R3601

Sub. Code
501301

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Biotechnology

BIOPROCESS ENGINEERING AND TECHNOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. The lag phase constitutes of _____ (CO1, K1)

   (a) No change in number, but an increase in mass

   (b) Change in number but decrease in mass

   (c) No change in number and decrease in mass

   (d) Constant number and mass

2. The association of endotoxin in gram-negative bacteria is due to the presence of _____ (CO1, K1)

   (a) Steroids

   (b) Peptidoglycan

   (c) Lipopolysaccharides

   (d) Polypeptide

3. Which of the following is an upstream process? (CO2, K2)

(a) Product recovery

(b) Product purification

(c) Media formulation

(d) Cell lysis

4. Which of the following is not a method of dry heat sterilization? (CO2, K4)

(a) Flaming (b) Hot air oven

(c) Incineration (d) Pasteurization

5. Which method relies on the gravitational settling of particles for the separation of insoluble products? (CO3, K1)

(a) Centrifugation

(b) Sedimentation

(c) Electrophoresis

(d) Filtration

6. What is the primary mechanism of separation in flocculation processes? (CO3, K1)

(a) Electrostatic attraction

(b) Mechanical agitation

(c) Ultrasonication

(d) Ion exchange

7. Which type of agitation is commonly used in stirred-tank bioreactors? (CO4, K1)

(a) Sonication

(b) Magnetic stirring

(c) Centrifugation

(d) Vortexing

8. What is the primary purpose of aeration in bioprocessing? (CO4, K2)

(a) To increase the temperature

(b) To provide oxygen for aerobic metabolism

(c) To sterilize the culture medium

(d) To speed up cell division

9. Which microorganism is commonly used in the fermentation of yogurt? (CO5, K3)

(a) *Saccharomyces cerevisiae*

(b) *Lactobacillus acidophilus*

(c) *Escherichia coli*

(d) *Bacillus subtilis*

10. Which fermentation process is used in the production of beer and wine? (CO5, K4)

(a) Acetic acid fermentation

(b) Lactic acid fermentation

(c) Alcoholic fermentation

(d) Malolactic fermentation

Part B ($5 \times 5 = 25$)

Answer **all** questions not more than 500 words each.

11. (a) Elaborate the importance of screening and maintenance strategies for industrially important microbes. (CO1, K2)

Or

(b) Discuss any two methodologies used for strain improvement in biotechnology to enhance yield and other desirable characteristics. (CO1, K1)

12. (a) Explain the significance of aeration in bioprocessing and its impact on microbial growth and product formation. (CO2, K3)

Or

(b) Give a detailed note on the heat transfer mechanism in bioprocessing. (CO2, K2)

13. (a) Write a brief note on the sedimentation process. (CO3, K3)

Or

(b) Explain in detail about the electrophoresis technique. (CO3, K3)

14. (a) Describe about the continuous culture. (CO4, K1)

Or

(b) Write an account on the water usage and recycling. (CO4, K4)

15. (a) Enumerate about the fermentation process involved in the preparation of alcoholic beverages. (CO5, K5)

Or

(b) Describe the process of converting the industrial wastes into useful products by fermentation process. (CO5, K1)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain in detail about the steps involved in the isolation of industrially important microbes. (CO1, K2)

Or

(b) Write a brief note on the microbial growth and death kinetics. (CO1, K2)

17. (a) Give an account on the measurement and control of bioprocess parameters. (CO2, K2)

Or

(b) Describe about the media formulation and optimization process. (CO2, K4)

18. (a) Elaborate on any one chromatographic technique involved in downstream processing with its significance. (CO3, K2)

Or

(b) Enumerate about the flocculation process involved in downstream processing. (CO3, K4)

19. (a) Discuss about the factors influencing the growth of microorganisms and the production of desired metabolites. (CO4, K5)

Or

(b) Illustrate the effluent treatment and its disposal method. (CO4, K5)

20. (a) Write an account on the role of microbes in the food industry with a suitable example. (CO5, K4)

Or

(b) Explain the process of production and purification of bacteriocins from lactic acid bacteria. (CO5, K5)

