

## Annexure-1

### CENTRAL UNIVERSITY OF HARYANA Master of Science in Biotechnology (Semester-wise structure)

#### Semester I

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_1_01_CC	Principles of Genetics and Molecular Biology	4	0	0	4
2.	SIAL BT_01_1_02_CC	Biomolecules and Metabolism	4	0	0	4
3.	SIAL BT_01_1_03_CC	Cell Biology	4	0	0	4
4.	SIAL BT_01_1_04_CC	Practical I	0	0	8	4
5.	SIAL BT_01_1_01_GEC	Principle of Biotechnology	4	0	0	4

#### Semester II

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_2_05_CC	Tools and Techniques in Biotechnology	4	0	0	4
2.	SIAL BT_01_2_06_CC	Microbial Process Engineering and Technology	4	0	0	4
3.	SIAL BT_01_2_07_CC	Immunology	4	0	0	4
4.	SIAL BT_01_2_08_CC	Practical II	0	0	8	4
5.	SIAL BT_01_1_02_GEC	Bioinformatics and Biostatistics (compulsory)	0	4	0	4
6.	<b>Any of the following two courses</b>		4	0	0	4
	SIAL BT_01_2_01_DCEC	Genomics and Proteomics				
	SIAL BT_01_2_02_DCEC	Microbial growth, enzyme and fermentation kinetics				

#### Semester III

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_3_09_CC	Cell and Tissue Culture	4	0	0	4
2.	SIAL BT_01_3_10_CC	Genetic Engineering	4	0	0	4
3.	SIAL BT_01_3_11_CC	Seminar Paper	0	4	0	4
4.	SIAL BT_01_3_12_CC	Practical III	0	0	8	4
5.	<b>Any of the following two courses</b>		4	0	0	4
	SIAL BT_01_3_03_DCEC	Agricultural Biotechnology and IPR				
	SIAL BT_01_3_04_DCEC	Medical Biotechnology				

#### Semester IV

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_4_01_SEEC	Dissertation	0	0	24	24

**Core Course (CC)**  
(Exclusive for Biotechnology students)

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_1_01_C_4004	Principles of Genetics and Molecular Biology	4	0	0	4
2.	SIAL BT_01_1_02_C_4004	Biomolecules and Metabolism	4	0	0	4
3.	SIAL BT_01_1_03_C_4004	Cell Biology	4	0	0	4
4.	SIAL BT_01_1_04_C_0084	Practical I	0	0	8	4
5.	SIAL BT_01_2_05_C_4004	Tools and Techniques in Biotechnology	4	0	0	4
6.	SIAL BT_01_2_06_C_4004	Microbial Process Engineering and Technology	4	0	0	4
7.	SIAL BT_01_2_07_C_4004	Immunology	4	0	0	4
8.	SIAL BT_01_2_08_C_0084	Practical II	0	0	8	4
9.	SIAL BT_01_3_09_C	Cell and Tissue Culture	4	0	0	4
10.	SIAL BT_01_3_10_C_4004	Genetic Engineering	4	0	0	4
11.	SIAL BT_01_3_11_C_4004	Seminar Paper (compulsory)	0	0	8	4
12.	SIAL BT_01_3_12_C_4004	Practical III	0	4	0	4

**General Elective Course (GEC)**  
(Offered to other departments)

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_1_01_GEC_4004	Principle of Biotechnology	0	4	0	4
2.	SIAL BT_01_1_02_GEC_4004	Bioinformatics and Biostatistics (Compulsory)	0	4	0	4

**Discipline Centric Elective Course (DCEC)**  
(Offered to the students of Biotechnology and other departments)

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_2_01_DCEC_4004	Genomics and Proteomics	4	0	0	4
2.	SIAL BT_01_2_02_DCEC_4004	Microbial growth, enzyme and fermentation kinetics	4	0	0	4
3.	SIAL BT_01_3_03_DCEC_4004	Agricultural Biotechnology and IPR	4	0	0	4
4.	SIAL BT_01_3_04_DCEC_4004	Medical Biotechnology	4	0	0	4

**Skill Enhancement Elective Course (SEEC)**  
(Offered Exclusively for Biotechnology students)

S. No.	Course code	Course title	L	T	P	C
1.	SIAL BT_01_4_01_SEEC_0066	Dissertation	0	0	24	24

SIAL BT\_01\_1\_01\_CC  
PRINCIPLES OF GENETICS & MOLECULAR BIOLOGY

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**UNIT - I**

**Inheritance and Molecular Organizations of Chromosomes:** Historical background, Extra chromosomal inheritance, Inheritance of quantitative traits, Sex linked, Sex influenced and Sex limited traits, Viral and bacterial chromosomes, Nucleosome and chromatin structure, Structure of centromere and telomere, Euchromatin and heterochromatin, Polytene and lamp brush chromosomes, Genome complexity.

**Linkage, Crossing over and Gene mapping in Eukaryotes:** Linkage and recombination of gene, Gene mapping by three point test cross, Tetrad analysis, Positive and negative interference, Molecular mechanism of recombination, Post-meiotic segregation, Mapping through somatic cell hybridization.

**UNIT- II**

**Mutation & Gene Concept:** Molecular mechanism of spontaneous mutations, Molecular mechanism of mutations induced by known chemical mutagens, Types of DNA repair, Molecular mechanism of suppression, Somatic mutations, Classical concept and fine structure of gene, Molecular concept of the gene, Pseudogenes, Overlapping genes, Oncogenes, Repeated genes, Gene amplification.

**Bacterial and Viral Genetics:** Transformation, Conjugation and Transduction, Molecular mechanism of recombination in bacteria, IS and Tn elements in Bacteria, E. Coli recombination system, Bacterial plasmids, Lytic cascade and lysogenic repression.

**UNIT- III**

**DNA Structure:** DNA as genetic material, Chemical structure and base composition of nucleic acids, Double helical structures, Different forms of DNA, Forces stabilizing nucleic acid structure, Super coiled DNA, Properties of DNA, Renaturation and Denaturation of DNA, T<sub>m</sub> and C<sub>ot</sub> curves, Structure of RNA.

