"Dissemination of Education for Knowledge, Science and Culture" -Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's Vivekanand College, Kolhapur (Empowered Autonomous)



DEPARTMENT OF MICROBIOLOGY

M. Sc. Part-I

Semester I and II

SYLLABUS

As per NEP 2020

Academic Year 2024-25



VIVEKANAND COLLEGE, KOLHAPUR (EMPOWERED AUTONOMOUS)

PG DEPARTMENT OF MICROBIOLOGY Syllabus for the Master of Science in Microbiology

M. Sc. I (Semester I & II) (National Education Policy 2020) Applicable From Academic Year: 2024 – 2025

- 1. Title: M. Sc. Microbiology, Vivekanand College, Kolhapur (Empowered Autonomous)
- 2. Faculty: Faculty of Science and Technology.
- **3.** Year of Implementation: For M. Sc. I (Semester I and Semester II): From July 2024.
- 4. **Programme Outcomes (POs):** After completing the M. Sc. Programme, the students will be able to:

PO1: Demonstrate and apply the fundamental knowledge of the basic principles of sciences in various fields.

PO2: Create awareness and a sense of responsibility towards the environment

and society to solve the issues related to environmental pollution.

PO3: Apply their professional, social, and personal knowledge.

PO3: Competent to pursue research or pursue a career in the subject.

PO4: Apply knowledge to build up small-scale industries for developing endogenous products.

PO5: Communicate scientific information in a clear and concise manner both orally and in writing.

PO6: Inculcate logical thinking to address a problem and become result oriented with a positive attitude.



Programme Specific Outcomes

- To acquaint the students with the basic as well as advanced concepts in Microbiology.
- To make aware the students about the importance of the subject in daily life.
- 3) To improve the laboratory skills of the students.
- To prepare students for further studies helping in their bright career in the subject
- 5) To make students knowledgeable with industrial processes
- To encourage the students to think the application of the subject studies for progression of mankind.



Departmental Teaching and Evaluation Scheme

2024-25 Microbiology M. Sc. I Semester I & II

Sr. No.	Course	Course code	Course Name	Tea Sch Hours	Teaching Scheme Hours/week		Examination Scheme and Co Marks Cr		Course Credit				
	ADDI.		TH	PR	ESE	CIE	PR	Marks	3				
			Semest	er-I						in the			
1	DSC-I	DSC20MIC11	Genetics and Molecular Biology	4		80	20	•	100	4			
2	DSC-II	DSC20MIC12	Immunology	4		80	20	-	100	4			
		DSE20MIC11	Taxonomy and Microbial Diversity		4 _ 80 20 -	- 80 20 -			100	4			
3	DSE-I	DSE20MIC12	Virology	4			100						
		DSE20MIC13	Biomolecules			_	_						
4	RMD	RMD20MIC11	Research Methodology	4	-	80	20	-	100	4			
5	DSC-PR-I	DSC20MIC19	Microbiology Lab-I	-	12	-	-	150	150	6			
		Semester-I 7	Total	16	12	320	80	150	550	22			
		1.8	Semeste	r-II	ar ar		153	See.					
1	DSC-III	DSC20MIC21	Techniques in Microbiology	4	-	80	20		100	4			
2	DSC-IV	DSC20MIC22	Microbial Physiology, Biochemistry and Metabolism	4	•	80	20		100	4			
		DSE20MIC21	Medical Microbiology						Marks Image: marks				
3	DSE-II	DSE20MIC22	Microbial Ecology	4		80	20	-		4			
		DSE20MIC23	Microbial Biotechnology										
4	DSC-PR-II	DSC20MIC29	Microbiology Lab-II	-	12	-		150	150	6			
5		FPR20MIC21	Field Project	_	1	4	4	4		-		100	4
5	FPR/OJT-I	OJT20MIC21	On Job Training		, i								
¥7.		Semester-II T	otal	12	16	240	60	150	550	22			
		Total (Semester	I & II)	28	28	560	140	300	1100	44			



	Mandatory		
Paper I	GENETICS AND MOLECULAR BIOLOGY Theory: 60 Hours (Credits -4)	Lecture/ Teaching hours	Credits
	Expected course outcome -		
	Upon successful completion of course, students are expected to		
	be able to -		
	 Know the mechanism of DNA replication in prokaryotes 		
	and eukaryotes		
	 Understand the concept of unique and repetitive DNA sequences 		
	Explain the modes of cell division with respect to mitosis		
	and meiosis		· .
	Know basic and advanced techniques used in molecular		
	genetics		
Module 1	 Origin of life- aspects of prebiotic environment, evolution of the pre-cell. Organic evolution: concepts and theories, mechanisms of speciation, genetic basis of evolution - Hardy-Weinberg genetic equilibrium, evolutionary clock. Molecular basis- genetic polymorphism and selection, coincidental and concerted molecular basis, gene duplication, sequence divergence, recombination and crossover fixation, pseudo-genes as dead ends of evolution Evidences for nucleic acids as genetic material. Organization of eukaryotic genetic material: Operon, Unique and repetitive DNA, Interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin and euchromatin. Polytene and Lampbrush chromosomes 	15 TD NE 564 Autonomotiv	01
Module 2	 Principles of Mendelian inheritance: linkage and gene mapping -Tetrad analysis, split and overlapping genes. 	15	01

M. Sc. Microbiology Part - I: Semester - I

	2. Law of DNA constancy and redundancy, C-value paradox,		
	Cot curves and DNA re-association constant, dosage		
	compensation, genetic load.		
	3. Molecular basis of mitosis and meiosis		
	4. Replication of DNA and duplication of chromosomes -		
	modes and molecular mechanisms of DNA replication in		
	prokaryotes (bacteria)and eukaryotes (nuclear and		
	mitochondrial) Co-transcriptional and post-transcriptional		
	processing of RNA, structure and stability of mRNA		
Module 3	1. Translation in eukaryotes - machinery, initiation,	15	01
	elongation, termination and release, post translational		÷1
	processing.		
	2. Localization of proteins in cell - mechanisms of		
	transport to nucleus, mitochondria, chloroplasts and		
	outside the cell		
	3. Molecular mechanism of homologous recombination		
	bacteria and other organisms- RecBCD and Ruv		
	systems, Holliday junction, interallelic, specialized		
	and site-specific recombination; Gene targeting		
	4. Restriction and modification of DNA - enzymes,	1.0	
	molecular, mechanisms and significance.		18
Module 4	1. Teratogenesis- chromosome aberrations, genetic disorders;	15	01
8	Genetic counseling.		
	2. Cancer and oncogenesis:		
	Transforming viruses, environmental factors causing cancer		
	carcinogens Molecular mechanism and sequence of changes		
	leading to oncogenesis - mutations, activation of proto-	COLLEG	~
	oncogenes, loss of function of tumour suppressor (anti-cancer)	Junio Como	+OLE
	genes, role of apoptosis and telomere shortens in cancer.	JUNE	RUSK
	3. Techniques in molecular genetics: Basic techniques - PCR,	1964) in
	LCR, Nick translation, Blotting techniques - Southern,	300word AN	tomon
	Northern and Southwestern blotting, colony hybridization		
	Applications - Chromosome walking, DNA foot printing and		
	16srRNAsequence analysis		
	4. Transfection - Protoplast fusion, electroporation		

	Functioning of immune system State State State		
aper II	IMMUNOLOGY Theory : 60 Hours (Credits -4) On completion of course , student learn about -	Lecture/ Teaching hours	Credits
	Champness, ASM Press, Washington		
	17. Molecular Genetics of Bacteria by L. Snyder and W.		
	16. An Introduction to Genetic Analysis Freeman1993		
	Sambrook, E. F. Fritsch and T. Maniatis		
	15. Molecular Cloning A Laboratory Manual, Vol.1,2,3 by J.		
	Wilson and J. Walker, Cambridge University Press		
	14. Principles and Techniques of Practical Biochemistry by K.		
	Prakash, JPR Publications		
	13. Principles of Genetics and Genetic Engineering by E. John Jothi		
	Publishers		
	12. Molecular Biology by P. C. Turner and others, Bioscientific		
	Rapley, Panima Publishing Corp. New Delhi		
	11. Molecular Biology and Biotechnology by I. M. Walker and R.		
	10 Genetic Engineering by S. Mitra, Macmillan India		
	9 Constics by S. Mitra, Macmillan India		
	8. Molecular Biology of the Gene by J. D. Watson and others,		
	Publishers		
	7. Genes – VI, VII, VIII and IX by B. Lewin, Jones and Bartlett		
	6. Microbial Genetics by D. Freifelder, J. Wiley and Sons		
	5. Genetics by Strickberger		
	4. Organic Evolution by R. S. Lulla, Seema Publications		
	3. Organic Evolution by N. Arumugam		
	Chand and Co., New Delhi		
	2. Concept of Evolution by P. S. Verma and V. K. Agarwal, S.		
	Publishing, NY.		
	1. Molecular Biology of the Cell by Alberts and others, Garland		
	REFERENCE BOOKS		

