SYLLABI AND SCHEME OF EXAMINATIONS FOR DISCIPLINE SPECIFIC COURSES OF MULTIDISCIPLINARY PROGRAMS WITH HONS. IN ONE MAJOR DISCIPLINE

B.Sc. (Life Sciences) with Hons. in Biotechnology

(Based on Curriculum and Credit Framework for UG Programs under NEP)

WITH EFFECT FROM THE SESSION 2026-27

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

Credit Structure for Undergraduate Programmes (Multidisciplinary with Hons. in One Major Discipline)

Semester	Discipline-Specific Courses (DSC) / Major courses	Minor(MIC)/ Vocational (VOC)/ Skill Enhancement Courses (SEC)/ Internship	Multidisciplinary courses(MDC)	Ability Enhancement courses(AEC)	Research project/ Dissertation	Value-Added Courses (VAC)	Total Credits
I	DSC - A1 @ 4 credits DSC - B1 @ 4 credits DSC - C1 @ 4 credits Fundamentals of Biotechnology	MIC1 @ 4 credits SEC1@ 3 credits** Laboratory techniques-I	MDC1 @ 3 credits	AEC1 @ 2 credits	----------	----------	24
II	DSC - A2 @ 4 credits DSC – B2 @ 4 credits DSC – C2 @ 4 credits Fundamentals of Molecular Biology	SEC2 @ 3 credits** Laboratory techniques-II	MDC2 @ 3 credits	AEC2 @ 2 credits	----------	VAC1 @ 2 credits VAC2 @ 2 credits	24
Students exiting the programme after second semester and securing 52 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/ Subject							
III	DSC – A3 @ 4 credits DSC – B3 @ 4 credits DSC – C3 @ 4 credits Recombinant DNA Technology	MIC2 @ 4 credits SEC3@ 3 credits** Laboratory techniques-III	MDC3 @ 3 credits	AEC3 @ 2 credits		----------	24
IV	DSC – A4 @ 4 credits DSC – B4 @ 4 credits DSC – C4 @ 4 credits Plant and Animal Biotechnology	MIC3(VOC)@ 4 credits	----------	AEC4 @ 2 credits	----------	VAC3 @ 2 credits	20
Students exiting the programme after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject							
V	DSC – A5 @ 4 credits DSC – B5 @ 4 credits DSC – C5 @ 4 credits Bioinformatics and Biostatistics	MIC4(VOC)@ 4 credits Internship @ 4 credits#	----------	----------	----------	----------	20
VI	DSC – A6 @ 4 credits DSC – B6 @ 4 credits DSC – C6 @ 4 credits Microbial Biotechnology	MIC5 @ 4 credits MIC6(VOC)@ 4 credits	----------	----------	----------	----------	20
Students will be awarded 3-year UG Degree in the relevant Discipline/Subject upon securing 132 credits.							
VII*	DSC – H1 @ 4 credits DSC – H2 @ 4 credits DSC – H3 @ 4 credits DSC – H4 @ 4 credits DSC – H5 @ 4 credits	SEC4 @ 4 credits OR MIC7 (VOC) @ 4 credits OR Internship @ 4 credits	----------	----------	----------	----------	24

VIII* (4yr UG Hon.)	**DSC – H6 @ 4 credits** **DSC – H7 @ 4 credits** **DSC – H8 @ 4 credits** **DSC – H9 @ 4 credits** **DSC – H10 @ 4 credits**	**SEC5 @ 4 credits OR MIC8 (VOC) @ 4 credits OR Internship @ 4 credits**	**----------**	**----------**	**----------**	**----------**	**24**
VIII* (4yr UG Hon. with Research)	**DSC – H6@ 4 credits** **DSC – H7@ 4 credits** **----------** **----------**	**SEC5 @ 4 credits OR MIC8 (VOC) @ 4 credits OR Internship @ 4 credits**	**----------**	**----------**	**Research project/ Dissertation@ 12 credits**	**----------** **TOTAL CREDITS**	**24** **180**

* Student should select one major discipline (Out of A, B, or C studied during first three years of UG Programmes) in which he/she wishes to pursue Honors. This framework is subject to modification as per UGC guidelines at the University level. The universities may decide to offer the Honors degree Programmes subject to the fulfillment of credit point table

** SEC for imparting practical skills related to Major (A, B and C)/minor.

#Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programmes without taking exit option.