**DNA Replication:** General features of DNA replication, Enzymes and proteins of DNA replication, Models of replication, Prokaryotic and eukaryotic replication mechanism, Replication in phages, Reverse transcription.

**UNIT- IV**

**Transcription:** Mechanism of transcription in prokaryotes and Eukaryotes, RNA polymerases and promoters, Post-transcriptional processing of tRNA, rRNA and mRNA (5'capping, 3'polyadenylation and splicing), RNA as enzyme-Ribozyme.

**Translation:** Genetic code, General features, Deciphering of Genetic code, Code in mitochondria, Translational mechanism in prokaryotes and eukaryotes, Post translational modification and transport, protein targeting (signalling), Non ribosomal polypeptide synthesis, Antibiotic inhibitors and translation.

**Recommended Books:**

1. Gardener et al (2001), Principles of Genetics, 8<sup>th</sup> Edition, John Wiley, New York
2. Brooker R.J. (1999), Genetics-analysis and Principles. Addison Wesley Longman Inc. California
3. Maloy S R, Cronan Jr. J R and Freifelder D. (1994), Microbial Genetics 2<sup>nd</sup> Edition, Jones and Bartlett Publishers, London.
4. Hartl, D L (2012). Essential of Genetics, 8<sup>th</sup> Editions, Jones and Barlett Publishers, London.
5. Klug WS, Cummings MR, Spencer CA and Palladino MA (2012), Concept of Genetics, 10<sup>th</sup> Edition, Pearson Education, Singapore.
6. Miglani, GS (2002), Advanced Genetics, Narosa Publishing House, New Delhi.
7. Snustad, Peter D, Summons MJ (2012) Genetics, 6<sup>th</sup> Edition, Wiley John & Sons.
8. Adams RLP et al (1992), The Biochemistry of Nucleic Acids, 11<sup>th</sup> Edition, Chapman and Hall, New York.
9. Lewin B. (2004), Gene VIII, Pearson Prentice and Hall, New Delhi.
10. Karp G. (2010), Cell and Molecular Biology-Concept and Experiments, 5<sup>th</sup> Edition, John Wiley, New York.
11. Lodish et al (2013), Molecular Cell Biology, 7<sup>th</sup> Edition, W H Freeman Publisher.
12. Malacinski GM and Freifelder D (1998), Essential of Molecular Biology, 3<sup>rd</sup> Edition, John and Bartlett Publishers, London.
13. Buchanan BB et al (2000), Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologist, Rockville, Maryland, USA.
14. Watson et al (2009), Molecular Biology of Gene, 5<sup>th</sup> Edition, Pearson Education, New Delhi

SIAL BT\_01\_1\_02\_CC  
**BIOMOLECULES AND METABOLISM**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**UNIT - I**

**Biomolecules:** An Introduction, General structure of biomolecules, Fundamental principles governing structure of biomolecules, Importance of covalent and non covalent bonds.

**Carbohydrates:** Structure and function of biologically important mono, d and poly-saccharides, Glycoproteins & glycolipids. Metabolism of carbohydrates-Glycolysis, Feeder pathways, Citric acid cycle, Gluconeogenesis, Glyoxylate and Pentose phosphate pathway, and their regulations.

**UNIT- II**

**Protein:** Structure of amino acids, non-protein and rare amino acids. A brief account of amino acid biosynthesis and degradation, Urea cycle, Structural organization of protein, Reverse turns and Ramachandran plot, Supra-molecular complexes of proteins, Chemical synthesis of peptides and small proteins. Protein sequencing, Enzymes.

**UNIT- III**

**Lipids:** Structure of fatty acids, Classification of lipids, Structure and functions of major lipid subclasses-Acylglycerols, Phospholipids, glycolipids, Sphingolipids, Waxes, Terpenes and Sterols, Fatty acids biosynthesis, degradation and their regulations, Ketone bodies synthesis, biosynthesis of TAG, Cholesterol, Phospholipids and Glycolipids

**UNIT- IV**

**Nucleic Acids:** Structure and properties of nucleic acid bases, nucleosides and nucleotides, Biosynthesis and degradation of purines and pyrimidines, Salvage pathway.

**Translation:** Structure and biochemical roles of fat and water-soluble vitamins and their co-enzymes

**Recommended Books:**

1. Nelson DL and Cox MM (2013), Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition, Freeman and Company, New York
2. Conn EE, Stumpf PK, Bruening G and Doi RH (1997) Outlines of Biochemistry, John Willey and Sons Inc. New York and Toronto.
3. Voet D, Voet JG, and Pratt CW (2013), Principle of Biochemistry, 4<sup>th</sup> Edition John Wiley and Sons Inc. New York
4. Elliott WH and Elliot DC (1997) Biochemistry and Molecular Biology, Oxford University press Inc. New York
5. Metzler DE (2001), Biochemistry (Vol I and II) Academic Press, London and New York.
6. Berg JM, Tymoczko JL and Stryer L (2012), Biochemistry, 7<sup>th</sup> Edition WH Freeman Publishers, New York
7. Garret RH and Grisham CM (2010) Biochemistry, 4<sup>th</sup> Edition, Brooks/Cole, Boston

**SIAL BT\_01\_1\_03\_CC**  
**Cell Biology**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**UNIT - I**

**Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility

**Membrane structure and function:** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes

**UNIT- II**

**Cell division and cell cycle:** Mitosis and meiosis , their regulation, steps in cell cycle, regulation and control of cell cycle

**Cell signaling:** Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers and regulation of signalling pathways

**UNIT- III**

**Cellular communication:** General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junction, extracellular matrix, integrins, neurotransmission and its regulation

**Cancer:** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth

**UNIT- IV**

**Photosynthesis and Respiration:** Photosynthetic apparatus, light reaction, cyclic and non cyclic photo induced electron flow, C3 and C4 cycle and their regulation and CAM pathway, photorespiration, dark phase of photosynthesis.

