

**SYLLABUS**  
**PRE- Ph. D. COURSE IN BIOCHEMISTRY**

**Department of Biochemistry**  
**School of Life Sciences**  
**HNB Garhwal University**  
**(A Central University)**  
**Srinagar (Garhwal), Uttarakhand**

Structure of the Course –Work;  
The Course Work consists of the following:

1. Core Course
2. Elective Course

Total number of credit for the core and elective courses will be **15** with the following pattern

- (a) Core Course- 4 +3 credits (two courses) 7 credits
- (b) Elective Course – 4+4 credits (Two courses) 8 credits

**Core course (Compulsory)**

PBC-01: Research Methodology(4 credit)

PBC-02: Review of literature and presentation of a seminar on a research theme related topic (3 credit)

**Elective- Courses (Any Two)**

PBE-01: Recent Trends in Biological Sciences(4 credit)

PBE-02: Diseases and Clinical Biochemistry(4 credit)

PBE-03: Applied and Environmental Microbiology(4 credit)

PBE-04: Animal tissue culture (4 credit)

PBE-05: Protein Biochemistry (4 credit)

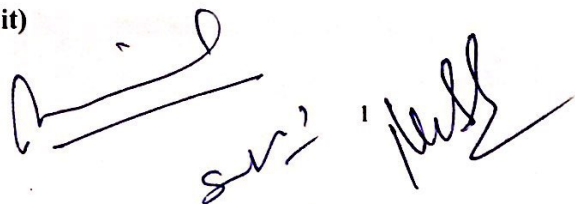
PBE-06-Current Concepts in Immunology. (4 credit)

PBE-07-Advanced Cancer Biology. (4 credit)

PBE-08-Tools and Techniques in Biochemistry. (4 credit)



Nisha Singh



### **Examination and Evaluation of the course-work**

(a) Evaluation shall be done on a continuous basis. For the purpose of uniformity, there will be two sessional tests and one End-semester examination. Sessional tests (of one hours duration) may employ one or more assessment tools such as objective tests, assignments, paper presentation, laboratory work, etc suitable to the course.

(b) Students shall compulsorily attend the two sessional tests, failing which they will not be allowed to appear for the end semester examination. In case of students who could not attend any of the sessional tests due to medical reason or under extraordinary circumstances, a separate test shall be conducted before the End Semester Examinations with the permission of the Dean of the School on recommendation of the Head of the Department.

(c) The Sessional tests will carry 40% of total marks for the course. The marks of the two Sessional Tests shall be taken into account for the computation of Grades.

There shall be one End semester examination of 2 hours duration carrying 60% of Marks in each course covering the entire syllabus prescribed for the course at the end of the semester only. The End semester examination shall be normally a written /laboratory - based examination. The End semester examination and evaluation shall be conducted by the University.

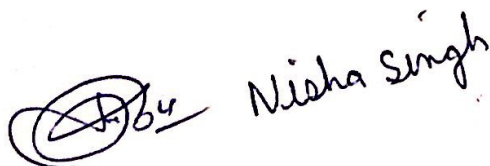
(d) A candidate who has less than 75% attendance shall not be permitted to sit in examination however, it shall be open to the Dean to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on payment of prescribed fee and such exemptions shall not under any circumstances be granted for attendance below 65%.

(e) The Dean through the Head of the Department shall announce the names of all students who will not be eligible to take the examinations and send a copy of the same to the Registrar and Controller of Examination.

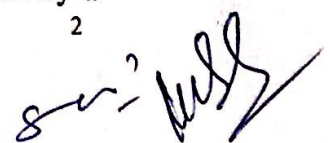
### **Marks and Grading of the course-work**

(a) A candidate has to secure a minimum of 50 percent of marks (Two Sessional Tests marks plus End-Semester examination mark) in the course taken together, to pass in that course. A candidate who has not secured a minimum of 50 percent of marks in a course shall be deemed to have failed in that course. A failed student shall be allowed to repeat the semester examinations for a maximum of three times and he/she has to pass the Pre Ph.D course before submission of the Ph.D. thesis. The Sessional Marks obtained by the student shall be carried over for declaring the result.