Semester I (Session 2026-27)														
Discipline Specific Courses/ Major Course			**Credits Distribution**			**Total Credits**	**Workload**			**Total Workload**	**Marks**			
	Nomenclature of Course	**Course Code**	**L**	**T**	**P**		**L**	**T**	**P**		**Theory**		**Practical**	**Total Marks**
											Internal	**External**		
DSC @ 4 credits	Fundamentals of Biotechnology	26CBTM401DS01	2	0	2	04	2	0	4	06	15	35	50	100
Semester II (Session 2026-27)														
DSC @ 4 credits	Fundamentals of Molecular Biology	26CBTM402DS01	2	0	2	04	2	0	4	06	15	35	50	100
Semester III (Session 2027-28)														
DSC @ 4 credits	Recombinant DNA Technology	27CBTM403DS01	2	0	2	04	2	0	4	06	15	35	50	100
Semester IV (Session 2027-28)														
DSC @ 4 credits	Plant and Animal Biotechnology	27CBTM404DS01	2	0	2	04	2	0	4	06	15	35	50	100
Semester V (Session 2028-29)														
DSC @ 4 credits	Bioinformatics and Biostatistics	28CBTM405DS01	2	0	2	04	2	0	4	06	15	35	50	100
Semester VI (Session 2028-29)														
DSC @ 4 credits	Microbial Biotechnology	28CBTM406DS01	2	0	2	04	2	0	4	06	15	35	50	100

L: Lecture; T: Tutorial; P: Practical

Note:

The Syllabi and Scheme of Examinations (SOE) for Discipline Specific Courses/Major Courses for UG Semester 7 and Semester 8 will be same as applicable for Syllabi and S.O.E. for Post Graduate semester 1 and semester 2 respectively.

Syllabi for Under Graduate Programme with Hons. in Biotechnology

Semester I

Session: 2026-27

Name of Program	**B.Sc. Life Science**	**Program Code**	**UMLS4**
Name of the Course	**Fundamentals of Biotechnology**	**Course Code**	**26CBTM401DS01**
Hours per Week	**2L+4P=6**	**Credits**	**2L+2P=4**
Maximum Marks	**100 (50 Theory** (35 EA+15 IA) **+ 50 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO 1: Understand the concepts in biotechnology
CLO 2: Gain the knowledge of tools of genetic engineering
CLO 3: Gain the knowledge of scope and applications of plant and animal biotechnology
CLO 4: Get an insight of scope and applications of biotechnology in environment, food and chemical industries

Unit 1: Introduction to biotechnology – an interdisciplinary pursuit; Main areas of application of biotechnology; Biotechnology research in India and biotechnology in context of developing world; Public perception of biotechnological products; Brief account of safety guidelines, risk assessment and ethics in biotechnology; Very brief account of intellectual property rights.

Unit 2: Introduction of genetic engineering, Nucleic acids basics and purification, basics of cloning (PCR, restriction enzymes, vectors etc.) gene and genomes, proteins and proteome, history and overview of genetic manipulations, DNA fingerprinting and forensic analysis. Potential laboratory biohazards of genetic engineering.

Unit 3: Brief account of immunotechnology: Immune system (immune cells, types of immunity and general structure and types of immunoglobulins), hybridoma technology and monoclonal antibodies. *In vitro* fertilization and embryo transfer technology in brief. Scope and applications of animal biotechnology and plant biotechnology.

Unit 4: Environmental Biotechnology: An overview, scope and market of biological control of environment. Brief account on bioremediation and waste treatment biotechnology, microbial insecticides, biofertilizers, microbes in oil recovery and bioleaching.