**Recommended Books:**

1. Alberts B et al (2002), Molecular Biolog of Cells, 4<sup>th</sup> Edition, Taylor and Francis
2. Lodish et al (2013), Molecular Cell Biology, 7<sup>th</sup> Edition, W H Freeman Publisher.
3. Gilbert SF (2002), Developmental Biology, SF Sinauer Associates Inc.
4. Karp G (2012) Cell and molecular biology: Concept and Experiments. John Willy, New York
5. Freedman LP (1998) Molecular Biology of Steroid and Nuclear Hormone Receptors, Birkhuser.
6. Nelson DL and Cox MM (2013), Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition, Freeman and Company, New York
7. Hardin J, Bertoni G and Kleinsmith LJ (2012), Beker's world of Cell. 8<sup>th</sup> Edition, Pearson

**SIAL BT\_01\_1\_04\_CC**  
**PRACTICALS-I**

**Any fifteen (15)**

1. General Laboratory-safety and Bio-safety measures in biotechnology laboratory.
2. Preparation of normal and molar solutions, buffers, pH setting etc.
3. Evaluation of various sterilization methods.
4. To study various parts of microscope and demonstration of microscopic techniques.
5. Quantitative estimation of proteins.
6. Quantitative estimation of reducing sugars and total sugars.
7. Estimation of total phenolic compounds.
8. Thin layer chromatography: sugars
9. Quantitative estimation of plant cell wall carbohydrates
10. Estimation of enzyme activities
11. Calculation of  $K_m$  and  $V_{max}$  of a given enzyme
12. Genomic DNA and plasmid DNA isolation from plant/bacteria
13. Qualitative and quantitative analysis of DNA.
14. Determination of gram -ve and gram +ve bacteria using gram staining.
15. Study of mitosis in onion root-tip cells.
16. Sub-cellular fractionation by differential centrifugation and demonstration of micrographs of different cell components.
17. Determination of protein sequence of a given polypeptide (Dry lab)
18. Calculating recessive gene frequency, sex -linked alleles frequency and Chi square test.
19. Inheritance patterns in Man – Numericals on Pedigree analysis- Autosomal patterns, X-linked patterns, Y-linked patterns, Mitochondrial inheritance patterns.
20. Gene mapping using three point test cross/tetrad analysis

# SIAL BT\_01\_1\_01\_GEC

## PRINCIPLES OF BIOTECHNOLOGY

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

### Unit 1

**Biotechnology:** An overview-definition, Scope and importance of biotechnology, Concepts of recombinant DNA technology and Gene Cloning.

**Microbial Biotechnology:** A brief account of microbes in industry and agriculture, Metabolic engineering for over production of metabolites.

### Unit 2

**Plant Biotechnology:** Introduction to plant tissue culture and its applications, Gene transfer methods in plants, Transgenic plants (A brief introduction), Chloroplast and mitochondria engineering.

**Animal Biotechnology:** In-vitro fertilization and embryo transfer in humans and livestock, Transfection techniques and transgenic animals, Animal Cloning.

### Unit 3

**Medical Biotechnology:** (A brief account) Biotechnology in medicine, Vaccines, Molecular diagnostics, Forensic, Gene therapy, Nano Medicine & Drug Delivery Cell & Tissue Engineering, Stem Cell therapy.

**Environmental Biotechnology:** (A brief account) Role of biotechnology in pollution control, Sewage treatment, Energy management, Bioremediation, Restoration of degraded lands and Conservation of biodiversity.

### Unit 4

**Nano Science & Technology:** An Overview, Insights and intervention into the Nano world, Important Developments, Societal implications & Ethical issues in Nanotechnology, Applications of Nanobiotechnology in different areas.

**Intellectual Property Right Issues:** PR Bio-business, Biotechnology for developing countries and IPR

### Recommended Books:

1. Nelson DL and Cox MM (2013), Lehninger Principles of Biochemistr, 6<sup>th</sup> Edition Freeman and Company, New York
2. Pelczar, M.J. et. al (2001), Microbiology- Concepts and Applications, International Ed. McGraw Hill Publication, New York
3. Stanbury, P.F., Hall, S., Whitaker, A. (1998), Principles of Fermentation Technology, 2<sup>nd</sup> edn. Butterworth-Heinemann Ltd
4. Plant Biotechnology – The genetic manipulation of plants (2003) by Slater A., Scott N. and Fowler M., Oxford University Press.
5. Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
6. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, New York.
7. Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T. George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2000).
8. Ajayan, P., Schadler, L.S. & Braun, P.V., 2003. Nanocomposite Science and Technology. Wiley-VCH Verlag.

**SIAL BT\_01\_2\_05\_CC**  
**TOOLS AND TECHNIQUES IN BIOTECHNOLOGY**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**Unit-I**

**Microscopy:** Principles, Resolving Power and applications of Light microscopy, Electron microscopy (SEM, TEM) and Confocal microscopy, Phase contrast microscopy.

**Centrifugation:** Brief history, Types of centrifugation, theory of centrifugation, Centrifugation techniques, Types of rotors, Density gradient centrifugation in isolation of cells, cell organelles and biomolecules.

**Unit-II**

**Electrophoresis:** History, Principles, Application and factor affecting of electrophoresis with detail reference to Agarose, PAGE, PFGE, Capillary electrophoresis, continuous, 2D-PAGE, IEF.

**Detection of Nucleic Acids and Proteins:** Southern, Western and Northern blotting, PCR, Immuno-blotting, Immuno-electrophoresis, DNA finger printing and ELISA.

**DNA Sequencing Techniques:** DNA sequencing methods of Sanger, Maxim-Gilbert, Pyro-sequencing, Solid sequencing, Ion-torrent sequencing, SMR etc.

**Unit-III**

**Spectroscopy:** Introduction, theory and principles of different types of Spectroscopy: Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy. Mass spectroscopy (LC-MS, GC-MS). Fluorescent spectroscopy, and their applications in biotechnology.

