

Dr. Homi Bhabha State University
M.Sc. (Part I) Semester II Subject:
Microbiology Syllabus

	Course Code: MSMBCC201T	Course Title: Cell Biology	
	MSMBCC201T: MS (Masters) MB(Microbiology) CC201(Core course 1) T (Theory)		
	Course Credits 4	Total contact hours: 60 Hrs	
Sr. No.			Reqd. hours
UNIT I	<p>An Overview of cells and cell research: The origin and evolution of cells, experimental Models in cell biology (<i>E.coli</i>, yeasts, <i>Caenorhabditis elegans</i>, <i>Drosophila thaliana</i>)</p> <p>Tools of cell biology: Phase contrast microscopy Fluorescence microscopy, Confocal microscopy, Electron microscopy, flow cytometry, Subcellular fractionation.</p> <p>Organelle Biology : Structure ,function and biogenesis of chloroplast and mitochondria, nucleus,endoplasmic reticulum, Peroxisomes,Golgi apparatus, lysosomes and Cytoskeleton system</p>		15 Hrs
UNIT II	<p>Cell membrane structure : Lipid bilayer, membrane proteins, Spectrins, Glycophorin, Multipass membrane proteins Bacteriorhodopsin Membrane Transport : Principles of membrane transport, ion channels and electrical properties of membranes</p> <p>Intracellular Compartments and Protein Sorting : Compartmentalization of cells, Transport of molecules between the nucleus and cytosol,peroxisomes,ER,Transport of proteins into chloroplast and mitochondria.</p> <p>Intracellular Vesicular Traffic :Endocytosis,exocytosis,Transportfrom ER to the Golgi Apparatus.</p>		15 Hrs

UNIT III	Cell Division and cell cycle : Cell cycle and Programmed cell death : Cell Cycle and Control system :,Intracellular control of cell cycle events, Apoptosis, Extracellular control of cell division,growth andapoptosis.	15 Hrs
	Mechanism of cell division: M-Phase,Mitosis,Cytokinesis, Cell adhesion : Cell adhesion and role of different adhesion molecules, gap junctions, ; Extracellular matrix, integrins, neurotransmission .	
UNIT IV	Cell signaling: Various types of cell signaling-endocrine, paracrine, juxtacrine and autocrine , Receptors and their classes, mechanisms of signal transduction and secondary messengers, Regulation of signal transduction pathways, Bacterial and plant two component systems	15 Hrs
	Suggested readings	
1.	Molecular Biology of The Cell – Albert, Johnson, Lewis, Raff, Roberts &Walter.	
2.	Molecular Cell Biology. Lodish, Birk, and Zipursky. Freeman	
3.	The Structure and Dynamics of Cell Membrane. – Lipowsky and Sackmann	
4.	Cell Movements: from Molecules to Motility- Bray GarlandPub. NY.	
5.	The cell : A Molecular Approach, 4 th Edition ,Geoffrey M. Cooper, Robert E. Hausman,ASM press.	
6.	Molecular Biology of The Cell – Albert, Johnson, Lewis, Raff, Roberts &Walter.	
7.	Molecular Cell Biology. Lodish , Birk, and Zipursky. Freeman	

Evaluation:

Theory:

Internal: 40 Marks: Presentation 30 marks, Attendance and class interaction 10 marks

External: 60 marks (Theory exam)

	Course Code: MSMBCC201P	Course Title: Cell Biology	
	MSMBCC201P: MS (Masters) MB(Microbiology) CC201(Core course 1) P (Practical)		
	Course credits 2	Total contact hours: 60 Hrs	
Sr. No.			Reqd. hours
1.	Study of cell cytology using Phase contrast Microscopy. Demonstration		
2.	Study of Cell structure using Confocal Microscopy. Demonstration		
3.	Study of Cell structure using Fluorescence Microscopy. Demonstration		
4.	Isolation of Chloroplasts.and study of its marker enzyme.		
5.	Isolation of Mitochondria from the cell and study of its marker enzyme		
6.	Study of Mitosis, Karyotyping and determination of mitotic Index		
7.	Study of Meiosis		
8.	Estimation of NO (Nitric Oxide) produced by Macrophages.		
9.	Study of Cell viability and membrane integrity		
10.	Demo of working of SEM		