	 Regulatory mechanisms of immune system 		2
	 Cancer immunology and treatment and prevention 		
	of cancer		
	 Various serodiagnostic techniques of diseases. 		
Module1	1. MHC complex: structure, function, MHC polymorphism,	15	01
	assembly and presentation of peptide MHC complex.		
	2. Signal transduction: Ras dependent and Jak/Stat pathway,		
	signal transduction by IL-1, IL-2 and T-cell antigen receptors		
	3. T-cell sensitization: TCR signaling by CD 45 and CD 28,		
	Interaction of T-cells with APCs.		
Module 2	1. Complement System: Regulation of complement pathways,	15	01
	complement deficiency disorders		
	2. Genetics of antibody synthesis: Types of genes, location and		
	positions of genes, genes for constant region, genes for		
	variable region of immunoglobulin		
	3. Antibody diversity: Introduction, Mechanism		
	4. Vaccines- DNA vaccines, edible vaccines, synthetic		
	peptide subunit vaccines, conjugate vaccines, recombinant		
	vector vaccine, anti-idiotypic vaccine		
Module 3	1. Transplantation immunology: Immunological basis of graft	15	01
	rejection, clinical manifestation, immunosuppressive therapy,		
	Kidney transplantation - ABO testing, pathology of graft		
	rejection		
	2. Tumor immunology: Development of tumors, Antigen of		
	tumor cells, immunological mechanisms against tumor cells,		
	escaping of tumor cell from immune response, immune		
	surveillance, immunocompromise and cancer, congenital		
	immunodeficiency and neoplasia, cancer in organ transplant		
	recipients and auto immune disorders, HIV and cancer,		
	Immunotherapy and immunoprophylaxis of human cancer.		
Module 4	1. Serodiagnosis of diseases: Approaches for serodiagnosis,	15	01
	detection of antigen or antibody, diagnostic titer, ASO, Cold		
	hemagglutination test, Weil-Felix test, Paul- Bunnel test.	NO COLLEGE	
	2. Immunochemical techniques and their applications:	ESTO	PE
	ELISA, RA test, FAT, Western blot, Technique,	IL-NIE	PUR
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Im	munoelectrophoresis (IEP), Immunodiffusion, Fluorescence
Ac	tivated Cell Sorters.
3. PC	CR based diagnostic tests
REFEI 1. B	RENCE BOOKS asic and clinical Immunology by Stites Daniel P., Stobo John
D	., Frudenberg H. H., Wells J. V
2. B	iotechnology Application and Research by P. N.
C	heremisinoff and R. P. Ouellette
3. E	ssential Immunology by Roitt Ivan M.
4. F	undamentals of Immunology 2nd ed. by Myrrik Quentin N.
aı	nd Weiser Russell S.
5. In	nmunobiotechnology by Mahadev Sharma and Nirmal
Ti	ripathi
6. In	nmunology by I Kannan
7. In	nmunology 3rd ed. by Roitt I. M., Brostoff J., Male D.K.
8. In	nmunology 5th ed. by R. A. Goldsby, T. J. Kindt, B. A.
0	sborne, J. Kuby
9. In	nmunology II by Bellanti Joseph A
10. N	Iedical Immunology 9th ed. by Daniel P. Stites, Abba I Terr,
Т	ristram G. Parslow
11. M	fedical Microbiology by Cruickshank Robert, Duguid J. P.,
N	Iarmion B. P., Swain R.H.
12. M	Iedical Microbiology by Irving William and others
13. M	ledical Microbiology 13th Edition by Jawetz Ernest, Melnick
Jo	seph L, Adelberg E.A.
14. M	edical Microbiology 6th Edition by Gupte Satish, Jaypee
Ві	others
15. M	edical Microbiology S Rajan MJP Publishers.
16. Pr	inciples and techniques in Practical Biochemistry by K.
W	ilson and J. M. Walker
17. Te	ext book of Microbiology by Vasanthakumari R.
18. Th	ne text book of Microbiology by Dubey R. C., Maheshwari
D.	K.
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	Taxonomy and Microbial Diversity	Lectures/ Teaching	Credits
	Theory: 60 Hours (Credits - 4)	hours	
	Expected course outcome -		
	Upon successful completion of course, students are expected to be able to -		
	 Understand the diversity of microorganisms 		
	 Know the concept of classification of microorganisms 		
	 Understand various characteristics of different types of microorganisms 		
	 Understand how to classify newly discovered organism 		01
Module 1	1. General characteristics and outline classification of Archaea	15	01
	2. General characteristics of Methanogenic, Extremely		
	Halophilic and Extremely thermophilic Archaeobacteria		
	3. General characteristics and outline classification of		
	Actinomycetes		
	4. Space biodiversity		
	Introduction		
	Aims and common goals		
	Life detection methods		
Module 2	1. Fungi: General characteristics and outline classification of	15	01
	fungi, Morphology of some common fungi - Mucor, Rhizopus,		
	Aspergillus, Penicillium and Fusarium		
	2. Yeasts: General characteristics and outline classification of		
	yeasts		
	3. General characteristics of Lichens and Mycorrhiza		
Module 3	1. Anoxygenic photosynthetic bacteria: general	15	01
	characteristics of purple bacteria and green bacteria		
	2. Oxygenic photosynthetic bacteria: General characteristics		
	of Cyanobacteria - external and internal features,		
	physiology and Ecology		
	3. Magnetotactic bacteria- General characteristics,		
	Magnetosomes, Enrichment and isolation of mocou	EGEN	
	Magnetotactic bacteria.	0 EE	
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Module 4	1. Bergey's Manual System of bacterial classification Brief history	15	01
	of the Bergey's Manual, Prokaryotic Domains		
	2. Classification of Prokaryotic organisms- Concept of bacterial,		
	Speciation, Bacterial nomenclature		
	3. Modern trends in Prokaryote taxonomy Polyphasic taxonomy-		
	Types of information used, polyphasic strategy, polyphasic		
	taxonomy in practice, Phylogenetic basis- Reconstruction and		
	interpretation of phylogenetic trees		
	REFERENCE BOOKS		
	1. Introductory Mycology by C. J. Alexopoulus (7th ed) Wiley		
	Eastern Pvt. Ltd., New Delhi.		
	2. Bergey's Manual of Systemic Bacteriology (2nd ed) Springer,		
	3 Basic Bacteriology (2nd ad) by C. Lamanna and E. Mallatta The		
	William and Wilking Company, Calcutta		
	4 Fundamental Principles of Bacteriology (3rd ed) by A. J. Salle		
	TMH Publishing Company, New Delhi		
	5. The Yeasts by A. H. Rose		
	6. General Microbiology (5th ed) by R. Y. Stanier and others		
	7. The Prokaryotes: A handbook on the Biology of Bacteria		
	by Martin Dworkin (Editor-in- Chief) and others Springer		
	8. Developmental Microbiology by J. F. Peberdy Blackie &		
	Sons, Glasgow		
	VIROLOGY	Lectures/	Credits
	Theory: 60 Hours (Credits -4)	Teaching hours	
	Expected course outcome -		
	The course helps to		
	 Know life cycles of plant, animal and bacterial 		
	viruses		
	 Understand plant virus transmission, effects of 		
	viruses on plant growth, and different plant		
	diseases	cours	
	 Understand therapy and prophylaxis of virat 	NO COLLEGE A	
	diseases.	JUNE	LIGUE
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	 Learn the methods of destruction of viruses 		
Module 1	1. Single burst and premature lysis experiment for phage host	15	01
	interaction		
	2. Productive cycle of T-odd phages		
	3. Productive cycle of lambda phage		
	4. Interaction of Bacillus phages with their hosts.		
	5. Properties of lambda lysogeny		
	6. Brief details of lysogenic interactions of P2, P22, P1 and Mu1		
	phages		
Module 2	1. Transmission of plant viruses:	15	01
	Vector transmission- insect, nematode and fungal vectors		
	Non vector transmission-Seed transmission, graft transmission,		
	mechanical transmission		
	2. Effect of viruses on plants- roots, stem, leaves, flowers and fruits		
	3. Gene expression and replication strategies of-		
	Poty virus, TMV		
	4. Control measures of plant viral diseases		
	Vector control, Chemical control		
Module 3	1. Productive cycle of animal viruses having DNA	15	01
	Herpesviruses		
	Parvoviruses		
	2. Productive cycle of animal viruses having double stranded		
	RNA- Reo virus		
	3. Productive cycle of animal viruses having single stranded RNA		
	Rhabdo		
	Picorna		
	Retro		
	Influenza		
Module 4	1. Slow viruses - Discovery, General features and importance	15	01
	2. DI particles – general features and interactions		
	Inhibition and inactivation of bacteriophages, animal		
	viruses and plant viruses- photodynamic inhibition,	Ea	
	inactivation by heat and radiations, inactivation by	EGE TO	
	chemicals (S)	D	_
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3. Antiviral chemotherapy- general approach, principals		
involved (inhibition of viral entry, inhibition of viral		
nucleic acid function, inhibition of viral protein		
function), chemicals of therapeutic use		
REFERENCE BOOKS		
REFERENCE BOOKS		
1. General Virology- by S. Luria		
2. Bacterial and Bacteriophage genetics- by Edward A. Birge		
3. Principles of Bacteriology, Virology and Immunology 8th ed.		
Vol. IV by Topley and Wilson		
4. Introduction to Plant Virology – by BosI.		
5. Field's Virology Vol I and II – by Lipincott		
6. Biotechnology: application and research- by Paul N.		