**Chromatography:** General principles and techniques of HPLC, FPLC, GLC, Adsorption Chromatography, partition chromatography, IEC, Gel permeation Chromatography, Affinity Chromatography. Applications of Chromatographic techniques in Biology

**Unit-IV**

**Radioisotope Technique:** Nature of Radioactivity, characteristics of different radiolabels, detection and measurement in Radioactivity, Nature and types of radiations, preparation of labelled biological samples. Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Flow cytometry. Safety measures in handling radioisotopes, RIA, Applications of radioisotopes in biological sciences.

**BOOKS RECOMMENDED**

1. Freifelder D. (1982), Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman and Company, San Francisco.
2. Rietdorf, J. (2010) Microscopy Techniques, Springer, Berlin
3. Walker J. and Wilson K (2010), Principles and Techniques-Practical Biochemistry, 7 th Edition, Cambridge University Press, London.
4. Robyt, J.F. and White, B.J. (1987) Biochemical Techniques: Theory and Practice, Waveland Press
5. Skoog, D.A.; Crouch, S.R. and Holler, F.J. (2006) Principles of Instrumental Analysis, 6thEdn. Brooks/Cole, USA
6. Slater R.J. (1990), Radioisotopes in Biology-A Practical Approach, Oxford University Press, New York.
7. Boyer, R.F. (2006) Modern Experimental Biochemistry, Pearson, New Delhi.



**SIAL BT\_01\_2\_06\_CC**  
**MICROBIAL PROCESS ENGINEERING AND TECHNOLOGY**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**Unit-I**

**Biotechnology of fermentation:** Methods and types of fermentation, dual/multiple fermentation, continuous fermentation and late nutrient addition, growth kinetics of microorganisms, fermenter systems and fermentation. Types of fermentation process, analysis of batch fed batch and continuous bioreactions

**Unit-II**

**Bioreactors:** Basic concepts of bioreactors, parameters of biochemical process, packed bed, fedbatch, bubble column, fluidized bed, trickle bed, CSTR, plug flow reactors, Innovative bioreactors, Reactor Dynamics and reactors with non-ideal characteristics, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.)

**Bioreactor Control:** Manual and automatic control system, on-line and off-line analytical instruments, methods of measurement of process variables, Data analysis and process control.  
Energy forming bio-processes for the production of liquid fuel (ethanol), and gaseous fuel (methane), Microbial production of hydrogen.

**Unit-III**

**Industrial microbial products:** Production of Alcohols, Acids, Solvents, Antibiotics, Amino Acids, Single Cell Proteins, Bioemulsifiers, Biosurfactants, Antibiotics, Insulin, Steroids, Metabolic Engineering.

**Unit-IV**

**Scale-up Studies:** Translation of laboratory, pilot and plant scale data, Criteria for translation between two scale of operation, Scale-up practices, Bases for scale-up methods, Comparison of various scale-up methods, Nongeometric scale-up

**Downstream processing:** Introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment

**Books Recommended:**

1. Pelczar, M.J. et. al (2001), Microbiology- Concepts and Applications, International Ed. McGraw Hill Publication, New York
2. Willey, J.M., Sherwood, L., and Woolverton, C. (2013) Prescott's Microbiology 9th Revised edition, McGraw Hill Higher Education, New York
3. Madigan, M.T., Martinko, J.M., Bender, K., and Buckley, D. (2011) Brock Biology of Microorganisms, 13th Edn., Pearson Education, USA
4. Stanbury, P.F., Hall, S., Whitaker, A. (1998), Principles of Fermentation Technology, 2<sup>nd</sup> edn. Butterworth-Heinemann Ltd
5. Cruger, W. and Kruger. (2002), Biotechnology –A Textbook of Industrial Microbiology, 2<sup>nd</sup> Edition, Panima Publishing Corporation, New Delhi.
6. Black, J.G. (2012), Microbiology: Principles and Explorations, 8<sup>th</sup> Edition, John Wiley and Sons, USA.
7. Pommerville, J.C. (2009) Alcamo's Fundamentals of Microbiology, Jones and Bartlett Publishers.
8. Tortora, G.J., Funke, B.R., Case, C.L. (2012) Microbiology -An Introduction, 11<sup>th</sup> Edition, Pearson education Pvt. Ltd. Singapore.

**SIAL BT\_01\_2\_07\_CC**  
**Immunology**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**Unit-I**

**Introduction:** History, Concept and Scope of Immunology.

**Immunity:** Innate and Acquired immunity, Passive and Active Immunity, Lymph and organs, Humoral and Cell Mediated immunity, Specificity and Memory, Major Histocompatibility Complex (MHC) and Complements.

**Unit-II**

**Antigen-Antibody interaction:** Antibody structure and function, Antigen-Antibody reactions, Antigen type-hapten, Generation of antibody diversity and complement system, Serological reactions, Agglutination, Precipitation, Immuno-electrophoresis, ELISA, RIA, Immuno-electromicroscopy.

**Cells of immune system:** Hematopoiesis and differentiation, Lymphocyte trafficking, B-lymphocyte, T-lymphocytes, Macrophages, Dendritic cells, Natural killer and lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.

**Unit-III**

**Generation of B-cell and T-cell response:** Activation of B and T- lymphocytes. Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity.

**Antigen processing and presentation:** Antigen processing and presentation, Generation of humoral and cell mediated immune responses, Cytokines and their role in immune regulation, T- cell regulation, MHC- regulation, Immunological tolerance, Hypersensitivity, Autoimmunity, Immunosenescence, Transplantation immunity.

**Unit-IV**

**Hybridoma Technology:** Monoclonal antibody production, Myeloma cell lines, Fusion of myeloma cells without antibody producing B-cells, Selection and screening methods for positive hybrids, Production, purification and characterization of monoclonal antibodies without Hybridoma, Genetic manipulation of immunoglobins.

**Diseases and Vaccines:** T-cell cloning, mechanism of antigen recognition by T-and B-lymphocytes, Genetic control of immune response, autoimmune diseases, immunodiagnosis, AIDS, types of vaccines, Strategies for the development of vaccines for infectious diseases.

