Roll No.----------

प्रश्नपुस्तिका क्रमांक
Question Booklet No.

O.M.R. Serial No. | | | | | | | |

K-1377

B.Sc. (Biotech.) (Sixth Semester) Examination, 2025-26

(NEP)

(BBT6005)

BIOPROCESS TECHNOLOGY

Paper Code
BBT6005

(To be filled in the OMR Sheet)

प्रश्नपुस्तिका सीरीज
Question Booklet Series
A

Time : 1:30 Hours] **[Maximum Marks-75**

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

(Remaining instructions on the last page)

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न–पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न–पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर–शीट पर ही हल करना है, प्रश्न–पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न–पुस्तिका तथा OMR आन्सर–शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न–पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हो या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(शेष निर्देश अन्तिम पृष्ठ पर)

1. In a stirred-tank bioreactor, the impeller primarily functions to:

   (A) Regulate pH of the culture medium

   (B) Enhance mixing and oxygen mass transfer

   (C) Measure temperature continuously

   (D) Introduce microbial inoculum

2. In a bioreactor, the pH probe primarily functions to:

   (A) Regulate pH of the culture medium

   (B) Enhance mixing and oxygen mass transfer

   (C) Measure real time temperature continuously

   (D) Measure real time pH continuously

3. The origin of bioprocess technology is historically associated with:

   (A) Recombinant DNA technology

   (B) Industrial chemical reactor design

   (C) Traditional fermentation practices

   (D) Artificial intelligence-based systems

4. In fed-batch culture, substrate feeding is characterized by:

   (A) Continuous feeding with continuous product removal

   (B) Single initial substrate addition only

   (C) Controlled addition of substrate without culture removal

   (D) Simultaneous multiple feed and discharge streams

5. In batch culture, substrate feeding is characterized by :

   (A) Continuous feeding with continuous product removal

   (B) Single initial substrate addition only

   (C) Controlled addition of substrate without culture removal

   (D) Simultaneous multiple feed and discharge streams

6. The specific growth rate (μ) represents:

(A) Rate of substrate depletion per unit time

(B) Total increase in cell number

(C) Rate of biomass increase per unit biomass

(D) Duration of exponential phase

7. Under steady-state conditions, the culture system that provides maximum productivity is:

(A) Batch culture

(B) Fed-batch culture

(C) Continuous culture

(D) Static culture

8. In batch culture, if the growth of E.coli starts with single cell, then how many numbers of cells will be there after 5 generations of the growth ?

