Kurukshetra University, Kurukshetra

(Established by the State Legislature Act-XII of 1956)
("A++" Grade, NAAC Accredited)

Syllabus of the Examination
for
Post Graduate Programme
in
M.Sc. Biotechnology

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF LIFE SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119

HARYANA, INDIA

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Department of Biotechnology
Kurukshetra University,
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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	1		
Name of the Course	Biomolecules		
Course Code	M24-BTY-101		
Course Type	CC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand cellular and organismal basis of living organisms. CLO 2: Evaluate the role of structure and functional relationships of various Biomolecules significant to Health of Living Beings. CLO 3: Understand application of Biomolecules at Industrial level. CLO 4: Perform structural analysis and chemical synthesis of significant Biomolecules.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Water:** Structure, hydrogen bonding, as a biological solvent, ionization and fitness of the aqueous environment for living organisms; pH; Buffers; an introduction to physiological buffers. **Carbohydrates:** Structure, occurrence and biological importance of important monosaccharides, oligosaccharides and polysaccharides; carbohydrate of Industrial importance (cane sugar, starch, gum arabica, pectin, cellulose); Glycosaminoglycans; Proteoglycans.	16
II	**Amino acids and Proteins**: Common structural features, classification by R group, Zwitter ion structures, acid-base properties and titration curves of amino acids; Essential amino acids; biologically active peptides; Classification and different structural levels (Primary, secondary, tertiary & quaternary) of proteins; Ramachandran plot. Basic introduction to terms: domains, motifs,	18

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	prion protein. Determination of amino acid sequences of proteins; Effect of amino acid sequence on the function of a protein and stability, Chemical synthesis of polypeptides.	
III	**Lipids:** Classification, structures, nomenclature of fatty acids; Essential fatty acids; Acylglycerols; Characterization of fats-Saponification value, iodine number, rancidity, acid value; Structure and properties of phospholipids and sphingolipids (sphingomyelins, cerebrosides & gangliosides); Structure and functions of prostaglandins, Prostacyclins, Thromboxanes, Leukotrienes and Sterols.	13
IV	**Nucleic Acids:** Structure and properties of purines and pyrimidine bases; Nucleosides and Nucleotides; Biologically important nucleotides; Nucleic acids as the genetic material – experimental evidences; Chargaff's rules; The covalent backbone of nucleic acids; Double helical model of DNA structure; Structural polymorphism of DNA (A, B and Z-DNA) and RNA; Denaturation & annealing of DNA; Biological functions of nucleotides; Chemical synthesis of oligonucleotides.	13
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Lehninger: Principles of Biochemistry, 7th edition, by David L. Nelson and M.M. Cox (2017) Maxmillan/Worth publishers/W.H. Freeman & Company
2. Essentials of Biochemistry, 5th edition by Satyanarayana and Chakrapani. (2019) Elsevier, India
3. Biochemistry, 5th edition, by R.H. Garrett and C.M. Grisham (2012). Michal Sabat, University of Virginia.
4. Biochemistry: Internationals edition by Jeremy M Berg, John L Tymoczko and Lubert Stryer. (2015). W.H. Freeman & Co., N.Y.
5. Biochemistry, 4 edition, by Donald Voet, Judith G. Voet (2010), John Wiley & Sons, INC
6. Chemistry of Biomolecules: An Introduction, by R. J. Simmonds. Royal Society of Chemistry

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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	1		
Name of the Course	Molecular Cell Biology		
Course Code	M24-BTY-102		
Course Type	CC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner willbe able to:	CLO 1: Acquire the knowledge and understanding of the fundamentals of molecular process of life. CLO 2: Analyse architecture of the genomes, genes, and the flow of genetic information through replication, transcription, translation. CLO 3: Correlate between signal molecules and their role in various cellular activities. CLO 4: Understand the genetic basis & causes of cancer and application of molecular biology to cancer prevention and treatment.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. Thecompulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Overview of cells and cell research:** Origin and evolution of cells, Cells as experimental models, tools of cell biology. **Fundamentals of Molecular Biology**: Heredity, Genes, and DNA, Expression of Genetic Information, Recombinant DNA, Detection of Nucleic Acids and Proteins	13
II	**Nucleus**: Nuclear envelope and traffic between the nucleusand cytoplasm, internal organization of the nucleus, nucleolus, nucleus during mitosis. **Protein Sorting and Transport**: Endoplasmic reticulum, Golgiapparatus, and Lysosomes, mechanism of vesicular transport	13
III	**DNA Replication:** DNA polymerases, replication fork, fidelity of replication, origins and initiation of replication, replication at the ends	18