**Books Recommended:**

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. (2012). Osborne Immunology, 8th Edition, Freeman.
2. Brostoff J, Seaddin JK, Male D, Roitt IM. (2002) Clinical Immunology, 6th Edition, Gower Medical Publishing.
3. Janeway et al., (2012), Immunobiology, 8th Edition, Current Biology publications.
4. Paul (1999). Fundamental of Immunology, 4th edition, Lippincott Raven,
5. Goding (1985) Monoclonal antibodies, Academic Press.

**SIAL BT\_01\_2\_08\_CC**  
**PRACTICALS-II**

**Any fifteen (15)**

01. Separation of amino acids/ sugars/ lipids by Thin Layer Chromatography.
02. Determination of molar extinction coefficient of tryptophan / tyrosine and Ultra violet absorption spectra of nucleic acids and proteins.
03. Purification of protein/enzyme by Gel filtration/Ion exchange chromatography/Affinity chromatography.
04. Polyacrylamide gel electrophoresis of proteins.
05. Determination of isoelectric point of glycine.
06. Determination of A, B, O and Rh blood groups in human beings.
07. Radial immunodiffusion.
08. Quantitative precipitin assay.
09. Immunoelectrophoresis.
10. Latex agglutination test.
11. Enzyme Linked Immunosorbent Assay (ELISA).
12. Database search using BLAST and Sequence submission protocols
13. Sequence alignments (Pair wise and Multiple), Sequence and structure visualization.
14. Construction of phylogenetic tree and prediction
15. Isolation, culturing and maintenance of microorganisms and study of microbial growth kinetics
16. Estimation of enzyme activities of cellulases, xylanases, amylases etc.
17. Ethanol production from *Saccharomyces cerevisiae* and study of fermentation kinetics
18. To study the design of fermenter and its working
19. Production of extracellular enzymes and its purification by salt and solvent precipitation
20. To study the microbial decolorization of industrial dyes/ analogues

**SIAL BT\_01\_1\_03\_GEC**  
**BIOINFORMATICS AND BIOSTATISTICS (COMPULSORY)**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**Unit-I**

**Scope of computers in current biological research:** Basic operations, architecture of computer. Introduction of digital computers. Organization, low level and high level languages, binary number system. The soft side of the computer – Different operating systems – Windows, Linux. Introduction of programming in C. Introduction to Internet and its applications.

**Introduction of Bioinformatics:** History, aims of Bioinformatics, Definition and Concepts, Components of Bioinformatics, Basic tools, Scope of Bioinformatics in molecular biology and Computers, Role of internet in Bioinformatics, Applications of Bioinformatics.

**Unit-II**

**Protein and Nucleic acid databases:** DNA-the staff of life, molecular sequence alignments and sequence search (BLAST, FASTA, CLUSTALW), molecular visualization integrated molecular biology database. Protein and Nucleic acid databases, databases accession, database searching, NCBI based study.

**Construction of phylogenetic tree and analysis:** Predicting structure and function, Molecular Evolution and phylogenetic trees, Methods for Phylogenetic analysis: Sequence Alignment, Construction of Phylogenetic Tree, Softwares (Ssearch, Treeview, Phylip, Rasmol).

**Unit-III**

**Presentation of Data:** Frequency distributions, graphical presentation of data by histogram, frequency polygon, frequency curve, and cumulative frequency curves.

**Measures of central tendency and dispersion:** Mean, Median, Mode and their simple properties (without derivations), and calculation of median by graphs, range, mean derivation, standard deviations, coefficient of variation.

**Unit-IV**

**Test of Significance and Experimental Design:** Sampling distribution of mean and standard error, large scale sample tests (tests for an assumed mean and equality of two population means with known S.D.), small sample tests (t-tests for an assumed mean and equality of means of two populations when sample observations are independent, paired and unpaired t-test, t-test for correlation and regression coefficients), t-test for comparison of variances of two populations, chi-square test for independent of attributes, goodness of fit and homogeneity of samples. Principles of experimental designs, completely randomized, randomized block and Latin square designs, simple factorial experiments (mathematical derivation not required), analysis of variance (ANOVA) and its uses.

**Books Recommended:**

1. Mount, D.W. (2002), Bioinformatics: Sequence & Genome Analysis, Cold Spring Harbor Laboratory Press.
2. Lesk, A.M. (2013), Introduction to Bioinformatics, 4th Edn. Oxford University Press, Oxford.
3. Day, R.A. (1996), How to Write and Publish a Scientific Paper, 4th Edition, Cambridge University Press, Cambridge
4. Krane, D.E. (2005), Fundamental Concept of Bioinformatics, Dorling Kindersley Pvt. Ltd.
5. Brown S.M. (2000), A Biologist Guide to Bio-computing and the Internet, A BioTechniques Books Publication, Eaton Publishing, USA.
6. Przytycka, T.M. and Sagot, M.F. (2011) Algorithms in Bioinformatics, Springer My Copy, UK.
7. Gupta, S.P. (2004). Statistical Methods., S. Chand & Sons, New Delhi.

## SIAL BT\_01\_2\_01\_DCEC GENOMICS AND PROTEOMICS

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

### Unit-I

**Origin and Evolution of genomics:** Origin of genomics, The first DNA genomes, Microcollinearity, DNA based phylogenetic trees, Genomes and human evolution, Evolution of nuclear and organellar (mitochondrial and Chloroplast) genome, The concept of minimal genome.

**Molecular maps of genomes and Comparative genomics:** Genetic maps, Physical maps, EST and transcript maps, Functional maps, Comparative genomics and collinearity/syteny in maps

### Unit-II

**Structural and Functional Genomics:** Whole genome shotgun sequencing, Clone-by-clone or 'hierarchical stotgun' Sequencing, Microbial genomes (including yeast), Plant genomes (Arabidopsis and rice), Animal genomes (fruit fly, mouse, human), Annotation of whole genome sequence and functional genomics, In silico methods, Insertion mutagenesis (T-DNA and transport insertion), TILLING, Management of data, Gene expression and transcript profiling, EST contigs and unigene sets, Use of DNA chips and Microarrays.

