

**NOIDA INTERNATIONAL UNIVERSITY  
SCHOOL OF SCIENCES**

**Study & Evaluation Scheme for M.Sc. (Microbiology)  
Effective from the Session: 2020-21**

**M.Sc Microbiology 1<sup>st</sup> Year  
SEMESTER-I**

S.No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit
			L	T	P	CA	TA	Total	External Exam		
1	STPM-101	Microbial Physiology & Metabolism	4	0	0	20	20	40	60	100	4
2	STPB-102	Principles of Genetics	4	0	0	20	20	40	60	100	4
3	STPB-103	Diversity Of Prokaryotes And Eukaryotes	4	0	0	20	20	40	60	100	4
4	STPM-104	Bacteriology & Virology	4	0	0	20	20	40	60	100	4
5	STPB-105/ TC-1	Bioethics , Biosafety & IPR/ Technical Communication	2	0	0	20	20	40	60	100	2
<b>Practical</b>											
1	SPPM-101	Microbial Physiology & Metabolism Lab	0	0	2			25	25	50	2
2	SPPB-102	Principles of Genetics Lab	0	0	2			25	25	50	2
2	SPPB-103	Diversity Of Prokaryotes And Eukaryotes Lab	0	0	2			25	25	50	2
3	SPPM-104	Bacteriology & Virology Lab	0	0	2			25	25	50	2
<b>Total</b>										<b>700</b>	<b>26</b>
<b>Note:</b> List of Practical will be supplied at the Start of every Semester											

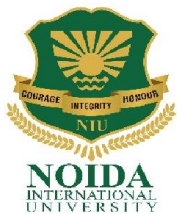
**M.Sc Microbiology 1<sup>st</sup> Year  
SEMESTER-II**

S.No	Course Code	Subject	Period			Evaluation Scheme			External Exam	Subject Total	Credit
			L	T	P	CA	TA	Total			
			1	STPM-201	Biomolecules	4	0	0			
2	STPB-202	Molecular Biology	4	0	0	20	20	40	60	100	4
3	STPB-203	Immunotechnology	4	0	0	20	20	40	60	100	4
4	STPB-204	Biostatistics, Computer Applications and Bioinformatics	4	0	0	20	20	40	60	100	4
5	STPM-205	“Seminar” Recent development in microbiology	2	0	0	15	10	25	75	100	2
<b>Practical</b>											
1	SPPM-201	Biomolecules	0	0	2			25	25	50	2
2	SPPB-202	Molecular Biology	0	0	2			25	25	50	2
3	SPPB-203	Immunotechnology	0	0	2			25	25	50	2
4	SPPB-204	Biostatistics, Computer Applications and Bioinformatics	0	0	2			25	25	50	2
<b>Total</b>										<b>700</b>	<b>26</b>

**Note:** List of Practical will be supplied at the Start of every Semester

**M.Sc Microbiology 2<sup>nd</sup> Year  
SEMESTER-III**

S.No	Course Code	Subject	Period			Evaluation Scheme			Subject Total	Credit	
			L	T	P	CA	TA	Total			External Exam
1	STPM-301	Enzymology and Bioprocess Technology	4	0	0	20	20	40	60	100	4
2	STPM-302	Industrial & Food Microbiology	4	0	0	20	20	40	60	100	4
3	STPM-303	Genetic Engineering	4	0	0	20	20	40	60	100	4
4	STPM-304	Parasitology	4	0	0	20	20	40	60	100	4
5	STPB-305/ STPB-306	CBCS Genomics and Proteomics /Bioinformatics	2	0	0	20	20	40	60	100	2
<b>Practical</b>											
1	SPPB-301	Enzymology and Bioprocess Technology	0	2				25	25	50	2
2	SPPB-302	Industrial & Food Microbiology	0	2				25	25	50	2
2	SPPM-303	Genetic Engineering	0	2				25	25	50	2
3	SPPM-304	Parasitology Lab	0	2				25	25	50	2
<b>Total</b>										<b>700</b>	<b>26</b>
<b>Note:</b> List of Practical will be supplied at the Start of every Semester											



M.Sc Microbiology 2<sup>nd</sup> Year  
SEMESTER-IV

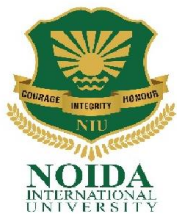
S.No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Credit
			L	T	P	CA	TA	Total	External Exam		
			1	STPM-401	Environmental Microbiology	4	0	0	20		
2	STPB-402	Clinical research and Entrepreneurship	4	0	0	20	20	40	60	100	4
<b>Total</b>										<b>200</b>	<b>8</b>

**Note:** List of Practical will be supplied at the Start of every Semester

S.No	Course Code	Subject	Project Report	Report Presentation	Viva Voce	Subject Total	Credit
1	STPM-403	Project	100	50	50	<b>200</b>	<b>8</b>

OVERALL CREDIT SCHEME

S. No.	SEMESTER	Theory Total	Practical Total	Subject Total	Total Credit
1	I	400	200	700	26
2	II	500	200	700	26
3	III	500	200	700	26
4	IV	200	200	400	16
			<b>Grand Total</b>	<b>2500</b>	<b>94</b>



**M.Sc Microbiology 1<sup>st</sup> Year  
SEMESTER-I**

**MICROBIAL PHYSIOLOGY AND METABOLISM (STPM- 101)**

L	T	P
4	0	2

**Unit 1: Growth and cell division:** Measurement of growth, growth physiology, cell division, growth yields, growth kinetics, steady state growth and continuous growth.

