hormones: Introduction. Biochemical nature, mode of action and physiological effects/role of Auxins, Cytokinins, Gibberellins & Absisic acid.

Secondary metabolites: Introduction.

Incubation systems: culture room, green house and shade house, advantages and limitations of each system.

Unit III : Introduction to plant biotechnology: history, concept of totipotency, heterogeneity, cytodifferentiation, organogenesis.

Preparation of explant.

Tissue culture media: general introduction, composition, sterilization.

Unit IV : Initiation, maintenance and importance of callus culture, suspension culture and single cell culture.

Micropropagation: principle, regeneration by-shoot tip, meristem, axillary shoot. Hardening of tissue cultured plants.

Organ Culture: principle, protocol and importance of root, stem, leaf, flower, ovary, embryo and anther culture.

Unit V : Protoplast culture: principle, isolation and culture of protoplast, importance of protoplast culture. Protoplast fusion-principle, methods, mechanism and importance.

Somatic embryogenesis-principle, induction, importance. Artificial seeds-concept, preparation, uses and limitations.

Somaclonal variations: concept, mechanism causing somaclonal variation, isolation and applications of somaclonal variants.

Applications, scope and importance of plant cell, tissue and organ culture in agriculture, horticulture, forestry, industries.

Recommended Books:

- Plant Biochemistry : Hans-Walter Heldt (Academic Press)
- Handbook of Photosynthesis : Mohammed Pessaraki (Editor) (CRC Press)
- Introduction to Plant Biochemistry : T. W. Goodwin and E. L. Mercer (Pergamon Press)
- The Biochemistry of Energy Utilization in Plants : D. T. Dennis (Blackie & Son)
- Plant Biochemistry : P. M. Dey and Harborne (Academic Press)

- Plant Physiology, Fifth Edition : Lincoln Taiz and Eduardo Zeiger (Sinauer Associates)
- Plant Physiology: Frank B. Salisbury, Cleon W. Ross (Brooks Cole)
- Plant Physiology : R. M. Devlin and F. H. Witham (Prindle Weber & Schmidt)
- Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture: J. Reinert and Y. P. S. Bajaj.(Springer-Verlag)
- Plant Cell Biotechnology: R. Endress (Springer-Verlag).
- Biotechnology in Agriculture: M. S. Swaminathan.(Macmillan Publishers India)
- Secondary Metabolism in Plant Cell Culture: P. Morrist, A. H. Scragg, A. Stafford, M. W. Fowler.(Eds.) (Cambridge University Press.)
- Agricultural Biotechnology: S. S. Purohit (Agro Botanica).
- Plant Biotechnology: J. Hammond, P. McGravery and V. Yusibov (Eds.) (Springer-Verlag).
- Plant Cell and Tissue Culture for the Froduction of Food Ingredients: T. J. Fu, G. Singh and W. R. Curtis (Eds.) (Kluwer Academic/Plenum Press).
- Biotechnology in Crop Improvement: H. S. Chawla (International Book Distributors).
- Plant Tissue Culture: K. K. De (New central Book Agency).

BC - 303 : Environmental Toxicology

Unit I: Principles of toxicology: Definition, Purpose and history of toxicology, Types of toxicity: acute, chronic, genotoxicity. Introduction to toxicity at the level of organ system: Dermato toxicity, gastrointestinal toxicity, Respiratory tract toxicity, hepatotoxicity, Nephrotoxicity, Cardiotoxicity, Heamatotoxicity, Immuno toxicity, Neurotoxicity and Reproductive toxicity. Toxicants in soil and air.

Unit II: Factors influencing toxicity: Route of exposures of toxicant, absorption, distribution and excretion of toxicant, Biotransformation Phase I reactions - oxidation, reduction, hydrolysis, hydration. Phase II reactions - conjugation, methylation, glutathione and amino acid conjugation.

Unit III: Evaluation of toxicity: Introduction to synergism, antagonism and potentiation. Animal's model used in toxicology studies, Determination of dose response curve and LD₅₀ or LC₅₀ and chronic exposures. Ames test.

Unit IV: Toxicology of Alcohol, caffeine and nicotine: Biological properties, health effects, regulatory standards and conclusion. Introduction of metal toxins: history, effects exposure, solutions to reducing exposure Mercury, Lead and Arsenic. Introduction to health effect of solvent: history, biological properties, products, health effect of solvent, reducing exposure and regulatory standards, Introduction to radiotoxicity, asbestos and insecticides toxicity.