Cheremisinoff, Robert P. Ouellette		
7. Molecular Biology and Biotechnology – by Walker and Gingold		
8. Medical Microbiology 2nd ed by Mims, Playfour and Roitt		
9. Brock's Biology of Microorganisms by Madigan		
10. Advances in General Microbiology Vol.I- by Shrivastava		
11. Plant Viruses as Molecular Pathogens by Jawed A Khan and		
Jeanne Dijkstra		
Biomolecules	Lectures/	Credits
Theory: 60 Hours (Credits - 4)	Teaching hours	
Expected course outcome -		
Upon successful completion of course, students are expected		
to be able to		
 Understand different types of 		
macromolecules of cell		
 Understand structure of macromolecules of 		
cell		
 Understand synthesis of macromolecules of 		
cell		
 Know functions of macromolecules of cell 		
 Understand regulation of different metabolic 	COLLEGENO	
pathways	ESTO	
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Module 1	1. Classification and properties of carbohydrates Mono-, di-,	15	01
	oligo and poly-saccharides, with examples, reducing and		
	non-reducing sugars, anomers, isomers, epimers, derivatives		
	of sugars- alcohols, amino acids and deoxy sugars)., chiral		
	carbon atom, chair and boat form, glucopyranose and		
	fructopyranose.		
	2. Gluconeogenesis from TCA intermediates or amino acids /		
	acetyl coA		
	3. Glycolysis regulation, Krebs cycle regulation		
	4. Phosphoketolase pathway		
Module 2	1. Cori cycle. Interconversion of hexoses and pentoses,	15	01
	Biosynthesis of disaccharides and polysaccharides.		
	Regulation of blood glucose and homeostasis, Glycogenesis		
	and glycogenolysis and their regulation.		
	2. Complex carbohydrates: Types and general functions, amino		
	sugars, sialic acid and mucopolysaccharides. Structure and		
	functions of glycoproteins and proteoglycans.		
	3. Blood group sugar compounds, sugar nucleotides, bacterial		
	cell wall components. Lectins - specificity, characteristics and		
	uses, pectin, Xylans		
Module 3	1. Definition and classification of lipids.	15	01
	2. Fatty acids - general formula, nomenclature and chemical		
	properties Structure, function and properties of simple,		
	complex, acylglycerols, phosphoglycerides, sphingolipids,		
	waxes, terpenes, steroids and prostaglandins.		
	3. Beta oxidation regulation. Role of acyl carnitine in fatty acid		
	transport.		
	4. Structure and composition of fatty acid synthetase complex,		
	Regulation of fatty acid synthesis and breakdown. Synthesis		
	of triacylglycerides.		
	5. Lipids in cell membrane, Ketone bodies - formation and		
	utilisation.		
Module 4	1. Structure of nucleoside, nucleotide	15	01
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	2. Properties of DNA- UV absorption, denaturation,		
	renaturation. Structure and functions of different types of		
	RNA		
	3. Secondary structure of DNA, Watson and Crick model of		
	DNA. A, B and Z forms of DNA, Tm and its relation to GC		
	content		
	4. Forces stabilizing nucleic acid structures, triple helix.		
	Superhelix topology- Topoisomerases. Nucleic acid binding		
	protein – Leucine		
	5. Chemical and enzymatic degradation of nucleic acids. Inborn		
	errors of nucleic acid Metabolism		
	REFERENCE BOOKS		
	1. Lehninger's Principles of Biochemistry by D. L. Nelson and		
	M. M. Cox, CBS Publications, 2000		
	2. Biochemistry by Lubert Stryer, 4th Edition		
	3. Biochemistry by Zubay		
	4. Biochemistry By Garrett and Grisham		
	5. Complex Carbohydrate by Nathan Sharon		
	RESEARCH METHODOLOGY	Lectures/	Credits
	Theory: 60 Hours (Credits - 4)	hours	
	Expected course outcome -		e. 18
	Upon successful completion of course, students are expected to be able to		
	 Understand fundamentals of research methodology 		
	 Understand mechanism of research writing and writing tools 		
	 Understand bioinformatics and its applications 		
	 Understand biostatistics 		
Module 1	Fundamentals of Research Methodology	15	01
	1. Meaning, Objectives, Motivation and Types of Research		
	2. Research Approaches.		
	3. Significance of Research, Research Methods versus		
	Methodology, Research and Scientific Method, Importance of		
	Knowing How Research is done?	Ste	
	4. Criteria of Good Research, research process and steps	RUGNA	
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	involved		
	5. Hypothesis: Meaning, function and types of hypothesis;		
	Null/Alternative hypothesis		
	6. Literature survey, sources of information, review.		
	7. Ethical issues and intellectual property rights		
	8. Publication process, selection of journals, citation index,		
	impact factor, h-index, i10 index, Journal Cite Score, Google		
	scholar index, Research gate, Academia, etc		
Module 2	Interpretation and Report Writing	15	01
	1. Meaning of Interpretation, Why Interpretation? Technique of		
	Interpretation, Precaution in Interpretation		
	2. Significance of Report Writing, Different Steps in Writing		
	Report Layout of the Research Report Types of Reports		
	3 Mechanics of Writing a Research Report: Writing		
	preliminaries main body of research references and		
	bibliography		
	A Processions for Writing Persoarch Persorts		
	 Frequencies for writing Research Reports. Meaning and importance of workshop seminar conference. 		
	symposium etc. in research		
	6 Plagiarism Concept and significance of plagiarism		
	7. Mariting tools: Crammerly Answerthenublic Quillbot		
	Notion Buzzeumo Convecane Chatant gimger		
	Notion, Buzzsumo, Copyscape, Chargpt, ginger		
	8. Referencing and citation tool: Endhole, Mendeley, Jabrer,		
	Zotero	45	01
Module 3	Bioinformatics and its applications	15	01
	definition, biological databases, types and examples, database		
	management systems (DBMS)		
	 Pattern matching and sequence alignment of nucleic acids and 		
	proteins – fundamental principles of pairwise sequence		
	alignment, local and global alignment, multiple sequence		
	alignment, sequence alignment tools and databases		
	3. Database Search engines: Google Scholar, Wiki- Database	COLLEGE	
	Science Direct, SciFinder, Scopus, inflibingt, Web of Science	ESTO	
	Find and the first of science,	JUNE)	
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	Indian Citation Index		
	4. Publishers in life Sciences: American Chemical Society, Royal		
	Society of Chemistry, Taylor and Francis, Elsevier, Springer,		
	Wiley, Themie		
Module 4	Biostatistics	15	01
	1. Basic concepts of biostatistics- definitions of statistics and		
	biostatistics, population, sample, variable and the various		
	types, statistic and parameter		
	2. Collection and presentation of data: primary and secondary		
	data, collection of data – enumeration and measurement,		
	significant digits, rounding of data, accuracy and precision,		
	recording of data. Tabular and diagrammatic presentation -		
	arrays, frequency distribution, bar diagrams, histograms and		
	frequency polygons		
	3. Descriptive statistics: measures of central tendency-mean,		
	median and mode, measures of dispersion		
	REFERENCE BOOKS:		
	Baginners, Research Methodology - A Step-by-Step Guide for		
	2 Montgomery D.C. Design & Analysis of Examinant Sil		
	2. Montgomery, D. C., Design & Analysis of Experiments, 5th		
	Ed., Wiley India (2007).		
	3. Kothari, C. K., Research Methodology-Methods and		
	Techniques, 2nd Ed., New Age International, New Delhi.		
	4. Ram Ahuja, "Research Methods", (2001), Rawat Publications,		
	New Delhi.		
	5. Cooper D., Schindler P., Business research methods", (2003)		
	Tata Mc-GrawHill, New Delhi		
	6. Bioinformatics: A Beginner's Guide by Jean-Michel Claverie		
	and C. Notredame (2003), Wiley Dream tech India (P) Ltd.,		
	New Delhi - 110 002		
	7. Elementary Bioinformatics by I. A. Khan (2005), Pharma Book		
	Syndicate, Hyderabad	COLLES	
	8. Bioinformatics: sequence and genome analysis by D. W.	promesto	
	Mount (2001), Cold Spring Harbor Laboratory Press, New	ESTD	
	15	1964	
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	York	
	9. Biostatistics A foundation for Analysis in the Health Sciences,	
¥0	by Wayne Daniel (7th Ed) Wiley- India edition	
	10. Biostatistics by N. Gurumani MJP Publishers	
	Practical Course Semester I	
	Genetics and Molecular Biology	2
	1. Isolation of RNA from yeasts	
	2. Isolation of Plasmid DNA from bacteria	
	3. Thermal denaturation of DNA	
	4. Gene transfer in E. coli by -conjugation	
	5. Demonstration of protoplast fusion in bacteria	
	6. Estimation of mutation rate in E. coli	
	7. Synthesis of inducible enzyme β -galactosidase in <i>E. coli</i>	
	8. PCR (demonstration)	
	9. Detection of karyotyping	
	10. Determination of genetic map unit	
	Immunology	2
	1. Ouchterlony's double diffusion test	
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- Radial immuno diffusion test
 Immunoelectrophoresis test
- 4. ASO test5. RA test6. RPR test