(b) The percentage of marks obtained by a student in a course will be indicated by a

 Nisha Singh







grade point and a letter grade. A Six (6) point scale shall be used for the evaluation of the performance of the student as given below:

MARKS	GRADE POINT	LETTER GRADE
75-100	5.50-6.00	O
65-74	4.50-5.49	A+
60-64	4.00-4.49	A
55-59	3.50-3.99	B+
50-54	3.00-3.49	B
Below 50 %	0.00-2.99	F

(c ) The system of evaluation shall be transparent and students shall have the right to examine their marked answer scripts. The teacher of a course shall give the attendance and performance sheets for Sessional Test I and Sessional Test II to the Head of the Department, who in turn shall consolidate all such sheets and the same shall be forwarded to the Controller of Examinations through the Dean. The Controller of Examinations shall issue the Mark and the Grade Statements to the Students.

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## **Core course (Compulsory)**

### **PBC-01: Research Methodology**

#### **UNIT- I**

Computer applications in Biology, Spreadsheet tools: Introduction to spreadsheet applications, features, using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts / graph and other features, Tools – Microsoft Excel or similar.

Presentation tools: Introduction, features and functions.

Power Point Presentation, customizing presentation, Showing presentation, Tools – Microsoft Power Point or Similar. Web Search: Introduction to Internet, Use of Internet and WWW, Use of search engines, Biological data bases.

#### **UNIT- II**

Research Methodology:- Meaning, types and objective of research, Selection of Research, Research methodology- philosophical, descriptive, experimental and genetical methods. Motivation in Research, Developing the hypothesis.

Types of information and sources: primary and secondary sources, overview of research process- phases and steps. Research process planning and conducting.

#### **UNIT -III**


Scientific Writing: Scientific Document; Organization and writing of research paper, Types of Scientific Communication, short communications, monographs, technical and survey reports, Importance of publishing research paper. Writing review article Components of a research paper– the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations.


#### **UNIT -III**

Presenting and Publishing paper: Format, choosing Journal, Title, Running Title, Writing Abstract, Keywords, Introduction section, Materials and Methods selection, Result section, Figures, tables, graphs, Discussion Section, References, Preparing posters for scientific presentation, Preparing and delivering of oral presentation, Research Grant Funding Agencies,

#### **UNIT- V**

Research Techniques: Enzyme assay, enzyme activity and specific activity determination. Cell disintegration and extraction techniques, separation of proteins by fractionation (ammonium sulphate, organic solvents). Ion exchange chromatography, molecular sieve chromatography, affinity chromatography, paper chromatography, thin layer chromatography, ultra-filtration, Ultracentrifugation. Gel electrophoresis, isoelectric focusing and immunoelectrophoresis, Microscopy, HPLC, FTIR, SEM/TEM, NMR.

 Nisha Singh

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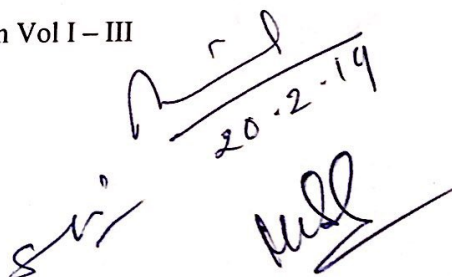


**Suggested readings:**

1. Biostatistics: A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pvt. Ltd.
3. Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery (S. C. Rastogi, N. Mendiratta, and P. Rastogi).
4. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
5. Protein Purification by Robert Scopes, Springer Verlag Publication, 1982
6. Tools in Biochemistry David Cooper
7. Methods of Protein and Nucleic acid Research, Osterman Vol I – III
8. Centrifugation D. Rickwood
9. Practical Biochemistry, V th edition, Keith Wilson and Walker.
10. Bioinformatics by David Mound
11. Practical Biochemistry, Vth edition, Keith Wilson and Walker.
12. Protein Purification by Robert Scopes, Springer Verlag Publication, 1982
13. Tools in Biochemistry David Cooper
14. Methods of Protein and Nucleic acid Research, Osterman Vol I – III
15. Centrifugation D. Rickwood



Nisha Singh



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**PBC-02 (Review of literature and presentation of a seminar on a research theme related topic)**

As per the academic ordinances relating to the Ph.D. course work, paper-II shall comprise of content of the topic of his/her research..The following shall be the course contents of this paper.

