Vidyasagar University
Syllabus of M.Sc. Course in Biotechnology
(Choice Based Credit System- CBCS)

Distribution of Marks :-

I. M.Sc. Part-I

SEMESTER – I

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIT-101	Chemistry of Biomolecules	Theory (Core)	10	40	50	4
BIT-102	Cell Biology and Genetics	Theory (Core)	10	40	50	4
BIT-103	Microbiology and Virology	Theory (Core)	10	40	50	4
BIT-104	Molecular Biology	Theory (Core)	10	40	50	4
BIT-105	Cell Biology and Genetics	Practical (Core)	10	40	50	4
BIT-106	Microbiology	Practical (Core)	10	40	50	4
Total marks and Credits					**300**	**24**

SEMESTER – II

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIT-201	Biochemistry	Theory (Core)	10	40	50	4
BIT-202	Immunology	Theory (Core)	10	40	50	4
BIT-203	Recombinant DNA Technology and Methods in Biotechnology	Theory (Core)	10	40	50	4
BIT-204	Quality Control and Management in Food and Pharma Industry	Elective Course	10	40	50	4
BIT-205	Biochemistry	Practical (Core)	10	40	50	4
BIT-206	Molecular Biology and Immunology	Practical (Core)	10	40	50	4
Total marks and Credits					**300**	**24**

SEMESTER – III

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIT-301	Plant Biotechnology	Theory (Core)	10	40	50	4
BIT-302	Animal Biotechnology	Theory (Core)	10	40	50	4
BIT-303	Biostatistics and Bioinformatics	Theory (Core)	10	40	50	4
BIT-304	Biochemical and environmental toxicology	Elective Course	10	40	50	4
BIT-305	Cell and Tissue culture	Practical (Core)	10	40	50	4
BIT-306	Bioinformatics	Practical (Core)	10	40	50	4

Total marks and Credits	300	24

SEMESTER – IV

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIT-401	Microbial Biotechnology	Theory (Core)	10	40	50	4
BIT-402	Agriculture and Food Biotechnology	Theory (Core)	10	40	50	4
BIT-403	Pharmaceutical and Clinical Biotechnology	Theory (Core)	10	40	50	4
BIT-404	Clinical and Industrial Biotechnology	Practical (Core)	10	40	50	4
BIT-405	Project Work	Practical (Core)	-	-	50	4
BIT-406	Project Presentation and Grand Viva	Practical (Core)	-	-	50	4
Total marks and Credits					**300**	**24**

Total Marks (Semester I to IV) : 1200

- Number of Theoretical papers- 15
  (Total credits: 15x4=60 Credits)
- Number of Practical papers- 09
  (Total credits: 9x4=36 Credits)

- Total Credits (Semester I to IV) : 96.
- One Paper= 50 marks= 4 credits

Each E.A.=40 marks (40 Hours duration) =3.2 credits
Each I.A.=10 marks =0.8 credits

DISTRIBUTION OF MARKS

Each theoretical and practical paper carries 40 marks each.10 marks will be allotted for internal assessment.

Questions for each theoretical paper:

Q.no.1. – 05 questions out of 8 (x2) = 10 marks.
Q.no.2. – 02questions out of 4(x5) = 10marks
Q.no.3. – 02 questions out of 4 (x10) = 20 marks

Total- 40 marks.

SEMESTER – I

Paper-I(BIT-101) (40 marks)
(40 Hours)

CHEMISTRY OF *BIOMOLECULES*

1. Atom and chemical bonds :- Atomic structure, ionization potential, electron affinity, electronegativity, Overview of different types of bonds (Sigma bonds, pi bonds, covalent bonds, coordinate bonds, metallic bonds, hydrogen bonds, hydrophobic and VanderWall forces) and their properties. (6Hrs.)
2. An overview on biomolecules –Carbohydrate, Protein, Lipid and Nucleic acid (6Hrs.)
3. Sequencing of proteins, Separation and detection of proteins, chemical synthesis of proteins. (4Hrs.)
4. An overview of enzyme classification, Overview of enzyme-reaction kinetics, Multienzyme complexes, Allosteric enzymes, Ribozymes. (8Hrs.)
5. Isotopes and radioactivity: Radioactivity, decay laws, production of radioisotopes, detection and measurement of dose, autoradiography, G.M. Counter, scintillation counter, radiation safety, use of radioisotopes in biological system. (8Hrs.)
6. Spectroscopy: Principles of light absorption, ultraviolet, visible and infrared absorption spectrophotometer and their working principles. Raman spectroscopy, NMR, Mass spectroscopy, MALDI-TOF and their biological application, circular dichroism (CD) and optical rotatory dispersion (ORD), fluorescence and phosphorescence. (10Hrs.)

Reference books:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry 4th edition Pub WH Freeman Co.
2. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3 rd Indian edition, Pub. Oxford.
3. Mathews, Van Holde and Ahern, Biochemistry by 3 rd edition, Pub Pearson education
4. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co. NY.
5. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2 nd edition Pub: Tata.
6. Voet, D., Voet J.G. (2004). Biochemistry 2nd Edn.
7. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc. NY
8. Zubey, G.L. Parson, W.W., Vance, D.E. (1994). Principles of Biochemistry WmC Brown publishers. Oxford.
9. Edwards and Hassall. Biochemistry and Physiology of the cell 2 nd Edn. McGraw Hill Co. UK. Ltd.

Paper-II (BIT-102) (40marks)
(40 Hrs.)