8. VDRL test

- 7. Isolation of immunoglobulins from whole blood
- Taxonomy and Microbial Diversity

 1. Isolation and morphological study of Aspergillus species by slide culture method

 2. Isolation and morphological study of Penicillium species by

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- 2. Isolation and morphological study of *Penicillium* species by slide culture method
- 3. Isolation and morphological studies of yeast from sugar and starchy materials
- 4. Induction and observation of Ascospores of Saccharomyces Structure ESTD

5. Isolatio	n and morphological studies of Actinomycetes by		
coversl	ip technique		
6. Isolatio	n and Characterization of thermophilic bacteria		
7. Isolatio	n and Characterization of acidophilic bacteria		
8. Isolatio	n and Characterization of halophilic bacteria		
	Virology		
1. Phage t	yping of <i>E. coli</i>		
2. Titration	n of <i>E. coli</i> phages		
3. Prepara	tion of high titer stock of E. coli phages		
4. Study o	f one step growth of T-4phage		
5. Isolation	n of plaque morphology mutants of phages by using UV		
radiatio	ns		
6. Isolation	n of plaque morphology mutants of phages by using		
chemica	l mutagen		
7. Demons	stration of egg inoculation techniques		
	Biomolecules	-	
1. Estim	ation of reducing sugar concentration by DNSA method		
2. Estim	ation total sugar concentration by		
Pheno	I-H2SO4 method and Anthrone method		
3. Estima	ation of glucose concentration by		
a) Gluc	ose oxidase method		
4. Determ	nination of fructose concentration by resorcinol method.		
5. Estima	tion of Cholesterol		
6. Estima	tion of Inorganic phosphate by Fiske & Subbarow		
Metho	d		
7. Estima	tion of Vit C concentration by DCPIP method		
8. Isolati	on of Characterization of casein from milk.		
9. Isolati	on and characterization of starch from potato		
10. Isolatio	on of cholesterol and lecithin from egg yolk		
REFEREN	ICE BOOKS		
1. Practica	al Microbiology by R. C. Dubey and D. K. Maheshwari.	COLLED	
S. Chan	id &Co.	ECTO	
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	And a local diversity of
2. Environmental Science and Biotechnology: Theory and	
Techniques by A. G. Murugesan and C. Rajakumari. MJP	
Publishers	
3. Medical Microbiology by Cruickshank and others. ELBS	
Publications	
4. Experimental Microbiology by R. J. Patel. Aditya Publishers,	
Ahmedabad	
5. Laboratory Methods in Food Microbiology by Harrigan,	
Academic Press	
6. Identification Methods for Microbiologists by B. M. Gibbs and	
F. A. Skinner. Academic Press	
7. Laboratory Microbiology by L. Jack Bradshaw. W. B. Saunders	
& Co.	
8. Benson's Microbiological Applications: Laboratory Manual in	
General Microbiology by Alfred E. Brown	
9. Microbiological Methods by Michael Collins	
10. Handbook of Microbiological Media by R. M. Atlas. CRC	
Publications	
11. Laboratory Exercises in Microbiology by Robert A. Pollock	
and other	
12. Applied Microbiology Laboratory Manual by F. Duncan.	
13. Practical Handbook of Microbiology by Emanuel Golman and	
Lawrence H. Green, 2ndEd	
14. Procedures/Guidelines for the Microbiology Laboratory	
15. Laboratory Exercises in Microbiology 5th ed. Harley Prescott	
16. Practical Biochemistry: An Introductory Course by Fiona Frais.	
17. Basic Biochemical Methods 2nd ed R. R. Alexander J. M.	
Griffith	
18. Biochemical Methods 2nd ed. by S. Sadasivam and A.	
Manickam.	
19. Hawk's Physiological Chemistry ed. by Bernard L Oser.	
20. A Textbook of Practical Biochemistry by David Plummer a college	
21. Laboratory Manual in Biochemistry by S. Jayaraman	
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	SEMESTER II		
Paper V	TECHNIQUES IN MICROBIOLOGY Theory : 60 Hours (Credits -4)	Lectures/ Teaching hours	Credits
	 Expected course outcome - Upon successful completion of course, students are expected to be able to - Understand various traditional and advanced techniques used in life science laboratory Understand the working and mechanism of the techniques used in the life science research Know regarding the ethics that have to follow in research studies Understand different applications of the techniques in the research work 		
Module 1	 Enrichment culture techniques – principles and selective Factors employed, enrichment systems – closed and open, single cell isolation methods Principles and methods of preservation of bacteria, viruses, yeasts and molds Isolation and cultivation of anaerobes – principles, reducing agents, indicators, anaerobic jar methods and anaerobic glove box, Hungate's roll tube technique and its serum bottle modification. Isolation of human and animal pathogenic fungi Microscopic techniques– Electron microscopy – principles and working of transmission and scanning microscopes. Dark field, phase contrast, polarisation, differential interference contrast (DIC), fluorescence, confocal scanning, scanning tunneling, atomic force microscopy. 	15	01
Module 2	 Good laboratory practices: Accuracy in preparation of solutions, media, etc. Qualifications of equipment – design (DQ), installation (IQ), operational (OQ) and performance (PQ), Validation and calibration 	15 GE KOLHAPUR	01
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	Documentation- Concepts, necessity and types		
	2. Safety in the laboratory:		
<	Common hazards in the laboratory-		
	Electrical equipment		
	Chemicals - corrosive, irritant, toxic, flammable, explosive		
	Ionising radiations, Infectious materials, Gas and fire		
	Safety measures-		
	In the use of equipments and gas facility		
	Personal protection		
	Waste disposal		
	First aid		
	3. Cell disruption methods - principles and methods of		
	disruption of microbial, plant and animal cells and separation		
	of cellular components		
Module 3	1. Chromatography - general principles and working of Column	15	01
	chromatography - gel, ion exchange. Gas chromatography		
	HPLC		8
	2. Electrophoresis- Polyacrylamide gel electrophoresis (PAGE) -		
	native and gradient gels, DNA Sequencing gels, SDS-PAGE,		
	isoelectric focusing, 2-DPAGEAgarose gel electrophoresis-		
	DNA gel, Pulsed field gel, RNA electrophoresis. Capillary		
	electrophoresis		
	3. Centrifugation - principles of differential and density		
	Gradient centrifugation, sedimentation		
	coefficient determination		
Module 4	1 Spectroscopy – Principles of IR and Remove	4.5	
	spectrophotometry, turbidimetry and nephelometry	15	01
	fluorimetry, luminometry, circular dichroism and optical		
	rotational dichroism spectrophotometry, FSR NMR Mass		
	spectrometry, X – ray crystallography		
	2. Radioisotopic techniques– Nature of radioactivity and general		
	principles of radioisotopic techniques Methods of detection of	OCOLLEGE	
	radioactivity – gas ionization (GM counter), excitation	ESTO	
	(scintiliation) and exposure of photographic emulsions	ILINIE)	UR-
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Research Institute, Pune		
7 Isolation Methods for Anaerobes by Shapton, Academic Press		
8. Tools in Biochemistry by D. Cooper		
8. Tools in Biochemistry by D. Cooper		
9. Protein Purification by R. Scopes, Springer Verlag		
Publications		
10. Analytical Biochemistry (Biochemical Techniques) by P.		
Asokan, Chinnaa Publications		
MICROBIAL PHYSIOLOGY, BIOCHEMISTRY AND	Lectures/	Credits
METABOLISM	Teaching hours	
Theory: 60 Hours (Credits -4)		
Expected course outcome -		
Upon successful completion of course, students are expected to		
be able to -	NIE	
1000	OLEGE TO	
 Understand various chemical reactions 		
 Understand various chemical reactions occurring during growth of organisms 	STD E	