PRACTICALS

1. Study of working, maintenance and safety measures during handling of autoclaves.
2. To study working, maintenance/calibration and precautions during handling of pH-meter, weighing balance, microscopes, and other miscellaneous biotech lab instruments.
3. To study maintenance of hygiene/ aseptic conditions of biotech labs, instruments

and glassware /plasticwares. Study of structure and working of laminar air flow cabinets.

4. Precautions in handling of biochemicals and study of their proper disposal after use.
5. Preparation of media and different sterilization techniques (surface/ glassware/ media/ laboratory), contamination sources and decontamination measures
6. To extract genomic DNA.
7. To extract plasmid DNA from bacterial culture.
8. Polymerase Chain Reaction

References:

1. Elements of Biotechnology- PK Gupta
2. Gene Biotechnology-S.N. Jogdand
3. Biotechnology 5thEdition (Cambridge)-John E. Smith
4. Biotechnology for beginners–Reinhard Renneberg Academic Press

Name of Program	**B.Sc. Life Science**	**Program Code**	**UMLS4**
Name of the Course	**Fundamentals of Molecular Biology**	**Course Code**	**26CBTM402DS01**
Hours per Week	**2L+4P=6**	**Credits**	**2L+2P=4**
Maximum Marks	**100 (50 Theory** (35 EA+15 IA) + **50 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO 1: Acquire the knowledge and understanding of the fundamentals of molecular processes of life.
CLO 2: Analyse architecture of the genomes, genes, and the flow of genetic information
CLO 3: Exhibit knowledge of differences in fundamental molecular processes between prokaryotes and
eukaryotes
CLO 4: Understand basics of gene expression and regulation.

Unit 1: DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bidirectional replication, DNA polymerases, The replication complex: preprimimng proteins, primosome, replisome

Unit 2: DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, Homologous recombination overview.

Unit 3: RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains, Transcription in eukaryotes: Eukaryotic RNA polymerases, mechanism of transcription initiation, promoter clearance and elongation

Unit 4: Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides

PRACTICALS

1. Lab rules and safety measures.
2. Preparation of solutions and buffers for experiments.
3. Isolation of DNA from bacteria/plant/blood.
4. Quantification of DNA by UV-Visible spectroscopy.
5. Purity analysis of DNA by spectroscopy (A260/A280).
6. Isolation of Plasmid DNA by alkaline lysis method.
7. Agarose gel electrophoresis of genomic DNA & plasmid DNA.

References:

1. Molecular Biology of the Cell, Alberts, B., Johnson, A., Lewis J., Raff, M., Roberts, K., and Walter, P., Garland Science Publishing (2008).
2. The world of the Cell, Becker, W.M., Klein smith, L.J. and Hal din, J., Seventh Edition, Pearson Education (2008).
3. The Cell - A Molecular Approach (sixth edition) Cooper, Geoffrey M.

Sunderland (MA): Sinauer Associates, Inc.;2013

4. Cell and Molecular Biology: Concepts and Experiments, 5th Edition, Gerald Karp: Wiley 2007
5. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.
6. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

Name of Program	**B.Sc. Life Science**	**Program Code**	**UMLS4**
Name of the Course	**Recombinant DNA technology**	**Course Code**	**27CBTM403DS01**
Hours per Week	**2L+4P=6**	**Credits**	**2L+2P=4**
Maximum Marks	**100 (50 Theory** (35 EA+15 IA) **+ 50 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO1: Understand concept and scopes of Genetic Engineering and central role of recombinant DNA technology in all fields of Biotechnology.
CLO2: Acquire the knowledge of basic concepts and different methodologies used for isolation, purification and manipulation of nucleic acids
CLO3: Understand the concepts of various cloning tools and techniques
CLO4: Learn about the recombinant protein production and applications of genetic engineering in human welfare

Unit 1: Genetic Engineering Introduction, scope and applications, Isolation of genomic and plasmid DNA, Quantitative estimation of DNA and RNA, Primer Designing, Polymerase Chain reaction, RT-(Reverse transcription) PCR, Real time PCR, Nucleic acid blotting (Southern, Northern blotting) and hybridization techniques- In-situ hybridization, FISH.