CELL *BIOLOGY AND GENETICS*

1. *Cell types*: Structure of prokaryotic and eukaryotic cells, ultra structure of animal and plant cell. Autocrine, paracrine and endocrine cells. Muscle cells and nerve cells. (3H)

2. *Biological membranes*: structure and properties, membrane constituents- phospholipids, glycolipid, cholesterol, membrane proteins. Transport of nutrients- ions and macromolecules across membrane – passive; diffusion, osmosis, ionophores, reverse osmosis and active transport, permease, Na Pump, Ca Pump, Co-transport, symport, antiport, endocytosis and exocytosis. Junction between cells- desmosomes, plasmodesmata. Plant cell wall. (8H)

3. *Cell motility*: Cilia and flagella of eukaryotes and prokaryotes, cyto- skeleton – Microtubules, microfilaments and intermediate filaments. (4H)

4. *Cell division and control*: Cell cycle and mitosis, Meiosis and its genetic Significance. (4H)

5. *Genetic Control of development*: Mitochondrial and chloroplast gene -maternal inheritance; Zygotic genes (eg. gap genes, segmental polarity genes and homeotic genes) in pattern formation, anterio-posterior embryogenesis; gene expression in animals (Drosophila) and plants (Arabidopsis). (6H)

6. Chromosomal Genetics:- molecular organization of chromosomes, karyotype constructions in normal and in genetic disorders,ISH, FISH. (3H)

7. Human Genetics:- Pedigree analysis, inheritance of sex linked and autosomal traits, chromosome aberrations, Biochemical genetics, polygenic inheritance, mapping of human genome, genetic counseling. (6H)

7. Population Genetics:- Genetic variation, random mating, genetic frequency and Hardy-Weinberg law, natural selection, genetic drift, inbreeding, genetic equilibrium, DNA polymorphism. (6H)

References:

1. Matthews, C.A. (2003). Cellular physiology of nerve and muscle. 4th Edn. Blackwell publishers.
2. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K., Watson, J.D. (1994). Molecular Biology of the Cell.
3. Cooper, G.M. (1997).The Cell: A molecular approach, ASM Press, USA.
4. Darnell, J., Lodish, H., Baltimore, D. (1990). Molecular Cell Biology. Scientific American Books Inc. NY.
5. Edwards and Hassall (1980). Biochemistry and Physiology of cell, 2 nd Edn. McGraw Hill Company.
6. Garrett, R.H., Gresham, C.M. (1995). Molecular aspects of Cell Biology, International edition, Saunders College Pub.
7. Holy Ahern (1992). Introduction to Experimental Cell Biology, Wm. C. Brown Publishers.
8. Karp, G. (1996). Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.
9. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J. (2004). Molecular Cell Biology, Scientific American Books Inc. NY.
10. Tobin and Morel (1997). Asking about “Cells” Saunders College Publisher.
11. Wolfe, S.L. (1991). Molecular and Cellular Biology, Wordsworth Pub.Co.
12. Hallwell, B., Gutteridge, J.M.C. (2002). Free Radicals Biology and Medicine. Oxford Press.UK.
13. Kanugo, M.S. (2002) Genes and aging. Cambridge University Press.
14. David Freifelder. (2004). Microbial genetics. 10th edition, Norosa publisher, New Delhi.
15. Lodish, H.D., Baltimore, A., Berk, B.L., Zipursky, P., Mastsydairs and Darnell, J. (2004). Molecular cell biology. Scientific American Books Inc., NY.
16. Gardner/Simmons/Snustad. (2006). Principal of Genetics. 8th Edn. John Wiley & sons.
17. Klug, W.S.,Cummings. (2003). Concepts of genetics, 7th Edn. Pearson Education.
18. Dale, J.W. (1994). Molecular Genetics of bacteria, John Wiley & Sons.
19. Streips and Yasbin. (2001). Modern microbial Genetics. Niley Ltd.
20. John Ringo (2004). Fundamental Genetics. Cambridge University Press.

Paper-III(BIT-103) (40marks)
(40 Hrs.)

MICROBIOLOGY *AND VIROLOGY*

1. *Structure of Prokaryotic organisms*: Ultra structure and chemistry of capsule, pili and flagella. Cell wall of Archaebacteria. Gram positive and Gram negative bacteria, tactic movements – chemo taxis. (3H)
2. *Classification*: classification and importance of micro organisms, short description of thermopiles, holophiles, acidophiles, Mycoplasma, Actinomycetes, Rickettsias, chlamydias. (4H)
3. *Bacterial growth and nutrition*: Growth requirements, growth factors, mathematical expression of growth, synchronous growth, continuous culture. (4H)
4. Plant–microbe interactions: Mycorrizae, Cyanobacteria, nitrification, denitrification, biological nitrogen fixation. (4H)
5. Microbial metabolism: EMP pathway, ED pathway, Krebs cycle, Fermentation, acetogenesis and methanogenesis. (4H)
6. Virus: Morphology, ultrastructure and genetic system of Bacteriophages (lambda, T4, T7, M13), plant viruses, (TMV, Potato virus X and Y, CaMV, CMV, TYMV), Animal viruses (vaccinia, adeno, hepatitis-B, Influenza, HIV), lytic cycle, lysogeny, Viral Replication, Retroviral replication and integration. (8H)
7. Antibiotics and antimicrobial agents, Sulfa drugs, Mode of action of important antibiotics, Mechanism of resistance to antibiotics. (5H)
8. Molecular Genetics: - Modes of gene exchange in Bacteria-transformation, conjugation and transduction. Transposable elements in Prokaryotes. Site specific recombination in lambda phage. (8H)

References:

1. Microbiology by MJ Pelczar Jr, ECS Chan, NR Krieg 5th Edition, Pub: Tata Mcgra-Hill Publishing Co Ltd.
2. Introductory Microbiology by Heritage Pub Heritage
3. General Microbiology by Stainer Pub; Ingraham and Wheeler (McMillan)
4. Alexander M (1977) Introduction to soil microbiology, John Wiley and Sons Inc.N.Y.
5. Atlas R.M. (1998) Microbiology, Fundamentals and applications 2nd Edition, Milan Publishing Co.
6. Brock T.D. and Madigan M.T (1992) Biology of Microorganisms 6th Edn. Prentice Hall, Eagle wood cliffs N.j.
7. Holt J.S. Kreig N.R., Sneath P.H.A and Williams S.T (1994) Bergey‟s Manual of Systemic Bacteriology 9th Edn. William and Wilkins, Baltimore.
8. Prescott L.M, Harley T.P and Klein D.A. (1996) Microbiology WMC. Brown publishers

Paper-IV(BIT-104) (40 marks)
(40 Hrs.)