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R3602

Sub. Code
501302

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Biotechnology

EMERGING TECHNOLOGIES

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Which one of the following is an application of an inverted microscope? (CO1, K2)

   (a) Observing bacterial colonies on a petri dish

   (b) Examining live cell cultures in flasks

   (c) Studying the structure of minerals

   (d) Viewing thin tissue sections

2. Fluorescence lifetime is typically measured in which unit? (CO1, K4)

   (a) Seconds

   (b) Microseconds

   (c) Nanoseconds

   (d) Milliseconds

3. In an Orbitrap mass analyzer, how are ions detected? (CO2, K2)

(a) By their time of flight

(b) By their oscillation frequency

(c) By their deflection in a magnetic field

(d) By their interaction with a detector plate

4. Which method is commonly used for protein identification in shotgun proteomics? (CO2, K4)

(a) Edman degradation

(b) MALDI-TOF mass spectrometry

(c) Western blot

(d) Peptide mass fingerprinting

5. Which of the following is a limitation of high-throughput screening? (CO3, K2)

(a) It can produce a high number of false positives

(b) It cannot be used to test large compound libraries

(c) It is only applicable to genetic screens

(d) It is unsuitable for use with automated systems

6. What type of analysis would you use to study gene expression levels across different conditions? (CO3, K5)

(a) Genome sequencing

(b) Proteomics

(c) Metabolomics

(d) RNA-Seq

7. What type of crystal structure is commonly analyzed using X-ray diffraction? (CO4, K2)

(a) Amorphous solids

(b) Gaseous substances

(c) Crystalline solids

(d) Liquid crystals

8. What information can be obtained from an AFM image? (CO4, K4)

(a) Electrical properties of the sample

(b) Topography of the sample surface

(c) Thermal properties of the sample

(d) Chemical composition of the sample

9. The role of the Cas proteins in the CRISPR-Cas system is (CO5, K3)

(a) To synthesize new DNA

(b) To cleave foreign DNA

(c) To repair damaged RNA

(d) To regulate gene expression

10. Which disease was successfully treated using CRISPR-Cas9 in a landmark clinical trial in 2020? (CO5, K3)

(a) Cystic fibrosis

(b) Alzheimer's disease

(c) Sickle cell anemia

(d) Diabetes mellitus

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain the basic components and working principles of a brightfield microscope. Discuss its advantages and limitations in biological research. (CO1, K2)

Or

(b) Elucidate the principles and components of near-field microscopy with a neat sketch. (CO1, K4)

12. (a) Explain the fundamental principles of ionization in mass spectrometry. (CO2, K2)

Or

(b) Discuss how mass spectrometer can be used to determine the mass and structure of proteins? (CO2, K5)

13. (a) Mention the significance of bioinformatics analyses in understanding genomic sequences and their functions. (CO3, K2)

Or

(b) Describe different approaches and strategies used for target identification. (CO3, K4)

14. (a) State Bragg's Law and explain its significance in X-ray diffraction. (CO4, K4)

Or

(b) Differentiate between solution NMR and solid-state NMR. (CO4, K4)

15. (a) Summarize the historical milestones and significance of the discovery of CRISPR-CAS systems. (CO5, K4)

Or

(b) Discuss how Cas9 induces a site-specific double strand break at the target site, enabling precise genome editing? (CO5, K3)

Part C ($5 \times 8 = 40$)

Answer **all** questions not more than 1000 words each.

16. (a) What makes a molecule fluorescent? Describe different types of fluorescent probes used in microscopy. (CO1, K5)

Or

(b) Discuss the principles, instrumentation, applications of FLIM, FRET and FCS as advanced fluorescence microscopy techniques with neat diagram. (CO1, K2)

17. (a) How nano LC-MS is extensively used for proteomics studies? Mention its applications in analyzing contaminants and food additives. (CO2, K2)

Or

(b) Explain the fundamental principles of imaging mass spectrometry. Discuss the challenges associated with imaging mass spectrometry. (CO2, K5)

18. (a) Enumerate how high throughput screening enables the screening of large compound libraries for identifying bioactive molecules? (CO3, K2)