Unit V : Biological toxin: Properties and effects of animal toxins – snake and scorpion, plants toxins – Ricin ,weeds, toxins produced by animals scorpion , snake, mycotoxins and its types and toxic effect.

Solid waste management: Toxic effects of solid waste, traditional methods of solid waste treatment i.e composting, incineration, land filling and modern technologies, treatment methods, plasma torch detoxification, advanced wet oxidation and Pyrolysis.

Recommended Books:

- Principles and Methods of Toxicology: A. Wallace Hayes (Edt.) (CRC Press)
- Hamilton and Hardy's Industrial Toxicology: R. D. Harbison (Mosby).
- Basic toxicology – Fundamental Target Organs and Risk Assessment: F. C. Lu (CRC Press)
- Environmental biology: K. C. Agrawal (Agro Botanica).
- Casarett and Doull's Toxicology: C. D. Klaassen, M. O. Amdur, J. Doull (Macmillan Publishing Co.).
- Environmental toxicology – Human Exposure and Their Health Effects: M. Lipmann (Ed.) (Wiley Interscience)
- Fundamental Toxicology for Chemists: J. H. Duffus and H. G. J. Worth (Eds.) (Royal Society of Chemistry).
- A Small Dose of Toxicology: The Health Effects of Common Chemicals: Steven G. Gilbert. (CRC Press).

BC - 304 : Laboratory Course – V

1. Plant tissue culture laboratory organization.
2. Comparative efficacy of chemical sterilents for sterilization of plant material.
3. Induction and characterization of callus.
4. Isolation of secondary metabolite from the callus tissue of medicinally important plant.
5. Regeneration (caulogenesis and rhizogenesis) of plant from callus.
6. Micropropagation through shoot tip/meristem culture.
7. Regeneration of high yielding banana plantlet from rhizome.
8. Somatic embryogenesis from suitable explant.
9. Isolation and determination of bioefficacy of phosphate solubilising microorganisms.
10. Isolation and determination of bioefficacy of nitrogen fixing microorganisms.
11. Separation of plant secondary metabolites (alkaloid/steroid/flavanoid) by TLC/HPTLC.
12. Estimation of chlorophyll a, chlorophyll b and total chlorophyll from leaf sample
13. Estimation of PS II activity in isolated chloroplasts.

(Any ten experiments to be performed.)

Recommended Books:

- An Introduction to Plant Tissue Culture: Kalyan Kumar De (New Central Book Depot).
- Plant Cell and Tissue Culture- A Laboratory Manual: J. Reinert and M. M. Yeoman (Springer-Verlag)
- Plant Tissue Culture- Techniques and Experiments: R. Smith (Academic Press)
- Methods in Plant Molecular Biology: M. A. Schuler and R. E. Zielinski (Academic Press)
- A Laboratory Manual of Plant Biotechnology: S. S. Purohit (AgroBotanica).
- Methods in Plant Tissue Culture: U. Kumar (Agrobios).

BC - 305 : Laboratory Course – VI

1. Isolation of chromosomal / genomic DNA from Bacteria / Yeast / plant / animal cell /tissue.
2. Estimation of DNA by DPA method.
3. Estimation of RNA by orcinol.
4. Agarose gel electrophoresis of DNA.
5. Induction of *lac* operon in *E. coli*.
6. Determination of T_m of DNA.
7. Determination of G+C content of DNA.
8. Calculation of arithmetic mean, mode and median.
9. Calculation of standard deviation.
10. Techniques of analysis of variance – one way and two way.
11. “Chi-squared” goodness-of-fit test.
12. Sequence analysis using BLAST.
13. Protein structure prediction –PDB.
14. Multiple sequence alignment – Clustal X.

Total 12 experiments to be performed

(Any 6 experiments each from one to seven and eight to fourteen).