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	Understand machanism (
	degradation		
	developments in Lin Landsome recent		
Module 1	developments in blochemistry		
	1. Carbohydrate metabolism: Citric acid cycle-	15	01
	Steps involved, Amphibolic nature, anaplerotic		
	reactions.		
	2. Oxidation of hydrocarbons:		
	Aliphatic hydrocarbons - alkanes and alkenes- alpha, beta and		
	omega oxidation		
	Aromatic hydrocarbons - beta keto adipate pathway,		
	Valerate pathway and gentisate pathway		
	3. Oxidation of fatty acids and phospholipids: beta-oxidation of		
	fatty acids, phospholipases and thioesterases, Catabolism of		-
	amino acids (General reactions)		
	4. Pasteur and Crabtree effect		
	5. Autotrophy - Concept, factors for, types of autotrophs,		
	mechanisms		
Module 2	1. Respiratory metabolism:	15	01
	Mitochondrial ETC- structure of mitochondrion,		
	ETC and its components, Shuttle system across		
	membrane, Atkinson's energy charge.		
	Oxygen toxicity- mechanism of oxygen toxicity, mechanism		
	to overcome the toxicity - catalase, peroxidase and super		
	oxide dismutase		
	2. Photo-phosphorylation in bacteria-		
	Photosynthetic and non-photosynthetic ETC		
	Cyclic and non-cyclic photophosphorylation	ND COLLEG	EN
	3. Drug metabolism in the body, mechanisms of detoxification o	ESTD	1924
	various substances	JUNE	UR=[
	4. Fermentation of saccharolytic clostridia and propionic acid	Ware bore Aut	anonis
	bacteria	15	
Module 3	1. Protein chemistry- Structure of peptide bond, stabilization of	15	01