MOLECULAR BIOLOGY

1. Biosynthesis of DNA – DNA replication, helicases, nucleases, DNA binding and unwinding proteins, topoisomerases, Messelson-Stahl, Bonhoeffer – Grier and Crains experiment. Mechanism of DNA replications in Prokaryotes & Eukaryotes. DNA ligase, replication intermediate – D-loop, theta form. Rolling circle replication. (7H)
2. Mutation:- Types of mutation, molecular basis of mutation, normal and induced mutation. (3H)
3. DNA repair – Photo reactivation, excision, mismatch, recombination, SOS, double strand break repair. (3H)

4. Transcription – RNA polymerases in prokaryotes – its molecular composition, different sigma factors – related to stress, viral infection etc. Mechanism of transcription, Post transcriptional control, Eukaryotic Promoters, enhancers, transcription factors, RNA Polymerases. RNA Processing enzymes, RNA editing, splicing -different modes of m-RNA, t-RNA splicing. (7H)

5. Translation: Prokaryotic and eukaryotic translation – Mechanism of initiation, elongation and termination. Amino acid activation, inhibitors, post translational modification of Proteins. (5H)

6. Regulation of gene expression: The operon hypothesis, Lac operon, trp operon,. Brief account of eukaryotic gene regulation. (5H)
7. Biosignaling - Over view of extra cellular signaling, G- Protein linked receptor and activity of G-Proteins, role of c-AMP in the regulation of cellular metabolism, Receptor tyrosine kinase, Ca^{++}, IP3, DAG as second messengers, regulation of cell surface receptors. (5H)

8. Molecular biology of cancer – Characteristics of tumor cells, viral and cellular oncogenes, structure, function and mechanism of actions of p53 and RB tumor suppressor protein. The multicausal, multistep nature of carcinogenesis. (5H)

References:

1. Principles of gene manipulation - An introduction to genetic engineering, Old R.W., Primrose S.B., Blackwell Scientific Publications, 1993.
2. Nelson, D.L., Cox, M.M. Lehninger Principles of Biochemistry (2005). 4th edition Pub WH Freeman Co.
3. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3rd Indian edition, Pub. Oxford.
4. Mathews, Van Holde, Ahern, Biochemistry by 3rd edition, Pub Pearson education.
5. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K. and Watson, J.D. (1994). Molecular Biology of the Cell.
6. Cooper, G.M. (1997).The Cell: A molecular approach, ASM Press, USA.
7. Darnell, J. Lodish, H., Baltimore, D. (1990). Molecular Cell Biology. Scientific American Books Inc. NY.
8. Garrett, R.H. and Gresham, C.M. (1995). Molecular aspects of Cell Biology, International edition, Saunders College Pub.
9. Karp, G. (1996). Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.
10. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J. (2004). Molecular Cell Biology, Scientific American Books Inc. NY.

PRACTICAL PAPERS

PAPER V-(BIT- 105)
Group – A – CELL BIOLOGY AND GENETICS

1. Cell fractionation (nucleus and mitochondria).
2. Localisation of Barrbodies
3. Mitosis – onion root tips
4. Meiosis – Grasshopper testis, flower buds
5. Cell fractionation – chloroplast and mitochondrial isolation
6. Study of chromosome aberration on mitosis in Allium lepa / Allium sativum.
7. Polytene chromosome – salivery gland of Drosophila / chironomus
8. Blood smear – differential staining and identification of different types of cell.

PAPER VI-(BIT- 106)
Group – B –MICROBIOLOGY

1. Staining technique **i)** simple staining **ii)** differential staining **iii)** endospore staining **iv)** capsule staining
2. Pure culture method – Enumerate the number of bacteria from air and soil.
3. Preparation of bacterial growth curve
4. Assay of antibiotics by agar cup method and dilution method
5. Biochemical tests **i)** Indole tests **ii)** Methyl red test **iii)** Voges Proskaur tests **iv)** Starch hydrolysis tests **v)** Tests for catalase, lipase, protcase, amylase and oxidase **vi)** Gelatin hydrosis test **vii)** Citrate Utilization Test.
6. Isolation of Rhizobium from legume root nodule
7. Water microbiology – Testing for quality of water (coliform test), H_2S strip test.

SEMESTER – I I

PAPER (BIT-201) (40 Marks)

BIOCHEMISTRY (40 Hrs.)

1. BIOENERGETIC - Energy coupling, concept of energy, principles of thermodynamics, standard free energy and equilibrium constant, differences between Δ G and Δ Go' and their relationship with spontaneous biological reactions . ATP as universal currency of free energy in biological systems. [8H]

2. Carbohydrate metabolism: Glycolysis, krebs cycle, electron transport chain, oxidative Phosphorylation. Substrate level Phosphorylation and photo phosphorylation. Gluconeogenesis, pentose phosphate pathway. Rate controlling steps and regulation. [8H]

3. Lipid metabolism –Regulation of Biosynthesis, oxidation saturated and unsaturated, fatty acids. [5H]

4. Amino acids metabolism –Biosynthesis and oxidative degradation of amino acids (e.g. - serine, Methionine, lysine, phenylalanine, leucine, isoleucine) [5H]

5. Nueleic acids metabolism – Biosynthesis of purines and pyrimidines (de novo and salvage pathways). Degradation of Purines and Pyrimidines. [5H]

6. Regulation of cellular metabolism – Integration of carbohydrate, lipid, protein and nucleic acid metabolism. Major control sites of metabolic pathways. [6H]

7. Vitamins and their Co-enzyme function. [3H]

References:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry, 4th Eition Pub WH Freeman Co.
2. Daniel, L, Purich, Melvin, I. Simon, John, N., Abelson. (2000). Contemporary enzyme kinetics and mechanism.
3. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3 rd Indian edition, Pub. Oxford.
4. Mathews, Van Holde and Ahern, Biochemistry by 3 rd edition, Pub Pearson education
5. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co. NY.
6. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2 nd edition Pub: Tata.
7. Voet, D., Voet J.G. (2004). Biochemistry 2nd Edn.
8. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc. NY
9. Jack kite. (1995). Mechanisms in protein chemistry, Garland publishers.
10. Gerhartz, W. (1990). Enzymes in industry: Production and applications. VCH publishers, NY.
11. Chaplin, M.F., Bucke, C. (1990). Enzyme technology. Cambridge university press, Cambridge.
12. Belter, P.A.,Cussier, E. (1985) Wiley Bio separations .
13. Asenjo, J. Dekker, M. (1993) Separation processes in biotechnology.