**Unit 2: Solute Transport:** Primary and Secondary transport: Introduction, Kinetics, ABC transporters, Phospho-transferase system, Drug export systems, amino acid transport.

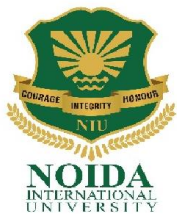
**Unit 3: Central Metabolic Pathways and Regulation:** Glycolysis, PPP, ED pathway, Citric acid cycle: Branched TCA and Reverse TCA, glyoxylate cycle. Utilization of sugars other than glucose and complex polysaccharides

**Unit 4: Nitrogen metabolism:** Metabolism of amino acids: Amino acid biosynthesis and utilisation, lysine and glutamine overproduction, stringent response, polyamine biosynthesis and regulation. **Metabolism of lipids and hydrocarbons:** Lipid composition of microorganisms, biosynthesis and degradation of lipids, lipid accumulation in yeasts, hydrocarbon utilization, PHA synthesis and degradation. **Metabolism of nucleotides:** Purine and pyrimidine biosynthesis, regulation of purine and pyrimidine biosynthesis, inhibitors of nucleotide synthesis.

**Unit 5: Physiological Adaptations and Intercellular signaling:** Introduction to two component system, regulatory systems during aerobic- anaerobic shifts: Arc, Fnr, Nar, FhlA regulon, response to phosphate supply: The Pho regulon Quorum sensing: A and C signaling system, sporulation in *Bacillus subtilis*, control of competence in *Bacillus subtilis*. Heat-Shock responses, pH homeostasis, osmotic homeostasis.

**STUDY MATERIALS:**

1. Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc., 2008
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H. Freeman and Company; 2008.
3. Microbial lipids edited by C. Ratledge and SG Wilkinson, second edition, Academic Press; 1988.
4. Microbial Physiology by Albert G. Moat and John W. Foster. Third edition, John Wiley and Sons; 2002
5. The Physiology and Biochemistry of Prokaryotes by David White. Second Edition, Oxford University Press; 2000.



**PRINCIPLES OF GENETICS - (STPB-102)**

L	T	P
4	0	2

**Unit I:**

**Mendelian principles & Extensions:** Dominance, segregation, independent assortment. Co-dominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

**Unit II:**

**Concept of gene :** Gene Concept, Allele, Multiple alleles, Pseudoallele, Complementation tests, Benzer's work on rII locus in T4 phases.

**Unit III:**

**Gene mapping methods:** Linkage maps, Tetrad analysis, Three- Point Test cross, Cytological basis of crossing over, Interference and Coincidence, Crossing over and Chiasma formation, Factor affecting recombination frequencies, Mapping with molecular markers, Mapping by using somatic cell hybrids, Development of mapping population in plants.

**Unit IV:**

**Genetics of Sex Determination and Differentiation:** Sex-linked, Sex- limited and Sex- influenced traits in *Drosophila* and Human beings, Theories of Sex-determination- Chromosomal theory, environmental theory and genic balance theory, Sex- determination in dioeciously plants, Sex reversal and Gynandromorphs, Human sex anomalies (Klinefelter's Syndrome and Turner's Syndrome), brief idea of Dosage Compensation and Lyon's hypothesis.

**Unit V:**

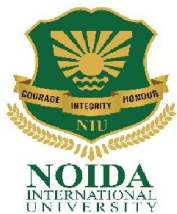
**Extra chromosomal inheritance:** Criteria for extra- chromosomal inheritance, Inheritance of Mitochondrial and chloroplast genes, plastid inheritance in *Mirabilis*, iojapa in corn, Kappa particles in *Paramecium*, Coiling in snails, male sterility in plants.

**Unit VI:**

**Biochemical Genetics:** Inborn errors of Metabolism in man, eye transplantation in *Drosophila*, Biochemical mutations in *Neurospora*, Biosynthetic pathways and Biochemical mutations. **Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. **Quantitative genetics:** Polygenic inheritance, Heritability and its measurements, QTL mapping.

**Suggested Readings:**

1. Gupta, P. K. (2009). GENETICS. *Rastogi Pub.*
2. Stickberger (2009). GENETICS.
3. Pierce, Benjamin A. (2002). Genetics: A Conceptual Approach.
4. Tamarin, Robert H. (2004). Principles of Genetics. VII Ed.



**DIVERSITY OF PROKARYOTES & EUKARYOTES - (STPB-103)**

L	T	P
4	0	2

**UNIT I:** Beginnings of Microbiology; Contributions of Lister, Koch and Pasteur; Microscopy-brief account of various types and their applications.

Methods in microbiology: Pure culture techniques, theory and practice of sterilization, Principles of microbial nutrition, culture media.

**UNIT- II**

Microbial Systematics and Taxonomy: Approaches to bacterial taxonomy, Classification including ribotyping; Ribosomal RNA sequencing, characteristics of primary domains; taxonomy, nomenclature and Bergey's manual (Introduction).

**UNIT- III:** Prokaryotic diversity: Bacteria: Purple and green bacteria, cyanobacteria, Mycobacteria, rickettsias, chlamydias and mycoplasmas. Archaea: Archaea as earliest life forms: halophiles, methanogens, hyperthermophilic archaea, thermoplasma. Eukarya: An introduction to protista, algae, fungi and slime molds.

**UNIT – IV:** Metabolic diversity among microorganisms: Pathways of glucose dissimilation in aerobic and anaerobic microbes, fermentation (alcoholic and acidic), nitrogen metabolism, nitrogen fixation.