Or

(b) Outline the criteria that make a prediction testable. Provide examples of predictions that meet these criteria and explain why they are considered testable. (CO3, K4)

19. (a) Give an account on fundamental principles of cryo-electron microscopy. Describe the steps involved in processing cryo-EM images and reconstructing 3D structures. (CO4, K3)

Or

(b) Illustrate the principles and techniques of atomic force microscopy in imaging biological specimens with neat sketch. (CO4, K4)

20. (a) Explicate the step-by-step process of how CRISPR-Cas functions in bacterial immunity and its adaptation for genome editing. (CO5, K3)

Or

(b) Discuss the promise of CRISPR-Cas technology as a next-generation therapeutic method. Explain its potential applications, advantages, challenges and ethical considerations in clinical settings. (CO5, K2)

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R3603

Sub. Code
501304

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Biotechnology

BIO-ENTREPRENEURSHIP

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. The product life cycle and R and D cycles of Biotechnology industry compared to IT industry is usually_____. (CO1, K3)

   (a) Very short (b) Medium to long

   (c) Same (d) 6 months

2. A not-for-profit industry-academia interface to strengthen emerging Biotech enterprise (CO1, K3)

   (a) Bio-Nest

   (b) BIRAC

   (c) Atal Incubation Centres

   (d) Startup India

3. Problem identification does not help the entrepreneur to _____ (CO1, K1)

   (a) Bring out new products in the market

   (b) Identify the needs of the market

   (c) Income generation

   (d) Scanning Environment

4. Successful ideas shall be generated by _____ (CO2, K1)

(a) trend spotting

(b) waiting for appropriate time

(c) meeting successful entrepreneurs

(d) choosing the most logical one

5. An agreement between two persons to carry on a business, entered in writing (CO2, K1)

(a) Partnership Deed

(b) Consortium Agreement

(c) Void agreement

(d) Interagency Cooperation Contract

6. A pricing strategy of charging lower prices for new products to help them enter the market and gain market share. (CO2, K3)

(a) Market penetration pricing

(b) Competitive pricing

(c) Strategic pricing

(d) Skimming-the-cream pricing

7. Widening the distribution and new version of the product to increase the profit is generally made during _____ stage of the product life. (CO2, K4)

(a) Introduction (b) Growth

(c) Decline (d) Every stage

8. Which of the following regarding Business plan is INCORRECT? (CO2, K2)

(a) Helps to focus ideas and serves as a feasibility study of the business's chances for success and growth.

(b) Serves as an operational tool to define the company's present status and future possibilities.

(c) Manage the business and prepare you for success.

(d) Overlooks market survey

9. SWOT model does not include (CO3, K2)

(a) Weaknesses (b) Opportunities

(c) Strength (d) Trade

10. National Biopharma Mission to establish technology transfer offices is established by (CO3, K2)

(a) Department of Science and technology

(b) Ministry of commerce and industry

(c) Department of Biotechnology

(d) Ministry of health

Part B ($5 \times 5 = 25$)

Answer **all** the questions not more than 500 words each.

11. (a) Differentiate Entrepreneurship and Intrapreneurship. (CO1, K3)

Or

(b) List out the types of biotechnology Industries with potential for entrepreneurial revenue generation. (CO1, K4)

12. (a) What are incubators? Explain in brief the functions of an incubator. (CO1, K1)

Or

(b) Explain the role of Export Promotion Council in India. (CO1, K4)

13. (a) Discuss various aspects taken into consideration during the process of physical resource mobilization. (CO2, K2)

Or

(b) Explain the brainstorming technique of idea generation (CO2, K4)

14. (a) Narrate the difference between a firm and a partnership company. What are the statutory and legal requirements to register a firm? (CO2, K3)

Or

(b) Explain Project life cycle with suitable diagram? (CO2, K2)

15. (a) Give a note on Knowledge centers and technology transfer agencies and the different levels of knowledge and technology transfer. (CO3, K2)

Or

(b) Entrepreneurs cannot survive and grow without fulfilling the ethical responsibility of society? Explain. (CO3, K2)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1000 words each.