Evaluation:

Practical:

Practical exam: 50 marks

	Course Code: MSMBCC202T	Course Title: Microbial Genetics	
	MSMBCC202T: MS (Masters) MB (Microbiology) CC202 (Core course 2) T (Theory)		
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
Unit I	<p>1.1 Viral genetics</p> <p>A. A. Mapping the Bacteriophage genome</p> <ol style="list-style-type: none"> i. Phage phenotypes ii. Genetic recombination in phages iii. Genetic fine structure mapping iv. Deletion mapping <p>B. Genes within genes: Bacteriophage Φ X174</p> <p>C. Constructing phage vectors- phage display vectors, suicide vectors, combining phage vectors and transposons</p> <p>1.2 Gene Transfer</p> <p>A. Drug resistance and gene transfer in bacteria</p> <p>B. Genetic exchange in Bacteria – An overview</p> <p>C. Mutant phenotypes in bacteria</p> <p>D. Basic test for transformation, conjugation and transduction</p> <p>E. Transformation:</p> <ol style="list-style-type: none"> i. The transforming principle ii. Natural competency iii. Process of natural transformation- <i>Bacillus subtilis</i> (in detail) iv. Overview of transformation in <i>Streptococcus pneumoniae</i> & <i>Haemophilus influenzae</i> v. Artificial transformation vi. Transformation and gene mapping <p>F. Conjugation:</p> <ol style="list-style-type: none"> i. Discovery of conjugation ii. F factors and R factors iii. The conjugation machinery and transfer of DNA iv. F+ X F- mating v. Hfr formation and conjugation vi. Formation of F primes and transfer from one cell to another vii. Genetic uses of F' viii. Gene mapping using Hfr crosses and 50% rule ix. Mapping closely linked genes x. Mobilization of nonconjugable plasmids xi. Conjugation from prokaryotes to eukaryotes <p>G. Transduction:</p> <ol style="list-style-type: none"> i. Discovery ii. Generalized transduction iii. P1 as model of generalized transduction iv. Specialized transduction- λ phage as model system LFT & HFT lysate Making merodiploids with specialized transducing phage Moving mutations from plasmids to specialized transducing phage to chromosome 		15 Hrs

<p>Unit II</p>	<p>2.1 Transposable genetic elements</p> <ul style="list-style-type: none"> A. Transposable Elements in Prokaryotes: An Overview The medical Significance of Bacterial Transposons B. Transposable Elements in Eukaryotes Ac and Ds Elements in Maize P Elements and Hybrid Dysgenesis in Drosophila Mariner, an Ancient and Widespread Transposon C. Retrotransposons, Retrovirus like Elements, Retroposons D. The Genetic and Evolutionary Significance of Transposable Elements, Transposons and Genome Organization, Transposons and Mutation, Rearrangement of Immunoglobulin Genes, Evolutionary Issues Concerning Transposable Elements <p>2.2 Genetic basis of cancer</p> <ul style="list-style-type: none"> A. A Common Killer B. Cancer: A Genetics Disease, The Many Forms of Cancer, Cancer and the Cell Cycle, A Genetics Basis for Cancer C. Oncogenes, Tumor-Inducing Retroviruses and Viral Oncogenes, Cellular Homologs of Viral Oncogenes: The Proto-Oncogenes, Mutant Cellular Oncogenes and Cancer, Chromosome Rearrangement and Cancer D. Tumor Suppressor Genes, Inherited Cancers and Knudson's Two-Hit Hypothesis, Cellular Roles of Tumor Suppressor Proteins E. Genetic Pathways to Cancer 	<p>15 Hrs</p>
<p>Unit III</p>	<p>3.1 Developmental genetics</p> <ul style="list-style-type: none"> A. Cloning Experiments B. The Genetics of Pattern Formation in Drosophila C. Homeobox Genes in other Organisms D. The Genetics of Flower Development in Arabidopsis E. Programmed Cell Death in Development F. Evo-Devo: The Study of Evolution and Development <p>3.2: The genetic control of animal development</p> <ul style="list-style-type: none"> A. Stem Cell Therapy: A Brave New World? B. The Process of Development in Animals <ul style="list-style-type: none"> i. Oogenesis and fertilization ii. The Embryonic Cleavage Divisions and Blastula Formation iii. Gastrulation and Morphogenesis C. Genetic Analysis of Development in Model Organisms <ul style="list-style-type: none"> i. Drosophila as a Model Organism ii. Caenorhabditis as a model organism D. Genetic Analysis of Development Pathways <ul style="list-style-type: none"> i. Sex Determination in Drosophila ii. Sex Determination in Caenorhabditis E. Molecular Analysis of Genes Involved in Development F. Maternal Gene Activity in Development <ul style="list-style-type: none"> i. Maternal-Effect Genes ii. Determination of the Dorsal-Ventral and Anterior-Posterior Axes in Drosophila Embryos G. Zygotic Gene Activity in Development <ul style="list-style-type: none"> i. Body Segmentation 	<p>15 Hrs</p>