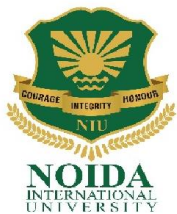
**UNIT – V:** Microflora of human (skin, oral cavity, gastrointestinal tract) entry of pathogens into the host, types of toxins (exo-, endo-) and their structure, mode of actions-infectious disease transmission; virulence and pathogenesis. Chemotherapy/antibiotics: antimicrobial agents, sulfa drugs, antibiotics: broad-spectrum antibiotics, mode of action.

**List of Practical- Microbial Diversity and Metabolism**

1. Preparation of liquid and solid media for growth of microorganisms.
2. Detailed study of different microscopes.
3. Isolation and maintenance of organisms by plating, streaking and serial dilution methods.
4. Isolation of microorganisms pure; cultures from soil
5. Isolation of microorganisms pure; cultures from water.
6. Isolation of microorganisms pure; cultures from air.
7. Growth, growth curve, measurement of bacterial population by turbidometry and serial dilution methods.
8. Effect of temperature on Microbial growth.
9. Effect of pH on Microbial growth.
10. Microscopic examination of bacteria, yeast and molds. a) Study of organisms by Gram stain b) Staining of bacterial spores.

**Reference Books:**

11. General microbiology (1999) by Roger Y Stanier (The Macmillan Press Ltd).
12. Biology of microorganisms (2008) by Michael T. Madigan, John M. Martinko, Paul V. Dunlap, Thomas D. Brock, David P. Clark (Pearson Benjamin Cummings).
13. Microbiology (1986) by Michael Joseph Pelczar, Eddie Chin Sun Chan, Noel R. Krieg (McGraw-Hill).
14. Microbiology: An introduction (2009) by Gerard J. Tortora, Berdell R. Funke, Christine L. Case (Benjamin/Cummings Publishing Company, Inc.).
15. A text book of microbiology (2006) by Dubey, R.C. and Maheshwari, D.K (S. Chand and Company, India).



**BACTERIOLOGY AND VIROLOGY – (STPM-104)**

L	T	P
4	0	2

**UNIT-I**

**Introduction to Bacteriology:** Introduction and history of bacteriology, Morphology and Ultra structure of bacteria: cell wall, L-form, cell wall synthesis, cell membranes- structure, composition and properties.

**Introduction to bacterial structure:** Capsule, flagella, Pili, gas vacuoles, chromosomes, magnetosomes, endospore, capsules and s-layers, cytoskeleton structure in bacteria, Reserve food materials in bacteria (PHB, Phosphate granules, oil droplets and sulphur inclusions) and bacterial chemo taxis.

**Bacterial taxonomy and nomenclature:** Concept of species and hierarchical taxa, DNA base homology, 16s rRNA and DNA hybridization. Outline of Bergy's system of bacterial classification. General features of Rickettsiae, Mycoplasma, and Actinomycetes.

**UNIT-II**

**Preservation and Maintenance of Bacteria:** Low temperature storage, mineral oil, cryopreservation, lyophilization, soil and glycerol stocks.

**Bacterial Genetics:** General account of prokaryotic genome and plasmid, Conjugation: F-factor, sex Pili, Hfr cells, mechanism and its role in development of multi drug resistance. Transduction: Lytic cycle, temperate phage, lysogenic cycles, mechanism of transduction, abortive transduction. Transformation and its mechanism.

**UNIT-III**

**History and development of Virology:** History of virology, general characteristics of Viruses, morphological variations, envelope, capsids and nucleic acids of viruses, replication and classification of viruses, viroids, prions.

**Isolation and preservation of Viruses:** Methods of isolation of Viruses, criteria for purification or purity of Viruses, preservation of viruses.

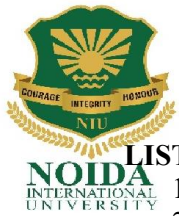
**Assay of Viruses:** Biophysical properties of viruses, plaque, pock method and direct count method, Haemagglutination.

**UNIT-IV**

**Bacteriophages:** Types, general properties of bacteriophage, detailed description of lambda phage, M13 phage and T phage. One step growth.

**Plant Viruses:** Structure, replication and transmission of viruses (Insects, amphids, air, innate). Viral diseases associated with wheat, tobacco and Okra, their symptoms, mode of infections and multiplication, control.

**Animal viruses:** Structure, replication and transmission of animal viruses, Introduction to viral diseases, Foot and mouth diseases, Rabies.

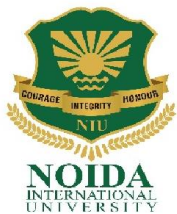


**LIST OF PRACTICAL:**

1. Introduction to GLP.
2. Media preparation and its sterilization.
3. To study the effect of temperature on the growth of bacteria.
4. To study the effect of pH on the growth of bacteria.
5. To study the effect of salt on the growth of bacteria.
6. To perform various Biochemical tests of bacteria (IMViC test)
7. To study the symptoms of viral infection in Plants.
8. To study the growth curve of bacteria (E.coli).