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	of chromosomes. **Mutations:** nonsense, missense, frameshift and point mutations;intragenic and intergenic suppression **DNA Repair:** Direct reversal of DNA damage, excision repair, error-prone repair, recombinational repair. **RNA Synthesis and Processing:** Prokaryotic transcription, Eukaryotic transcription: RNA polymerases and transcription factors, model systems of transcriptional control: lac operon, trp operon lambda phage; promoters, enhancers, repressors, RNA processing and turnover, **Protein Synthesis, Processing and Regulation:** universal genetic code, degeneracy of codons, mechanisms of initiation, elongation and termination of translation, wobble hypothesis, Protein folding and processing, regulation of protein function, protein degradation	
IV	**Cell Signalling**: Signalling molecules and their receptors, functions of cell surface receptors, pathways of intracellular signal transduction, signal transduction and cytoskeleton, Developmental abnormalities due to defective signalling pathways, Signal transducing machinery as targets for potential drugs **Cell death and cell renewal:** programmed cell death, stem cells and maintenance of adult tissues. Embryonic stem cells and therapeutic cloning. **Cancer**: Development and causes of cancer, tumour viruses, oncogenes, tumour suppressor genes, application of molecular biologyto cancer prevention and treatment.	16
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Biology of the Cell, Alberts, B., Johnson, A., Lewis J., Raff, M., Roberts, K., andWalter, P., Garland Science Publishing (2008).
2. The world of the Cell, Becker, W.M., Klein smith, L.J. and Hal din, J., SeventhEdition, Pearson Education (2008).
3. The Cell - A Molecular Approach (sixth edition) Cooper, Geoffrey M. Sunderland (MA):Sinauer Associates, Inc.; c2013
4. Cell and Molecular Biology: Concepts and Experiments, 5th Edition, Gerald Karp: Wiley2007
5. Essentials of Molecular Biology, David Friefilder, Jones and Barllett Publications.
6. Gene VII (7th Edition) Benjamin Lewin, Oxford University Press, U.K., 2000.
7. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.) VCH Publishers, Inc., New York, 1995.
8. Molecular Biology LabFax, T.A. Brown (Ed.), Bios scientific Publishers Ltd., Oxford, 1991.
9. Molecular Biology of the Gene (4th edition), J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A. M. Weiner, The Benjamin/Cummings Publ. Co., Inc., California, 1987.
10. Molecular Biology of the Gene (7th Edition) by James D. Watson Tania A. Baker , Stephen P. Bell , Alexander Gann , Michael Levine , Richard Losick .Pearson, 2013
11. Molecular Cell Biology (4th edition) by Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. New York: W. H. Freeman; 2000.
12. Encyclopaedia of Molecular Biology, J. Kendrew, Blackwell Scientific Publications, Oxford.

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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	1		
Name of the Course	Microbiology and Biotechniques		
Course Code	M24-BTY-103		
Course Type	CC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Analyze the Scope and Importance of Microbiology, understand the microbial world, exhibit the knowledge for isolation, purification, and preservation of microbial cultures and biosafety measures. CLO 2: Distinguish various types of microbes, understand the classification strategy and describe various approaches to identify the microbes, discuss and analyze the industrial importance of microbes. Exhibit the knowledge of various sterilization techniques, analyze their use and safety measures, also understand and describe the role & action of antibiotics, disinfectants and techniques to evaluate their potency. CLO 3: Have knowledge of analytical tools and techniques of biotechnology for processing of biomaterials/products. CLO 4: Learn methods/tools of microscopy and applications of electrophoretic techniques.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Various branches and Applications of Microbiology, History and	16

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	contributions of various scientists to this science , Spontaneous generation versus biogenesis, Distinguishing features of prokaryotic and eukaryotic microbial cells, Morphology and arrangement of bacterial cells, Bacterial- flagella, fimbriae, capsule, spores and cysts, cell walls of Gram +ve and Gram –ve bacteria, Nutritional requirements and nutritional categories of microorganisms, Influence of environmental factors on microbial growth (temperature, oxygen concentration, pH, pressure, solute, light, radiations), Enrichment culture techniques for isolation of microorganisms, pure culture techniques and preservation techniques, study of growth curve, Quantitative measurement of growth.	
II	Distinguishing features of bacteria, viruses, fungi, protozoa, algae; Introduction to Microbial Classification and Taxonomy, Taxonomic ranks, Various approaches for identification of microorganisms including molecular approaches; Gram (+) and Gram (-) bacteria, fungi and algae of medical and industrial importance; Sterilization methods- dry heat, moist heat, radiations, filtration, and gaseous sterilization. Factors affecting antimicrobial action, Mode of action of antimicrobial agents, Antibiotics and their mode of action, Disinfectants and techniques to evaluate the potency of antimicrobial chemical agents, Types of toxins and their mode of action.	14
III	Bio-separation, cell disruption, extraction, purification and storage techniques: Bio-separation; Cell disruption; Purification by chromatographic techniques (Paper, Thin layer, Gel-filtration, ion-exchange, Affinity chromatography, Gas liquid chromatography, High pressure liquid chromatography, Reversed Phase chromatography); Drying; Crystallization; Storage and packaging Centrifugation Methods: Principles of Sedimentation, centrifugation techniques and their applications, differential centrifugation, density gradient and ultracentrifugation techniques.	16
IV	Electrophoresis: Concept, Factors affecting electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, PAGE, SDS-PAGE, Isoelectrofocusing, 2-Dimentional electrophoresis Microscopy: Light Microscopy – Magnification, resolving power, Numerical aperture, Limit of Resolution, Principles and applications of bright field, phase contrast, fluorescence, scanning and transmission electron microscopy.	14
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