	ii. Specification of Cell Types iii. Organ Formation	
Unit IV	<p>4.1 Mapping Human Genes at the Molecular Level RFLPs as Genetic Markers Linkage Analysis Using RFLPs Positional Cloning: The Gene for Neurofibromatosis</p> <p>4.2 The Candidate Gene Approach: The Gene for Marfan Syndrome Fluorescent in Situ Hybridization (FISH) Gene Mapping Genetic Disorders: Diagnosis and Screening</p> <p>4.3 Prenatal Genotyping for Mutations in the β- Globin Gene Prenatal Diagnosis of sickle-Cell Anemia Single Nucleotide Polymorphisms and Genetic Screening DNA Microarrays and Genetic Screening Genetic Testing and Ethical Dilemmas Treating Disorders with Gene Therapy</p> <p>4.4 Gene Therapy for Severe Combined Immunodeficiency (SCID) Problems and Failures in Gene Therapy The Future of Gene Therapy: New Vectors and Target-Cell Strategies Ethical Issues and Gene Therapy</p> <p>4.5 DNA Fingerprints Minisatellites (VNTRs) and Microsatellites (STRs) Forensic Applications of DNA Fingerprints Genome Projects Use Recombinant DNA technology</p> <p>4.6 The Human Genome Project: An overview The Ethical, Legal, and Social Implications (ELSI) Program After the Genome Projects</p> <p>4.7 Biotechnology is an Outgrowth of Recombinant DNA Technology Insulin Production by Bacteria</p> <p>4.8 Transgenic Animal Hosts and Pharmaceutical Products Transgenic Crop Plants and Herbicide Resistance Marshalling recombinant DNA technology to fight AIDS</p>	15 Hrs
	Suggested readings	
	<ol style="list-style-type: none"> 1. Watson, Baker, Bell, Gann, Levine, Losick, "Molecular Biology of the Gene", Fifth Edition, Pearson Education (LPE) 2. Trun, Trempey, "Fundamental Bacterial Genetics", Blackwell Publishing 3. Russell, P.J., "iGenetics- A Molecular Approach", Third Edition, Pearson International Edition 4. Snustad & Simmons, "Principals of Genetics", Third Edition, John Wiley & Sons Inc 5. Watson, Gilman, Witkowski, Zoller, "Recombinant DNA", Second Edition, Scientific American Books 	

	6. Klug & Cummings, "Concepts of Genetics", Seventh Edition, Pearson Education (LPE) 7. Pierce, B.A., "Genetics- A Conceptual Approach", Second Edition, W. H. Freeman & Co 8. Lewin, B., "Genes-IX", Jones and Bartlett Publishers	
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Evaluation:

Theory:

Internal: 40 Marks: Presentation 30 marks, Attendance and class interaction 10 marks

External: 60 marks (Theory exam)

	Course Code: MSMBCC202P	Course Title: Microbial Genetics	
	MSMBCC202P: MS (Masters) MB (Microbiology) CC202 (Core course 2) P (Practical)		
	Course Credit: 2	Total contact hours: 60 Hrs (2 batches)	
Sr. No.	Course Contents (Topics & subtopics)		
1	Transformation		
2	Conjugation, zygotic induction		
3	Transduction		
4	Identification of phage nucleic acid		
5	Curing of plasmids		
6	Study of transposable elements		
7	Isolation of host range mutants		
8	Problems on gene transfer mechanisms		
9	Problems on viral genetics		
10	Cancer genetics- visit to ACTREC		