PAPER -BIT-202

(40 Marks)
(40 Hrs.)

IMMUNOLOGY

1. IMMUNE SYSTEM- Structure and functions of cells and organs involved in immune system- T-cells, B-cells, macrophages, Mast cells , Innate immunity, acquired immunity. [4H]
2. General concepts of: i) Antigens ii) Immunogens iii) Haptens iv) Adjuvants. [2H]
3. Immunoglobulins- Structure, classes, complement systems- structure, components, activations, pathways and regulations. The molecular genetics of antibody diversity. [6H]
4. Major histocompatibility complex (MHC) – Structure and functions of MHC and the HLA system. HLA and tissue transplantation. [5H]
5. Immune Response – B-lymphocytes-maturation, activation and differentiation; T-lymphocytes-maturation, activation and differentiation. [8H]
6. Hypersensitivity: General features of hypersensitivity reactions overview of Type – I, Type – II, Type – III and Type – IV hypersensitivity. [4H]
7. Antigen antibody reactions- Molecular basis of antigen-antibody reaction. In vitro methods- Agglutination. Precipitation. Diagnostic methods- Immuno diffusion, immuno electrophoresis. ELISA, RIA and Western Blot. [5H]
8. Antibody production – Hybridoma Technology- Application of cell culture for production of lymphokines, cytokines. Chimeric antibody, Humanized antibody, Reshaped antibody. [4H]
9. Vaccines – Different types of vaccines. Active and Passive immunization. Production of toxoids, production of Recombinant vaccines. [4H]

References:

1. Abdul, K., Abbas, Andrew K. L., Jordan, S. P. (1998). Cellular and Molecular Immunology. Sanders College Pub.
2. Benjamine, E., Cocoi., Sunshine. (2000). Immunology 4 th edition- Wiley- Liss. Publ.NY.
3. Borrebacc, C.A.K. (1995). Antibody Engineering, 2nd eidtion. Oxford University Press.
4. Dimmock, N.J., Primrose, S.B. (1994). Introduction to Modern Virology, Blackwell Science Ltd.Oxfird.
5. Hyde, R.M. (1992). Immunology, 2nd edition, Williams and Wilkins, Baltimore.
6. Kuby, J. (2003). Immunology 5th Edition. WH. Freeman and Company, NY.
7. Klaus D. Elgert (1996). Immunology. ELBS, Blackwell Scientific Publishers, London.
8. Roitt, I.M. (1998). Essential Immunology, ELBS, Blackwell Scientific Publishers,London.
9. Richard A., Goldsby, Thomas, J., Kindt, Barbara, A., Osborne (2000). Kuby Immunology, 4th edition. W.H. Freeman and Company, NY.
10. Tizard I.R.(1995). Immunology, 4th edition, Saunder College Pub.
11. William E Paul (1989). Fundamentals in Immunology, Raven Press. NY.

PAPER –BIT-203 (40 Marks)
RECOMBINANT DNA TECHNOLOGY (40 Hrs.)

1. Gene cloning - General concept, restriction endonuleases, enzymatic tools for gene cloning, linkers and adaptors. [4H]

2. Vectors Used in Gene cloning.
   i. Plasmids (pBR 322, pACYC 1854, pUC Vectors,).
   ii. Yeast plasmid vectors (episomal plasmid, replicative plasmid).
   iii. Ti plasmid, binary vector, Co-integrate vector.
   iv. Cosmids, phagemids.
   v. Bacteriophage vector – λ phage cloning vectors M13 phage.
   vi. YAC, BAC, HAC, PAC
   vii. Shuttle vectors.
   viii. Expression vectors. [8H]

3. c-DNA and genomic cloning – PCR and DNA markers, Genomic libraries, c-DNA libraries, identification and analysis of cloned DNA. Approaches for identification of genes (colony and plaque hybridization, Immunological detection, Southern blot analysis) Radioactive labelling, Non-radioactive labelling. [7L]

4. In vitro mutagenesis– Site directed mutagenesis, deletion mutagenesis, PCR based mutagenesis. [3H]

5. Gene transfer methods- Marker genes (reporter genes, selectable markers) Gene transfer in plants (Agrobacterium mediated gene transfer, physical gene transfer methods, chemical gene transfer methods) Gene transfer in animals (transfection methods, ES cell transfer, Targeted gene transfer) [10H]

6. Antisense & ribozyme technology – Molecular mechanism of antisense molecules, Si-RNA. Biochemistry of ribozymes-hammerhead, hairpin and other ribozymes, Strategies for designing ribozymes. Application of antisense and ribozyme technologies. [8H]

Reference books:

1. Nicholl D.S.T. Introduction to Genetic Engineering Cambridge (3rd Ed.) University press.UK. 2008
2. Old R.W., Primrose S.B. Principles of gene manipulation - An introduction to genetic engineering (5th Ed.), Blackwell Scientific Publications, UK. 1996.
3. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, 1994.
4. Ernst-L Winnacker, From Genes to Clones: Introduction to Gene Technology. WILEY-VCH Verlag GmbH, Weinheim,Germany Reprinted by Panima Publishing Corporation,New Delhi. 2003
5. Benjamin Lewis, Genes IX (3rd Ed.) Oxford University & Cell Press,NY.2004
6. Robert Williamson.Genetic Engineering (1st Ed.) Academic Press.1981.USA
7. Rodriguez. R.L (Author), Denhardt D.T. Vectors: A Survey of Molecular Cloning Vectors and Their Uses (1st Ed.) Butterworth-Heinemann publisher.UK. 1987
8. Ansubel F.M., Brent R., Kingston R.E., Moore D.D. et al. Short protocols in molecular biology(4th Ed), Wiley publishers. India. 1999.
9. Sambrook J et al. Molecular cloning Volumes I, II and III. Cold Spring Harbor laboratory Press, New York, USA. (1989, 2000)
10. Terence A Brown. Genomes, (2nd Ed.) BioScientific Publishers.UK.2002
11. Anthony JF Griffiths, William M Gelbart, Jeffrey H Miller, and Richard C Lewontin Modern Genetic Analysis (1st Ed.)W. H. Freeman Publishers.NY. 1999
12. S. B. Primrose, Richard M. Twyman.Principles of gene manipulation and genomics (7th Ed.) John Wiley & Sons publishers.2006

PAPER- BIT-204 (40 Marks)
Quality Control and Management in Food and Pharma Industry (40 Hrs.)
(Open Elective) 4 Credits

Unit- I : Bioethics Legalty, morality and ethics, the principles of bioethics, autonomy, human rights, beneficience, privacy justice equality etc. (3 hrs.)

