M.D.UNIVERSITY, ROHTAK
SCHEME OF STUDIES & EXAMINATION
4th YEAR B. TECH. IN BIOTECHNOLOGY,
SEMESTER VII
EFFECTIVE FROM THE SESSION 2018-19

Modified 'F' Scheme

SN	Course No.	Subject	Teaching Schedule				Examination Schedule Marks of Class				Duration of exam
			L	T	P/D	Total	Th.	Work	P/VV	Total	
1	BT-401F(M)	Basics of Nanobiotechnology	3	1	-	4	100	50	-	150	3
2	BT-403F(M)	Bioentrepreneurship	3	1	-	4	100	50	-	150	3
3	BT-405F(M)	Bioinformatics and Computational Biology	3	1	-	4	100	50	-	150	3
4		Elective	3	1	-	4	100	50	-	150	3
5	BT-407F(M)	Genomics & Proteomics	3	1	-	4	100	50	-	150	3
6	BT-409F(M)	Intellectual Property Rights in Biotech	3	1	-	4	100	50	-	150	3
7	BT-411F(M)	Bioinformatics Lab.	-	-	3	3	-	50	50	100	3
8	BT-413F(M)	Genomics and Proteomics Lab.	-	-	3	3	-	50	50	100	3
9	BT-415F(M)	Nanotechnology Lab.	-	-	3	3	-	50	50	100	3
		Total	**18**	**6**	**9**	**33**	**600**	**450**	**150**	**1200**	

Electives:

- BT-417F(M) Basics of Stem cells
- BT-419F Bioethics and Biosafety
- BT-425F Virology

MAHARSHI DAYANAND UNIVERSITY
B. TECH. BIOTECH. 7TH SEM
Basics of Nanotechnology

Sub. Code: BT-401F(M)   **MAX. MARKS :150**
Periods/week   **Sessional:50**
L:3 T:1   **External:100**

Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION-A

Introduction & Background: Introduction to Nanotechnology, Historical Background advances in nanotechnology, its future prospects & applications in different fields such as: agriculture, healthcare, instrumentation, textile, food industry, cosmetics etc. Ethical issues in nanotechnology.

SECTION-B

Synthesis Methods of Nanomaterials: Biological synthesis, Green & Chemical synthesis of various nanomaterials such as Gold, Silver, Zinc Oxide, Tin Oxide, Iron nanoparticles with characterization techniques. Chemical Synthesis of Carbon Nanotubes: Single Walled & Multi Walled Carbon Nanotubes along with characterization techniques.

SECTION-C

Techniques used in Nanotechnology: UV-Visible Spectroscopy, Particle Size Analyzer, X-Ray Diffraction, Fourier Transform Infrared Spectroscopy, Scanning Electron Microscopy, Transmission Electron Microscopy.

SECTION-D

Role of Nanotechnology: in Disease diagnosis such as Cancer Detection & Therapy. Nanotechnology used in drug delivery systems. Materials used for the fabrication of nanodevices. Lab-on-chip, Micro fluidics devices and their properties.

Text Books/References:

1. Bhushan, Bharat. 2004, Handbook of Nanotechnology. Springer.
2. Hari Singh Nalwa 2011. Encyclopedia of Nano Science & Nanotechnology. American Scientific Publishers.
3. Kulkarni, S, K. 2014. Nanotechnology-Principles and Practices. 3rd Edition, Capital Publishing Company.
4. David E. Reisner (2008) Bionanotechnology- Global Prospects, CRC Press
5. Avouris, P., Klitzing, K. Von, Sakaki H. & Wiesendanger, R. (2003). Nano Science and Technology Series. Springer.

Sub. Code: BT-403F(M)   **MAX. MARKS :150**
Periods/week   **Sessional:50**
L:3 T:1   **External:100**

Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION-A

Introduction: Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology, Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Government schemes for commercialization of technology (Eg. Biotech Consortium)

SECTION-B

Project management: Search for a business idea, concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal.

SECTION-C

Financial analysis: Ratio analysis, Investment process, Break even analysis, Profitability analysis, Budget and planning process.
Sources of finance: Source of development finance, Project financing, Institutional financing to Entrepreneurs, Financial institutions, Role of consultancy organizations.

SECTION-D

Marketing channels: Methods of marketing, marketing channels, Marketing institutions and assistance.
Biotech enterprises: Setting up Small, Medium & Large scale industry, Quality control in Biotech industries, Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities.