1. The candidate shall be required to write a critical review on his/her assigned subject of research.
2. The candidate shall present seminar on a research theme related topic before the committee.



Nisha Singh



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## **Elective- Courses (Any Two)**

### **PBE-01: Recent Trends in Biological Sciences**

#### **UNIT I**

Gene cloning- General strategy for gene cloning, transformation. Application of gene technology, Gene Silencing, Geneknock out and gene therapy, DNA sequencing dideoxy chain termination and Sanger's +/- method.

cDNA library – screening by oilgonucleotide probe, nick translation, site directedmutagenesis, linkage analysis.

#### **UNIT II**

Immunology:structure and classes of antibodies, genetic basis of antibodydiversity.

MHC I and II: structure and antigen presentation.T and B lymphocytes activation and role in humoral and cell mediated immunity.

Vaccines live and attenuated, killed, multi-subunit and DNA vaccines.

Hypersensitivity and auto immune diseases. ELISA, RIA, Hybridoma Technology.

#### **UNIT III**

Animal Culture:

Media requirements and sterilization techniques, primary andestablished cell lines.

Culture methods: hanging drop, monolayer and suspension.Advantages and disadvantages. Stem cells: adult and embryonic, applications to tissue engineering.Applications of animal cells.

#### **UNIT IV**

Plant tissue culture:

Cell and callus culture, Micropropagation, somatic cell hybridization,protoplast fusion, cybrids, artificial seeds, Agrobacterium mediated gene transferand use of Ti plasmid. Applications of plant tissue culture engineering, pathogenresistance (BT gene), herbicide tolerance, salt tolerance, production of secondarymetabolites and transgenic plants.

#### **UNIT V**

Biofertilizers:Symbiotic free nitrogen fixers, asymbiotic free nitrogen fixers, algal, phosphate solublizing, mycorrhizae and green manure.

#### **Suggested readings:**

1. Bergey's Manual of Systematic Bacteriology (2nd Ed.), Volumes1 to 4 Springer
2. The Search for Bioactive Compounds from Microorganisms by S. Omura
3. Continuous Culture (Vol. 8) by A. C. R. Dean, D. C. Ellwood and C. G. T. Evans
4. Annual Reviews in Microbiology Volumes 46 & 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press



Nisha Singh

7





5. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante. Technomic Publishing Co. Inc
6. Advances in Applied Microbiology volumes 6, 10, 17 by D. Perlman and Umbreit (eds). Academic Press.
7. The Physiology and Biochemistry of Prokaryotes by D. White. Oxford University Press
8. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II<sup>nd</sup> edition, Cold spring harbor laboratory press, New York.
9. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
10. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu, D. Kim and L.J. Cseke, CRC Press Florida 1995
11. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
12. Methods in Enzymology Gene Expression Technology, Vol. 185 D. V. Goedel, Academic Press Inc, San Diego, 1990
13. DNA Science: A First Course in Recombinant Technology, D. A. Mickliss and G. A. Freyer, Cold Spring Harbor Laboratory Press, New York, 1990
14. Molecular Biotechnology, 2<sup>nd</sup> Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994
15. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blackwell Science, Oxford, 1997
16. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998
17. Kuby : Immunology; RA Goldsby, Thomas J. Kindt, Barbara A. Osborne.
18. Immunology by Roitt I. M., Brostoff J. and Male D. Gower medical publishing London.
19. Fundamentals of immunology 4<sup>th</sup> ed., Paul 1999, Lippencott Raven.



Nisha Singh





## **PBE-02: Diseases and Clinical Biochemistry**

### **UNIT I**

Enzymes: Use of enzymes in the diagnosis and monitoring of myocardial infarction, liver diseases and pancreatic diseases. Normal and abnormal serum values of the enzymes and their significance, acid and alkaline phosphatase, SGOT, SGPT,  $\alpha$ -amylase, LDH, creatine kinase, troponin T.