Unit – II : Biosafety Concept and issues, rational Vs subjective perceptions of risks and benefits – relationship between risk hazard, exposure, and safe gaurds – biosafety concerns at the level of individuals, institutions, society, region country and the world – Lab associated infections. (4 hrs.)

Unit-III: Quality control laboratory: Design of QC laboratory for chemical, instrumental and microbiological analysis. Good Practices in QC laboratory, Schedule L1, standardization of reagents, labeling of reagents, control samples, controls on animal house, data generation and storage, QC documentation, LIMS. (8hrs.)

Unit-IV: Concept and importance of Pharmaceutical quality control and quality assurance. Process validation, purity and shelf life of pharmaceuticals. (6hrs.)

Unit-V: International Organization of Standardization (ISO): Overview, structure, interpretation and case studies of food safety and Quality management including ISO-22000, ISO-9001:2000, ISO22000:2005, ISO 17025/CODES/GLP, Retailers standards: BRC food and BRC IOP standards, IFS, SQF: 1000, SQF: 2000. (7hrs.)

Unit – VI : IPR GATT and IPR, forms of IPR, IPR in India, WTO Act, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India's position, patenting of biological material. (7hrs.)

Unit – VII : Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Agricultural Practice(GAP), Storage and distribution of food, sanitation and safety in food services. (5hrs.)

References:

Frederic H. Erbisch, Karim M. Maredia (2004). Intellectual Property Rights in Agricultural Biotechnology, CABI Publisher. Mittal D.P. (1999).

Indian Patents Law. Taxmann Allied Services (p) Ltd. Christian Lenk, Nils Hoppe, Roberto Andorno (2007).

Ethics and Law of Intellectual Property: Current Problems in Politics, Science and Technology, Ashgate Publisher (p) Ltd. Felix Thiele, Richard E. Ashcroft (2005).

Bioethics in a Small World. Springer. John Bryant (2002) Bioethics for Scientists. John Wiley and Sons Publisher.

Kokate C. K., Purohit A. P., Gokhale A. B. (2000) Pharmacology, 4th Ed., Nirali Prakashan.

Mannfred A. Holliger, (2008), Introduction to pharmacology, 3rd Ed., CRC Press 38

Maron Dorothy M. and Bruce N. Ames, (1983), Revised methods for the Salmonella mutagenicity test, Mutation Research, 113:173-215

. The training manual for Food Safety Regulators. Vol.II- Food Safety regulations and food safety management. (2011) Food safety and Standards Authority of India. New Delhi

PRACTICAL PAPERS

PAPER- BIT-205
BIOCHEMISTRY

1) Quantitative estimation of

   a. Total sugar/ Glycogen ii) Reducing sugar iii) Amino acids iv) Total protein v) Total lipid vi) Cholesterol vii) Ascorbic acid viii) RNA

2) Separation of amino acids sugar and phospholipids by TLC/Column Chromatography
3) Analysis of oils- iodine number, saponification value and acid number
4) Preparation of buffer- a) phosphate buffer (b) citrate buffer (c) Tris HCI
5) Extraction and spectrophotometric estimation of following enzyme
   a) α Amylase b) Protease
   c) Dehydrogenase d) Alkaline Phosphatase

PAPER- BIT-206

MOLECULAR BIOLOGY AND IMMUNOLOGY

1) Isolation of plasmid DNA from *E. coli* by adopting two methods – (A) Alkaline SDS method B) Boiling lysis, Agarose Gel electrophoresis
2) Isolation of genomic DNA from bacteria
3) Isolation of genomic DNA from plant cell/animal cell
4) Transformation by $CaC1_2$ and PEG method
5) Selection of cloned micro-organism by blue/white colony
6) Restriction enzyme digestion of DNA and calculation of molecular weight of the digested DNA
7) DNA amplification by PCR method
8) Immunization of mice
9) Serum separation from whole blood and Precipitation of immunoglobulins (Igs) from serum by ammonium sulphate precipitation followed by dialysis of ammonium sulphate precipitated Immunoglobulins.
10) Electrophoresis of the immunoglobulin preparation
11) Separation of Lymphocytes from blood
12) Single radial immuno diffusion and determination of Ig concentration , Ochterlony double diffusion method
13) Blood group testing

SEMESTER – III

Paper – XIII (BIT-301) (40 marks)

PLANT BIOTECHNOLOGY (40 Hrs.)

1. ***Cell and tissue culture:*** Tissue culture media, totipotency of plant cells, isolation and Maintenance of Callus and suspension cultures; organogenesis and somatic embryogenesis; shoot tip culture, clonal propagation, somaclonal variations and applications of regenerated plant, production of Virus free plants; Embryo rescue; Protoplast isolation, culture & fusion; Production of haploids, hairy root culture.

   (8H)

2. ***Germplasm conservation:*** Cryopreservation, DNA banks and germplasm conservation. (2H)

3. ***Plant transformation technology:*** Transformation of plant systems using various methods - *Agrobacterium* mediated gene transfer; Binary vector, co-integrate vector; Direct gene transfer (Electroporation, Particle gun & other methods); use of 35S and other Promoters, Reporter genes, Multiple gene transfer, methods of nuclear and organelle transformation. (10H)

4. ***Application of Biotechnology in Plant improvement:*** Improvement of photosynthetic efficiency of plants; Concepts of transgenic plants - Developing virus resistant plants, Fungal resistant transgenics, resistant to bacterial pathogens; Resistance to insects (endotoxin gene of *Bacillus* thuringensis), Protease inhibitors and Baculo-viruses; Herbicide resistance; improvement of quality of seed storage Proteins; Manipulation of starch biosynthesis; Genetic engineering of plant oils; post-harvest biotechnology - genetic engineering for extended shelf-life of fruits, genetic manipulation of flower Pigmentation; Development of male sterility; Development of stress – tolerant plants – regulation of gene expression under stress condition; Gene silencing and antisense technology.