16. (a) Write a note on Management, Capital and technological challenges and opportunities for bioentrepreneurship in India. (CO1, K1)

Or

(b) Elaborate on the required Elements of Entrepreneurial Opportunity for a Biotech business. Justify the huge capital requirement to setup a biotech company. (CO1, K3)

17. (a) What is environment scanning and what is its significance in generating ideas? (CO1, K1)

Or

(b) Enlist the factors involved in sensing opportunities in starting up a pharmaceutical company. (CO1, K4)

18. (a) What are the types of MSMEs? What are the advantage and disadvantage of a sole proprietorship enterprise? Which type of bioenterprises is suitable for sole proprietorship? (CO2, K3)

Or

(b) Enlist the salient features of a Company. What are the benefits of a one person company. (CO2, K3)

19. (a) Construct a R & D pipeline from discovery research to clinical trials and market launch of a viral vaccine. (CO3, K5)

Or

(b) Define value chain and explain the different models for Biotechnology commercialization. (CO3, K2)

20. (a) Write a note on Licensing. What are the four key licensing strategies a biotech company can leverage from their IP portfolio? (CO3, K2)

Or

(b) Give a note on TRIPS agreement. What are the provisions in TRIPS to protect trade related intellectual property. (CO3, K2)

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R3604

Sub. Code
501305

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Biotechnology

INTELLECTUAL PROPERTY, RIGHT, BIOSAFETY AND BIOETHICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. The Doha Declaration on the TRIPS Agreement and Public Health clarified that WTO members may implement which of the following flexibilities to promote access to medicines? (CO1, K3)

   (a) Granting patent term extensions for essential drugs

   (b) Issuing compulsory licences and allowing parallel imports

   (c) Applying data exclusivity beyond the patent term

   (d) Harmonizing patent laws to international pharmaceutical standards

2. Which of the following would not be considered prior art when evaluating a patent's novelty? (CO1, K3)

(a) A journal article describing the same invention, published six months before your filing date.

(b) A poster presentation with copies publicly distributed at an academic conference before filing.

(c) An internal memo detailing the invention, shared only within the R and D department under confidentiality.

(d) A foreign patent application published three months before your filing date.

3. Under India's Geographical Indications of Goods (Registration and Protection) Act, 1999. which of the following entities is eligible to apply for registration of a geographical indication? (CO1, K3)

(a) Only individual producers with at least five years of production experience

(b) Any association of persons, producers, or an organization/authority representing the producers of the concerned goods

(c) Only government bodies and registered non-profit organizations

(d) Foreign companies holding trademarks for the geographic term

4. Which of the following is excluded from patentability under Section 3 of the Indian Patents Act, 1970? (CO2, K4)

(a) A novel chemical compound

(b) A mathematical method

(c) A pharmaceutical composition

(d) A process for manufacturing an alloy

5. Which of these organisms does NOT hold a GRAS (Generally Recognized as Safe) status? (CO2, K4)

(a) *Saccharomyces cerevisiae*

(b) *Lactococcus lactis*

(c) *Candida albicans*

(d) *Bacillus subtilis*

6. Which international agreement specifically regulates the transboundary movement of living modified organisms (LMOS)? (CO2, K3)

(a) Kyoto Protocol

(b) Cartagene Protocol on Biosafety

(c) Paris Agreement

(d) Nagoya Protocol

7. Which statutory body grants approval for large-scale open-field trials and commercial release of genetically engineered organisms in India? (CO2, K4)

(a) Review Committee on Genetic Manipulation

(b) Institutional Biosafety Committee

(c) Genetic Engineering Appraisal Committee

(d) District Level Committee

8. The Biotechnology Regulatory Authority of India Bill proposed a regulatory framework primarily for: (CO2, K3)

(a) Chemical pesticide registration

(b) Approval of genetically modified organisms and products

(c) Clinical trial oversight for all pharmaceuticals

(d) Accreditation of food testing laboratories

9. Which alternative to embryonic stem cell cloning reduces ethical concerns by reprogramming adult cells? (CO3, K2)

(a) Totipotent cell harvest

(b) Somatic Cell Nuclear Transfer

(c) Induced Pluripotent Stem Cells (iPSCs)

(d) Blastocyst complementation

10. Under bioethical guidelines, if a procedure is likely to cause pain that cannot be alleviated by medication, the researcher should: (CO3, K2)

(a) Proceed but document the pain level

(b) Provide only a mild analgesic and continue

(c) Euthanize the animal to prevent unnecessary suffering

(d) Increase observation frequency to monitor distress

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words.