**References:**

1. Black, J.G. (2011) Microbiology: principle and exploration. 7<sup>th</sup> edition, Wiley publications.
2. Cann, A (2011) Principle of molecular Virology. Academic press London
3. Carter J Saunders V. (2007) Virology Principles and Applications. John Wiley and Sons.
4. Davis, B.D Delbecco. R. Eisen, H.N Ginsberg, H.S and Wood, W.B (2007) Microbiology, IInd edition. Vol. II. Harper and Row
5. Flint S.J; Enquist, L.W; Skalka, AMK (2004) Principles of Virology; molecular biology; pathogenesis and control, ASM press
6. Paniker, CJK (2013) A textbook of Microbiology, 9<sup>th</sup> edition, University Press
7. Stainer, R.Y, Ingraham, J.L, Wheelis, M.L, and Painter, P.R (2013). General Microbiology, MacMillan Press Ltd. UK



**CBCS\*\* BIOETHICS, BIOSAFETY & IPR - (STPB-104)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>2</b>	<b>0</b>	<b>0</b>

**Unit I**

Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding, biotechnology in international relations, globalization and development divide.

**Unit II**

Introduction to bioethics: Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.

**Unit III**

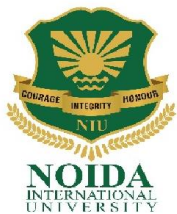
Biosafety: Definition of bio-safety, Biotechnology and bio-safety concerns at the level of individuals, institutions, society, region, country and world with special emphasis on Indian concerns. Biosafety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety. Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions (Indian context).

**Unit IV**

Introduction to IPR: IPR, forms of IPR and Intellectual property protection. Concept of property with respect to intellectual creativity, Tangible and Intangible property. WTO: agency controlling trade among nations, WTO with reference to biotechnological affairs, TRIPs. WIPO, EPO.

**BOOKS RECOMMENDED:**

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press. ISBN-1555811804,9781555811808.
2. Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219
3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
5. Intellectual Property Right- Wattal- Oxford Publicatiopn House.(1997) ISBN:0195905024



**TECHNICAL COMMUNICATION (TC-I)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>2</b>	<b>0</b>	<b>0</b>

**UNIT I**

Concept of Communication, What is Technical Communication? Features of Technical Communication, Process of Communication, Flow of Communication

Difference between general & Technical Writing, Difference between general & Technical Communication, Semantic & Organizational Barriers of Communication

**UNIT II**

Define Writing Skills, Importance and Objectives of Improving writing Skills, Importance of Drafting & Revision.

Resume Writing, Thesis Writing, Memos, Reports, Technical Vocabulary

Homophones, Difficult & Confusing Words

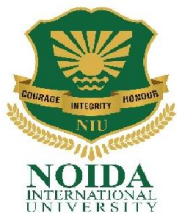
**UNIT III**

What is a Group Discussion? Discuss the importance of Group Discussion, Guidelines to an Effective Group Discussion and Parameters of a Group Discussion

Most Useful TIPS for cracking a Group Discussion, Role Of a leader in a Group Discussion\

**UNIT IV**

What are Employability Skills? Interpersonal Skills, What are Soft Skills & Hard Skills? Difference between Soft and Hard Skills, Soft Skills at Workplace, Net Etiquettes.



## **M.Sc Microbiology 1st Year SEMESTER-II**

### **BIOMOLECULES (STPB-201)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

#### **UNIT-I**

Chemical foundations of Biology – pH, pK, acids, bases, buffers, weak bonds and covalent bonds. Classification, structure, properties and biological significance of carbohydrates. Monosaccharides, Disaccharides, and Polysaccharides. Biological role of peptidoglycans, glycosaminoglycans and Lectins. Lipids - classification, structure and properties of fatty acids, triglycerides, phospholipids, sphingolipids and cholesterol.

#### **UNIT-II**

Amino acids - Classification, structure and physico-chemical properties. Chemical synthesis of peptides – solid phase peptide synthesis. Proteins - classification, purification and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Confirmation of proteins – Ramachandran plots. Denaturation of proteins. Hetero cyclic compounds – Heme and Chlorophylls.

#### **UNIT-III**

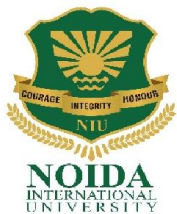
Structure and properties of purines, pyrimidines, nucleosides, and nucleotides. Covalent structure of DNA and different forms of DNA - A,B and Z. DNA super coiling. Types of RNA and covalent structure of t-RNA. Classification, structure and physiological roles of Vitamins.

#### **UNIT-IV**

Hormones- classification and mechanism of action of steroid and protein hormones. Signal transduction cascade by cyclic AMP, Phosphoinositate and calcium (Ca<sup>+</sup>), G-proteins, growth factors and membrane receptor tyrosine kinases. Phytohormones and their physiological roles.

#### **References:**

1. Principles of Biochemistry by A. L. Lehninger, Ed. (worth).
2. Biochemistry by L. Stryer 4 Ed. (Freeman-Toppan).
3. Text Book of Biochemistry by West et. al., (Mac Millan).
4. Principles of Biochemistry by Smith et. al., (Mc Graw Hill).
5. Harper's Biochemistry (Langeman).
6. Biochemistry by D.Voet and J.G.Voet (John weily).
7. Biochemistry by U. Satyanarayana (Books & Allied (P) Ltd).



**MOLECULAR BIOLOGY (STPB-202)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

**UNIT – I**

Organization of genetic material - Packing of DNA in to chromatin - protein components of chromatin, histones, nucleosome organization. Solenoids loops, domains & scaffolds. Gene amplification, polytene chromosomes. DNA replication – apparatus, enzymes involved and mechanism. Replication at telomeres. DNA damage and repair mechanism. Nuclear genome.C - value paradox. Mitochondrial & plastid genomes and genes. Fine structure of the eukaryotic gene. Split genes. Different kinds of genes: overlapping, assembled, polyprotein & nested genes.