**Pharmacogenomics:** Use in biomedicine involving diagnosis and treatment of diseases, genomics in medical practice, personalized medicine, DNA polymorphism and treatment of diseases, use of SNP in pharmacogenomics, pharmacogenomics and industry.

### Unit-III

**Study and Scope of proteomics:** Introduction, definition concepts and approaches of proteomics studies and activities.

**Quantitative and Qualitative proteome analysis technique:** Separation technique- 2D PAGE, 2-DE (BN-PAGE), image analysis, Mass- spectrophotometry, LC-TMS, MALDI, and SALDI

### Unit-IV

**Protein interaction and Protein complex:** Protein interaction, DNA- Protein interaction, Yeast two hybrid and 3-hybrid system and their applications.

**Drug Discovery and Development:** Current issues, drug targets, Drug efficacy, Drug toxicology, Protein chips and Antibody Microarray, proteomics in cancer research.

### Books Recommended:

1. Leister D. ( 2005) Plant Functional Genomics , Taylor & Francis
2. Weckwerth W. ( 2006) Metabolomics :Methods and Protocols , Humana Press
3. Lodish H. Berk A. et al (2013) Molecular Cell Biology , W.H. Freeman and Company, New York
4. Primrose S.B. and Twyman R. (2009) Principles of Genome Analysis and Genomics. John Willey and Sons Ltd
5. Dubitzky W., Granzow M., Berrar D.P. (2007) Fundamentals of Data Mining in Genomics and Proteomics. Springer Science-Business Media.
6. Lovric J. (2011) Introducing Proteomics: From concepts to sample separation, mass spectroscopy and data analysis. John Willey and Sons Ltd.
7. Mine Y., Miyashita K., Shahidi F. (2009) Nutrigenomics and Proteomics in Health and Disease: Food Factors and Gene Interaction. Wiley Blackwell

**SIAL BT\_01\_2\_02\_DCEC**  
**MICROBIAL GROWTH, ENZYME AND FERMENTATION KINETICS**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**UNIT –I**

**Microbial Growth Kinetics:** Thermodynamic principles, Stationary cell growth, Growth yield, Specific growth rate, Product yield, Yield equations, Maintenance energy, Kinetics of balanced growth, Transient growth kinetics, Growth kinetics of batch, fedbatch, plug flow and continuous culture, Comparison of batch and continuous culture system, Product synthesis kinetics, Growth and non-growth associated product synthesis

**UNIT-II**

**Enzyme Kinetics:** Classification and Nomenclature of Enzymes. Enzyme kinetics. Factors affecting the rates of enzyme catalysed reactions. Assay of enzyme activity – units of enzyme activity. Multisubstrate reactions. Enzyme – substrate (protein ligand) binding. Methods for measurement of  $k_m$ . Enzyme inhibition – Competitive, non-competitive and uncompetitive. Allosteric enzymes, Ribozymes and catalytic antibodies.

**UNIT-III**

**Fermentation kinetics:** Methods and types of fermentation, Submerged fermentation, dual/multiple fermentation, continuous fermentation and late nutrient addition, growth kinetics of microorganisms, fermenter systems and fermentation. Solid state fermentation, Effect of environmental parameters on kinetics and growth of product formation and cellular physiology, Process variables and process control, Principles of solid state bioreactor design and operation and product leaching.

**UNIT-IV**

**Mass Transfer in Microbial System:** Fluids and its properties, Non-Newtonian fluids, introduction to transport phenomena, Gas–liquid mass transfer, Intra-particle diffusion, Oxygen transfer and utilization in gassed microbial system, mass transfer resistances, Oxygen transfer rate and factors affecting it, determination of oxygen transfer coefficient, oxygen transfer efficiency, transport bottlenecks in bioprocesses, heat transfer in biological processes, heat transfer coefficient correlations.

**Recommended Books**

1. Nelson DL and Cox MM (2013), Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition Freeman and Company, New York
2. Pelczar, M.J. et. al (2001), Microbiology- Concepts and Applications, International Ed. McGraw Hill Publication, New York
3. Willey, J.M., Sherwood, L., and Woolverton, C. (2013) Prescott's Microbiology 9th Revised edition, McGraw Hill Higher Education, New York
4. Madigan, M.T., Martinko, J.M., Bender, K., and Buckley, D. (2011) Brock Biology of Microorganisms, 13th Edn., Pearson Education, USA
5. Stanbury, P.F., Hall, S., Whitaker, A. (1998), Principles of Fermentation Technology, 2<sup>nd</sup> edn. Butterworth-Heinemann Ltd
6. Cruger, W. and Cruger. (2002), Biotechnology –A Textbook of Industrial Microbiology, 2<sup>nd</sup> Edition, Panima Publishing Corporation, New Delhi.
7. Tortora, G.J., Funke, B.R., Case, C.L. (2012) Microbiology -An Introduction, 11<sup>th</sup> Edition, Pearson education Pvt. Ltd. Singapore.

## SIAL BT\_01\_3\_09\_CC CELL AND TISSUE CULTURE

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

### UNIT-I

**Introduction to plant cell and tissue culture:** Historical perspective, Laboratory organization, aseptic manipulations, culture media preparation, Use of plant growth regulators, Single cell culture, Initiation and maintenance of suspension culture- batch and continuous culture, Callus culture, Protoplast culture, Somatic hybridization.

### UNIT - II

**Plant tissue culture techniques:** micropropagation, Meristem culture, Shoot tip culture and production of virus free plants, Somaclonal variations, In vitro production of haploid plants – Androgenesis (anther and pollen culture) and Gynogenesis (ovary and ovule culture), Doubled haploid production through distant hybridization, In vitro and in vivo pollination and fertilization, Embryo culture, embryo rescue, somatic embryogenesis, artificial seeds, germplasm conservation and cryopreservation.