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Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Lim, D.V. (1998) Microbiology, West Publishing Company, New York.
2. Brock, T.D. (1990) Microbiology: A text book of Industrial Microbiology, Sameur Association.
3. Tortora, G. J., Funke, B. R. and Case, C. L. (2016) Microbiology: An introduction, Pearson Education.
4. Atlas, R.M. (1998) Microbiology: Fundamental and Applications, Macmillan Publishing Company, New York.
5. Pelczar, M.J., Chan, E.G.S. and Krieg, N.R. (2007) Microbiology, McGraw Hill Inc.
6. Heritage, J., Evance, E.G.V. and Killington, R.A. (1999) Microbiology in action, Cambridge University Press
7. Willey, J., Sherwood, L. and Woolverton, C. J. (2017) Prescott's Microbiology, McGraw-Hill Education
8. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., Painter, P. R. (2005) General Microbiology, MacMillan Press Ltd.
9. Molecular Cloning: A Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000
10. Richard E. Venn (2003), Principal and Practice of Bioanalysis. Taylor and Francis.
11. Walker J. and Wilson K (2010), Principles and Techniques-Practical Biochemistry, 7th Edition, Cambridge University Press, London.
12. Slater R.J. (2002), Radioisotopes in Biology-A Practical Approach, Oxford University Press, New York
13. Sawhney, S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
14. Upadhayaye, A; Upadhyaye, K and Nath N. (2002), Biophysical Chemistry: Principles & Techniques, Himalaya Publication House, New Delhi.
15. David Sheehan, Physical Biochemistry; Principles and applications (2000): Wiley Press

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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	1		
Name of the Course	Enzyme Technology		
Course Code	M24-BTY-104		
Course Type	CC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand and analyse the importance of enzymes, classification, their salient features & categories of enzymes and exhibit the knowledge of enzyme activity- specific activity calculation, correlate the structural framework with catalytic power of enzyme. CLO 2: Describe what enzymes do and how they do and their regulation in the living system. CLO 3: Describe and analyse the factors affecting enzyme activity, exhibit the knowledge of enzyme kinetics, & describe different types of enzyme inhibitions. CLO 4: Judge the scope and importance of enzymes in various sectors, understand the various strategies for the production- purification of enzymes, and the techniques to modify and increase the stability and reusability of enzymes.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	History of Enzymology; General characteristics of enzymes; advantages of enzymes over chemical catalysts, Nomenclature and classification of enzymes, Significance of Enzyme Commission number; Determination of three dimensional structure of enzyme by	15

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	X-ray crystallography and NMR spectrometry, importance of 3-D structure of an enzyme; Classification of enzyme structures, structures adopted by enzymes, principles that govern the 3-D structure adopted by enzymes; Forces for stability of 3-D structure; Denaturation and renaturation; Isoenzymes, enzyme specificity, monomeric and oligomeric enzymes, multienzyme complex, holoenzyme, apo-enzyme, cofactor, coenzyme, prosthetic group; enzyme activity unit, turn over number and specific activity, Ribozymes and Abzymes – A brief account.	
II	Enzyme action; effect of enzyme on the rate and equilibrium of a reaction; principles that explain catalytic power and substrate specificity of enzymes; enzyme substrate complex(Lock & Key Model, Induced Fit Theory, Substrate Strain Theory), factors responsible for catalytic efficiency of enzyme; proximity and orientation effect, acid-base catalysis, covalent catalysis, strain and distortion theory; Nature of active site, identification of functional groups at active sites; regulatory enzymes- covalently modulated enzymes, allosteric enzymes and their mode of action; regulation of enzyme activity in the living system.	15
III	An introduction to enzyme kinetics and its importance, Methods used for investigating the kinetics of enzyme catalysed reactions; factors that influence the velocity of enzyme catalysed reaction(effect of substrate concentration, enzyme concentration, pH, temperature, presence of activator/inhibitor etc.); Michaelis-Menten equation, Vmax, Km and its significance; Lineweaver Burk plot- its advantages and limitations, Eadie- Hofstee and Hanes plots; enzyme inhibition, types of enzyme inhibitions- competitive, uncompetitive, non-competitive, mixed type inhibition and determination of Ki, Determination of Km and Vmax in the presence and absence of inhibitor; feed- back inhibition; Bisubstrate reactions- brief introduction to sequential and Ping-Pong mechanism with examples.	15
IV	Strategies used for enzyme production, isolation and purification at laboratory and industrial scale from plant, animal and microbial sources , method of calculating the purification fold; estimation of enzyme activity; characterization of an enzyme, criteria of enzyme purity, determination of the molecular weight (MW) and the number of sub-units of an enzyme; enzyme immobilization and its importance; protein engineering; enzyme therapy, enzyme inhibitors and drug design; enzymes as biosensors, enzyme reactors; Applications of enzymes in medicine, textile, leather, detergent, paper, bakery, dairy industry, beverage and fruit processing, food processing and preservation, clinical applications of enzyme estimation.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**

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• Class Participation:	5	Written Examination
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Segal, L.H. (1975) Enzyme Kinetics, Wiley Interscience, USA
2. Walsh, C. (1979) Enzymatic reaction mechanism, Freeman and Company, USA.
3. Gerhartz, W. (1990) Enzyme in Industry, Production and Application, VCH.
4. Shultz, A.R. (1994) Enzyme Kinetics, Cambridge Press.
5. Fresht (1995) Enzyme structure and mechanism, 2nd edition, Freeman and Company.
6. Palmer, T. and Bonner P.L. (2007) Enzymes, Woodhead Publishing Limited.
7. Dixon, M and Webb E.C. (1997) Enzymes, 3rd edition, Academic Press, New York.
8. Price N.C. and Stevens L. (2001) Fundamentals of Enzymology, Oxford University Press