Unit 2: Nucleic acid Modifying Enzymes: DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Methylases, Terminal deoxynucleotidy1 transferase, Reverse transcriptase, Restriction endonucleases (R.E.)- Nomenclature, types, Recognition sequence, blunt and sticky ends, applications, Ligases, Linkers, Adaptors, Homopolymer tailing.

Unit 3: Cloning Vectors; Types- Plasmid, bacteriophage, phagemid, cosmid. Plasmid Biology: Structural and Functional Organization of Plasmids, Stringent and Relaxed Plasmids, Incompatibility of Plasmid Maintenance, Artificial chromosomes (YAC, BAC, PAC), Genomic library, cDNA library.

Unit 4: Production of Recombinant proteins in bacteria: Central role of *E. coli* in genetic engineering, Construction of recombinant DNA, Preparation of competent cells, Transformation, Selection and Screening of Recombinant clones by different screening strategies (Probes, Colony and plaque hybridization) and expression of the recombinant proteins in *E. coli*. Applications of the recombinant proteins.

PRACTICALS

1. To perform plasmid isolation from *E. coli* and its quality determination by agarose gel electrophoresis
2. Isolation of genomic DNA from bacteria and plants.
3. Designing primers for PCR.
4. To perform PCR with given template and primers.
5. Demonstrate about RT-PCR
6. To perform Restriction digestion of given DNA sample.
7. Performing ligation reaction of two DNA fragments.
8. Transformation of *E. coli* with foreign DNA.

References:

1. Singh B.D. Biotechnology: Expanding Horizon (2010)3rdedition. Kalyani Publishers.
2. Gupta P.K. Biotechnology and Genomics (2013)1st Edition. Rastogi publishers
3. Clark D.V and Pazdernik, N. J Applying Genetic Revolution (2009) Academic Press
4. Gene cloning and DNA analysis–An Introduction (2015)7thedition,T.A Brown, Blackwell publisher.
5. Essential genes (2006), Benzamin Lewin, Pearson education international.
6. Genome-3(2007) T.A Brown. Garl and science, Taylor & Francis, New York.
7. Principles of gene manipulation and Genomics (2006)7th edition, S.B Primose and R.M Twyman, Blackwell publishing.
8. Principles of Genetic Engineering (2009), Mousumi Debnath, pointer publisher, Jaipur.
9. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.
10. Human Molecular Genetics (2004) 3rd edition, Tom Strachan & Andrew P Read, Garl and science.

Name of Program	**B.Sc. Life Science**	**Program Code**	**UMLS4**
Name of the Course	**Plant and Animal Biotechnology**	**Course Code**	**27CBTM404DS01**
Hours per Week	**2L+4P=6**	**Credits**	**2L+2P=4**
Maximum Marks	**100 (50 Theory** (35 EA+15 IA) **+ 50 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO 1: Students will understand the importance of Plant Tissue Culture in various aspects like ascetic culture conditions, culture media, organogenesis, somatic embryogenesis, micro-propagation
CLO 2: Students will learn the applications of plant transformation for improving the productivity and performance of plants under biotic and abiotic stresses.
CLO 3: To gain knowledge of animal cell culture fundamentals
CLO 4: To apply principles of Biotechnology concepts in veterinary sciences i.e. production of Transgenic animals, Artificial insemination, *In vitro fertilization*, Embryo transfer technology.

Unit 1: Introduction to in vitro plant culture methods, Use of growth regulators, Embryo culture, embryo rescue, wide hybridization and its applications, Introduction to Embryogenesis and Organogenesis: Principles and Practical Applications, Haploids production methods and their applications

Unit 2: Agrobacterium-Mediated Gene Delivery, Direct Gene Transfer Methods: PEG-Mediated, Electroporation, and Particle Bombardment, Cointegrate and Binary Vectors: Structure and Applications, Screenable and selectable markers, Chloroplast Transformation, Transgenic plants and their applications.