### **UNIT II**

Blood chemistry: Normal and abnormal constituents of blood, glucose, urea, uric acid, creatinine, bilirubin, and proteins. Lipid profile and its significance. Blood groups, Rh factor compatibility and blood transfusion. Hemoglobinopathies: anaemia, thalassemia, sickle cell anaemia.

### **UNIT III**

Liver diseases: Types of jaundice, molecular basis and biochemical assessment, viral hepatitis, alcoholic hepatitis, cirrhosis. Cardiac diseases: Ischaemic heart disease, angina pectoris, myocardial infarction. Cardiac profile tests, atherosclerotic plaques.

### **UNIT IV**

Cancer: Molecular basis, carcinogenesis, oncogenes, benign and malignant, metastasis, tumor markers and tumor staging.

### **UNIT V**


Genetic disorders: Down's, Turner's and Klinefelter's diseases.

Infectious diseases at the outset of 21st century like AIDS, SARS, and Dengue.

Inborn errors of metabolism, metabolic disorders, diabetes.

### **Suggested Readings:**

1. Immunology – A Short Course by Benjamin and others Wiley – Liss Inc.
2. Immunology by Roitt. Published by Mosby
3. Lecture notes on Epidemiology and Community Medicines by Farner and Miller
4. Handbook of Practical Immunology by D. W. Weir Volumes 2 & 3
5. Basic and Clinical Immunology by Stites and others (eds). Lange Medical Publications
6. Mycoplasmas by J. Maniloff (ed). American Society for Microbiology
7. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante. Technomic Publishing Co. Inc

 Nisha Singh





## **PBE-03: Applied and Environmental Microbiology**

### **UNIT I**

Design of production nutrient media, preparation of inoculum, alternative carbon and nitrogen sources, pretreatment of carbon, growth kinetics

### **UNIT II**

Hydrocarbon Fermentations, Steroid Transformations,  
Fermentative production of Cephalosporins and Tetracyclines

### **UNIT III**

Microbial catalysis in the generation of Flavour and fragrance chemicals  
Biosynthesis of Insect Pheromones and Ergot alkaloids  
Flux Control Analysis and Metabolic Engineering in Fermentation Microbiology.

### **UNIT IV**

Microbiology and production of Lactic Starter Culture Concentrates  
Microbiology of Dried Milk Powders and Concentrated Milks.  
Quality Control in the Food and Dairy Industry – HACCP system.

### **UNIT V**

Recent advances in Microbiological waste treatment methods -  
a. Activated Sludge Process  
b. Anaerobic sludge digestion  
c. Root zone technology  
d. Microbial biosorption technology  
e. Mass scale production of Effective Microorganisms (EM) for waste treatment.  
f. Economics of waste treatment

### **Suggested Readings:**

1. Industrial Microbiology by L. E. Casida Jr. Wiley International Ltd.
2. Microbial Technology by H. J. Peppler. Academic Press
3. Annual Reviews in Microbiology Volume 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
4. Enzyme Biotechnology by S. Sridhar
5. Food Microbiology by M. R. Adams and M. O. Moss
6. Dairy Microbiology Volumes 1 and 2 by R. K. Robinson.
7. Fermentation Microbiology and Biotechnology by E. M. T. El-Mansi and C. F. A. Bryce.
8. Microbiological Aspects of Pollution Control by Dart and Stretton. Surabhi Publishers, Jaipur



Nisha Singh  
10





## **PBE-04: Animal tissue culture**

### **UNIT I**

**Introduction:** Historical Background, Advantages and Disadvantages of using cell culture, Types of tissue culture, Biology of cultured cells.

### **UNIT II**

**Growth and Maintenance of Cells in Culture:** Laboratory design and layout, Equipment for Tissue culture lab, concept and importance of aseptic techniques, Components of culture medium, Media supplements, serum-free media, Role of CO<sub>2</sub> in culture medium,

### **UNIT III**

**Various Cell Culture**

Primary culture, subculture and cell lines, cloning and selection, cell separation, characterization, differentiation, transformation and immortalization

### **UNIT IV**


**Techniques in Animal Tissue Culture:** Production of Monoclonal antibodies, DNA transfer techniques, Cell separation techniques, Cell counting and monitoring, Viability measurements, Cell line identification, analysis of the cell cycle, Cryopreservation, scaling up animal cell culture: Scale up in suspension, Scale up in monolayer, Bioreactors., Modes of culture: batch, fed-batch or continuous.