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Session: 2024-25			
Part A - Introduction			
Name of the Programme	Biotechnology		
Semester	1		
Name of the Course	Lab Course based on Biomolecules and Enzyme Technology		
Course Code	M24-BTY-105		
Course Type	PC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Acquire knowledge and hands-on training of analytical tools and techniques of biotechnology & understanding of good laboratory practices. CLO 2: Learn Diagnostic, qualitative and quantitative and aspects of various biomolecules. CLO 3: Work independently and freely on enzymes, their activity estimation part, and kinetics and will be able to analyse, how enzymes activity can be affected. CLO 4: Understand the various strategies & analyse the strategy to be taken for the production-purification and immobilisation of particular enzyme. Imbibe the value of team spirit while working together in team during practical sessions.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course

	Practicals	**Contact Hours**
	Practical Exercises 1. Safety measures to be taken while handling Biochemicals. 2. Qualitative and quantitative estimation of various sugars. 3. To study enzyme inhibition potential of biomolecules against medically significant target enzymes. 4. Estimation of proteins by Biuret, Lowry and Bradford method. 5. Analysis of fats/oils – iodine number, saponification value, acid value, free fatty acids. 6. Determination of various metabolites in given biological	120

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	samples. 7. Quantitative estimation of DNA and RNA content in the given sample by coloured reaction. 8. Lab rules and safety measures to be taken in Enzyme Technology Lab. 9. Important points to remember for Enzyme Technology work 10. To estimate the quantity of protein by UV-absorption method 11. To estimate the activity of amylase enzyme in serum/urine, saliva 12. Assaying of alkaline phosphatase activity 13. To study the Time course of enzyme catalyzed reaction 14. To study the effect of substrate concentration on the activity of enzyme 15. To determine the Km and Vmax values of enzyme catalyzed reaction 16. To study the effect of enzyme concentration on the activity of enzyme 17. To determine Temperature optima for the enzyme 18. To determine pH optima for the enzyme 19. Partial purification of enzyme by change of pH, temperature, addition of organic solvents and ammonium sulphate fractionation technique and to determine the specific activity of the enzyme 20. Purification of enzyme by Adsorption/ Affinity/ Ion exchange/ gel-filtration chromatography and to determine the specific activity of the enzyme 21. Immobilization of the enzyme	

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Sawhney S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
2. Mahajan R, Sharma J and Mahajan R.K. (2010) Practical Manual of Biotechnology for students of Biochemistry, Microbiology, Biotechnology and other branches of Applied Sciences. Vayu Education of India. ISBN No.978-93-80712-22-2.

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Session: 2024-25			
Part A - Introduction			
Name of the Programme	Biotechnology		
Semester	1		
Name of the Course	Lab Course based on Molecular cell Biology; Microbiology and Biotechniques		
Course Code	M24-BTY-106		
Course Type	PC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Isolate and analyse DNA and RNA. CLO 2: Learn DNA and RNA analysis techniques. CLO 3: Handle general & specific problems while processing of experimental material and learn to devise solution by choosing appropriate methodology/biotechnique for processing & handling of biomaterials/products/ microbes. CLO 4: Exhibit the knowledge of testing the potency of antibiotics / disinfectants / antiseptics, understand the techniques for the isolation, and identification of microbial isolates. Imbibe the value of team spirit while working together in team during practical sessions.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course

Practicals	Contact Hours
Practical Exercises 1. Genomic DNA isolation from *E. coli* and blood. 2. RNA isolation from *E. coli* blood 3. Plasmid DNA isolation from *E. coli.* 4. Molecular weight determination of the DNA. 5. Spectrophotometric analysis of DNA/ RNA. 6. Determination of Tm value.	120

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	7. Plasmid purification using DNA binding membrane 8. Paper and Thin Layer Chromatography 9. Gel Filtration, Ion-exchange and Affinity Chromatography 10. Agarose gel electrophoresis and PAGE 11. Centrifugation 12. Methods for preparation of nanobioparticles 13. Lab rules and safety measures in Microbiology lab. 14. Commonly used equipment for microbial work 15. Use of bright-field microscope 16. Preparation of cotton plugs and culture media 17. Aseptic techniques 18. Sub-culturing/ Picking off technique 19. Measurement of the growth of microbial culture. 20. Study of Thermal death point and thermal death time of microbes. 21. Micrometry. 22. Growth curve of bacteria. 23. Various staining methods – Gram staining, capsule, spore, fungal staining, Acid fast staining, Negative staining etc. 24. Isolation and enumeration of micro-organisms of air, water and soil. 25. Pure culture of micro-organisms. 26. Biochemical tests useful in bacterial taxonomy. 27. Parameters for identification of unknown micro-organisms. 28. Antibiotic sensitivity test and MIC value. 29. Evaluation of disinfectants and antiseptics, evaluation of sterilization methods.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Cappuccino JG and Welsh C (2016) Microbiology-A Laboratory Manual, 11th edition, Pearson Education Limited
2. Aneja K.R. (2007) Experiments In *Microbiology*, Plant Pathology And Biotechnology. New Age International Private Limited.
3. Sawhney S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
4. Mahajan R, Sharma J and Mahajan R.K. (2010) Practical Manual of Biotechnology for students of Biochemistry, Microbiology, Biotechnology and other branches of AppliedSciences. Vayu Education Of India. ISBN No.978-93-80712-22-2.
5. Molecular Cloning: A Laboratory Manual (2000), J. Sambrook, E.F. Fritsch and T.