Unit 3: History of animal cell culture, culture media and equipments, primary and secondary culture, continuous cell line, suspension culture somatic cell cloning and hybridization, transfection and transformation of cell, commercial scale production of animal cell, application of animal cell culture.

Unit 4: Structure of sperm and ovum, cryopreservation of sperm and ova of livestock, artificial insemination, superovulation, in-vitro fertilization, cryopreservation, Embryo transfer technology, Transgenic animals and their applications

PRACTICALS

1. Preparation of stocks of macronutrients, micronutrients, vitamins and hormones for Murashige and Skoog medium.
2. Preparation of Murashige and Skoog medium, filter sterilization of hormones and antibiotics.
3. Surface-sterilization of seeds/explants using disinfectants like ethanol, sodium hypochlorite.
4. To extract genomic DNA from plant sample.
5. Extracting plasmid DNA from bacterial cultures for plant transformation experiments.
6. Sterilization techniques, Sources of contamination and decontamination measures in plant and animal tissue culture,

7. Preparation of Hanks Balanced salt solution
8. Preparation of Minimal Essential Growth medium
9. Isolation of lymphocytes
10. DNA isolation from tissue and quantification

References:

1. Plant Tissue Culture: Theory and Practice. S.S. Bhojwani, M.K. Razdan Elsevier.
2. Plant Biotechnology: The genetic manipulation of plants, A. Slater, N. Scott and M. Fowler, Oxford University Press, 2008.
3. Plant Biotechnology- Principles And Applications, M. Z. Abdin: Springer, 2017
4. P. K. Gupta Plant Biotechnology, Rastogi Publication, Meerut, India.
5. epgp.inflibnet.ac.in
6. Singh B. D. Biotechnology: Expanding Horizon (2010) 3rd edition. Kalyani Publishers.
7. Gupta P.K. Biotechnology and Genomics (2013)1st Edition. Rastogi publishers
8. Freshney I. Culture of Animal Cells: A Manual of Basic Technique, 5th Edition Publisher: Wiley-Liss, 2005 ISBN: 0471453293
9. Nigel Jen, Animal Cell Biotechnology: Methods and protocols, Humana Press.
10. Portner R. 2007. Animal Cell Biotechnology. Humana Press.

Name of Program	**B.Sc. Life Science**	**Program Code**	**UMLS4**
Name of the Course	**Bioinformatics and Biostatistics**	**Course Code**	**28CBTM405DS01**
Hours per Week	**2L+4P=6**	**Credits**	**2L+2P=4**
Maximum Marks	**100 (50 Theory** (35 EA+15 IA) **+ 50 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO 1: Understand the basic principles and concepts of bioinformatics
CLO 2: Concept utilization in applying bioinformatics tools to solve biological problems.
CLO 3: Learn statistical methods to analyze summarize and present data.
CLO 4: Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation

Unit 1: Overview of bioinformatics: history, scope, and detailed applications. Introduction to biological databases and data types, Bioinformatics resources (GenBank, ENA, DDBJ, UniProt, PDB etc): Understanding the structure of each source and using it on the web. Detailed Overview of NCBI.

Unit 2: Basic structural introduction of Biomolecules studied in Bioinformatics (polynucleotide, polypeptides, Gene, Protein). Format of Sequence databases, Introduction to Pairwise Sequence Analysis and Sequence alignment, Introduction and applications of Multiple sequence alignment. BLAST: Principle, analysis of results and application.

Unit 3: Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data; Measurement of central tendency (mean, mode and range); Dispersion (standard error and standard deviation); Probability and distribution. Normal, Poisson and binomial distributions.

Unit 4: Population and sampling test of significance. Test hypothesis; Student t-test for small samples. ANOVA: One-way and two-way, Chi^2 test for analysis, correlation and regression; Emphasis on examples from Biological Sciences.