### UNIT-III

**Animal cell and tissues culture:** Historical background, terminology, advantages and limitations of cell & tissue culture, aseptic area, elements of aseptic environment, sterile handling, media sterilization, the substrate, choice of culture vessel, treated surfaces.

**Defined media and supplements:** physicochemical properties, balanced salt solutions, complete media, role of serum and supplements, serum free media: advantages and disadvantages of serum and serum free media, replacement of serum, development of serum free media.

### UNIT-IV

**Primary culture and Sub-culturing of animal cells:** types of primary cell culture, isolation of the tissue, primary culture, Subculture and propagation, Criteria for subculture, Subculture of monolayer cells, growth cycle and split ratio, propagation and subculture in suspension, dilution and suspension cloning, scaling up in suspension and monolayer, large scale production of cells using bioreactors, microcarriers and perfusion techniques, cell synchronization methods and applications.

**Cell line maintenance and characterization:** Preservation and maintenance of animal cell lines, Stem cells, cryo-preservation, transport of animal germplasm (i.e. semen, ova and embryos), cell characterization, antigen markers.

#### **Recommended Books:**

1. Bhojwani S.S. and Razdan M.K. (2005), Plant tissue culture – Theory and Practice, Elsevier publication.
2. Clynes M. (1998), Animal Cell Culture Techniques, Springer-Verlag Berlin Heidelberg.
3. Davey M.R. and Anthony P. (2010), Plant Cell Culture: Essential Methods 1st Edition, Wiley Publishers.
4. Davis J.M. (2011), Animal Cell Culture: Essential Methods, 1st Edition, Wiley Publishers.
5. Freshney R.I. (2010), Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition, Wiley-Blackwell.
6. Gamborg O.L. and Phillips G. (2013), Plant Cell, Tissue and Organ Culture: Fundamental Methods (Springer Lab Manuals), Springer.
7. Jha T.B. and Ghosh B. (2005), Plant Tissue Culture: Basic and Applied, Orient Blackswan publishers.
8. John R.W.M. (2000), Animal Cell Culture - A Practical Approach, 3rd edition, Oxford University Press.

## SIAL BT\_01\_3\_10\_CC GENETIC ENGINEERING

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

### UNIT-I

**Nucleic Acids:** Isolation, Purification, and Yield Analysis, Radiolabelling of nucleic acids: End labelling, nick translation, labelling by primer extension, DNA sequencing.

**Enzymes of recombinant DNA technology:** Restriction endonucleases, DNA modifying enzymes, Other nucleases, Polymerases, Ligase, kinases and phosphatases.

### UNIT-II

**Gene cloning and library construction:** Gene cloning vectors (Plasmids, Phages, Cosmids, Artificial chromosomes, Shuttle vectors, Expression vectors), Joining of DNA Fragments to vectors, Homo polymer tailing, cohesive and blunt end ligation, adaptors, linkers, Genomic and c-DNA libraries.

**Selection, screening and analysis of recombinants:** Southern blotting, Polymerase chain reaction, Northern blotting, Western blotting, Nucleic acid microarrays

### UNIT-III

**Manipulating gene expression:** Vector Engineering and codon optimization, host engineering, Strategies of gene delivery, in vitro transcription and translation, expression of cloned genes in bacteria, expression in yeast, expression in insect cells, expression in mammalian cells, expression in plants, Site-directed Mutagenesis, Protein Engineering.

### UNIT-IV

**Applications of genetic engineering:** Animal transgenesis and live-stock improvement, Transgenic plants and applications in crop improvement, Medical applications: Molecular genetic diagnosis of human diseases, gene therapy, DNA vaccines, Biosafety and ethical considerations.

#### **Recommended Books:**

1. Altman A. and Hasegawa P.M. (2011), Plant Biotechnology and Agriculture: Prospects for the 21st Century 1st Edition, Academic Press.
2. Brown T.A. (2006), Genomes 3, Garland science, Taylor & Francis, NewYork.
3. Brown T.A. (2010), Gene Cloning and DNA Analysis: An Introduction, 6th Edition, Wiley-Blackwell.
4. Dale J.W., Schantz M.V. and Plant N. (2011), From Genes to Genomes: Concepts and Applications of DNA Technology, Wiley-Blackwell.
5. Saldana H. A. (2014), Genetic Engineering: Basics, New Applications And Responsibilities, Intech publishers.



**SIAL BT\_01\_3\_11\_CC**  
**SEMINAR PAPER**

Every student, who has been enrolled in M.Sc. (Biotechnology) course, shall have to deliver a Seminar on a Recent Topics, as per the programme of the Department of Biotechnology. Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members well in advance so that the same may be displayed on the notice board. The speaker has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.

**SIAL BT\_01\_3\_12\_CC**  
**PRACTICAL III**

**Any fifteen (15)**

1. To study the laboratory organization and aseptic manipulations in plant and animal cell culture lab.
2. Isolation and culturing of animal cells from primary tissue explant.
3. Sub-culturing of monolayer confluent cells.
4. Counting of animal cells using hemocytometer.
5. Staining of monolayer confluent cells using geimsa and crystal violet.
6. To discriminate between viable and non viable cells using trypan blue.
7. Animal cell cloning in microtitration plates.
8. Preparation of Murashige and Skoog medium, stocks of macronutrients, micronutrients, vitamins and hormones, autoclaving, filter sterilization of hormones and antibiotics.
9. Callus culture using various explants, regeneration of shoots and root induction.
10. Anther/ Pollen and Ovary/ Ovule culture.
11. Protoplast isolation and culture.
12. Preparation of artificial seeds through gel entrapment.
13. DNA extraction and DNA estimation from plants
14. Melting temperature determination of DNA
15. PCR analysis and DNA finger printing methods, RAPD, SSR etc.
16. Preparation of genomic DNA library
17. mRNA isolation and preparation of cDNA library
18. Cloning of DNA in plasmid
19. Blue white screening of clones
20. Restriction Digestion of clones and visualization of bands

**SIAL BT\_01\_3\_03\_DCEC**  
**AGRICULTURAL BIOTECHNOLOGY AND IPR**

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

**UNIT-I**

**Conventional and modern tools for Crop Improvement:** Conventional methods for crop improvement (Pedegree breeding, Heterosis breeding, Mutation breeding), Limitations of conventional breeding, Plant Genome – Nuclear and cytoplasmic, Significance of organelle genomes, Genome size and sequence components, Molecular markers: Definition, properties, types of molecular markers: Restriction based and PCR based, RFLP, RAPD & AFLP, Development of SCAR and SSR markers, Other markers: CAPS, SNP, Comparison of different marker systems.