   (14H)

5. ***Plants as producers of speciality chemicals:*** Molecular farming-benefits and risks, ethical issues related to G.M. crop; Plantibodies, edible vaccines, edible interferons, Production of secondary metabolites.

   (6H)

References:

1. Chrispeels M.J.et al. Plants, Genes and Agriculture-Jones and Bartlett Publishers, Boston.1994.
2. Gamborg O.L. and Philips G.C.Plant cell, tissue and organ culture (2nd Ed.) Narosa Publishing House. New Delhi.1998
3. Hammound J, P McGravey & Yusibov.V. Plant Biotechnology, Springer verlag.2000
4. Heldt. Plant Biochemistry and Molecular Biology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi. 1997
5. Lydiane Kyte and John Kleyn. Plants from test tubes. An introduction to Micropropagation (3rd Ed.). Timber Press, Portland. 1996
6. Murray D.R. Advanced methods in plant breeding and biotechnology.Panima Publishing Corporation.1996
7. Nickoloff J.A.Methods in molecular biology, Plant cell electroporation and electrofusion protocols-Humana press incorp, USA. 1995.
8. Sawahel W.A. Plant genetic transformation technology. Daya Publishing House, Delhi.1997
9. Gistou, P and Klu, H.Hand book of Plant Biotechnology (Vol. I & II).John Publication.2004
10. Slatu A et al.The genetic manipulation of plant. Oxford University Press.2003
11. Kirakosyan A and Kaufman P.B.Recent Advances in Plant Biotechnology (1st Ed.).Springer Publishers.2009
12. Halford N.G. Plant biotechnology: current and future applications of genetically modified crops. John Wiely Publishers.2006

Paper – XIV (BIT-302)
ANIMAL BIOTECHNOLOGY 40 marks
40 Hours

1) ***Primary culture and established cell line***: Culture media required for animal cell culture. Isolation of animal tissue. Disaggregation of tissues (physical and enzymatic methods). Establishment of primary cell lines and continuous cell lines. Characterization of cultured cells. Valuable products from cell culture- tPA, blood factor VIII, Erythropoietin (EPO) etc. (10H)

2) ***Manipulation of cultured cells and tissues***: Scaling up of animal cell culture. Cell synchronization. Cell transformation, tissue engineering - 3-D culture, artificial skin and artificial cartilage. (6H)

3. ***In vitro fertilization (IVF)***: Sexing of sperms and embryos, spermatogenesis and oogenesis, infertilities in human male and female. Ovary stimulation. Oocyte recovery and uptake. Sperm preparation. IVF and embryo transfer, assisted reproductive technology (ART). IVF in cattle, embryo splitting. (7H)

4. ***Stem cells***: Types, characteristics, tissue healing, therapy, application in Research and Industry. (4H)

5. Gene targeting: Targeted gene transfer. Knockout mice. (5H)

6. ***Transfection and transgenesis***: Different types. Transgenic fish and mammals (Mice, Sheep etc.). Animal cloning. Animal as a bioreactor and molecular farming. (8H)

Reference books:

1. Ballinic C.A., Philips J.P and Moo Young M.Animal Biotechnology. Pergamon press, New York. 1989.
2. Watson J.D.et al. Molecular Biology of Gene (6th Ed.) Publisher BenjaminCummings.2007.
3. Berger S. L. and A.R. Kimmel.Methods in enzymology guide to molecular cloning techniques (Vol 152). Academic Press Inc. San Diego.1996
4. Glick, B.R. and Pasternak J.J. Molecular Biotechnology.ASM Press, Washington DC.2003.
5. Jenni,P, Mather and David Barnes, Methods in Cell Biology (Vol 57) Academic Press.2001
6. Ratlege, C. and B. Kristiansen, Basic Biotechnology. Cambridge Univ. Press, London.2001
7. Watson J.D et al. Molecular Biology of the Gene(6th Ed), The Benjamin Cummings Pub.Co.Inc.USA.2008
8. Shantharam, D., Jane F Montgomery. Biotechnology, Biosafety & Biodiversity: Scientific & Ethical issues for Sustainable development. 1999
9. Jan Freshney. R .Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (6th Ed.) Wiley & Sons. 2010
10. John Davis., Animal Cell Culture: Essential Methods (1st Ed.) Wiley-Blackwell and Sons publisher. 2011

Paper – BIT-303
BOSTATISTICS AND BIOINFORMATICS

40 marks
40 Hours

1. STATISTICAL METHODS – Collection tabulation and graphical representation of data, histogram, frequency polygons. [2H]
2. Measures of central tendency – Arithmetic mean, median, mode, range, standard deviation, Standard error and co-efficient of variation. [3H]
3. Concept of correlation and regression method of least squares. [3H]
4. Concept of Probability and Probability distribution(binomial, Poisson) [3H]
5. Hypothesis testing – Basic idea about sample distribution, tests based on normal, student t test, Chi square test for goodness of fit, Analysis of Variance. [4H]
6. Basic computer and biological databases: Concept on basic computers, Accession codes and identifiers, major tools and contents of the Biological database. [3H]
7. Computational sequence analysis: Dot plots, sequence comparison using dynamic programming, searching sequence databases, Sequence analysis – sequence reading, sequence alignment – Global local sequence alignment, Pair-wise sequence alignment, Multiple sequence alignment, phylogenetic analysis, coding region identification. Web-based structure tools, Protein analysis, secondary structure prediction, Post translational modification sites. [8H]
8. Genomics and Proteomics: Primer designing, Genome sequencing Projects, human genome project, comparative genomics - Gene Prediction, Gene Counting and SNPs, potentiality of Proteomics, Types of Proteomics, Basic technology for Proteomics, Application of Proteomics technology. [8H]
9. Molecular structure structure analysis: Molecular dynamics, molecular modeling and simulation, Homology modeling, Computer aided drug designing, Molecular docking. [6H]

Reference books:

1. Daniel (1999). Biostatistics (3rd edition) Panima Publishing Corporation.
2. Khan (1999). Fundamentals of Biostatistics, Panima Publishing Corporation
3. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists, Joh
4. Bazin, M.J. (1983). Mathematics in microbiology Academic press
5. Campbell, R.C. (1974). Statistics for Biologists, Cambridge Univ. Press, Cambridge
6. Bliss, C.I.K. (1967). Statistics in Biology, Vol.1 Mc Graw Hill, New York.
7. Dhananjaya (2002). Introduction to Bioinformatics, www.sd-bio.com series 2. Jan (2001). Nucleic acid research, Genome Database issue
8. Higgins & Taylor (2000). Bioinformatics, OUP.
10. Baxavanis (1998). Bioinformatics.
11. Fry, J.C. (1993). Biological Data Analysis. A practical Approach. IRL Press, Oxford.