**UNIT – II**

Transcription in prokaryotes and eukaryotes. Mechanism of transcription, enzymes and transcription factors, zinc finger, leucine zipper mechanism. Maturation and processing of mRNA, splicing, 5' end capping & 3' end tailing. RNA editing and transport. RNAi and small RNAs.

**UNIT – III**

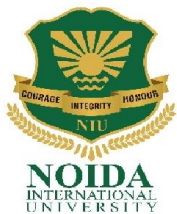
Translation in prokaryotes and eukaryotes: Genetic code - properties of the genetic code, deciphering of the genetic code. Ribosome as a translation factory. t - RNA as an adaptor, its mode of function. Post translational modifications. Leader sequences & protein targeting.

**UNIT – IV**

Regulation of gene expression in prokaryotes - The operon concept, lac & tryp operons. Transcriptional control. Post translational control. Regulation in eukaryotes - Control by promoter, enhancer and silencers. Cis-trans elements. Environmental & developmental regulation. DNA methylation & gene expression. Chromatin structure & gene expression.

**BOOKS RECOMMENDED:**

1. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan)
2. Genes VIII by B.Lewin (Oxford)
3. Cell and Molecular Biology by E,D.P.DeRoberties (International edition)
4. Molecular Biology by David Frefielder.
5. DNA Science by Carolina Publishing Company.
6. Molecular Biology of the Gene by J.D.Watson et. al.,(Benjamin).
7. RNAi-Design and application by Basic (Springer).
8. Small RNAs-Analysis and Regulatory functions by Nellen (Springer).



**IMMUNOTECHNOLOGY (STPB-203)**

L	T	P
4	0	2

**Unit I:**

**Introduction:**History and scope of immunology; types of immunity; anatomy of lymphoid organs- primary and secondary lymphoid organs; immunoglobulin structure- function and synthesis; memory cells, idiotypic network, lymphocyte differentiation.

**Unit II:**

**Biology of complement systems:**Structure and function of MHC class I and II molecules; antigen recognition and presentation; humoral and Cell mediated immune responses; hypersensitivity reaction; immune suppression and immune tolerance; auto immune disorders.

**Unit III:**

**Antigen & Antibodies:**Antigen- isolation, purification and characterization of various antigens and haptens; antibodies- production, purification and quantification of immunoglobulins; antigen - antibody reaction; hybridoma and monoclonal antibody production; immuno-diagnosis and applications; human monoclonal antibodies; catalytical antibodies; complement fixation; assessment of immune complexes in tissues.

**Unit IV:**

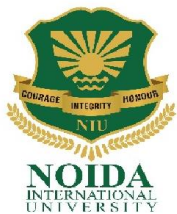
**Immunotechnology:**Purification of mononuclear cells from peripheral blood; isolation and characterization of T cells subsets; B cells and macrophages; fluorescent activated cell sorter; mitogen and antigen induced lympho-proliferation assay; cell mediated lympholysis; mixed lymphocyte reaction; assessment of delayed hypersensitivity reactions; macrophage cultures; assay of macrophage activation;isolation of dendritic cells; In situ and In vivo characterization of cells from tissues; generation of T cell clones; HLA typing.

**Unit V:**

**Vaccine Technology:** Biology and assay of cytokines; Vaccine technology including DNA vaccines - identification of T and B epitopes for vaccine development. immunodiagnosis of Infectious diseases; immuno screening of recombinant library.

**Suggested Readings:**

1. Immunology, Richard A. Goldsby, Thomas J. Kindt. Barbara, A. Osborne, Janis Kuby 5th Edition, 2003. W. H. Freeman & Company.
2. Immunology, L.M. Roitt, J. Brestoff and D.K. Male, 1996.
3. Immunology, V Edition - Richard A.Goldsby, Thomas. J. Kindt, A. Osborne, JanisKuby, 2003. W.H. Freeman and company.
4. Immuno-biology, JanewayCA and Paul Travers 1994.
5. Immunological techniques, D.M. Weir, 1992.
6. Immunology, I.Roitt, 1960
7. Current Protocols in Immunology 3 Volumes, Wiley Publications 1994.
8. Monoclonal Antibodies: Principles and Practice, J. W. Goding, 1983. Academic Press
9. Hybridoma Technology in the Biosciences and medicine, T.A. Springer, 1985. Plenum PressNY.
10. Vaccines, New Approaches to immunization, F.Brown, R.M.Chanock, KA Lerner, 1986. Cold spring Harborolab.
11. Topley and Wilson principles of bacteriology, Virology and immunology, G. Wilson, A.Miles, M.T.Paker, 1984. Arnold, Heineman.
12. Basic and Clinical Immunology, D.P. Stities and J.D. Stobo.



**BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS (STPB-204)**

L	T	P
4	0	2

**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.

**UNIT-II**

Introduction to Bioinformatics – Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB. Database searching using BLAST and FASTA.

**UNIT-III**

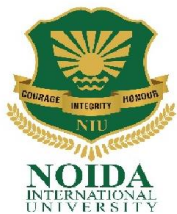
Multiple sequence alignment and Dynamic programming. Gene and Genome annotation – Tools used. Physical map of genomes. Molecular phylogeny - Concept methods of tree construction. Protein secondary structure prediction. Protein 3D structure prediction. Protein docking. Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery.

**UNIT-IV**

Brief description and tabulation of data and its graphical representation. Measures of central tendency and dispersion - mean, median, mode, range, standard deviation, variance. Simple linear regression and correlation. Types of errors and level of significance. Tests of significance – F & t tests, chi-square tests, ANOVA.