### **UNIT V**

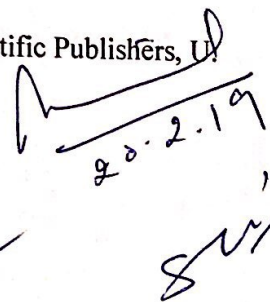
**Applications of Tissue Culture:** Mammalian cell products: Viral vaccines, Monoclonal Antibodies, Glycoproteins, Clotting factors, Plasminogen activators, Erythropoietin etc. Role of tissue culture in Gene therapy, Artificial skin, Artificial organs.

### **Suggested Readings:**

1. Freshney, R.T. (2006). Culture of Animal Cells, 5th Ed., John Wiley and Sons, New York.
2. Butler, M. (2004). Animal Cell Technology, 2nd Ed., BIOS Scientific Publishers, UK.

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## PBE-05: Protein Biochemistry

### UNIT I

Protein Basics: Amino acids; Primary, secondary, tertiary & quaternary structure of proteins; post translational modifications. Structural organization of soluble & membrane proteins; structure- function relationships.

### UNIT II

Isolation, Purification & Characterization of Proteins: Precipitation, fractionation & chromatographic methods; Electrophoresis: SDS-PAGE, Native PAGE, chromatofocussing & isoelectric focussing; determination of amino acid composition & sequence, assignment of disulphide bonds, molecular weight & oligomeric structure; bioinformatics tools for protein characterization, western blotting & functional characterization of proteins.

### UNIT III

Protein Engineering, Folding & Prediction: Protein folding themes, folding proteins in vitro, protein structure prediction & modeling, prediction of protein function; Protein engineering: codon shuffling & codon optimization.

### UNIT IV

Protein Interactions: General properties of ligand binding interaction, binding affinities, rate of binding & dissociation, relationship between protein conformation & binding, allostery. Yeast- two hybrid & Yeast-three hybrid technology, surface-plasmon resonance, FRET & other methods for studying protein interactions.

### UNIT V

Protein Structure Determination: Circular Dichroism, X-ray crystallography & Nuclear magnetic resonance.

### Suggested Readings:

1. Nelson DL and Cox MM (2001) Lehninger Principles of Biochemistry, 3rd Edition, Macmillan Worth Publishers, New Delhi.
2. Voet D and Voet JG (2001) Biochemistry, 3rd Edition, John Wiley & Sons, New York.
3. Keith Wilson, John Walker. Practical Biochemistry: Principles and Techniques, Edition 5. Cambridge University Press.

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## PBE-06: Current concepts in Immunology

### UNIT-I

Growth of Immunology as a discipline, cellular and molecular components of the Immune system.

Recent discoveries of molecular mechanisms of pathways involved in effector functions of innate immunity, Recognition mechanisms of innate immunity: PAMPs and DAMPs, Interface between innate and adaptive immunity

### UNIT-II

Immunoglobulin molecule: structure-function relationship, and molecular mechanisms of generation of antibody diversity, Monoclonal Antibodies and Antibody engineering  
Alternative pathways of antigen processing and presentation, Transplantation

### UNIT-III

Regulation of differentiation, selection, and activation of T lymphocytes, Recognition mechanisms of NK cells., Immuno pathology and mechanisms of hypersensitivity reactions, Immune tolerance and autoimmunity, Immune deficiency diseases, Vaccines

### UNIT-IV

Applications of immunological principles (diagnostics etc.); tumor immunology, and immune response during bacterial, parasitic and viral infections would be discussed in context of the current knowledge of immunological mechanisms through tutorials or student presentations and discussions.