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Session: 2024-25	
Name of the Programme	Biotechnology
Semester	1
Name of the Course	Seminar
Course Code	M24-BTY-107
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Find out the recent areas and themes of research. CLO 2: Learn presentation and discussion skill.
Credits	Seminar
	2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters as decided by staff council of the department. There will be no external examination/viva-voce examination.	

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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	**2**		
Name of the Course	Genetic Engineering		
Course Code	M24-BTY-201		
Course Type	CC-5		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand concept and scopes of Genetic Engineering and central role of recombinant DNA technology in all fields of Biotechnology. CLO 2: Acquire the knowledge of basic concepts and different methodologies used for isolation, purification and manipulation of nucleic acids, gene cloning, transformation, selection of desired clones, protein-protein interactions, site directed mutagenesis, gene expression and regulation, and nucleic acid sequencing. CLO 3: Understand the concepts and methodology of PCR and its uses in diverse fields of life sciences. CLO 4: Work in the latest research areas of biotechnology like microbial, industrial, plant, animal, environmental, health etc. Using genetic engineering techniques.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Genetic Engineering** Introduction and scope of Genetic Engineering, Miles stones in Genetic engineering **Nucleic Acids**	16

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	Purification of total cell DNA, plasmid DNA, phage DNA, Yield Analysis, , Nucleic acid blotting and hybridization **Manipulation of purified DNA** DNA modifying enzymes- Terminal deoxynucleotidyl transferase, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Methylases Restriction Endonucleases- Host controlled restriction and modification, Nomenclature, types, Recognition sequence, blunt and sticky ends, applications. Ligases- *E. coli* and T4 DNA ligases, Linker, Adaptor, Homopolymer tailing **Gene Cloning Vectors** General features, Types of cloning vectors- Plasmid, bacteriophage, phagemid, cosmid, artificial chromosomes (YAC, BAC, PAC)	
II	**Transformation of *E. coli*** Concept, Selection of transformed cells, Identification of recombinants (bacteria and phages) **Cloning of Specific Gene** Direct selection, identification from a gene library-genomic library, cDNA synthesis and cloning-Properties of cDNA, mRNA enrichment, cDNA library. **Methods for Clone Identification** Screening strategies-Colony and plaque hybridization, Abundancy probing, Heterologous probing, Immunological screening, Differential screening, Subtractive hybridization. **Protein-Protein Interactions-**Phage display, Yeast two hybrid system, Yeast three hybrid system.	14
III	**Nucleic Acid Sequencing** DNA Sequencing: Rapid DNA sequencing techniques and strategic details of range of methodologies e.g. Dideoxyribonucleotide chain termination, Chemical degradation, Automated DNA sequencing, Thermal cycle sequencing, Pyrosequencing. **Polymerase Chain Reaction** Concept, Basic PCR reaction, Factors affecting the PCR, Types of PCR (RT- PCR, Real time PCR, Allele specific PCR, Multiplex PCR), Applications of PCR **Site Directed Mutagenesis** Oligonucleotide directed mutagenesis, PCR amplified oligonucleotide directed mutagenesis, Random mutagenesis with degenérate oligonucleotide primers / nucleotide analogs.	15
IV	**Gene expression and Regulation studies** Primer extension, S1 mapping, Gel retardation assay, Deletion analysis, Reporter genes, DNA foot printing, Modification interference assays, HRT, HART **Manipulation of gene expression in prokaryotes** Problems with production of recombinant proteins in *E coli*, optimizing expression of foreign genes in *E. coli*- Strong and	15

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	regulatory promoters, Codon usage, Fusion proteins, Increasing protein stability and secretion, Translation expression vectors, Protease deficient host strains. **Heterologous protein production in Eukaryotes** *Saccharomyces cerevisiae* and *Pistia pastoris* expression systems, Baculovirus Insect cell expression systems, Mammalian cell expression system.	
		Total Contact Hours 60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Gene cloning and DNA analysis – An Introduction (2015) 7th edition, T.A Brown, Blackwell publisher.
2. Essential genes (2006), Benzamin Lewin, Pearson education international.
3. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, NewYork.
4. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primose and R.M Twyman, Blackwell publishing.
5. Principles of Genetic Engineering (2009), Mousumi Debnath, pointer publisher, Jaipur.
6. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.
7. Human Molecular Genetics (2004) 3rd edition, Tom Strachan & Andrew P Read, Garland science.
8. Molecular Biology of Gene (2008) 6th edition, Watson, Baker, Bell. Gann, Levine and Losick, Pearson education Inc.
9. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
10. Molecular Cloning: A Laboratory Manual (2000), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York
11. DNA Cloning: A Practical Approach (1995), D.M. Glover and B.D. Hames, IRL Press, Oxford.
12. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes (1998), S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.