Paper – XV (BIT-304)
BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY
(Open Elective)

40 marks
40 Hours

1. Eco-toxicology and its environmental significance. Toxic effects: Basis for general classification & nature. Dose – Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures. Factors influencing Toxicity. (5H)

2. Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reactions/Conjugation: Methylation, Glutathione and amino acid conjugations. Detoxification. Mechanisms of Toxicity: Disturbance of Excitable membrane function. Genotoxicity. Tissue specificity of Toxicity. (6H)

3. Principles & Procedures of testing for acute toxic effects: Regulatory guidelines, Mammalian systems affected & the clinical signs of Systemic Toxicity. Factors affecting acute Toxicity studies. Toxicity testing: Test Protocol, Genetic toxicity testing & Mutagenesis assays: In vitro Test systems – Bacterial Mutation Tests: Reversion Test, Fluctuation Tests and Eukaryotic Mutation Tests. In vivo Mammalian Mutation tests – Host mediated assay & Dominant Lethal Test. Use of Drosophila in Toxicity testing. DNA repair assays. Chromosome damage test. Toxicological evaluation of Recombinant DNA – derived protiens. (8H)

4. Pesticide toxicity: Insecticides: Organochlorines, Organophosphates and Carbamates. Fungicides. Herbicides. Environmental consequences of pesticide toxicity. Biopesticides. Diagnosis of toxic changes in liver and kidneys: Metabolism of Haloalkanes, Haloalkenes & Paracetamol with their toxic effects on tissues. (6H)

5. Food toxicology: Role of diet in cardio-vascular diseases and cancer. Toxicology of food additives. Metal toxicity: Toxicology of Arsenic, mercury, lead and cadmium. Environmental factors affecting metal toxocity – effect of light, temperature & PH. (7H)

6. Air pollution: Common air Pollutants & their sources. Air pollution & ozone. Air pollution due to chlorofluorocarbons (CFCS) and asbestos. Occupational toxicology & assessment of occupational hazards: Industrial effluent toxicology & Environmental health. An overview of regulatory agencies: Responsibilities of regulatory agencies. Management of Toxicological risk. Regulatory systems & organizations. (8H)

References :

1. General and Applied Toxicology by Marrs and Turner, Macmillan Press Ltd.
2. Basic Environmental Toxicology by Lorris G. Corkerthm and Barbara S S Shane CRP Press Inc.
3. Introduction to Food Technology by Takayurki Shibamato & Leonard F. Bzeldanes.
4. Molecular Biotechnology by Barnard R Glick & J J Pastmak.
5.. An Introduction to Environmental Management:Dr.AnandS.Bal,Himalaya Publishing House (2005).
6. Energy Resources and Environment: V.K. Prabhakar, Anmol Publisher
7. Biomas Energy and Environment: H.R. Ravindranath, Oxford University Press,New York.
8. Non-Conventional Energy Sources: G.D. Rai, Khanna Publication, New Delhi

Paper XVII (BIT-305)

(Practical paper)

Cell & Tissue Culture

- Preparation of media.
- Preparation of Primary culture, cell viability and counting
- Grafting in rose plant
- Surface sterilization of field grown tissues
- Micropropagation technique
- Anther and pollen culture
- Callus induction
- Study of xylogenesis
- Hardening of tissue culture plants
- Agrobacterium mediated transformation

Paper XVIII (BIT-306)

(Practical paper)

Bioinformatics

- An overview of computational analysis of biological sequences
- Transcript Analysis
- Biological databases
- Introduction to PERL scripting
- Genomics and Computational Molecular Biology Genomics
- Sequence analysis, Analysis Tools for Sequence Data Bank
- Pairwise sequence alignment
- Multiple sequence alignment
- BLAST database, BLAST and genome annotation
- Patterns & Motifs
- Database Concepts
- Visualization of bimolecular structure.

SEMESTER-IV

MICROBIAL BIOTECHNOLOGY 40 marks
Paper - BIT-401 40 lectures

1. ***Industrial microorganisms***: Yeast, Bacillus, Aspergilus, Penicillium etc., microbial fermentation, microbial growth and microbial culture, genetic improvements of microbial cells – strain improvement. The component parts of a fermentation process. (8H)
2. ***Industrial Production:***
   - i) alcoholic beverages (Wine, Beer, Rum, Whiskey)
   - ii) organic solvents (Acetone Butanol, Glycerol)
   - iii) organic acids (Citric acid, Acetic acid)
   - iv) amino acids (Lysine, Glutamic acid)
   - v) vitamin $B_{12.}$
   - vi) antibiotics (Penicillin, Streptomycin)
   - vii) toxin (β-exotoxin)
   - viii) enzymes including purification and immobilization
   - ix) probiotics (10H)
3. ***Single cell Protein (SCP):*** Microorganisms used, substrates for production of SCP, method of production of SCP, advantages and disadvantages. (2H)
4. ***Bioprocess engineering:*** Introduction to bioprocess engineering, design and operation of conventional fermenters, bioreactors, measurement and control of bioprocess parameters.
5. **Downstream processing** – introduction, Cell disruption, Precipitation methods, solid-liquid separation, liquid- liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization, biosensors – construction and applications, bioleaching. (8H)
6. ***Bioremediation:*** Bioremediation in paper & pulp industry; Bioremediation of heavy metats, Bioremediation of contaminated Soils & wasteland, Bioremediation of Xenobiotics. (4H)
7. ***Application of enzymes:*** Industrial uses, analytical uses, therapeutic uses, manipulative uses; General idea about biosensor and biochips. (4H)

Reference books:

1. General Microbiology by Stainer Pub; Ingraham and Wheeler (McMillan)
2. Alexander M (1977) Introduction to soil microbiology, John Wiley and Sons Inc.N.Y.
3. Atlas R.M. (1998) Microbiology, Fundamentals and applications 2nd Edition, Milan Publishing Co.
4. Brock T.D. and Madigan M.T (1992) Biology of Microorganisms 6th Edn. Prentice Hall, Eagle wood cliffs N.j.
5.. Prescott L.M, Harley T.P and Klein D.A. (1996) Microbiology WMC. Brown publishers

Paper - BIT-402 **(40 marks)**
(40 Lectures)

Agriculture & Food Biotechnology

1. Introduction to Agriculture biotechnology (2L)

2. Production of secondary metabolites:
   a. Production of secondary metabolites.
   b. Large scale plant tissue culture.
   c. Production of foreign compounds in Transgenic Plants. (5L)

3. Biofertilizers and Biopesticides :

   a) Biofertilizers: Mass cultivation of *Rhizobium* spp, *Azotobacter*, *Azospirillum*, Blue green algae, Azolla, phosphate solubilizing microorganisms. Benefits from biofertilizers. Vermicomposting.
   b) Biocontrol of bacteria and phytopathogenic fungi.
   b. Terminataor technology (cotton).
   c. Biotechnology of weed control. (8L)

4. Legal and public aspect: IPR, Patenting of biotech products, Bioethics, ethical issues related to use of GM crops. (3L)

5.Food processing: Food preservation and spoilage, sterilization and pasteurization, Food irradiation, Food additives (Preservatives, colour, emulsifiers and stabilizers). canning and packing of foods. (6L)

*6.*Production and uses of fermented foods, Soya foods, Food fads, Organic foods, Edible films. (5L)

7. Marine Biotechnology :Important Marine Products: Bioactive compounds from marine organisms, GFP, RFP - characteristics and their applications, Green mussel adhesive protein Chitosan and its applications, Marine Processes and control: Biofouling ,biofilms, corrosion and antifouling treatment ,Ballast water : consequences & management Red tides : causative organisms and control ,Marine pollution & its control ; Seaweeds for removal of metal pollutants , Probiotic bacteria and their importance in aquaculture, Marine food analysis-spoilage, quality control. (8L)

References:

1.. Gistou, P and Klu, H.Hand book of Plant Biotechnology (Vol. I & II).John Publication.2004
2. Halford N.G. Plant biotechnology: current and future applications of genetically modified crops. John Wiely Publishers.2006
3. Ratlege, C. and B. Kristiansen, Basic Biotechnology. Cambridge Univ. Press, London. 2001
4. Chrispeels M.J.et al. Plants, Genes and Agriculture-Jones and Bartlett Publishers, Boston.1994.
5. Gamborg O.L. and Philips G.C.Plant cell, tissue and organ culture (2nd Ed.) Narosa Publishing House. New Delhi.1998
6. Hammound J, P McGravey & Yusibov.V. Plant Biotechnology, Springer verlag.2000
7. Heldt. Plant Biochemistry and Molecular Biology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi. 1997
8. Lydiane Kyte and John Kleyn. Plants from test tubes. An introduction to Micropropagation (3rd Ed.). Timber Press, Portland. 1996
9. Murray D.R. Advanced methods in plant breeding and biotechnology.Panima Publishing Corporation.1996
10. Nickoloff J.A.Methods in molecular biology, Plant cell electroporation and electrofusion protocols-Humana press incorp, USA. 1995.
11. Sawahel W.A. Plant genetic transformation technology. Daya Publishing House, Delhi.1997
12. Gistou, P and Klu, H.Hand book of Plant Biotechnology (Vol. I & II).John Publication.2004

Pharmaceutical and Clinical Biotechnology.

Paper - BIT-403 (40 Marks)
(40 Hours)

1. Introduction to pharmaceutical and medicinal biotechnology: (2H)

2. Production and downstream Processing of Biotech Products. Production (Expression systems cultivation systems, cultivation media), downstream processing, over expression and purification of recombinant therapeutic proteins. (5H)
3. Formulation of Biotech products, including Biopharmaceutical considerations: Microbiological considerations, experiments used in Parental formulations of biotech products, shelf life of Protein Based Pharmaceuticals, Delivery of Proteins routes of Administration and Adsorption Enhancement, Approaches of rate controlled delivery. (5H)
4. Pharmacokinetics and Pharmacokinetics of Peptide and Protein drugs: Elimination of Protein therapeutics, distribution of Protein therapeutics, Pharmacodynamics of Protein therapeutics, Heterogenecity, Chemical modifications of Protein therapeutics. (5H)

5.Clinical uses of Hematopoiesis growth factors, Interferon & interleukins, insulin and growth hormones. (5H)

6. . Monoclonal antibody based Pharmaceuticals: Molecular structure , Pharmacology & Clinical uses of antibody based Pharmaceuticals. (5H)
7.Personalised medicine, Neurodegenerative disorders (Parkinson, Ahlzimers and multiple Sclerosis). (5H)
8.Nanotechnology: Introduction, types and synthesis of different nanomaterials, Application of nanomaterials, nanobiosensors, risk potential of nanomaterials. (5H)
9.IPR and ethical implication of Human genome project and Clinical research. (3H)

References:

1. Judit Pongracz and Mary Keen, Medical Biotechnology 1st Edition, Elsevier publications, 2008
2. S N Jogdand Medical Biotechnology 2nd Edition Himalaya publishers 2008
3. Keith Wilson & John Walker, Practical Biochemistry- 5th edition, Cambridge University Press, UK 2000
4. Bartram G. Katzung, Basic & Clinical Pharmacology, 9th Edition, Mc Graw Hill Publications 2004
5. Devlin TM, Text book of biochemistry with Clinical Correlations 5th edition,2002
6. Richard B Silverman, Organic Chemistry of Drug design and Drug action Elsevier Science, Academic Press

Clinical and Industrial Biotechnology

Paper –BIT-404 (Practical) (40 Marks)

1. Immunoprecipitation test
2. Western blotting
3. ELISA
4. Production of biofertilisers and biopesticides
5. Detection of adulterants in food.
6. Use of fermenter with special reference to scale up operation.
7. Production of secondary metabolites through callus and suspension culture.
8. Preparation of Artificial seed and study of VAM.