Text/References:
1. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases by D. Hyne & John Kapeleris, 2006.
2. The Buisiness of Biotechnology: From the Bench of the Street: By Richard Dana Ono Published Butterworth- Heinemann, 1991.
3. Entrepreneurship in Biotechnology: Managing for growth from start-up By Martin

Grossmann, 2003.

4. Best Practices in Biotechnology Education: By Yali Friedman, Published by Logos Press, 2008. 356 pages.

5. Plant Development and Biotechnology: by Robert Nicholas Trigiano, Dennis John Gray; Published by CRC Press, 2004, 358 pages.

6. Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2005.

7. Projects: Planning Analysis, Selection, Implemantation & Review, Prasannan

8. Chandra, Tata Mc Graw-Hill Publishing Co. 12997.

MAHARSHI DAYANAND UNIVERSITY
B. TECH. BIOTECH. 7TH SEM
BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

Sub. Code:BT- BT-405F(M)   **MAX. MARKS :150**
Periods/week   **Sessional:50**
L:3 T:1   **External:100**

Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION-A

Computer And Operating System: Introduction to computation Biology, history of programming and operating systems and their applications in Biology

Software engineering in Bioinformatics: Perl and Bioperl, Numerical data analysis using R and Python

SECTION-B

Biological Databases: Introduction to Bioinformatics, Biological database overview, XML, HTML and CML, Bioinformatics toolbox, SimBiology, FASTA, SCF, SBML, Affymetrix, GenePix and ImaGene, Retrieving data from online databases

Types of biological databases, Databanks, Nucleotide databanks – Genbank, NCBI, EMBL, DDBJ, Protein databanks –Sequence databanks – PIR, SWISSPROT, TrEMBL; Structural databases – PDB, SCOP, CATH, PDB; Sequence storage – Sequence accuracy – EST, STS

SECTION-C

Sequence Analysing And Alignment: Statistical significance of alignment; Sequence assembly analysis; global and local alignment, Pair-wise and multiple sequence alignment: Hidden Markov models.

Programs and methods for sequence alignment. Dot plots, Dynamic programming algorithms, Heuristics- FASTA, BLAST; Scoring matrices- PAM, BLOSUM, PSSM, HMM, gaps and gap penalties.

SECTION-D

Managing Scientific Data And Applications: Introduction, challenges faced in integration of Biological information, SRS/MRS, Kleisli Query System and TAMBIS for a Bioinformatics Database.

Applications of Bioinformatics in different fields including proteomics, genomics, evolutionary studies and genetics, genealogy, anthropology, history, health, food, medicine, genetic engineering, pharmaceutical sciences and other industries, environment and future technologies.

Text/Reference Books

1. Bioinformatics by Higgins and Taylor.
2. Bioinformatics by Lacroin and Critchlow.
3. Computational Biology by Wunschiers.
4. Current Topics in Computational Molecular Biology by Jiang and Xu.
5. Bioinformatics: Sequence and Genome Analysis by Mount.

Sub. Code: BT-407F(M)   **MAX. MARKS : 150**
Periods/week   **Sessional: 50**
L:3 T:1   **External: 100**

Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION-A

Introduction: Structural organization of genome in Prokaryotes and Eukaryotes; mitochondrial DNA, chloroplast; DNA sequencing principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis-physical and genetic mapping: Physical mapping of genome: Conventional cytogenetics, Physical mapping by restriction hybridization analysis, FISH and related techniques, Chromosome painting and microdissection, Long range physical mapping, Contig assembly, Chromosome walking and map-based cloning.

SECTION-B

Genome Sequencing Projects: Microbes, plants and animals; Accessing and retrieving genome project information from web; Identification and classification using molecular markers, EST's and SNP's, genealogy based on mtDNA and Y-chromosome haplogroups.
Comparative and Evolutionary Genomics: Introduction, comparative genomics of plants, animals and microbes, introduction to genome evolution, Acquisition of new genes, Evolution of coding and non-coding regions, Molecular phylogenetics and applications, Evolution of multigene families in the genome

SECTION-C

Proteomics: Structural proteomics, Protein analysis (includes measurement of concentration, aminoacid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale solution, isoelectric focusing; Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hyrid system.