**BOOKS RECOMMENDED:**

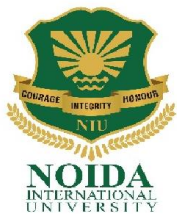
1. Bioinformatics – D.Mount
2. Programming in C by Balaguru Swamy.
3. Introduction to Bioinformatics by Arthur M.Lesk, Oxford.
4. Biostatistics – Daniel. (Wiley).
5. Statistics by S.C.Gupta.
6. Statistical Methods by G.W.Snedecor&W.G.Cochran.
7. Fundamentals of Biostatistics – Khan & Khanum.
8. Let us C – Kanetkar.
9. Fundamentals of Biostatistics by U.B.Rastogi (Ame Books Ltd).



**“SEMINAR” (STPM-205)  
RECENT DEVELOPMENT IN MICROBIOLOGY**

<b>L</b>	<b>T</b>	<b>P</b>
<b>2</b>	<b>0</b>	<b>0</b>

Every student, who has been enrolled in M.Sc. (Microbiology) course, shall have to deliver a Seminar on a Recent Topic related to Recent and Applied Developments in Microbiology. 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.



**M.Sc Microbiology 2<sup>nd</sup> Year  
SEMESTER-III**

**BIOPROCESS TECHNOLOGY (STPM-301)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

**Unit 1:**

Isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, product decomposition, effect of environmental conditions. Bioreactors; Media for industrial fermentation, types of fermentation processes; Analysis of batch, Fed-batch and continuous bioreactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.).

**Unit 2:**

Measurement and control of bioprocess parameters, basic principles of feedback control, proportional, integral and derivative control; Downstream Processing: introduction, removal of microbial cells and solid matter, foam preparation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

**Unit 3:**

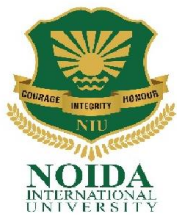
Enzyme and cell immobilization and their industrial applications; Use of microbes in mineral beneficiation and oil recovery; Industrial production of chemicals: Alcohol (ethanol), acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline), amino acids (lysine, glutamic acid). Effluent treatment: DOC and COD treatment and disposal of effluents.

**Unit 4:**

Introduction to Food Technology- elementary idea of canning and packing, sterilization and Pasteurization, technology of typical Food/Food products (bread, cheese, idli), food preservation, fermented foods and probiotics.

**Suggested Readings:**

1. Stanburry P.P. and Whitaker, A. 1984. Principles of Fermentation Technology. Pergamon Press, OxfordUK.
2. Steinkraus, K.H. 1983. Handbook of Indigenous Fermented Foods. Marcel Dekker, New York.
3. Casida, J.E., 1968. Industrial Microbiology, Wiley Eastern Publication
4. Cruegar, W. and Cregar, A., 1989. Biotechnology: A text book of industrial Microbiology, 2nd edition. Panima Publishing corporation, New Delhi.
5. Patel. A.H. 1966. Industrial Microbiology, Mac Millan India Ltd.
6. Stanbury, A.H., A. Whittaker and Hall S.J. 1995. Principles of fermentation technology 2nd edition, Pergamon Press.
7. Lehninger, Nelson, D. L. and Cox, M. M 2000. Principle of Biochemistry, Worth Publishers.
8. StryerI. 2000. Biochemistry, , H.Freeman and Company.



**INDUSTRIAL AND FOOD MICROBIOLOGY (STPM-302)**

L	T	P
4	0	2

**Unit-I:**

Introduction to industrial microbiology: Sources of industrially important microbes, strain development, types of fermentation and fermenters, process optimization, and recent developments in fermentation technology.

Downstream processing of microbial products: Filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane processes, drying (lyophilization and spray drying), and crystallization

**Unit-II:**

Fermentation economics: Basic objective for successful economically viable fermentation process, cost break down for well established fermentation processes, market potential of the products, cost aspects of various stages in the processes development including effluent treatment

Production aspects: Microbial strains, substrates, strain improvement, flow diagrams, product optimization, and applications of industrial alcohol (ethanol and butanol), amino acids (lysine, phenylalanine, tryptophan), antibiotics (cephalosporins, tetracyclines, polyenes), enzymes and immobilized enzymes, SCP, microbial polyesters, biosurfactants, and recombinant products (insulin, somatostatin, thaumatin).

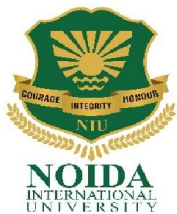
**Unit-III:**

Microbiology of foods: Vegetables, fruits, milk, fermented and non-fermented milk products, fresh meats, poultry and non-dairy fermented foods.

Microbial spoilage of foods Food preservation: Chemical, physical and biological methods. Fermentation processes: Production of milk and milk products, plant based products, fish products, meat products and food beverages. Food-borne diseases

**Reference book:**

1. Biotechnology: A Text Book of Industrial Microbiology by W. Crueger & A. Crueger, Panima Publishing Corporation, New Delhi/Bangalore, 2000.
2. Principles of Fermentation Technology by P.F. Stanbury, W. Whitaker & S.J. Hall, Aditya Books (P) Ltd., New Delhi, 1997.
3. Modern Industrial Microbiology & Biotechnology by N. Okafer, Scientific Publishers, Enfield, USA., 2007.
4. Fermentation Microbiology and Biotechnology by El Mansi & Bryce, Taylor & Francis, London, Philadelphia, 1999.
5. Fermentation Biotechnology by O.P. Ward, Open University Press, Milton Keynes, U.K., 1989 6. Industrial Microbiology: An Introduction by Waites, Morgan, Rockey & Highton, Blackwell Science, 2001.