Evaluation:

Practical:

Practical exam: 50 marks

	Course Code: MSMBCC203T	Course Title: Biochemistry	
	MSMBCC203T ; MS (Masters) MB(Microbiology) CC203 (Core Course 3) T (Theory)		
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	Basic aspects of bioenergetics- electron carriers, electron donors, inhibitors, uncouplers, energy bond, phosphorylation Brief account of photosynthetic and accessory pigments- chlorophyll, bacteriochlorophyll, rhodopsin, carotenoids, phycobilliproteins.		15 Hrs
UNIT II	Respiratory metabolism- Embden Meyerhoff Pathway, Hexose Monophosphate shunt, Entenr Doudroff path-way, glyoxylate pathway, Krebs cycle, oxidative and substrate level phosphorylation, reverse TCACycle, gluconeogenesis, Pasture Effect, Fermentation of carbohydrates- Homo and heterolactic ferementations.		15 Hrs
UNIT III	Carbohydrates: anabolism, autotrophy, oxygenic and anoxygenic photosynthesis, autotrophic generation of ATP, Fixation of CO ₂ : Calvincycle, C ₃ and C ₄ pathway, Synthesis of polysaccharides- peptidoglycan,biopolymers as cell components		15 Hrs
UNIT IV	Nitrogen fixation - Biochemistry of N ₂ fixation, Structure and propertiesof nitrogenase, Assimilation of Nitrogen, dinitrogen, nitrate nitrogen, ammonia, synthesis of major amino acids, polyamines		15 Hrs
	Suggested readings		
1.	Lehninger Principles of Biochemistry: Albert Lehninger, David Nelson, and Michael Cox, Publisher : W H Freeman & Co; 7th edition (2017)		
2.	Biochemistry: Jeremy M. Berg , Lubert Stryer, John Tymoczko and Gregory Gatto, Publisher: WH Freeman; 9th edition (2019)		
3.	Outlines of Biochemistry: Eric Conn, Paul Stumpf, George Bruening and Roy Doi. Publisher: Wiley; 5th edition (2006)		

4.	Fundamentals of Biochemistry: Life at the Molecular Level: Donald Voet, Judith Voet, and Charlotte Pratt. Publisher: Wiley, 5th edition (2016)	
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Evaluation:

Theory:

Internal: 40 Marks: Presentation 30 marks, Attendance and class interaction 10 marks External: 60 marks (Theory exam)

	Course Code: MSMBCC203P	Course Title: Biochemistry	
	MSMBCC203P : MS (Masters) MB(Microbiology) CC203(Core Course 3) P (Practical)		
	Course Credit: 2	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		
1	Extraction, separation and determination of absorption spectra of plant pigments		
2	Preparation of Cytochrome C from goat heart		
3	Isolation of NAD from baker's yeast		
4	SDS PAGE of cytosolic proteins		
5	Study of bacterial fermentation: Thin layer chromatography of bacterial cell free supernatant for presence of organic acids		
6	Isolation and estimation of RNA and DNA from yeast, liver, and plants		
7	Estimation of pyruvate by 2,4 Dinitrophenyl hydrazine method		
8	Evidence of B-Galactosidase induction in presence of lactose in E.coli strains.		
9	Demonstration of 2D electrophoresis		
10	Estimation of leg hemoglobin in root nodules		

Evaluation:

Practical:

Practical exam: 50 marks

	Course Code: MSMBIE201T	Course Title: Medical Microbiology & Immunology	
	MSMBIE201T; MS (Masters) MB (Microbiology) ID201 (Inter Disciplinary 1) T (Theory)		
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	Emerging Diseases Detailed Study of following infections including Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab. diagnosis, Prophylaxis, and Treatment viz. Dengue, Listeriosis, VRE (Vancomycin Resistant enterococci) Leptospirosis, Hepatitis non A , Swine flu, conditions caused by Campylobacter , and Prions		15 Hrs
UNIT II	2.1 Introduction to Clinical Research 2.1.1 Good Clinical practice Guidelines 2.1.2 Ethical aspects of Clinical Research 2.1.3 Regulatory Requirements in Clinical Research 2.1.4 Clinical Research Methodologies and Management 2.1.5 Clinical Data Management and Statistics in Clinical Research. 2.1 Modern Diagnostic Methods 2.2.1 Advances in Molecular and Immunological Techniques 2.2.2 Microarrays 2.2.3 Advances in Fluorescence Technology		15 Hrs
UNIT III	3.1 Tolerance 3.1.1 Central Tolerance 3.1.2 Peripheral Tolerance 3.1.3 Tolerance Induction 3.1.4 T-cell Tolerance 3.1.5 B-cell Tolerance 3.1.6 Incomplete Tolerance 3.2 Autoimmunity 3.2.1 Organ-Specific Autoimmune Diseases 3.2.2 Systemic Autoimmune Diseases 3.2.3 Animal Models for Autoimmune Diseases 3.2.4 Evidence Implicating the CD4+ T cell, MHC, and TCR in Autoimmunity 3.2.5 Proposed Mechanisms for Induction of Autoimmunity 3.2.6 Treatment of Autoimmune Diseases 3.3 Blood Transfusion & Transplantation		15 Hrs

	<p>3.3.1 ABO & Rh Blood Groups 3.3.2 Potential Transfusion Hazards 3.3.3 Transfusion Alternatives 3.3.4 Immunologic Basis of Graft Rejection 3.3.5 Clinical Manifestations of Graft Rejection 3.3.6 General Immunosuppressive Therapy 3.3.7 Specific Immunosuppressive Therapy 3.3.8 Immune Tolerance to Allografts</p>	
Unit IV	<p>Infectious diseases: Diagnostics & Preventive measures</p> <p>4.1 Immune Response to Infectious diseases 4.1.1 Immune Response to protozoal infections and parasitic infestations 4.1.2 Immune Response to fungi 4.1.3 Immune Response to prions</p> <p>4.2 Manipulations of the Immune system 4.2.1 Extrinsic regulation of unwanted immune responses 4.2.2 Using immune response to attack tumors</p> <p>4.3 Manipulating the immune response to fight infection</p>	15 Hrs
	Suggested readings	
	<ol style="list-style-type: none"> 1. Immunology – Kuby 6th Edition; W.H. Freeman & Co., New York. 2. Immunology- Kuby, 8th Edition; McMillan Education. 3. Immunology – Essential and Fundamental; Sulabha Pathak and Urmi Palan; 3rd Edition; Capital Publishing Company. 4. The Elements of Immunology- Fahim Halim Khan- Pearson Education. 5. Immunology: an introduction- 4th Edition- Ian R. Tizard- Thomson. 6. Immunobiology -the immune system in health and disease 6th ed.-Janeway Travers. GS. 7. Roitt's Essential Immunology - 13th Edition; Wiley Blackwell. 8. Immunology –Roitt, Brostoff, Male ; 6th edition; 9. Mosby Immunology and Immunotechnology- Ashim Chakravarty; Oxford University Press 	

Evaluation:

Theory:

Internal: 40 Marks: Presentation 30 marks, Attendance and class interaction 10 marks External: 60 marks
 (Theory exam)

	Course Code: MSMBIE201P	Course Title: Microbial Genetics	
	MSMBIE201P ; MS (Masters) MB(Microbiology) IE201(Inter Disciplinary Course 1) P (Practical)		
	Course Credit: 2	Total contact hours: 60 Hrs (2 batches)	
Sr. No.	Course Contents (Topics & subtopics)		
	<ol style="list-style-type: none"> 1. Collection of human blood & Separation of lymphocytes from human blood using Ficoll Hypaque density gradient centrifugation. 2. Viable staining of lymphocytes using trypan blue. 3. Differential staining of blood 4. Identification of <i>S.typhi</i> by serotyping. [Purification of H and O antigens from <i>S.typhi</i>]. 5. Major Minor cross matching of blood 6. Isoagglutinin titre 7. Demonstration Experiments: PCR, Complement Fixation Test, Rapid identification for Dengue virus (IgM & IgG) kit method "TULIP" Immunochromatography 		
	<p>References</p> <ol style="list-style-type: none"> 1. Medical laboratory technology: by Godkar. 2. Clinical immunology: Principle & Practice 3rd ed. 2008 (Part -11 – clinical diagnostic immunology) 3. Practical Immunology: Frank Hay and Olwyn Westwood, 4th Edition Blackwell Science. 4. A textbook of practical and Clinical Immunology: Talwar and Gupta , Vol 1; 2nd edition <p style="text-align: center;">Manual of Molecular and Clinical Lab Immunology (Manual of Molecular and Clinical Laboratory Immunology by Barbara Detrick, Robert Hamilton; John Schmitz; 8th Edition.</p>		