Recommended Books:

- Molecular Cloning – A Laboratory Manual –Vol. I, II & III: Sambrook and Russel (Cold Spring Harbour Laboratory Press).
- Practical Biochemistry - Principles and Techniques: K. Wilson and J. Walker (Cambridge Press).
- An Introduction to Practical Biochemistry: D. T. Plummmer (Tata McGraw Hill).
- Methods in Agricultural Biochemistry: S. Sadashivam and A. Manikam (New Age Publication).
- Laboratory Manual in Biochemistry: J. Jayraman (New Age Publication Ltd.)
- Biostatistics: Theory and Problems: Kathamba Rajan (Himalaya Publishing House)
- Fundamentals of Biostatistics: I. A. Khan and K. Khanum (Ukaaz Publications)
- An Essential Guide to the Basic Local Alignment Search Tool- BLAST : I. Korf, M. Yandell and J. Bedell (O’Reilly Network Publishers)
- Proteomics in Practice: A Laboratory Manual of Proteome Analysis: R. Westermeier and T. Naven (Wiley-VCH)
- Introduction to Proteomics: Tools for the New Biology: D. C. Leibler and J. R. Yates (Humana Press)

BC - 401 : Genetic Engineering

Unit I : Genetic engineering: Concept. Restriction enzymes – nomenclature, properties, types, mode of action. Restriction modification system.

Cloning vectors: Plasmids, bacteriophages, cosmids, phagemids. Artificial chromosomes. Binary and shuttle vectors, expression vectors.

Unit II : Cloning: Steps involved, strategies for each step with details of – cDNA synthesis of generation of DNA, joining cDNA to vector DNA by homopolymer tailing , transformation with rDNA, transfection with r-phage DNA, screening by immunochemical and nucleic acid hybridization method.

Unit III : DNA library: cDNA and genomic DNA library.

Mapping: S1 nuclease mapping, restriction mapping and their applications.

Mutagenesis: Site directed mutagenesis and its applications.

Polymerase chain reaction, RFLP, RAPD, AFLP and their applications.

Unit IV : Transformation in plants: feature of Ti and Ri plasmid, basis of tumour formation, mechanism of DNA transfer, role of virulence genes, use of reporter genes. Viral vectors and their applications, particle bombardment, electroporation, microinjection. Application of plant transformation for productivity, performance, herbicide resistance, long shelf life of fruits and vegetables. *Arabidopsis thaliana*: as a “model organism”. GM crops. Transgenic animals.

Unit V : Blotting techniques : Southern blotting, Northern blotting, Western blotting, Dot blot. DNA sequencing : enzymatic, chemical and automated.

DNA chip technology and microarrays: Types and production of chips. Applications of microarrays on DNA chips. RNAi. Gene silencing and antisense technology.

Gene therapy: Vectors for gene therapy, gene editing and gene replacement.

Scope and applications of genetic engineering in medicine, agriculture and industry.

Introduction to Biosafety and Bioethics.

Recommended Books:

- Recombinant DNA: J. D. Watson, M. Gilman, J. Witkowski and M. Zoller (Scientific American Books – distributed by W. H. Freeman and co.).
- Lewin’s Genes XI : J. E. Krebs, S. T. Kilpatrick, E. S. Goldstein (Jones and Bartlett Publishers, Inc).
- Principles of Gene Manipulation – An Introduction to Genetic Engineering: R. W. Old and S. B. Primrose (Blackwell Scientific Publications).
- Genes: B. Lewin (Oxford University Press).
- Biochemistry: L. Stryer (W.H. Freeman & co.).
- Lehninger Principles of Biochemistry: D. L. Nelson & M. M. Cox (Macmillan Worth Publishers).
- Cell and Molecular Biology: P. Sheeter and D. E. Blanchi (John Wiley & sons Inc.)
- Methods in Molecular Biology, Vol. 92 – PCR in bioanalysis: S. J. Metzger (Humana press).
- Gene function – *E. coli* and its heritable elements: R. C. Glass (Croom Helm).
- Principles of Genetics: E. J. Gardner, M. J. Simmons, D. P. Snustad (John Wiley & sons Inc.).
- Genetic Engineering: R. Williamson (Academic press Inc.).
- Molecular Cloning – a laboratory manual : J. Sambrook, E. F. Fritsch and T. Maniatis (Cold Spring Harbor Laboratory Press).

- Molecular Biotechnology: S. B. Primrose (Blackwell Scientific Publication).
- Methods in Enzymology – Vol. 152; guide to molecular cloning techniques (Academic Press).
- DNA Cloning – A Practical Approach: D. M. Glover and B. D> Hames (IRL Press).
- Gene Therapy – Principles and Applications: T. Blankenstein (Birkhauser Verlag).
- Genetic Engineering: P. K. Gupta (Rastogi publications).
- Biotechnology and Genomics: P. K. Gupta (Rastogi publications).
- Biotechnology: R. C. Dubey (S. Chand).
- The Indian Environment Protection Act, 1986 (Govt. of India).
- Rules for manufacture, use / import / export / and storage of hazardous microorganisms or cells act, 1989 (Govt. of India).
- Food Safety and Standards Act. 2006 (Govt. of India).