## GENETIC ENGINEERING (STPM-303)

L	T	P
4	0	2

### Unit I:

**Genetic Engineering:** Definition and explanation, scope of GE, Concept and importance of GE, RDT in prokaryotes and eukaryotes, Restriction enzymes, modifying enzymes, Isoschizomers and cloning into mutagenesis, DNA Fingerprinting.

### Unit II:

**Vectors used in Genetic engineering:** Plasmid, Phage, M13, Phagemid, BAC, YAC, Expression vectors, Use of Promoters, Expression through Strong and Regulatable Promoters, Binary and Shuttle Vectors.

### Unit III:

**Libraries and molecular probes:** Construction and Screening of genomic and cDNA libraries, BAC libraries and assembly of BACs into contigs, Molecular probes and their preparation, labeling and applications, Southern, Northern, Western blotting, Chromosome walking, Chromosome jumping.

### Unit IV:

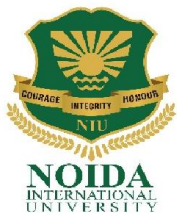
**Polymerase Chain Reaction:** Basic principles and its modifications, designing of primers, Different schemes of PCR, application of PCR, RACEs, Electronic PCR (e-PCR), RT- PCR, Real- Time PCR.

### Unit V:

**Gene Sequencing:** Different methods of gene isolation, techniques for sequencing (Maxam & Gilbert degradation method, Sanger's Dideoxy method), Organo-chemical gene synthesis mechanism, cDNA using reverse transcriptase.

### Suggested Readings:

1. Molecular Cloning: a Laboratory Manual, J Sambrook, E F Fritsch and T Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. Principles of Gene manipulation(1994) Old R.N. and Primrose S.B.
3. From Genes to Clones (1987) Winnaeker E.L.
4. Recombinant DNA (1992) Watson J.D., Witreowski J., Gilman M. and Zooller M.
5. An Introduction to Genetic Engineering: Nicholl, D.S.T.
6. Molecular Biotechnology (1996) Pasternak
7. The Biochemistry of Nucleic acid(1996)Adam et al
8. 7. Genetic Engineering (1998)Janke k. swtlow



**PARASITOLOGY (STPM-304)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>0</b>	<b>2</b>

**Unit I: Introduction:** Basic concept of Parasitology, Parasites, Classification of Parasites, Host, Types of host, Relationships between host and parasites

**Unit II: Protozoa:** (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment)

Entamoeba,  
Giardia,  
Plasmodium,  
Leishmania,  
Trypanosoma

**Unit III: Platyhelminthes:** (Introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment)

Taenia,  
Echinococcus

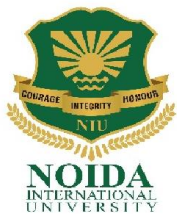
**Unit IV: Nematelminthes:** (introduction, A-etiology, pathogenicity, life cycle, lab diagnosis and treatment)

Ascaris,  
Ancylostoma,  
Necator,  
Enterobius,  
Wuchereria

**Unit V: Lab Diagnosis:** Different specimens of parasitology, Collection & transportation. Processing of parasitological specimens

**SUGGESTED READINGS**

1. 'Textbook of Microbiology' by CP Baveja , 2nd edition, Arya longman Pvt. ltd
2. 'Medical parasitology' by Arora & Arora, 3th edition, CBS publishers & Distributors Pvt. Ltd.
3. 'text book of Medical Laboratory' by Satish Gupta, Edition - latest, J.P. Bros, New Delhi – 1998
4. 'Medical parasitology' by Chatarjee , 3th edition
5. 'Textbook of Medical Lab Technology' by Praful Godkar, Edition latest,
6. 'Medical Microbiology and Immunology' by Warren Levinson, eighth Edition, Lange Medical books/ McGraw-Hill Publication.



**CBCS\*\* GENOMICS AND PROTEOMICS (STPB-305A)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>2</b>	<b>0</b>	<b>0</b>

**Unit 1:**

**Origin and Evolution of genomics:** Origin of genomics, the first DNA genomes, SCOT and microsatellite, DNA based phylogenetic trees, genomes and human evolution, evolution of nuclear and organelle (mitochondrial and Chloroplast genome), Anticipated Benefits of Genome Research

**Unit 2:**

**Annotation of whole genome sequence and functional genomics:** Whole genome shotgun sequencing, *In silico* methods, insertion mutagenesis (T-DNA and transport insertion), gene expression and transcript profiling, EST contigs and unigene sets, use of DNA chips and microarrays.

**Unit 3:**

**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 4:**

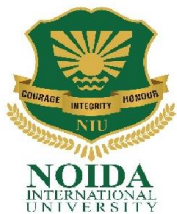
**Proteomics:** Introduction, definition concepts and approaches of proteomics studies and activities. Introduction proteome analysis tool and technique: Separation technique- 2DPAGE, image analysis, Mass-spectrophotometry.

**Unit 5:**

**Protein interaction and Protein complex:** Protein interaction, DNA- Protein interaction, Drug Discovery and Development

**Suggested Readings:**

1. Discovering Genomics, Proteomics and Bioinformatics: A. M. Campbell and L. J. Heyer.
2. High Throughput Techniques in Post Genomic Era: R. S. Dassanayake and Y. I. N. Silva Gunaverdena.
3. Genomes: T.A. Brown.



**CBCS\*\* BIOINFORMATICS (STPB-305B)**

L	T	P
2	0	0

**Unit1:**

**Introduction to computers and bioinformatics-** Types of operating systems, concepts of networking and remote login, basic fundamentals of working with unix.