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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	**2**		
Name of the Course	Animal Cell & Tissue Culture		
Course Code	M24-BTY-202		
Course Type	CC-6		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Acquire potential to develop and establish and maintain an independent animal cell culture laboratory. CLO 2: Have knowledge of the maintenance and characterization of animal cell cultures. CLO 3: Explore animal cell culture for virology, cancer research, drug development and cytotoxicity testing, production of high value therapeutics as well as for various *in vitro* tests CLO 4: Develop potential for entrepreneurship and start up initiatives for industrial products of animal cell culture.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Animal cell and tissues culture**: Historical background, development, advantages and limitations of cell & tissue culture. **Requirements of cell & tissue culture:** aseptic area, incubation, preparation and sterilization, storage, specialized equipment, consumable items. **Aseptic techniques:** elements of aseptic environment, sterile handling **Culture vessels and substrates:** the substrate, choice of culture vessel, treated surfaces	14
II	**Techniques of cell culture** – batch, batch fed and continuous cultures,	14

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	cytotoxicity and viability assays, cell separation techniques, flow cytometry and fluorescence associated cell sorting. **Design and types of media:** balanced salt solutions, complete media, role of serum and supplements, serum free media: advantages and disadvantages of serum and serum free media, replacement of serum, development of serum free media.	
III	**Primary culture:** types of primary cell culture, isolation of the tissue, primary culture, **Sub-culturing of animal cells:** Subculture and propagation, Criteria for subculture, Subculture of monolayer cells, growth cycle and split ratio, propagation and subculture in suspension. **Cloning and selection:** dilution and suspension cloning, scaling up in suspension and monolayer, large scale production of cells using bioreactors, micro-carriers and perfusion techniques. **Cell line characterization**: need for characterization, authentication, cell morphology, chromosome content, DNA content, RNA and protein expression, enzyme activity, antigen markers.	18
IV	**Industrial products of animal cell cultures:** enzymes, hormones, monoclonal antibody, cytokines, tissue plasminogen activators etc. **Applications of animal cell culture:** Stem cell technology, virology, cancer research, gene therapy, drug development and cytotoxicity, animal cloning, genetic counselling, cryopreservation and cell banking	14
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Animal Cell Culture - Practical Approach (3rd edition), Ed. John R.W. Masters, Oxford, 2000.
2. Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
3. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
4. Biotechnology, Vol. 7b 1993 Rehm. H.J. and Reed, G.(eds) VCH Publications.
5. Cell Culture Lab Fax. Eds. M Butler & M. Dawson, Bios Scientific Publications Ltd. Oxford.
6. Cell Growth and Division: a Practical Approach. Ed. R. Basega, IRL Press.
7. Culture of Animal Cells, (6^{th} edition), R. Ian Freshney. Wiley-Liss, 2010.
8. Animal Cell Technology, Mukhopadhyay, A., 1st Edn, I.K. International Publishing House. 2009

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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	**2**		
Name of the Course	Plant Cell & Tissue Culture		
Course Code	M24-BTY-203		
Course Type	CC-7		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand the concepts, bio-safety measures, applications and recent knowledge of tools and techniques related to cell cultures and different modes of *in vitro* regeneration. Know how to develop and establish a PTC laboratory for small scale to industrial level. Able to communicate and write effectively on scientific principles and ideas in the field of plant tissue culture. CLO 2: Launch start-ups and become entrepreneurs in the field of micropropagation, somaclones and pathogen free plants production or other related industry. CLO 3: Attain knowledge about production of novel hybrid plants and their significance in agriculture and plant breeding. CLO 4: Learn techniques of germplasm conservation and protoplast culture and its usage in crops improvement,		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to plant cell tissue culture and historical perspective. Laboratory organization setup (R & D level and industrial level);	18

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	Aseptic manipulations and bio-safety aspects in PTC; Culture media – components, preparation and development/formulation of media for new plant system. Callus culture: characteristics, significance and limitations; Initiation and maintenance of cell cultures: static techniques of single cell culture, suspension culture and types, assessment of growth and viability of cultured cells. Organogenesis and factors influencing organogenesis. Somatic embryogenesis: process of somatic embryos production, factors influencing and its importance in plant breeding and propagation. Production of synthetic seeds.	
II	Large scale plant micropropagation – technical stages of micropropagation, factors affecting *in vitro* culture of plants (physical, chemical, genotypic and others), applications and limitations of micropropagation. Meristem and Shoot tip culture, methods of production of pathogen free plants and their limitations. Methods of indexing of virus free plants. Somaclonal variations: Genetic and epigenetic, molecular basis of variation, limitations and their significance in plant breeding.	14
III	*In vitro* production of haploid plants – Androgenesis (anther and pollen culture) and Gynogenesis, Factors affecting androgenesis, ontogeny of androgenesis, diploidization of haploid plants. Significance and uses of haploids in agriculture. Wide hybridization and embryo rescue technique.	12
IV	Protoplast culture and somatic hybridization – Isolation, culture and fusion of protoplast, selection of fusion products, assessment of somatic hybrid plants, production of cybrids, applications of protoplast culture and somatic hybridization in the improvement of crop plants. *In vitro* germplasm conservation and cryopreservation.	16
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Plant tissue culture – Theory and Practice (2005) by Bhojwani S. S. and Razdan M. K., Elsevier publication.
2. Elements of Biotechnology by P. K. Gupta, 4th Reprint (2nd Edition): 2019-2020, Rastogi pub.
3. Introduction to Biotechnology (2009) by H. S. Chawla, 3rd edition, Science publishers, USA
4. Plant cell, organ and tissue culture (1995) by Gamborg O.L. and Phillips G.C., Springer Verlag pub. Germany.