BC - 402 : Fermentation Technology

Unit I : Introduction to fermentation technology: The range of fermentation processes, Microbial biomass, microbial enzymes, recombinant products, transformation products. Chronological development of fermentations industry.

Unit II : Screening of organism: Primary, secondary screening, modern concept for screening. Nisbet guideline for overproduction media.

Preservation and improvement of industrially important organisms: Criteria for choice organism, selection of autotrophic mutants, morphological mutant, analogue, precursor, resistant mutant, recombinations. Preservation methods, low temperatures, dehydration, quality control of preserved cultures, culture collection centers.

Unit III : Medium for industrial fermentations: Criteria's for designing fermentation medium formulation, cellular yield coefficient, media component , carbon sources, nitrogen source, minerals, antifoams, precursors, inducers and inhibitors. Media optimization by using Plackett Burmen design.

Unit IV : Inoculums development for industrial fermentation, criteria to inoculate organism, criteria for transfer of inoculums. Development of inoculums for yeast, fungi, actinomycetes and bacteria.

Sterilization of industrial fermentation medium: Methods of sterilization - steam, Radiation, filtration, gaseous. Batch sterilization, filtration. Batch and Continuous sterilization.

Unit V : Solid state fermentation: advantages, disadvantages, comparison with submerged fermentation, bioreactors used for solid state fermentations. Dual fermentation - examples, need and significance.

Downstream processing: Cell separation, disintegration, extraction – liquid- liquid, two phase liquid. Precipitation, purification, crystallization, spray drying, drum dryers, packaging. Specific examples of fermentation product recovery.

Recommended Books:

- Principle of Fermentation Technology: P. F. Stransberry, A. Whitekar & S. J. Hall (Aditya Books).
- Industrial Microbiology: L. E. Casida JR (New Age International Publishers Ltd.).
- Industrial Microbiology: S. C. Prescott & C. G. Dunn (Agrobios).
- Solid Substrate Cultivation: H. W. Doelle, D. A. Mitchell & C. E. (Elsevier Applied Science).
- Biotechnology of Antibiotics: Vandamme Drugs and Pharmaceuticals, Vol. 22 (Ed.) (Marcel Dekker Inc.).
- Bitechnology of Filamentous Fungi: D. B. Franklinstein and C. Ball (Bitterworth-Heinemann).
- Biotechnology of Antibiotics: Vandamme Drugs and pharmaceuticals, Vol. 22 (Ed.) (Marcel Dekker Inc.).
- Process Biotechnology – Fundamentals: Mukhopadhyay (Viva Books Pvt. Ltd.).
- Microbial Technology - Fermentation Technology, Vol. I & II: A. H. J. Pepler & D. Perlmann (Academic Press).

BC - 403 : Industrial Biotechnology and Animal Tissue Culture

Unit I: Production study of important biotechnological products: Erythropoietin, insulin.

Industrially significant fermentations: Antibiotics - Penicillin, tetracycline Rifamycin. Vitamins - Riboflavin. Organic acids - citric acid, lactic acid. Alcohols – ethanol. SCP. Lovostatins. Vaccine - BCG.

Unit II: Introduction to quality control, good manufacturing practices (GMP).

Principle of production of quality control of biologicals, National control of biological product and international movement of biological material. Quality control of BCG, DPT, typhoid, Hepatitis B vaccines.

Unit III : Introduction to animal tissue culture; Application of a tissue culture, limitation of tissue culture, Designing of the tissue culture laboratory; equipment and glassware used in animal tissue culture.

Unit IV: Aseptic techniques; precaution for maintaining sterility, sterilization of materials, media, balanced salt solution, sterility & toxicity testing, serum sterilization. Tissue culture media: properties and special rearrangement, synthetic medium, commonly used antibiotic, serum & serum free medium.

Unit III: Types of culture, primary explants culture, cell culture, organ culture, epidermal keratinocytes, corneal epithelium, mammary epithelium, culture and maintenance of cell line, monolayer cultures, cell suspension. Types of microbial contaminant sources of seed culture.