	conformation, Secondary structure, alpha helix, beta	
	conformation, Ramachandran plot, Tertiary structure	
	Quaternary structure	
	2. Biosynthesis of amino acids: a- ketoglutarate	
	oxaloacetate family, Pyruvate family	
	3. Lipid metabolism in prokaryotes-	
	Biosynthesis of fatty acids	
	Phospholipid biosynthesis - phosphatidylethanolamine and	
	Phosphatidylglycerol	
	Regulation of lipid metabolism	
	4. Purine and pyridine biosynthesis- de novo pathway and	
	salvage pathway	
Module 4	1. Osmosis- Effect of osmotic stress on microorganisms, 15 01	-
	plasmolysis and plasmoptysis, Microbial response to	
	osmotic stress	
	2. Permeation- Primary active transport, secondary active	
	transport, co-transport Transport of ions	
	across the membrane V-type, F-type and P	
	type ATPases	
	3. Bio-signaling- Molecular mechanisms, signaling in bacteria-	
	The two- component signaling mechanism in bacterial	
	chemotaxis	
	4. Microbial hormones and quorum sensing in	
6	microorganisms	
-	REFERENCE BOOKS	-
	1. Text book of Biochemistry 4th ed. by West, Todd, Mason and	
	Burgen	
	2. Principles of Biochemistry 5th ed. by White, Handler, Smith	
	3. Lehninger Principles of Biochemistry by Nelson and Cox	
	4. Biochemistry by Zubay	
	5. Elements of Biochemistry by O. P. Agrawal	
	6. Bacterial Metabolism by H. W. Doelle	
	7. Bacterial Metabolism by Gottschalk	
	8. Advances in General Microbiology by Shrivastava	
	9. Biochemistry by Stryer	
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	Biochemistry of Lipids, Lipoproteins and membranes by D.		
	E. Vance and J. E. Vance Elsevier Science		
	10. Microbial Physiology by A. G. Moat and others Wiley India		
	Edition		
	MEDICAL MICROBIOLOGY	Lectures/	Credits
	Theory: 60 Hours (Credits -4)	hours	
	Expected course outcome -		
	Upon successful completion of course, students are expected to		
	be able to –		
	 Understand various bacterial, fungal, and viral diseases 		
	in humans		
	 Understand mechanisms of disease development 		
	 Understand medical applications of microbial 		
	metabolites		
	 Know immunological disorders. 		
Module 1	1. Virulence: Establishment, spreading, bacterial adhesion to	15	01
	host cells, bacterial invasion of host cells and its		
	mechanisms		
	2. Attributes of microorganisms that enable them to cause		
	disease: Exotoxins (Diptheria, Cholera, Clostridial,		
	Staphylococcal)		
	Endotoxins of gram-negative bacteria		
	Extracellular enzymes (Coagulase, Lysozyme)		
	3. Pathogen survival mechanisms:		
	Capsulation, sporulation, cyst formation		
	Against Environmental factors-		
	Physical (Heat, radiations)		
	Chemical (antibiotics and disinfectants)		
	immune escape mechanisms		
	4. Collection and transport of clinical specimens (clinical		
	samples from throat, alimentary tract, genito-urinary tract,		
	conjuctiva, ear, blood), preliminary processing of specimens		
Module 2	1.Bacterial Diseases: causative agent - morphological, cultural,	15	01
	biochemical, antigenic characters; lab diagnosis,	le l	
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	transmission, prevention and control of diseases caused by		
	Leptospira icterohemorrhagy, Streptococcus mutans Rickettsia		
	burnetti, Mycobacterium tuberculosis		
	2. Fungal Diseases: Etiology, clinical features, pathogenesis,		
	laboratory diagnosis, prevention and control		
	Superficial Mycoses -Pityriasis		
	Subcutaneous Mycoses -Mycetoma		
	Systemic Mycoses -Histoplasmosis		
Module 3	1. Etiology, clinical features, pathogenesis, Laboratory	15	01
	diagnosis, Prevention and control of diseases caused by-		
	Herpes virus		
	Encephalitis virus		
	Influenza -H1N1		
	 Diseases caused by Protozoa – Leishmaniasis, Filariasis Pathology of AIDS and prevalence of Tuberculosis, 		
×	Mycoplasma and Cryptococcus infections		
	3. Special microbial metabolites and their applications in health		
	care - Lovastatin, Daunorubicin		
Module 4	1. B-cell immune deficiency disorders:	15	01
	X-linked a gamma globinaemia		
	Selective IgA and IgM deficiency		
	2. T-cell immunodeficiency disorders: Congenital thymic		
	aplassia		
	3. Combined B-cell and T-cell immunodeficiency disorders:		
	Ataxia telangiectasia		
-	Graft versus hostdisease.		
	4. Complement disorders: complement component deficiency		
	5. Rheumatic disease: Systemic lupus erythematosus		
	6. Atopic diseases: Allergic rhinitis and asthma		
	7. Autoimmune diseases: Organ specific and systemic		
	autoimmune diseases, mechanism of induction of		
	autoimmunity and treatment		
	REFERENCE BOOKS		
	1. Basic and clinical Immunology by D. P. Stites, J. D. Stobo, H	D COLLEGE 40	
	H. Frudenber, J. V. Wells	ESID	APU
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 Medical Microbiology, 6th Edition by S. Gupte, Jaypee Brothers Publications Medical Microbiology, by W. Irving, T. Boswell and D. Aladeen Medical Microbiology, by R. Cruickshank, J. P. Duguid, B. P. Marmion, R. H. A. Swain The Textbook of Microbiology, by R. C. Dubey and D. K. Maheshwari Text book of Microbiology by R. Vasanthkumari Medical Microbiology by S. Rajan MJP Publishers Immunology II by J. A. Bellanti Medical Immunology 9th ed. by D. P. Stites, I. T. Abba, T. G. Parslow Immunology by I Kannan Immunobiotechnology by M. Sharma and N. Tripathi Biotechnology Application and Research by P. N. Cheremisinoff and R. P. Ouellette Immunology 5th ed. by R. A. Goldsby, T. J. Kindt, B. A. Osborne and J. Kuby Fundamentals of Immunology 2nd ed. by Q. N. Myrrik and R. S.Weiser Essential Immunology by I. M. Roitt Immunology 3rd ed. by 1. M. Roitt Immunology 3rd ed. by 1. M. Roitt Immunology 3rd ed. by 1. M. Roitt Upon successful completion of course, students are expected to be able to - Understand concept of microbial ecosystem Understand the effect of environmental factors on the microbial life Know interactions of microbes with other microbes and other living systems like plants and animals. 	JUNE 1964	13
 Medical Microbiology, 6th Edition by S. Gupte, Jaypee Brothers Publications Medical Microbiology, by W. Irving, T. Boswell and D. Aladeen Medical Microbiology, by R. Cruickshank, J. P. Duguid, B. P. Marmion, R. H. A. Swain The Textbook of Microbiology, by R. C. Dubey and D. K. Maheshwari Text book of Microbiology by R. Vasanthkumari Medical Microbiology by S. Rajan MJP Publishers Immunology II by J. A. Bellanti Medical Immunology 9th ed. by D. P. Stites, I. T. Abba, T. G. Parslow Immunology y I Kannan Immunology by I Kannan Immunology by J Kannan Immunology Sth ed. by R. A. Goldsby, T. J. Kindt, B. A. Osborne and J. Kuby Fundamentals of Immunology 2nd ed. by Q. N. Myrrik and R. S.Weiser Essential Immunology by I. M. Roitt Immunology 3rd ed. by I. M. Roitt Upon successful completion of course, students are expected to be able to - Understand the effect of environmental factors on the microbial life Know interactions of microbes with other microbes and 	2 11 11 12	
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 Medical Microbiology, 6th Edition by S. Gupte, Jaypee Brothers Publications Medical Microbiology, by W. Irving, T. Boswell and D. Aladeen Medical Microbiology, by R. Cruickshank, J. P. Duguid, B. P. Marmion, R. H. A. Swain The Textbook of Microbiology, by R. C. Dubey and D. K. Maheshwari Text book of Microbiology by R. Vasanthkumari Medical Microbiology by S. Rajan MJP Publishers Immunology II by J. A. Bellanti Medical Immunology 9th ed. by D. P. Stites, I. T. Abba, T. G. Parslow Immunology by I Kannan Immunology by I Kannan 		
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 Medical Microbiology, 6th Edition by S. Gupte, Jaypee Brothers Publications Medical Microbiology, by W. Irving, T. Boswell and D. 		
3. Medical Microbiology, 6th Edition by S. Gupte, Jaypee Brothers Publications		
3. Medical Microbiology, 6th Edition by S. Gupte, Jaypee		
Melnick, E. A. Adelberg		
2. Medical Microbiology, 13th Edition by E. Jawetz, J. L.		

	 Know control of pest with biological way. 		
Module 1	1. Concept and importance of microbial ecology.	15	01
	Microbial communities and ecosystems - Development of		
	microbial communities, Experimental Ecosystem models -		
	Batch system, Flow Through System, Microcosm, Germ free		
	animal		
	2. Physiological ecology of Microorganisms: abiotic		
	limitations to microbial growth, starvation strategies,		
	environmental determinants -temperature, radiation,		
	pressure, salinity, water activity, pH, redox potential,		
	magnetic force, organic and inorganic compounds		
Module 2	1. Culture dependent and culture independent analyses of	15	01
	microbial communities		
	2. Quantitative ecology: Sample collection, processing		2
	and detection of microbial populations		
	3. Determination of microbial numbers, biomass, measurement		
	of microbial metabolism		
Module 3	1. Biological interactions -	15	01
	Microbe - Microbe interactions - Interaction within single		
	microbial population- positive and negative interactions,		
	Interactions between diverse microbial populations-		
	mutualism, commensalism, synergism, ammensalism,		
	parasitism and predation		
	2. Microbe - Plant interactions - Interactions with aerial plant		
	structures		
	3. Microbe – Animal interactions- Microbial contributions to		
	animal nutrition, Commensal and mutualistic intestinal		
	symbionts, Symbiotic light production		
Module 4	1. The animal as an environment – The indigenous microbial	15	01
	population of alimentary tract and skin, factors affecting		0.000,000,20
	composition of flora, sources of nutrients for organisms in		
	the alimentary tract and on skin, energy metabolism in	COLLED	
	rumen	MANDOCCE	er.
	2. Ecological control of pests and disease causing populations	JUNE	NEUR
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	Modification of populations, reservoirs of pathogens and		
	vector populations. Microbial control of pests, genetic		
	engineering in biological control		
	REFERENCE BOOKS		
	1. Microbial Ecology by M. Lynch and others		
	 Experimental Microbial Ecology by R. C. Burns and others 		
	3. Environmental Microbiology by K. Vijava Pamach, MIP		
	Publishers		
	4. Microbial Ecology by Larry L. Barton and Diana F. Northun		
	Copyright © 2011 Wiley-Blackwell		
	5. Soil Microbiology by N. S. Subba Rao Oxford and IBH		
	Publishing Co. Pvt. Ltd		
	6. Introduction to Soil Microbiology by M. Alexander, John		
	Wiley and Sons Inc. New York, London		
	7. Microbial Ecology by R. M. Atlas and R. Bartha		
	8. The Prokaryotes: A handbook on the Biology of Bacteria; M.		
	Dworkin (Editor in Chief) and others.		
Paper VII	Microbial Biotechnology	Lectures/	Credits
F 3		TT 1 .	
2.5	Theory: 60 Hours (Credits - 4)	hours	
2.5	On completion of course, students learn about –	hours	- A-
2.5	On completion of course, students learn about – Scope of biotechnology for betterment of human life 	hours	
	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering 	hours	
	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 	hours	
Module 1	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 1. Microbial biotechnology: Scope and its applications in 	leaching hours	01
Module 1	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Bio fertilizers, PGPR 	leaching hours	01
Module 1	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 1. Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Bio fertilizers, PGPR Mycorrhizae), environmental, and food technology 	leaching hours	01
Module 1	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 1. Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Bio fertilizers, PGPR Mycorrhizae), environmental, and food technology 2. Use of prokaryotic and eukaryotic microorganisms in	leaching hours	01
Module 1	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 1. Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Bio fertilizers, PGPR Mycorrhizae), environmental, and food technology 2. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications 	leaching hours	01
Module 1	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 1. Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Bio fertilizers, PGPR Mycorrhizae), environmental, and food technology 2. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications 3. Genetically engineered microbes for industrial application: 	leaching hours	01
Module 1	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 1. Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Bio fertilizers, PGPR Mycorrhizae), environmental, and food technology 2. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications 3. Genetically engineered microbes for industrial application: Bacteria and Yeast 	1 eaching hours	01
Module 1 Module 2	 On completion of course, students learn about - Scope of biotechnology for betterment of human life Production of various microbial products through gene engineering Various applications of microbial biotechnology in agriculture, food, and pharmaceutical industry 1. Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Bio fertilizers, PGPR Mycorrhizae), environmental, and food technology 2. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications 3. Genetically engineered microbes for industrial application: Bacteria and Yeast 1. Recombinant microbial production processes in the state of the sta	1 eaching hours	01