SECTION-D

Pharmacogenetics: High throughput screening in genome for drug discovery, identification of gene targets, pharmacogenetics and drug development
Functional Genomics and Proteomics: Introduction, Strategies to find functional genes in the genome, Gene tagging strategies and application. ESTs and its utility in genomics, Differential gene

profiling methods, DNA chips/Microarrays, SAGE and SNPs analysis, Protein and peptide microarray-based technology; PCR-directed protein in situ arrays

Texts/References:
1. Fundamentals of Biochemistry by D Voet, JG Voet and CW Pratt
2. Genomes by TA Brown
3. Molecular Biotechnology by BR Glick and JJ Pasternak
4. Discovering Genomics, Proteomics and Bioinformatics by AM Campbell and LJ Heyer
5. Principles of Gene Manipulation and Genomics by S Primrose and R Twyman

MAHARSHI DAYANAND UNIVERSITY
B. TECH. BIOTECH. 7TH SEM
INTELLECTUAL PROPERTY RIGHTS IN BIOTECH

Sub. Code: BT-409F(M)   **MAX. MARKS : 150**
Periods/week   **Sessional: 50**
L:3 T:1   **External: 100**

Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION-A

Intellectual property rights: History & Background of Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO) and the UNESCO, Sustentative Patent Law Treaty (SPLT). Introduction of Patent, Copy Right, Trademark, Trade Secret, Industrial Design, Geographical Indications.

SECTION-B

Patent: Concept of Patent, Product / Process Patents & Terminology**,** Consideration Elements of Patentability, - Novelty and Non, Obviousness (Inventive Steps and Industrial Application), Non-Patentable Subject Matter. Duration of patent in India, USA and European Union. Role of patentee & Licensor

SECTION-C

Patent Databases & Patent Information System: Patent Offices in India, Patent Application and its Contents, Patentable subject matter, Writing of the Patent Document, Procedure for Filing of Patent Application in India and types of Applications. Infringement of patent rights; Remedies for infringement of patent rights. Ownership and Maintenance of Patents

SECTION-D

Breakthrough of IPR: Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries Biodiversity and naturally occurring substances. Patentable Inventions with Special Reference to Biotechnology Products entailing Creation of New Forms of Life, Role of IPR in biotechnology and life sciences. Government Policies at National and International level in patenting IPR. Role of DST, DBT, BCIL, DIPP, TIFAC in India with respect to IPR.

Text / Reference Books
The law and Strategy of Biotechnology Patents, Sibley Kenneth.

MAHARSHI DAYANAND UNIVERSITY
B. TECH. BIOTECH. 7TH SEM
BIOINFORMATICS LAB

Sub. Code: BT- BT-411F(M)

Periods/week   **MAX. MARKS :100**
L   T   P   **Sessional:50**
       3   **External:50**
Duration of Ext. Exam: 3 Hrs

1. Computer basic
2. Search, retrieval of biological database/protein/nucleotide sequences
3. BLAST and FASTA analysis
4. CLUSTAL
5. Phylogenetic analysis
6. HMM for sequence analysis
7. Write a sequence assembly program
8. Gene finder
9. Develop a simple gene finder program for identifying introns and exons
10. Motif and pattern searching in biomolecules
11. Protein structure prediction (2D and 3D)
12. Energy minimization and simulated annealing
13. Identifying palindromes and DNA sequence
14. DNA and RNA structure prediction

Text / Reference Books

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas, Baxevanis and Francis.
2. Developing Bioinformatics Computer Skill by Gibes and Jombeck.
3. Computational Molecular Biology: An Algorithmic Approach by Pevzner.
4. Introduction to Computational Biology, Map, sequences and genomes by Waterman.

NOTE: A College must offer 70% of the above listed experiment. The remaining 30% experiment may be modified by college according to facilities available.

GENOMICS AND PROTEOMICS Lab.

Sub. Code: BT-413F(M)	**MAX. MARKS :100**
Periods/week	**Sessional:50**
L T P	**External:50**
- - 3	

Duration of Ext. Exam: 3 Hrs

Laboratory work to be carried out as per Theory Syllabus.

15. DNA Isolation
16. mt DNA isolation
17. Y-chromosome isolation
18. RNA isolation
19. PCR
20. RFLP
21. RAPD
22. 2D Electrophoresis
23. Blotting Techniques
24. MALDI
25. SAGE
26. DNA Chips

Text / Reference Books
1. Discovering Genomics, Proteomics and Bioinformatics by AM Campbell and LJ Heyer
2. Principles of Gene Manipulation and Genomics by S Primrose and R Twyman

NOTE: A College must offer 70% of the above listed experiment. The remaining 30% experiment may be modified by college according to facilities available.