11. (a) How does GI tagging help economic stability in a geographical area? (CO1, K3)

Or

(b) Evaluate how TRIPS has reshaped patent, trademark and copyright laws. (CO1, K3)

12. (a) Critically analyze the substantive patentability criteria in different jurisdictions. (CO2, K3)

Or

(b) Discuss the role of patent claim drafting and prosecution in securing robust patent protection. (CO2, K3)

13. (a) Discuss biosafety challenges associated with the controlled release of genetically modified organisms (GMOs). (CO3, K3)

Or

(b) Illustrate with examples how non-compliance to "Good Laboratory Practice" (e.g., data falsification or missing records) has undermined scientific credibility. (CO3, K3)

14. (a) Evaluate institutional structures of regulatory bodies, advisory committees on biosafety and biotechnology and their enforcement capacity. (CO4, K2)

Or

(b) Critically evaluate the policy and regulatory context that led to the drafting of the biotechnology Regulatory Authority of India Bill, 2013. (CO4, K2)

15. (a) Outline best practices for transparent reporting to stakeholders and regulatory bodies following laboratory-acquired infections or containment breaches. (CO3, K2)

Or

(b) Explore how differing cultural and religious worldviews shape public acceptance of GM crops. (CO3, K3)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words.

16. (a) An overseas nutraceutical firm seeks patents on formulations derived from a centuries-old indigenous herb. Local communities in India claim biopiracy and demand benefit sharing. Outline an essay to cover: (CO1, K3)

    (a) The role and functioning of the Traditional Knowledge Digital Library (TKDL).

    (b) Geographical Indications and suigeneris systems as tools against misappropriation.

    (c) Practical mechanisms for community-led documentation and fair benefit- sharing agreements.

Or

(b) Write a note on Patent Cooperation Treaty (PCT) system and its role in facilitating international patent protection. Outline the procedural stages involved in filing a PCT application and their strategic benefits for inventors. (CO1, K4)

17. (a) Provide, with timeline, a detailed outlook on the steps to register a Geographical Indication (GI) under the GI Act, 1999. (CO2, K4)

Or

(b) Critically evaluate the evolution of copyright exceptions and limitations in India. (CO2, K3)

18. (a) Analyze Ethical, Legal, and Social Implications of High-Containment Research. (CO2, K3)

Or

(b) Compare the prescribed containment measures and facility requirements across Biosafety Levels 1–4, highlighting key differences in laboratory design, personnel practices, and emergency procedures. (CO3, K3)

19. (a) Outline the regulatory framework for a hypothetical novel monoclonal antibody, from discovery to market entry and beyond. (CO3, K2)

Or

(b) Describe the institutional architecture–RDAC, IBSC, RCGM and GEAC–and analyse their respective roles in project approval, containment oversight, and field-trial authorisation. (CO4, K2)

20. (a) Evaluate current scope of the 3Rs principles and analyze the challenges to implement 3R in modern biomedical and toxicological studies. (CO1, K3)

Or

(b) Explore emerging frontiers—CRISPR-edited stem cells, organoid models, and exosome-based therapies—and their novel bioethical questions. (CO3, K3)

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R3605

Sub. Code
501308

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Biotechnology

LAB - VI : BIOPROCESS ENGINEERING AND TECHNOLOGY

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. What is the primary purpose of using a microscope? (CO1, K1)