	pharmaceutical industries Streptokinase, recombinant		
	vaccines (Hepatitis B vaccine)		
	2. Microbial polysaccharides and polyesters,		
	3. Microbial production of bio-pesticides, bioplastics		
	4. Microbial biosensors		
Module 3	1. Applications of recombinant DNA technology -	15	01
	Synthesis of commercial products: Amino acids, ascorbic		
	acid, novel antibiotics, peptide antibodies		
	2. Synthesis of biopolymers: gum, rubber,		
	Polyhydroxyalkanoates		
	3. Unconventional microbial systems for production of high		
	quality protein drugs		
Module 4	Upstream, Fermentation and Downstream Processing	15	01
	for the following:		
	1. Antibiotics (Rifamycin)		
	2. Microbial enzymes (Chitinase).		
	3. Exopolysaccharides (Pullulan)		
	4. Vitamins (Beta carotene)		
	REFERENCE BOOKS		
	1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology,		
	2 nd Edition, Cambridge University Press.		
	2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial		
	Microbiology and Biotechnology, 2nd Edition, ASM Press.		
	3. Gupta PK (2009) Elements of Biotechnology 2nd edition,		
	Rastogi Publications		
	4. Lazer AN and Nikaido H (2007) Microbial Biotechnology,		
	2nd edition, Cambridge University Press		
	5. Lydersen B., N. a. D' Elia and K. M. Nelson (Eds.) (1993)		
	Bioprocess Engineering: Systems, Equipment and Facilities,		
	John Wiley and Sons Inc.		
	6. Operational Modes of Bioreactors, (1992) BIOTOL series,		
	Butterworths Heinemann. Shuichi and Aiba.	HAND COLLED	er
	7. Biochemical Engineering. Academic Press. 1982 Stanbury and	ESTO	PE
	Whittaker. Fermentation technology	THE THE	PUR*
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8. Swartz I. R. (2001) Advances in Eachemichia cali and dustia		
of therapeutic proteins. Current Opinion in Biotechnolog	on V	
12, 195-201.	y,	
9. Prescott, Harley and Klein's Microbiology by Willey IN	1	
Sherwood LM, Woolverton CI (2014), 9th edition, Mc Gray	A7	
Hill Publishers.		
10. Dubasi Govardhana Rao, 2010 Introduction to Biochemica	ă I	
Engineering Tata Mcgraw Hill Education		
11. Peter F. Stanbury. Principles Of Fermentation Technology		
2E, Elsevier (A Division of Reed Elsevier India Pyt Limited)		
2009 15 lectures 8	,	
12. Vijai Kumar Gupta, Monika Schmoll, Minna Maki, Maria		
Tuohy, Marcio Antonio Mazuteditors Applications of		
Microbial Engineering. CRC Press 2013		
13. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular		
Biotechnology 4th edition, ASM Press,		
14. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of		
Fermentation Technology 2nd edition. Elsevier Science		
15. Crueger W, Crueger A (1990) Biotechnology: A text Book		
ofIndustrial Microbiology 2nd edition Sinauer associates, Inc		
16. Sudhir U. Meshram, Ganghdhar B Shinde, Applied		
biotechnology. I. K. International Pvt. Ltd. 2009		
Practical Course of Semester II		
Techniques in Microbiology	2	
1. Enrichment and isolation of chitin degrading bacteria		
2. Enrichment of Clostridium species using potato, Thioglycollate	•	
broth and Candle jar		
3. Spectroscopy-		
i. Verification of Beer'slaw		
ii. Determination of absorption maxima		
iii. Molar extinction coefficient and difference spectra		
4. Chromatography-		
i. Separation of dyes and amino acids on silica gel column	HAND COLLEGE	e
ii. Ion exchange chromatography of amino acids / proteins	ESTD	L'HER
5. Agarose gel electrophoresis	1954	Rela
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and others	JUNE 1964	alla
11 Laboratory Exercises in Missoliaten Laboratory	STAR ESTO	
Publications	NO COLLEGE	
 Microbiological Media by Michael Collins Handbook of Microbiological Media by D. M. Aut. Social 		
Microbiological Methods by Michael Calling		
Ribbons, Academic Press		
8 Methods in Microbiology (Vol 1 3A and 5B) by Marcine		
7 Microbiology by Alfred F. Brown		
General		
6 Benson's Microbiological Applications Laboratory Manual in		
&Co.		
5. Laboratory Microbiology by L. Jack Bradshaw W B Saundara		
F. A. Skinner. Academic Press		
4. Identification Methods for Microbiologiste by B. M. Cibberry		
Academic Press		
3. Laboratory Methods in Food Microbiology by Harrison		
Ahmedabad		
2. Experimental Microbiology by R. I. Potol. A diture Deskilled		
International Publishers		
1. Laboratory Manual in Biochemistry by L Lavoratory Manual		
REFERENCE BOOKS		
7. Determination of phonel coefficients of the state		
6. Effect of hypotonic and hyp		
5. Determination of RNA content of bacteria		
4. Determination of DNA content of bacteria		
3. Determination of carbohadante and file in the		
2 Determination of analytic states of the states		
F. coli	f	
1 Determination ()	2	
III. Soll culture technique for spore formers		
ii. Stab cultures of microaerophilc organisms		
i. Slant cultures of aerobic and facultative organisms		
7. Preservation of microbial cultures-		
6. Density gradient centrifugation of budding yeast cells		
	 bensity gradient centrifugation of budding yeast cells Preservation of microbial cultures- i. Slant cultures of aerobic and facultative organisms ii. Stab cultures of microaerophile organisms iii. Soil culture technique for spore formers Microbial Physiology, Biochemistry and Metabolism Determination of specific growth rate and generation time of <i>E. coli</i> Determination of protein content of bacteria Determination of carbohydrate content of bacteria Determination of RNA content of bacteria Determination of phenol coefficient of 'test disinfectant' REFERENCE BOOKS Laboratory Manual in Biochemistry by J. Jayaraman. New Age International Publishers Experimental Microbiology by R. J. Patel. Aditya Publishers, Ahmedabad Laboratory Methods in Food Microbiology by Harrigan, Academic Press Laboratory Microbiology by L. Jack Bradshaw, W. B. Saunders & & Co. Benson's Microbiological Applications Laboratory Manual in General Microbiology by Alfred E. Brown Methods in Microbiology (Vol. 1, 3A and 5B) by Norris and Ribbons. Academic Press Laboratory Exercises in Microbiology by Robert A. Pollock and others 	 b. Density gradient centrifugation of budding yeast cells 7. Preservation of microbial cultures- Slant cultures of aerobic and facultative organisms Stab cultures of microaerophilc organisms Soil culture technique for spore formers Microbial Physiology, Biochemistry and Metabolism 2 Determination of specific growth rate and generation time of <i>E. coli</i> Determination of protein content of bacteria Determination of protein content of bacteria Determination of DNA content of bacteria Determination of NNA content of bacteria Determination of phenol coefficient of 'test disinfectant' REFERENCE BOOKS 1. Laboratory Manual in Biochemistry by J. Jayaraman. New Age International Publishers 2. Experimental Microbiology by R. J. Patel. Aditya Publishers, Ahmedabad 3. Laboratory Methods in Food Microbiologists by B. M. Gibbs and F. A. Skinner. Academic Press 4. Identification Methods for Microbiologists by B. M. Gibbs and F. A. Skinner. Academic Press 5. Laboratory Microbiology by L. Jack Bradshaw. W. B. Saunders & Co. 6. Benson's Microbiology by L. Jack Bradshaw. W. B. Saunders & Co. 7. Microbiology by Alfred E. Brown 8. Methods in Microbiology (Vol. 1, 3A and 5B) by Norris and Ribbons. Academic Press 9. Microbiological Methods by Michael Collins 10. Handbook of Microbiological Media by R. M. Atlas. CRC Publications 11. Laboratory Exercises in Microbiology by Robert A. Pollock and others