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5. Plant Tissue Culture – Basic & Applied (2005) by Jha T.B. & Ghosh B., Universities press.
6. Plant cell culture – A practical approach (1994) Dixon R.A., Gonzales R.A. Oxford University press, UK.
7. Bhojwani S.S. (2003), Agrobiotechnology & Plant Tissue Culture
8. Smith R.H. (2000), Plant Tissue Culture, Academic Press
9. Evans D.A. (2003), Plant Cell Culture, Taylor & Francis.
10. Malik Z. A., Usha K., Kamaluddin and Athar A. (2017) Plant Biotechnology: Principles and Applications. Springer Nature, Singapore.

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Session: 2024-25			
Part A - Introduction			
Name of Programme	Biotechnology		
Semester	**2**		
Name of the Course	Bioinformatics		
Course Code	M24-BTY-204		
Course Type	CC-8		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Know about basic tools and concepts of Bioinformatics and their significance in applied and basic Biology. They will also learn application of various bioinformatics tools. CLO 2: Learn role of various *in silico* tools in managing large data generated by various Biotechnological techniques and tools. CLO 3: Develop concept of sequence alignment, matrix, algorithms and tools to generate more accurate predictions of various Biological data. CLO 4: Have overview about molecular level phylogenetics, Proteomics, Genomics and Human Genome Project.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Bioinformatics and Biological Databases:** Central Dogma of molecular biology. Basics of Human Genome project. Introduction, Goal, Scope, Applications of Bioinformatics. Introduction to Biological Databases and Information Retrieval systems. Introduction to Pairwise Sequence Alignment: Evolutionary Basis, Sequence Homology versus Sequence Similarity, Sequence Similarity versus Sequence Identity, scoring matrix. Database Similarity Searching: Exhaustive and Heuristic, Basic Local Alignment Search Tool	18

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	(BLAST), FASTA. Multiple Sequence Alignment: Exhaustive Algorithms, Heuristic Algorithms. Position- Specific Scoring Matrices, Motifs and Domains, Regular Expressions, Protein Family Databases, Sequence Logos	
II	**Gene and Promoter Prediction:** Categories of Gene Prediction Programs, Gene Prediction in Prokaryotes, Gene Prediction in Eukaryotes, Promoter and Regulatory Elements in Prokaryotes, Promoter and Regulatory Elements in Eukaryotes, Prediction Algorithms. **Molecular Phylogenetics:** Molecular Evolution and Molecular Phylogenetics, Terminology, Gene Phylogeny versus Species Phylogeny, Forms of Tree Representation, Finding a True Tree. Distance-Based Methods, Character-Based Methods, Phylogenetic Tree Evaluation, Phylogenetic Programs.	14
III	**Structural Bioinformatics:** Introduction to Protein Structure Database. Protein Structural Visualization, Protein Structure Comparison, Protein Structure Classification. Methods of Secondary and tertiary Structure Prediction for Globular Proteins: Homology Modelling, Threading and Fold Recognition, *Ab Initio* Protein Structural predictions. Introduction to Drug Discovery.	14
IV	**Genomics and Proteomics:** Genome Mapping, Genome Sequence Assembly, Genome Annotation, Comparative Genomics, Functional Genomics, Sequence-Based Approaches, Microarray-Based Approaches, Comparison of SAGE and DNA Microarrays, Introduction to Proteomics, various tools and techniques, application/significance of Proteomics to mankind.	14
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Essential Bioinformatics, Jin Xiong,2006, Cambridge University Press.
2. Bioinformatics: Methods and Applications. 2013.Rastogi, Mendritta and Rastogi.Edition 4 th. PHI earnin publishers.
3. Introduction to Bioinformatics, edition 4 th Arthur M. Lesk, 2014, Oxford University Press
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition, Andreas D. Baxevanis, B. F. Francis Ouellette, 2001, Wiley- Interscience
5. Introduction to Bioinformatics, Teresa Attwood, David Parry-Smith,2016. Addison Wesley Longman ltd.
6. Bioinformatics: A Primer, Narayanam. 2005.New Age international Pub.
7. Bioinformatics: Sequence, Structure and Databanks: A Practical Approach (The Practical Approach Series, 236), Des Higgins (Editor), Willie Taylor (Editor), 2000, Oxford Univ Press.