**Unit2:**

**Biological databases-** Overview, modes of database search , mode of data storage (Flat file format, db-tables), flatfile formats of GenBank, EMBL, DDBJ, PDB.

**Unit3:**

**Sequence alignment** –Concept of local and global sequence alignment, Pairwise sequence alignment, scoring an alignment, substitution matrices, multiple sequence alignment. **Phylogenetic analysis-** Basic concepts of phylogenetic analysis, rooted/uprooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbour joining, Maximum parsimony, Maximum likelihood).

**Unit4:**

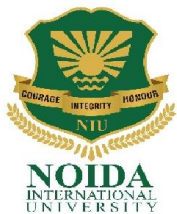
**Generation and analysis of high throughput sequence data-** Assembly pipeline for clustering of HTGS data, format of “.ace” file, quality assessment of genomic assemblies, International norms for sequence data quality, Clustering of EST sequences, concept of Unigene.

**Unit5:**

**Annotation procedures for high through-put sequence data-** Identification of various genomic elements (protein coding genes, repeat elements, strategies for annotation of whole genome, functional annotation of EST clusters, gene ontology (GO) consortium.

**STUDY MATERIALS:**

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Baxevanis A.D. and Ouellette, Third Edition. John Wiley and Son Inc., 2005.
2. Bioinformatics Sequence and Genome Analysis by Mount D.W., CSHL Press, 2004.
3. Introduction to Bioinformatics by Tramontano A., Chapman & Hall/CRC, 2007.
4. Understanding Bioinformatics by Zvelebil, M. and Baum, Chapman & Hall/CRC, 2008.



**M.Sc Microbiology 2<sup>nd</sup> Year  
SEMESTER-IV**

**ENVIRONMENTAL MICROBIOLOGY (STPB-401)**

L	T	P
4	0	0

**Unit 1:** Microorganisms and their Habitats: Structure and function of ecosystems; Terrestrial Environment: Soil profile and soil microflora; Aquatic Environment: Microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersal of microbes; Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter

**Unit 2** Microbial Interactions: Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation, Microbe-Plant interaction: Symbiotic and non symbiotic interactions Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

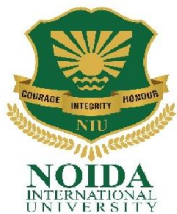
**Unit 3** Biogeochemical Cycling: Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction, Phosphorus cycle: Phosphate immobilization and solubilisation, Sulphur cycle: Microbes involved in sulphur cycle, Other elemental cycles: Iron and manganese

**Unit 4** Waste Management: Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill), Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary, sewage treatment

**Unit 5** Microbial Bioremediation: Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.

**References:**

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press



**CLINICAL RESEARCH AND ENTREPRENEURSHIP (STPB-402)**

<b>L</b>	<b>T</b>	<b>P</b>
<b>2</b>	<b>0</b>	<b>0</b>

**Unit 1:**

**Clinical Research:** Basic conventional drug design approaches, Drug development process (Preclinical, clinical and toxicological studies). Past, Present and future Importance, Mile stones of regulations. FDA, US, Indian clinical research, global scenario of clinical research, Regulatory agency. Designing clinical trials- History, principles, scheme for conducting clinical trials, planning defining, objectives, variables, study populations, testable hypothesis.

**Unit 2:**

**Ethical Issues in clinical research-** Introduction, codes, declaration and guidelines, informed consent, special issues, Roles and responsibilities of IRBS, issues with ethics review

**Unit 3:**

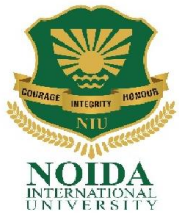
**Introduction of Entrepreneurship:** definition, history and scope of Biotechnology Entrepreneurship.  
**Biotechnology Marketing & Companies:** Biotechnology in capital market; Initial Public Offering (IPO) in the capital market; examples of success and failure of biotechnology companies and the possible reasons.  
**Patenting, licensing and partnership in biotechnology industry:** Patents on biological inventions, licensing revenue, selection of right partner; negotiations of the terms of the deal.

**Unit 4:**

**Entrepreneurship Skills:** Entrepreneurship Skills of bio-entrepreneur, bio-entrepreneurial training; research experience, creativity, communication skills and other attributes; participation in conferences, training and educational courses; institutes offering entrepreneurship courses.

**References:**

1. Research in Education- John V. Best, John V. Kahn 7th edition
2. Presentation skills - Michael Hallon- Indian Society for Institute education
3. Practical Introduction of copyright.- Gavin Mcfarlane
4. Thesis projects in Science & Engineering – Richard M. Davi
5. Biotech Entrepreneur-to-Entrepreneur: <http://www.bioe2e.org>
6. Startup junkies <http://www.startupjunkies.org/research.html>
7. Biopreneur serves as a focal point for bringing together scientists,
8. Businesspeople and investors [http://www.biopreneur.org/biotech-](http://www.biopreneur.org/biotech-investment.htm)
9. [investment.htm](http://www.biopreneur.org/biotech-investment.htm)
10. Bio Entrepreneur guide :
11. <http://www.bioenterprise.com/assets/entrepreneurguide.pdf>



**PROJECT (STPB-403)**

Every student will be required to undertake a research project based on any of the areas of Microbiology. The research project should have applied significance. The project report will be submitted in the form of dissertation duly certified by the supervisor of the Department of Microbiology or at national institutes and Universities in India, by seeking the placement. The project will be presented for evaluation at the end of semester by external experiments.