   (a) To measure the weight of tiny objects

   (b) To magnify small objects

   (c) To see in the dark

   (d) To detect magnetic fields

2. Which of the following is the first step in isolating microorganisms from soil samples? (CO1, K2)

   (a) Streak plating

   (b) Serial dilution

   (c) Incubation

   (d) Gram staining

3. What type of enzyme inhibition can be overcome by increasing substrate concentration? (CO2, K2)

(a) Competitive inhibition

(b) Non-competitive inhibition

(c) Uncompetitive inhibition

(d) Mixed inhibition

4. In an enzyme assay, what is the purpose of using a buffer? (CO1, K2)

(a) To denature the enzyme

(b) To provide a substrate for an enzyme

(c) To maintain a constant pH

(d) To inhibit enzyme activity

5. What is batch fermentation? (CO1, K1)

(a) Continuous addition of nutrients

(b) A process where products are continuously removed

(c) Fermentation with no aeration

(d) A fermentation process where all ingredients are added at the start

6. Which type of reactor is commonly used for continuous fermentation? (CO1, K1)

(a) Batch reactor

(b) Fed-batch reactor

(c) Continuous stirred- tank reactor (CSTR)

(d) Packed bed reactor

7. The pore size range for microfiltration membranes typically is (CO1, K1)

(a) 0.1 to 1.5 micrometers

(b) 0.001 to 0.01 micrometers

(c) 1 to 10 micrometers

(d) 10 to 100 micrometers

8. Which bioseparation technique uses an electric field to move molecules through a gel? (CO1, K2)

(a) Ultrafiltration

(b) Electrophoresis

(c) Chromatography

(d) Centrifugation

9. What is the primary purpose of High-Performance Liquid chromatography? (CO1, K2)

(a) To separate and identify components in a mixture

(b) To measure the pH of a solution

(c) To determine the boiling point of a liquid

(d) To measure the viscosity of a solution

10. Which of the following is a common application of FPLC? (CO1, K1)

(a) DNA sequencing

(b) Protein purification

(c) Virus culture

(d) Antibiotic sensitivity testing

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain the working principle of a microplate reader. How does it detect and measure absorbance, fluorescence, and luminescence? (CO2, K3)

Or

(b) Explain the basic principle of spectrophotometry. How is the Beer-Lambert law applied in spectrophotometric analysis? (CO2, K3)

12. (a) How do temperature and pH affect enzyme activity and stability? Explain the molecular basis of these effects. (CO2, K3)

Or

(b) What are the key principles behind the development of enzyme assays? (CO2, K4)

13. (a) What are the defining characteristics of a batch process? (CO3, K2)

Or

(b) Explain the principle behind a fed-batch process. (CO3, K4)

14. (a) How does microfiltration exploit size exclusion for separating cells from a liquid medium? (CO4, K5)

Or

(b) Explain the differences between the mobile phase and the stationary phase in chromatography. (CO3, K2)

15. (a) What are the advantages and limitations of high-performance liquid chromatography (HPLC)? (CO3, K4)

Or

(b) Explain the role of the stationary phase in FPLC. What types of stationary phases are commonly used? (CO5, K5)

Part C (5 × 8 = 40)

Answer **all** the questions not more than 1000 words each.

16. (a) Describe the differences between light microscopy, electron microscopy, and fluorescence microscopy. What are the specific applications of each type? (CO2, K5)

Or

(b) Explain the steps involved in the isolation of bacteria from soil samples. (CO2, K4)

17. (a) Describe the concept of the enzyme-substrate complex. How does the formal complex influence the reaction kinetics? (CO2, K5)

Or

(b) Explain the role of enzyme kinetics in optimizing assay conditions for maximum sensitivity and specificity. (CO2, K4)

18. (a) How do environmental factors (such as energy consumption and waste management) differ between batch, fed-batch, and continuous processes? (CO3, K4)

Or

(b) Compare and contrast batch culture and continuous culture methods. What are the advantages and disadvantages of each method in studying microbial growth kinetics? (CO3, K4)

19. (a) What are the fundamental principles of microfiltration in the context of separating cells from both? (CO4, K4)

Or

(b) How can solvent extraction be used to separate biomolecules from complex mixtures? (CO4, K4)

20. (a) How would you optimize the separation of complex mixtures using GC-MS? (CO5, K5)