Protocol for routine characterization of cell line viable cell counting, cell morphology plating and seeding efficiency.

Recommended Books:

- Principal and Practices of Animal Tissue Culture: Sudha Ganangal (University Press).
- Quality Assurance in Microbiology: Rajesh Bhatia and R. Ichhpujani (CBS publisher and distributors).
- Biopharmaceuticals - Biochemistry & Biotechnology: G. Walsh (Wiley).
- Animal Cell Culture – Practical Approach: R. W. Jhon (Masters Oxford).
- Culture of Animal Cell: R. I. Freshney (Wiley - Liss).
- WHO Report :Recommended Composition of Influenza Virus Vaccines for use in the 2012-2013 northern hemisphere influenza season February 2012.
- WHO good manufacturing practices for active pharmaceutical ingredients World Health Organization WHO Technical Report Series, No. 957, 2010.
- Methods in Cell Biology - Vol. 57 - animal cell culture methods: J. P. Mathon and D. Barnes (Eds.) (Academic Press).
- Industrial Microbiology: L. E. Casida JR (New Age International Publishers Ltd.).
- Industrial Microbiology: S. C. Prescott & C. G. Dunn (Agrobios).
- Microbial Technology - Fermentation Technology, Vol. I & II: A. H. J. Pepler & D. Perlmann (Academic Press).

BC - 404 : Laboratory Course - VII

1. Isolation and characterization of plasmid DNA
2. Restriction digestion of DNA and analysis by agarose gel electrophoresis.
3. Amplification of DNA by polymerase chain reaction (PCR).
4. Separation of peptides by PAGE.
5. Preparation of competent bacterial cells and their transformation by using plasmid.
6. *Agrobacterium* mediated transformation of plant material.
7. Demonstration of Southern blotting technique.
8. Estimation of dissolved oxygen and BOD of water.
9. Citric acid production by fermentation
10. Antibiotic production by fermentation
11. Analysis of Proline in infected plants.
12. Estimation of Lysine in cereal grains.
13. Preparation of media for animal tissue culture & culturing of cells.
14. Maintenance of cell line.
15. Test for cell viability.

Total 12 experiments to be performed
(Any 6 experiments each from one to seven and eight to fourteen).

Recommended Books:

- Molecular Cloning – A Laboratory Manual –Vol. I, II & III: Sambrook and Russel (Cold Spring Harbour Laboratory Press).
- Practical Biochemistry - Principles and Techniques: K. Wilson and J. Walker (Cambridge Press).
- An Introduction to Practical Biochemistry: D. T. Plummer (Tata Mc Hill).
- Methods in Agriculture al Biochemistry: S. Sadashivam and A. Manikam (New Age Publication).
- Laboratory Manual in General Microbiology: H. J. Binson (Wm C Brown Publishers).
- Laboratory Manual in Biochemistry: J. Jayraman (New Age Publication Ltd.)
- Laboratory Exercises in Microbiology: J. P. Harly and L. M. Prescott (WBC / Mac Hill).

BC - 405 : Laboratory Course - VIII

(Project Work / Dissertation)

Epilogue

Skills imparted: The curriculum is designed in such way that the student will get basic and applied knowledge of the subject. One of the major objectives considered during designing is to make technically educated human resource. The included basic subjects in theory and practical like biochemistry of secondary metabolites, human physiology, molecular biology, microbial physiology would be helpful to find out unseen facts in various environmental, agriculture, metabolic and infectious problems in day to day life. The subjects like genetic engineering, plant tissue culture, applied biochemistry, animal tissue culture and biochemical techniques are designed in such a way that students will get theoretical and practical knowledge of modern scientific advances in the field. To make skillful human resource with precision, the course like biostatistics and bioinformatics are included. The subject like Microbial biotechnology, toxicology, would give not only the practical knowledge of industry and industrial processes but also make aware the students with the global environmental problems like pollutions, contamination and infections.

Practical courses are based on theory courses and are designed to improve research oriented skills of students.

Job opportunity: The designed curriculum offers job opportunities in various sectors like,

- Pharmaceutical industry : Clinical, medicine, vaccine, QC division
- Biotech industry: Recombinant product, QC, QA
- Agrochemical & pesticide industry
- Chemical industry: synthesis, testing
- Environmental protection industry & Agencies
- Research leading up to Ph D degree
- Self entrepreneurship
- Marketing of biological & pharmaceutical products