MAHARSHI DAYANAND UNIVERSITY
B. TECH. BIOTECH. 7TH SEM

Nanotechnology Lab

Sub. Code: BT-415F(M)   **MAX. MARKS :100**
Periods/week   **Sessional:50**
L   T   P   **External:50**
            3
Duration of Ext. Exam: 3 Hrs

1. Chemical Synthesis of Nanoparticles
2. Preparation of plant extracts.
3. Green Synthesis of Nanoparticles.
4. Characterization of Nanoparticles using UV-Vis Spectroscopy.
5. Characterization of Nanoparticles using FTIR.
6. Characterization of Nanoparticles using Microscopy.
7. Characterization of Nanoparticles using XRD.
8. Effect of synthesis parameters on nanoparticles
9. Antimicrobial Activity of Green Synthesized Nanoparticles.
10. Antimicrobial Activity of Chemically Synthesized Nanoparticles.

MAHARSHI DAYANAND UNIVERSITY
B. TECH. BIOTECH. 7TH SEM
Basics of Stem Cells

Sub. Code: BT-417F(M)   **MAX. MARKS: 150**
Periods/week   **Sessional: 50**
L: 3   T: 1   **External: 100**
Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION-A

Basic of Stem Cell: Stem cell properties, pluripotency, totipotency, embryonic stem cells - adult stem cells, umbilical cord stem cells, difference and similarities between the embryonic and adult stem cells.

SECTION-B

In vitro fertilization technique , blastocyst , inner cell mass , growing ES cells in lab, laboratory tests to identify ES cells , properties of ES cells. Somatic stem cells, test for identification of adult stem cells, adult stem cell differentiation, trans- differentiation & plasticity.

SECTION –C

Stem Cells in Drug Discovery & Tissue Engineering: Role in Target identification, differentiation pathways manipulation, difference between stem cell therapy & cell protection, drug discovery using stem cells, drug screening and toxicology.

SECTION –D

Therapeutic applications & Genetic Engineering: genetically engineered stem cells, stem cells and Animal cloning, Therapeutic applications, Parkinson disease, Neurological disorder, heart disease, spinal cord injuries, diabetes, burns - HLA typing- Alzheimer's disease, tissue engineering application, production of complete organ, kidney, eyes, heart, brain.

Texts/References

1. Ann A. Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and
Therapeutic Potential, Jones and Bartett, 2003.
2. Peter J. Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998.
3. Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, Academic Press, 2006.
4. A.D.Ho., R.Hoffiman, Stem Cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
5. C.S.Potten, Stem Cells, Elsevier, 2006.

MAHARSHI DAYANAND UNIVERSITY
B. TECH. BIOTECH. 7TH SEM
BIOETHICS AND BIOSAFETY

Sub. Code: BT-419F   MAX. MARKS: 150
Periods/week   Sessional: 50
L: 3   T: 1   External: 100
Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION-A
Introduction- causes of unethical acts, ignorance of laws, codes, policies and Procedures, recognition, friendship, personal gains, Professional ethics-professional conduct.
Ethical decision making, ethical dilemmas good laboratory practices, good manufacturing practices, laboratory accreditation.

SECTION-B
Social- genetic discrimination: insurance and employment, human cloning & its impact on feticide sex determination Artificial Insemination, In Vitro Fertilization (IVF), Gamete Intrafallopian Transfer (GIFT) & Zygote Intrafallopian Transfer (ZIFT), Surrogacy,Involuntary Sterilization, Drug abuse during Pregnancy. Transplantation and Xenografting: Fetal Tissue Transplantation. Xenografts.

SECTION-C
Ethical: Eugenics, Genetic Disease and Genetic Screening. Somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function. Social and ethical issues. AIDS: Disclosure, Transmission-Health Care Industry. Euthanasia (Right to Die): Advance Directives, Living Wills, Resuscitate Orders. Physician Assisted Suicide vs. death due to withdrawing/ withholding treatment.

SECTION-D
Biosafety- Definition, Requirement, Containment facilities, biohazards, genetically modified organisms (GMOs) living modified organisms (LMOs), Biosafety for human health and environment designing and management of laboratory and culture room as per the norm of GLP, GMO and FDA. Social and ethical aspects of biological weapons. The Cartagena Protocol on Biosafety. Biosafety Management: environmentally responsible use of biotechnology.