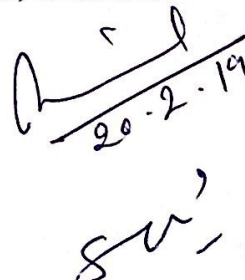
### Suggested Reading:

1. Immunology (4th edn. 1998) by Ivan Roitt, J Brostoff and David Mole (4th edn) Mosby Times Mirror Int. Publ. Ltd.,
2. Essential Immunology (9th ed. 1997) by Ivan Roitt Blackwell Science Ltd.
3. Immunology (1992) by Janis Kuby W H Freeman and Co. Ltd. USA.
4. Immunology (2nd edn. 1991) by Edwards S Golub, Sinauer Associate, Sunderland.



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## PBE-07: Advanced Cancer Biology

### UNIT I

Introduction to Cancer Biology, Tumor suppressors and oncogenes, Cancer growth and metastasis, Epithelial to Mesenchymal Transition, Angiogenesis, Apoptosis and Autophagy

### UNIT II

Microenvironment of Tumor cells Stroma, Interaction, Tumor immunology, Factors regulating tumor progression, Animal models for cancer growth and metastasis, Cancer stem cells

### UNIT III

Signalling mechanisms: Cancer growth and metastasis, Altered Cellular signaling in cancer cells, Role of Antioxidants in cancer, Signalling for metastasis and stem cells, Reprogramming metabolism and rewiring signalling, Osteoblastic and osteolytic metastasis, Role of PTHrP, CSF-1 and RANKL in cancer progression and metastasis.

### UNIT IV

Therapeutic Intervention, Success and failure of present therapies, Micro-RNA mediated cancer treatment and targeted drug delivery, Drug resistance, Molecular diagnosis and stem cell therapy.

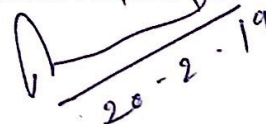
### Suggested Reading:

1. The Biology of Cancer, 2nd Edition, Robert A Weingberg, ISBN-10:0815342209, ISBN-13: 978-0815342205
2. Cancer Biology, 4th Edition, Raymond W Ruddon, ISBN-10:0195175441 ISBN-13: 978-0195175448



Nisha Singh



  
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**PBE-08L: Tools and Techniques in Biochemistry****UNIT I**

General principles of spectroscopy and spectrometry, theory and applications of various spectroscopic techniques; Mass spectrometry and its biological applications.  
Cell fractionation; Centrifugation; Isolation and purification of membrane proteins and lipids

**UNIT II.**

Use of Restriction and modification enzymes in cloning, Plasmid/ Phagemid vector, Ligation, Transformation and Plasmid isolation, Oligonucleotide synthesis and purification, Amplification of DNA using PCR; Design of primers ;Applications of PCR in research, Basic DNA sequencing methods, Sanger' s chain termination method, and automated DNA sequencing, Introduction to next generation sequencing(NGS).

**UNIT III.**

Global expression profiling; Whole genome analysis of mRNA and protein expression; Realtime PCR to monitor changes in expression levels;Concept of microarrays and its applications for DNA,RNA and proteins.

**UNIT IV**

Basic requirements for in vitro cell culture, live cells staining and counting, and synchronization of mammalian cells. Application of FACS for detection of apoptotic cells and cell cycle phases.

Expression vectors Expression, isolation and purification of heterologous proteins Chromatography techniques for protein purification; Mapping of protein interactions: two hybrid.

**Suggested Reading:**

1. Physical Biochemistry: Application to Biochemistry and Molecular Biology (1982) 2<sup>nd</sup> ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN: 0-7167-1315-2 / ISBN: 0-7167-1444-2.
2. Molecular Cloning: A Laboratory Manual (2012) Vol. 1-3, 4<sup>th</sup> ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2.
3. Animal Cell Culture & Technology (2004) 1<sup>st</sup> ed., Butler, M., Taylor & Francis Publishers (UK), ISBN-1: 859960499.
4. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7<sup>th</sup> ed., Keith Wilson and John Walker, Cambridge University Press India Pvt. Ltd., ISBN-13: 978-0-521-17874-7 / ISBN: 10: 0-07-099487-0.
5. R. Burgess, M.P. Deutcher. 2009. Guide to Protein Purification, Academic Press, San Diego, USA.

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