Or

(b) Describe the importance of column selection and optimization in chromatographic separations. (CO5, K4)

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R3606

Sub. Code
501309

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Biotechnology

LABORATORY VII - BIOINFORMATICS

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Who was one of the original authors of the BLAST sequence alignment program and directed NCBI? (CO1, K2)

   (a) Claude Pepper

   (b) Francis Collins

   (c) David Lipman

   (d) Eric Lander

2. What does the acronym BLAST stand for? (CO1, K1)

   (a) Basic Level Analysis Search Tool

   (b) Basic Local Alignment Search Tool

   (c) Bioinformatics Local Analysis Search Tool

   (d) Basic Level Alignment Search Tool

3. What is Multiple Sequence Alignment (MSA)? (CO2, K1)

(a) Alignment of two biological sequences

(b) Alignment of three or more biological sequences

(c) Alignment of one biological sequence

(d) Alignment of two or more protein structures

4. In a phylogenetic tree, what does a branch point (node) represent? (CO2, K2)

(a) The end of a lineage

(b) A common ancestor of the descendant taxa

(c) A mutation event

(d) A geographic barrier

5. Which nitrogenous base is found in RNA but not in DNA? (CO3, K1)

(a) Adenine (b) Thymine

(c) Guanine (d) Uracil

6. What feature of a primer increases the risk of non-specific amplification during PCR? (CO3, K3)

(a) High GC content

(b) Low melting temperature

(c) Presence of repetitive sequences

(d) Correct length

7. What is another name for homology modeling? (CO4, K2)

(a) Dc novo modeling

(b) Ab initio modeling

(c) Comparative modeling

(d) Threading

8. Which database provides a comprehensive collection of experimentally supported miRNA-target interactions? (CO4, K3)

(a) miRBase

(b) PubMed

(c) miRTarBase

(d) NCBI GenBank

9. What does RMSD stand for in the context of protein structure analysis? (CO4, K1)

(a) Root Mean Square Deviation

(b) Relative Molecular Size Difference

(c) Random Mutation Selection Data

(d) Ribosomal Misfolding Disorder

10. Which of the following is NOT a core research area at EMBL? (CO1, K2)

(a) Structural Biology

(b) Bioinformatics

(c) Marine biology

(d) Genomics

Part B ($5 \times 5 = 25$)

Answer **all** questions not more than 500 words each.

11. (a) What is GenBank? How does GenBank contribute to scientific research? (CO1, K2)

Or

(b) Describe the steps involved in conducting a BLAST analysis. (CO1, K2)

12. (a) Explain the significance of phylogenetic analysis in molecular biology. (CO2, K3)

Or

(b) Explain the main steps involved in conducting multiple sequence analysis of protein sequences. (CO2, K4)

13. (a) What are restriction sites and describe any two restriction site prediction tools. (CO3, K2)

Or

(b) Write a detailed note on GRAIL. (CO3, K2)

14. (a) Discuss two methods used for RNA structure prediction. (CO3, K2)

Or

(b) Comment on SCOP. (CO4, K2)

15. (a) Discuss two tools used for miRNA prediction. (CO4, K3)

Or

(b) Explain the significance of homology modelling in molecular biology. (CO4, K2)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Give a detailed account on NCBI and its resources. (CO1, K2)

Or

(b) Explain the role and significance of EMBL in the field of biotechnology and bioinforrnatics. (CO1, K2)

17. (a) What are primers? Outline the rules and steps involved in primer designing. (CO3, K3)

Or

(b) Give a detailed account on gene prediction methods. (CO3, K2)

18. (a) Give a detailed account on phylogenetic analysis of DNA sequences. (CO2,K3)

Or

(b) Give a detailed account on RNA structure prediction. (CO3, K2)

19. (a) Write a detailed note on PDB. (CO4,K3)

Or

(b) Discuss the tools for mutation and analysis of the energy minimization of proteins structures. (CO4, K3)

20. (a) Explain the process of multiple sequence alignment using ClustalW. (CO2, K3)

Or

(b) Give a detailed account on homology modelling of proteins. (CO4, K3)