Text / Reference Books
1. Moral Matters: Ethical Issues in Medicine and the Life Sciences (1995) by Caplan, A, John Willey & Sons, Inc.
2. In the Name of Eugenics (1995) by Kevles, D., Cambridge: Harvard University Press.
3. Altered fates Gene Therapy and retooling of Human Life (1995) by Lyon, J. & Gorner, P., New York: W.W. Norton &Co., Inc
4. Case Studies in Bioetheics (1995) by Yashon, R.., R.J. Publications.
5. Cartagena Protocol in Biosafety, January (2000)
6. Biological warfare in the 21st century (1994), by M.R. Dano, Brassies London.
7. Safety Considerations for Biotechnology (1992) OECD, Paris.
8. *Biosafety Management* (2000) by P.L. Traynor. Virginia Polytechnic Institute's Publication.

Sub. Code: BT-425F   MAX. MARKS: 150
Periods/week   Sessional: 50
L: 3   T: 1   External: 100
Duration of Ext. Exam: 3 Hrs

Instructions for setting of paper: Nine questions are to be set in total. First question will be short answer question covering whole syllabus and will be compulsory to attempt. Next eight questions will comprise of two questions each from the four sections. Student will be required to attempt four questions selecting one from each section. Each question will be of 20 marks.

SECTION A
General Virology
Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses; morphology & ultrastructure; capsids &their arrangements; types of envelopes and their composition-viral genome, their types and structures; virus related agents(viroids, prions).

SECTION B
General Methods of Diagnosis and Serology.
Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures; primary & secondary cell cultures; suspension cell cultures and monolayer cell cultures; cell strains, cell lines and transgenic systems; serological methods - haemagglutination & HAI; complement fixation; immunofluorescence methods, ELISA and Radioimmunoassays; assay of viruses -physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy)-Infectivity assay (plaque method,end point method) – Infectivity assay of plant viruses.

SECTION C
Bacterial Viruses
Bacteriophage structural organization; life cycle; one step growth curve; transcription; DNA replication; eclipse phase; phage production; burst size; lysogenic cycle; bacteriophage typing; application in bacterial genetics; brief details on M13,Mu,T3,T4, and Lamda P1.

SECTION D
Plant Viruses
Classification and nomenclature; effects of viruses on plants; appearance of plants; histology, physiology and cytology of plants; common virus diseases of plants; paddy, cotton, tomato, and sugarcane; viruses of cyanabacteria, algae, fungi; life cycle; type species of plant viruses like TMV, Cauliflower Mosaic Virus and Potato Virus X; transmission of plant viruses with vectors (insects, nematodes, fungi) and without vectors (contact, seed and pollens); diagnostic techniques in seeds; seed stocks and diseased plants (seed morphology, seedling; symptomatology, indicator plants, serological methods, histochemical tests and fluorescent microscopy); prevention of crop loss due to virus infection-virus-free planting material; vector control.

Animal Viruses
Classification and nomenclature of animal human viruses; epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses Picorna.Ortho myxo, Paramyxo, Toga and other arthropod viruses, Rhabdo. Rota, HIV and other Oncogenic

viruses; DNA viruses; Pox, Herpes, Adeno, SV 40; Hepatitis viruses, viral vaccines (conventional vaccines, genetic recombinant vaccines used in national immunisation programmes with examples, newer generation vaccines including DNA Vaccines with examples) interferons, and
antiviral drugs.

Text Books

1. Morag C and Timbury M.C (1994) Medical virology-X Edition. Churchill Livingstone, London.
2. Dimmock NJ, Primrose SB (1994). Introduction to Modern Virology, IV Edition, Blackwell Scientific Publications, Oxford
3. Conrat HF, Kimball PC and Levy JA (1994) Virology-Ill Edition Prentice Hall, Englewood cliff, New Jersey.
4. Mathews, RE.,(1992) Functionals of Plant virology, Academic press, San Diego.
5. Topley and Wilson's (1995) Text Book on Principles of Bacteriology, Virology and Immunology. Edward Arnold, London.
6. Lennetter, EH (1984) Diagnostic procedures for Viral and Rickettsial diseases. American Public Health association, NY.
7. William Hayes (1985) The genetics of Bacteria and their Viruses. Blackwell Scientifi Publishers, London.