**UNIT-II**

**Molecular Breeding:** Marker Assisted Selection (MAS), screening and validation, Trait related markers and characterization of genes involved, Mapping genes on specific chromosomes, QTL mapping, Gene pyramiding, Transcript mapping techniques, Development of ESTs, The concept of gene synteny, The concept of map-based cloning and their use in transgenics.

**UNIT-III**

**Transgenics in crop improvement:** Genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency, Genetic engineering for biotic stress tolerance (Insects, fungi, bacteria, viruses, weeds). Genetic engineering for abiotic stress (drought, flooding, salt and temperature), Genetic engineering for quality improvement of Protein, lipids, carbohydrates, vitamins & mineral nutrients, Plant secondary metabolites: Control mechanisms and manipulation of alkaloids and industrial enzymes (Shikimate and PHA pathway), Importance of secondary metabolites in medicine and agriculture.

**UNIT - IV**

**Intellectual Property Rights, Biosafety and Ethical Issues:** Intellectual property rights (IPR), Patents, trade secrets, copyright, trademarks, Plant genetic resources, GATT & TRIPPS, Patenting of biological material, Patenting of transgenic organisms and genes, Plant breeders rights (PBRs) and farmers rights, Concerns about GM crops – environmental, biosafety and ethics.

**Recommended Books:**

1. Altman A. and Hasegawa P.M. (2011), Plant Biotechnology and Agriculture: Prospects for the 21st Century 1st Edition, Academic Press.
2. Henry R. J. (2012), Molecular Markers in Plants, Wiley-Blackwell.
3. Jackson J.F. and Linskens H.F. (2003), Genetic Transformation of Plants, Springer.
4. Slater A., Scott N. and Fowler M. (2008), Plant Biotechnology – The genetic manipulation of plants, 2nd edition, Oxford University Press.
5. Stewart C.N. and Touraev, A. (2011), Plant Transformation Technologies, 1st edition, Wiley-Blackwell.

## SIAL BT\_01\_3\_04\_DCEC Medical Biotechnology

*The Examiner will set two questions from each of the Units I-IV with eight questions in all. The students shall attempt five questions in all by choosing at least one question from each of the Units I-IV. All questions shall carry equal marks*

### UNIT-I

**Classification of genetic diseases:** Chromosomal disorders- Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, Chromosomal instability syndromes. Gene controlled diseases – Autosomal and X- linked disorders, Mitochondrial disorders.

### UNIT-II

**Molecular basis of human diseases:** Pathogenic mutations. Gain of function mutations: Oncogenes, Huntingtons Disease, Pittsburg variant of alpha 1 antitrypsin. Loss of function - Tumour Suppressor, Genomic, Dynamic Mutations - Fragile- X syndrome, Myotonic dystrophy, Mitochondrial diseases

### UNIT-III

**Diagnostic techniques:** Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques- Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood, Diagnosis using protein and enzyme markers, monoclonal antibodies, DNA/RNA based diagnosis Hepatitis, CML – bcr/abl, HIV - CD 4 receptor, Microarray technology- genomic and cDNA arrays, application to diseases.

### UNIT-IV

**Clinical management and Metabolic manipulation:** PKU, Familial Hypercholesterolemia, Rickets, ADA, Congenital hypothyroidism, Gene therapy - Ex-vivo, In vivo, In situ gene therapy, Strategies of gene therapy: gene augmentation, Vectors used in gene therapy Biological vectors – retrovirus, adenoviruses, Herpes Synthetic vectors– liposomes, receptor mediated gene transfer, Gene therapy trials – Familial Hypercholesterolemia, Cystic Fibrosis, Solid tumors, Cell and tissue engineering: Stem cell Potential use of stem cells – Cell based therapies, Nanomedicine.

#### Recommended Books:

1. George A.J.T. and Urch C.E. (2000), Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine) Humana Press.
2. Glick B.R., Patton C.L. and Delovitch T.L. (2013), Medical Biotechnology, 1st edition, ASM Press.
3. Jochen Decker, U. Reischl (2004), Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine), Humana Press.
4. Kayser O. and Warzecha H. (2012), Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, 2nd Edition, Wiley-Blackwell.
5. Strachan T. and Read A. (2010), Human Molecular Genetics, 4th edition, Garland Science publisher.

## SIAL BT\_01\_4\_01\_SEEC DISSERTATION

Each candidate have to carry out the dissertation work assigned to him/her and should submit bound copies of the research work performed by him/her duly certified by the guide/supervisor. The project report should include abstract, review of literature, introduction, materials and methods, observation & results, discussion, summary & conclusion followed by bibliography. The references should be arranged alphabetically under the format given below:

### **Referred Journal**

Sharma TC, Sharma CT and Sharma T (2006) Expression of alkaline pectinase in *Bacillus* sp. Lett. Appl Microbiol 12:245-350

### **Book**

Demartino, GN (1996) Purification of proteolytic enzyme. In: Cellulolytic enzyme: an advance approach. Maheshwari RJ and James JS eds, Springer Germany.

### **Thesis**

Garg ML (2006) Screeing, isolation and identification of thermotolerant *P.aeruginosa* amylase. PhD Thesis, Arunachal Pradesh University, Arunachal Pradesh, India.

### **Website**

[www.elsevier.com](http://www.elsevier.com)