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Session: 2024-25			
Part A - Introduction			
Name of the Programme	Biotechnology		
Semester	**2**		
Name of the Course	Lab Course based on Cell and Tissue Culture Technology		
Course Code	M24-BTY-205		
Course Type	PC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Analyses and solve various problems related to plant and animal tissue culture and will be able to setup PTC and ATC laboratory. CLO 2: Get acquainted with different tools and techniques used in Plant and animal Tissue Culture. CLO 3: Get hand on Training in different techniques of cell culturing such as media preparation, Cell isolation, suspension culture, primary culture, trypsinization, sub culturing cryopreservation of cells, various cell viability/cytotoxicity assays. CLO 4: Understand bio-safety measures related to Animal and Plant Tissue Culture.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course		
	Practicals	**Contact Hours**
	Practical Exercises 1. Components of an animal cell culture lab, aseptic techniques used in animal cell culture 2. Preparation of medium and primary cell culture 3. Staining and counting of animal cells, viability/cytotoxic/Proliferative assays in animal cells 4. Trypsinization/Disaggregation of cells 5. Estimation of lipid peroxides in cytotoxicity induced animal cells 6. Freezing and thawing of cells 7. To study the PTC laboratory organization setup. 8. Aseptic manipulations and bio-safety measures in PTC lab. 9. Preparation of MS medium stocks, hormones, autoclaving, filter	120

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	sterilization of hormones and antibiotics. 10. Preparation of Murashige and Skoog's basal and regeneration media. 11. Preparation of aseptic plant material via seed germination. 12. Callus induction using various explants. 13. Regeneration of shoots (micro-propagation), root induction, role of hormones in morphogenesis. 14. Acclimatization of tissue culture plants and establishment in pots. 15. Anther culture. 16. Protoplast isolation and culture. 17. Initiation and maintenance of cell suspension cultures of plant cells. 18. Development of synthetic seeds. 19. To study development of Somatic Emryogenesis.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. H. S. Chawla (2009) Introduction to Biotechnology, 3rd edition, Science publishers, USA.
2. Dixon R.A., Gonzales R.A. (1994) Plant cell culture – A practical approach. Oxford University press, UK.
3. Lindsey K. (2007) Plant Tissue Culture Manual. Springer (India) publication.
4. H. S. Chawla (2008) Plant Biotechnology- Laboratory Manual. Oxford & IBH publishing Co. Pvt. Ltd. India.
5. Animal Cell Culture - Practical Approach (3rd edition), Ed. John R.W. Masters, Oxford, 2000.
6. Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
7. Culture of Animal Cells, (6th edition), R. Ian Freshney. Wiley-Liss, 2010.

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Session: 2024-25			
Part A - Introduction			
Name of the Programme	Biotechnology		
Semester	2		
Name of the Course	Lab Course based on Genetic Engineering & Bioinformatics		
Course Code	M24-BTY-206		
Course Type	PC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Get acquainted with different tools and techniques used in Genetic Engineering Experiments. CLO 2: Manipulate DNA for its diverse use in different Biotechnology areas. They will be able to analyses and solve various problems related to Genetic Engineering and Bioinformatics CLO 3: Know the concept of virtual Library, format of various biological databases and Bioinformatics tools. CLO 4: Work on various computational tools for analysing, alignment, phylogenetics of biological data.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course		
Practicals		**Contact Hours**
	Practical Exercises 1. Restriction Digestion of DNA 2. Ligation of DNA fragments 3. Preparation of competent cells, Bacterial transformation 4. To perform gene amplification using PCR 5. Gene cloning in plasmid vector 6. Gene expression in *E. coli* and analysis of gene product 7. Detailed study of NCBI Homepage. 8. To perform BLAST for Nucleotide Sequence 9. To perform virtual library via NCBI 10. To perform BLAST for a protein sequence 11. To perform multiple sequence alignment via CLUSTAL 12. To perform phylogenetic analysis	120

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	13. To display PDB structure using Rasmol 14. Comparative study of the two formats: Gene Bank/ Genepept and FASTA	

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Cloning: A Laboratory Manual (2000), J. sambrook, E.F. Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York
2. DNA Cloning: A Practical Approach (1995) , D.M. Glover and B.D. Hames, IRL Press, Oxford,
3. Richard E. Venn (2003), Principal and Practice of Bioanalysis. Taylor and Francis.
4. Sawhney, S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
5. Wilson, K. and walker, J. Principles and Techniques of Biochemistry & Molecular Biology, Cambridge University Press.
6. Mahajan, R., Sharma, J. and Mahajan, R.K. (2010), Practical Manual of Biotechnology, Vayu Education of India.
7. Bioinformatics: Methods and Applications. 2013. Rastogi, Mendrifta and Rastogi. Edition 4 th. PHI earnin publishers.
8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition, Andreas D. Baxevanis, B. F. Francis Ouellette, 2001, Wiley- Interscience
9. Bioinformatics: Sequence, Structure and Databanks: A Practical Approach (The Practical Approach Series, 236), Des Higgins (Editor), Willie Taylor (Editor), 2000, Oxford Univ Press.

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Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Biotechnology**		
Semester	**2**		
Name of the Course	**Constitutional, Human and Moral values, and IPR**		
Course Code	**M24-CHM-201**		
Course Type	**CHM**		
Level of the course (As per Annexure-I	**400-499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: CLO 2: CLO 3: CLO 4:		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course (Will be available from common pool)

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Syllabus will be provided by central pool	
II		
III		
IV		
	Total Contact Hours	30

Suggested Evaluation Methods			
Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

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