PRACTICALS

1. Overview of NCBI homepage URL is:https://www.ncbi.nlm.nih.gov
2. Understanding and using on web: Genbank, Uniprot, PDB
3. Understanding and using tools at Expasy
4. Understanding and using on web: PDB
5. Visit PubMed database. Explore search based on various criteria and using Boolean Operators.
6. Using tools BLAST and interpretation of results
7. Multiple sequence alignment tool Clustal Omega
8. Measurements and sampling
9. Calculation of mean, median and mode
10. Graphical representation of data: Bar Diagrams, Scatter pots, Pie charts in Excel
11. Calculation of one-way and two-way analysis of varianceChi^2 test for analysis

References:

1. "Bioinformatics: Principles and Applications" by Zhumur Ghosh and Bibekan and

Mallick.
2. "Introduction to Bioinformatics" by S. Jawahar and S.Arumugam.
3. "Bioinformatics: A Practical Handbook" by Rashmi S.Shenoyand Ajay S.Verma.
4. "Bioinformatics: Concepts, Skills, and Applications" by Rastogi S. C.
5. "Practical Bioinformatics" by B. Jayaramand R. K. Shyamasundar.
6. "Bioinformatics For Dummies" by Jean-Michel Claverie and Cedric Notredame.
7. "Introduction to Bioinformatics" by Arthur M. Lesk
8. "Understanding Bioinformatics" by Marketa J.Zvelebil and Jeremy O. Baum.
9. "Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools" by Supratim Choudhuri
10. Introductory Biostatistics, 1st edition, (2003), Chap T. Le; John Wiley, USA.
11. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

Name of Program	**B.Sc. Life Science**	**Program Code**	**UMLS4**
Name of the Course	**Microbial Biotechnology**	**Course Code**	**28CBTM406DS01**
Hours per Week	**2L+4P=6**	**Credits**	**2L+2P=4**
Maximum Marks	**100 (50 Theory** (35 EA+15 IA) **+ 50 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO1: Understand the concepts in Microbial Technology
CLO2: Gain knowledge of the scope of industrial Microbiology
CLO3: Get an insight into scope and applications of industrially important microorganisms
CLO4: Learn the process of the formation of industrially important products

Unit 1: Microbial Biotechnology: Scopes, application and challenges. History and evolution of microbiology, Introduction to classification of microorganisms, Stains and staining procedures: Acidic, basic and neutral stains, Gram staining, Acid fast staining, Biology of industrial micro-organisms: Industrial microorganisms, growth metabolism regulation, substrate assimilation/product formation. Microbial preservations of industrial important strains.

Unit 2: Primary and secondary metabolites and their overproduction. Media for industrial fermentations. Culture media sterilization formulation for industrial purpose. Strains improvement of industrially important microbes.

Unit 3: Industrial production and uses of alcoholic beverages, Bioethanol production, Food starter cultures; Bakery, Dairy and Meat industry.

Unit 4: Microbial transformation of steroids and sterols and their applications. Microbial production of biopolymers, bioplastics, healthcare products: antibiotics and antimicrobial. Microbial production of Single-cell protein (SCP). Vaccine, Therapeutic agents.

PRACTICALS

1. Lab rules and safety measures in microbiology lab.
2. Isolation of bacteria from different sources.
3. Study of different staining methods: simple staining, Gram staining, spore staining, negative staining etc.
4. Enumeration of microorganism-total & viable count.
5. Measurement of the growth of microbial culture.
6. Pure culture of micro-organisms. Study of growth curve of bacteria.
7. Preparation of culture media for industrial strains.
8. Production and analysis of amylase.
9. Production and analysis of lactic acid.
10. Isolation of industrially important microorganism from natural resources.
11. Isolation of antibiotic producing microorganisms
12. Wine production

References:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial

Microbiology.2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. 1. Pelczar MJ, Chan ECS and Krieg NR.(1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Tortora, G.J., Funke, B.R.and Case, C.L.(2016) Microbiology: An introduction, Pearson Education.
7. Willey, J., Sherwood, L. and Woolverton, C.J. (2017 Prescott 'smicrobiology, McGraw-Hill Education