Practical Exam: 50 marks

	Course Code: MSMBSEC201T	Course Title: Bioinformatics	
	MSMBSEC201T; M (Masters) MB (Microbiology) SEC201 (Skill Enhancement Course 1) T (Theory)		
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	<p>DNA Sequencing, Sanger Sequencing, Massive Parallel, Short- Read Sequencing, DNA Sequencing in Metagenomic and for Single-Cell Sequencing, Real-Time, Single-Molecule Sequencing, DNA Sequence Assembly, Base Calling and Trimming, Assembly of DNA Sequences, Closing of Genomes, DNA Sequence Formats, Annotation.</p> <p>Sequence Alignment – Global or Local Pairwise Alignments? Substitution Matrices, Gap, Dynamic Programming, Multiple Alignment- Clustal, Other Multiple Alignment Programs, BLAST</p> <p>– NCBI BLAST, Ortholog Detection, BLAST2 Sequences, Statistics, Variants of BLAST</p>		15 Hrs
UNIT II	<p>Introduction to Bioinformatics Databases, Data Formats Used with Bioinformatics Databases, Organization of Databases and Bioinformatics Institutions, Major Bioinformatics Databases – GenBank, The European Nucleotide Archive (ENA), Swiss-Prot and UniProt, Genomics Databases, Raw Sequence Read Datasets, Other Databases, Primary and Secondary Bioinformatics Databases, Data Formats in Bioinformatics Databases, Accession Numbers.</p> <p>Protein Structure Databases and Predictions, Primary and Secondary Structures, Domain Prediction and Databases, Protein 3D Structure, Overview of Proteomics Databases and Servers</p>		15 Hrs
UNIT III	<p>Oligonucleotide probes: Background for Oligonucleotide Design, Practical Approach to Oligonucleotide Design Whether of Exploratory Nature or for Diagnostic Purpose; General Rules for Design of Oligonucleotides – Lengths of PCR Primers and Products, Lengths of Oligonucleotide Hybridization Probes, Design of Primers for PCR and “Kwok’s Rules”, Design of Probes for Hybridization, T_m Calculations, Estimation of T_m by Formula, Formamide Considerations, Estimation of T_m by Nearest Neighbor Prediction, Special Applications, Exploratory Applications, Diagnostic Applications, Data Formats, Programs.</p>		15 Hrs
UNIT IV	<p>Background, Understanding the Phylogenetic Tree, Assumptions About Data in Order to Perform Phylogenetic Analysis, Phylogenetic Model</p>		15 Hrs

	Parameters, The Tree Structure, Substitution Matrix and Evolutionary Models, Weighting of Characters, Phylogenetic Methods, Maximum Parsimony , Distance Matrix/Neighbor Joining, Maximum Likelihood, Bayesian (Mr. Bayes) Inference of Phylogeny, Comparison of Phylogenetic Methods, Bootstrap,Data Formats, Phylogenetic Program Packages	
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Suggested readings

1.	Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.	
2.	Baldi, P. and Brunak, S. 2001 Bioinformatics: The machine learning approach, The MIT Press.	
3.	Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.	
4.	Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press.	
5.	Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.	
6.	Mount, D.W., Bioinformatics: 2001, Sequence and Genome Analysis. CSHL Press.	
7.	Durbin R., Eddy S., Krogh A. and Mithchison G. 2007 Biological Sequence Analysis, CambridgeUniversity Press	

Evaluation:

Theory:

Internal: 20 Marks: Presentation/assignments/continuous evaluation 15 marks, Attendanceand class interaction 5 marks

External: 30 marks (Theory exam)