Medical Microbiology	2
1. Using Bergey's Mannual of Systematic Bacteriology for	
identification of Bacteria	
2. Isolation and characterization of respiratory pathogenic	
bacteria from throat	
3. Determination of susceptibility to dental caries by Snyder test	
 Isolation and characterization of etiological agent of dental caries 	
5. Isolation and characterization of enteric nathogens from	
clinical samples	
6. Isolation and characterization of Urinary tract in fact	
causing bacteria from urine	
7. Antibiotic sensitivity of Urinary tract infection causing bacteria.	
Microbial Ecology	
1. Qualitative and Quantitative study of water microflora	
2. Study of microflora in Winogradsky column	
3. Qualitative and quantitative study of air microflora	
4. Isolation and characterization of microflora from human skin	
5. Demonstration of bacterial synergism and antagonism	
6. Detection of siderophores production by microorganisms	
7. Isolation and characterization of ruminant bacteria from	
animal gut.	
REFERENCE BOOKS	
 Practical Microbiology by R. C. Dubey and D. K. Maheshwari. S. Chand & Co 	
2. Environmental Science and Biotechnology: Theory and	
Techniques by A. G. Murugesan and C. Rajakumari. MJP Publishers	
3. Medical Microbiology by Cruickshank and others. Func	
Publications	
4. Experimental Microbiology by R. J. Patel, Aditya Publishan	
Ahmedabad	GEN
5. Laboratory Methods in Food Microbiology by Haming) PEE
Academic Press	PURY
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	6. Identification Methods for Microbiologists by B. M.
	Gibbs and F. A. Skinner. Academic Press
	7. Laboratory Microbiology by L. Jack Bradshaw, W. B. Saunders
	& Co.
	8. Benson's Microbiological Applications: Laboratory Manual in
	General Microbiology by Alfred E. Brown
	9. Microbiological Methods by Michael Collins
	10. Handbook of Microbiological Media by R. M. Atlas. CRC
	Publications
	11. Laboratory Exercises in Microbiology by Robert A. Pollock
	and other
	12. Applied Microbiology Laboratory Manual by F. Duncan.
	13. Practical Handbook of Microbiology by Emanuel Golman
	and Lawrence H. Green, 2ndEd
	14. Procedures/Guidelines for the Microbiology Laboratory
	15. Laboratory Exercises in Microbiology 5th ed. Harley Prescott
Practical	Microbial Biotechnology
VI E3	
	1. Study of yeast cell immobilization by sodium alginate method
	2. Pigment production from fungi (Melanin production from
	Aspergillus fumigatus)
	3. Isolation of xylanase or lipase producing bacteria
	4. Study of algal Single Cell Proteins.
	5. Production of bio fertilizer
	6. Isolation of IAA producing bacteria and quantification of IAA
	REFERENCE BOOKS
	1. Practical Microbiology by R. C. Dubey and D. K.
	Maheshwari. S. Chand & Co.
	2. Environmental Science and Biotechnology: Theory and
	Techniques by A. G. Murugesan and C. Rajakumari. MJP
	Publishers
	3. Experimental Microbiology by R. J. Patel, Aditya Publishers.
	Ahmedabad
	4. Analysis of Plants, Irrigation water and Soils by R B
	Somawanshi and others .Mahatma Phule Agricultural
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University, Rahuri		_
5. Identification Methods for Microbiologists by B. M. Gibbs		
and F. A. Skinner. Academic Press		
6. Laboratory Microbiology by L. Jack Bradshaw. W. B.		
Saunders &Co.		
7. Benson's Microbiological Applications Laboratory Manual in		
Genera Microbiology by Alfred E. Brown		
8. Methods in Microbiology (Vol. 5B and Vol. 3A) by Norris and	L	
Ribbons. Academic Press		
9. Bergey's Manual of Systematic Bacteriology		
10. Microbiological Methods by Michael Collins		
11. Handbook of Microbiological Media by R. M. Atlas. CRC		
publication		
12. Laboratory Exercises in Microbiology by Robert A. Pollock		
and others		
13. Laboratory Techniques in Microbiology and Biotechnology		
by R. P.		
14. Tiwari, G. S. Hoondal and R. Tewari, Abhishek Publications,		
Chandigarh		
15. Handbook of Techniques in Microbiology by A. S. Karwa, M.		
K. Rai and H. B. Singh. Scientific Publishers, Jodhpur		
16. Laboratory Exercises in Microbiology by J. P. Harley and L.		
M. Prescott 5th Ed.		



Nature of Question Paper

Instructions: 1) Question 1 is compulsory.

2) Figures to the right indicate full marks.

3) Draw neat labeled diagrams wherever necessary.

4) Use of calculator is allowed.

Time : 3 hours

Total Marks: 80

Therory papers

Q.1. Select correct alternative and rewrite the sentence	(16)

1)	a)	b)	c)	d)
ii)	a)	b)	c)	d)
iii)	a)	b)	c)	d)
iv)	a)	b)	c)	d)
v)	a)	b)	c)	d)
vi)	a)	b)	c)	d)
vii)	a)	b)	c)	d)
viii)	a)	b)	c)	d)
ix)	u)	b)	c)	u)
x)	a)	6)	c)	a)
xi)	a)	b)	c)	d)
xii)	a)	b)	c)	d)
xiii)	a)	b)	с)	d)
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xiv)				
15	a)	b)	c)	d)
xv)				
	a)	b)	c)	d)
xvi)				
	a)	b)	c)	d)

Section I

Q.2. Attempt any One.	(16)
i) ii)	

Q.3. Attempt any Two

i) ii) iii)

Q. 4 Attempt any Four

i) ii)			
iii)			
iv)			
v)			
vi)			

Section II

Q.5. Attempt any Two.	(16)
i) ii)	

Q.6. Attempt any Two

i) ii) iii)

Q. 7 Attempt any Four

i) ii)



(16)

(16)

(16)

(16)

iii) iv) v)

vi)

Instruction to paper setters: Equal weight age should be given to all units.

Sem.	Core Course	Marks	Evaluation	Paper	Answer	Standard
I	Ι	80	Semester wise	Each paper of 80 marks	As per Instruction	40 %
II	II	80	Semester wise	Each paper of 80 marks	As per Instruction	40 % (32 marks)

SCHEME OF MARKING (THEROY)

SCHEME OF MARKING (CIE) Continuous Internal Evaluation

Sem.	Core Course	Marks	Evaluation	Paper	Answer	Standard of
I	DSE E 1	20	Compation		BOOKS	passing
		20	Semester wise	one	As per	40 %
II	DSE F 1	20	Semester wise		instruction	(8 marks)
			Semester wise	one	As per Instruction	40 % (8 marks)

SCHEME OF MARKING (PRACTICAL)

Sem	Course	Marks	Evaluation	Sections	Standard
Ι	Practical I, II and III	150	Semester	As per	40 %
II	Practical IV, V, and VI	150	Semester	As per Instruction	40 %

*A separate passing is mandatory