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R3607

Sub. Code
501508

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2025

Third Semester

Biotechnology

Elective : VACCINES

(CBCS – 2022 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Neutrophils, basophil, lymphocytes, eosinophil and monocytes are examples of _____. (CO1, K1)

   (a) Physical barrier (b) Cellular barriers

   (c) Cytokine barriers (d) Physiological barriers

2. _____, a fluid secreted by mothers during the initial days of lactation contains nutrients that boost a baby's immune system and help fight infection. (CO1, K1)

   (a) Sebum (b) Synovia

   (c) Colostrum (d) Cerumen

3. The phagocytes can recognize pathogens by means of _____ (CO2, K2)

   (a) necrosis factor

   (b) complement activation

   (c) pattern recognition receptors

   (d) adhesion molecules

4. A rare disease congenital agammaglobulinemia is caused due to abnormality in _____ (CO2, K2)

(a) humoral antibody

(b) cell-mediated immunity

(c) acidic/alkaline pH

(d) homeostasis

5. Which of the following statement is true regarding vaccination? (CO3, K3)

(a) Vaccination is a method of immunization

(b) Vaccination is a method of passive immunization

(c) Vaccination is a method of artificial passive immunization

(d) Vaccination is a method of natural passive immunization

6. Which of the following is useful to stimulate antibody production? (CO3, K3)

(a) An adjuvant (b) A hapten

(c) Antiserum (d) Purified antigen

7. Subunit vaccine is all, Except (CO4, K2)

(a) A whole purified virus

(b) A purified part or pieces of the antigen

(c) An expensive type of vaccine

(d) A Hepatitis-B vaccine

8. Which of the following is not an example of a live attenuated vaccine? (CO4, K2)

(a) Tetanus vaccine

(b) MMR vaccine

(c) Varicella (chickenpox) vaccine

(d) Influenza vaccine

9. Which of the following type ofvaccine did the Moderna and Pfizer-BioNTech developed for COVID-19? (CO5, K5)

(a) mRNA vaccine (b) Subunit vaccine

(c) Toxoid vaccine (d) Vector-borne vaccine

10. Which of the following statement is Incorrect about the vaccine development process? (CO5, K4)

(a) A vaccine consists of live attenuated or killed germ cells

(b) Aluminum can be used as an adjuvant in a vaccine

(c) Animal trials are not necessary for vaccines before going to the human trial

(d) An effective and safe vaccine production can take up to 10 to 15 years

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Write a short note on adaptive immunity with example. (CO1, K1)

Or

(b) Write about cells of immune system. (CO1, K1)

12. (a) Write in detail about antigen presenting cells. (CO2, K2)

Or

(b) Explain the mechanism of immune response with any one bacterial infection. (CO2, K2)

13. (a) Brief account on role of cytokines in vaccination. (CO3, K3)

Or

(b) Write an account on microparticle mediated delivery system. (CO3, K3)

14. (a) Write classification of vaccines based on routes of administration. (CO4, K2)

Or

(b) Brief account on subunit vaccines. (CO4, K2)

15. (a) Discuss the Tuberculosis vaccine design. (CO5, K4)

Or

(b) Write about the developments in vaccine technologies. (CO5, K5)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain the role of B cells in activation of adaptive immunity. (CO1, K1)

Or

(b) Explain mechanism of activation of innate immunity. (CO1, K1)

17. (a) Write the mechanism involved in Cell mediated Immunity. (CO2, K2)

Or

(b) Give an account on generation of memory T and B cells. (CO2, K2)

18. (a) Explain the concept of adjuvant mediated delivery system of vaccines. (CO3, K3)

Or

(b) Explain the mechanism of induction Th1 and Th2 and its response through antigen delivery system. (CO3, K3)

19. (a) Write about conventional vaccines and its design. (CO4, K2)

Or

(b) Explain the mechanism of peptide vaccine. (CO2, K2)

20. (a) Write about the needs of vaccine with respect to emerging diseases caused by Zika. (CO5, K5)

Or

(b) Discuss in detail about mucosal vaccination. (CO5, K4)

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