(A) 16

(B) 32

(C) 64

(D) 5

9. Exponential phase of growth is characterized by:

(A) Constant cell concentration

(B) Linear increase in biomass

(C) Maximum metabolic activity

(D) Product inhibition

10. Which term describes the constant cell concentration in batch culture?

(A) Lag density

(B) Final density

(C) Stationary phase

(D) Biomass yield

11. Which of the following phases in a batch culture is associated with nutrient depletion?

(A) Lag phase

(B) Log phase

(C) Stationary phase

(D) Exponential phase

12. In continuous culture, dilution rate (D) is defined as:

(A) Rate of cell death per unit time

(B) Rate of product formation

(C) Volumetric flow rate divided by reactor volume

(D) Difference between growth and decay rates

13. Fed-batch culture is especially useful when?

(A) A secondary metabolite is the product

(B) Fast exponential growth is required

(C) Cells are easily washed out

(D) Nutrients are toxic at high concentration

14. The primary objective of using continuous culture systems is to:

(A) Reduce contamination

(B) Achieve high product purity

(C) Maintain cells in exponential growth phase

(D) Inhibit growth

15. Which microbial culture type provides the most control over specific growth rate?

(A) Continuous culture

(B) Fed-batch culture

(C) Batch culture

(D) Static culture

16. The Monod equation describes the relationship between:

(A) Temperature and enzyme activity

(B) Substrate concentration and growth rate

(C) Time and biomass concentration

(D) Oxygen transfer and pressure

17. Which growth phase is ideal for harvesting primary metabolites?

(A) Lag phase

(B) Stationary phase

(C) Log phase

(D) Death phase

18. In fermentation, biomass yield refers to:

(A) The amount of product obtained

(B) Ratio of biomass produced to substrate consumed

(C) Amount of oxygen used

(D) Rate of product formation

19. The death phase in microbial growth is characterized by:

(A) Decrease in viable cell count

(B) Balanced cell growth

(C) Abundant nutrient availability

(D) Increased enzyme synthesis

20. During the lag phase, microbial cells exhibit:

(A) Constant cell number with decreasing biomass

(B) Constant cell number with increasing cellular mass

(C) Constant biomass and cell number

(D) Maximum cell number with declining biomass

21. Real-time monitoring of microbial growth is commonly performed using:

(A) ELISA

(B) Spectrophotometric measurement of optical density

(C) Autoclaving

(D) Refractometry

22. A major limitation of batch fermentation is:

(A) Low contamination risk

(B) Easy scale-up

(C) Osmotic stress to growing cells

(D) High product consistency

23. In exponential growth, the number of cells increases:

(A) Linearly

(B) Steadily

(C) Logarithmically

(D) Constantly

24. A fed-batch system is more suitable for processes where:

(A) All nutrients must be added at once

(B) High oxygen transfer rate is not required

(C) Substrate inhibition needs to be avoided

(D) No agitation is possible

25. The yield coefficient (Yx/s) represents:

(A) Biomass formed per unit substrate consumed

(B) Substrate consumed per unit product formed

(C) Product formed per unit time

(D) Biomass formed per unit time

26. Which of the following is a *batch culture* characteristic?

(A) Continuous input and output

(B) Steady-state growth

(C) Closed system with limited nutrients

(D) Real-time feedback control

27. The sequence of events in a biotechnical process to produce a product will be:

(A) Upstream, Downstream and Fermentation

(B) Upstream, Fermentation and Downstream

(C) Fermentation, Upstream and Downstream

(D) Downstream, Fermentation and Upstream

28. A sparger in a fermentation vessel functions to:

(A) Inject nutrients

(B) Remove gases

(C) Provide aeration by dispersing air

(D) Control agitation

29. Which vessel type is most suitable for low shear-sensitive cells?

(A) Stirred tank reactor

(B) Airlift reactor

(C) Packed bed reactor

(D) Cyclone column

30. Cyclone columns are commonly used in:

(A) Aeration and cell separation

(B) Protein extraction

(C) Aeration and cell separation

(D) Gas chromatography

31. Packed tower reactors are most effective when used with:

(A) Free-floating cells

(B) Immobilized enzymes or cells

(C) High-pressure systems

(D) Light-sensitive cultures

32. Which part of a bioreactor is directly involved in oxygen transfer?

(A) Cooling jacket

(B) Foam breaker

(C) Sparger

(D) Drain valve

33. Upstream processing includes all of the following *except*:

(A) Media preparation

(B) Inoculum development

(C) Sterilization

(D) Product purification

34. The term ‘inoculum’ refers to:

(A) The starting culture used for fermentation

(B) Sterile tubing in the reactor

(C) A device for monitoring temperature

(D) The foaming agent

35. Airlift bioreactors use the following to circulate medium:

(A) Mechanical stirrer

(B) Baffles

(C) Gas flow

(D) Pumps

36. Which of the following is an advantage of airlift reactors over stirred tanks?

(A) Better for high viscosity fluids

(B) Lower shear stress

(C) Higher maintenance costs

(D) Require external agitation

37. Sterilization of bioprocess media is essential to:

(A) Improve product flavor

(B) Maintain process temperature

(C) Prevent contamination

(D) Accelerate foam formation

38. The term “upstream processing” typically ends with:

(A) Media formulation

(B) Product recovery

(C) Fermentation

(D) Biomass harvesting

39. Which of the following is used for inoculum development in industrial setups?

(A) Laminar flow cabinet

(B) Shaker flasks and seed fermentors

(C) Column chromatography

(D) PCR

40. A foam breaker in a bioreactor is used to:

(A) Sterilize the vessel

(B) Improve mixing

(C) Prevent overflow due to foam

(D) Maintain oxygen levels

41. In media sterilization, which method is commonly used in industrial bioreactors?

(A) Dry heat

(B) Filtration

(C) Autoclaving (steam sterilization)

(D) UV treatment

42. Culture/production vessels must be designed to:

(A) Limit oxygen supply

(B) Resist corrosion and pressure

(C) Maintain acidic pH

(D) Promote back-contamination

43. An ideal bioreactor design aims to maximize:

(A) Shear stress

(B) Power consumption

(C) Mass transfer and productivity

(D) Vessel weight

44. A packed tower is primarily used for:

(A) Cell harvesting

(B) Solid-liquid separation

(C) Gas-liquid mass transfer

(D) Antibiotic production

45. A key advantage of using a cyclone column reactor is:

(A) High energy demand

(B) Effective solid-gas separation

(C) Poor oxygenation

(D) Low product yield

46. The oxygen transfer rate (OTR) in a bioreactor is influenced by:

(A) Stirring speed

(B) Type of inoculum

(C) Culture age only

(D) Media color

47. A good inoculum must be:

(A) Aged and slow-growing

(B) Contaminated for variability

(C) Physiologically active and pure

(D) Highly diluted

48. The goal of upstream processing is to:

(A) Minimize aeration

(B) Inactivate the enzymes

(C) Prepare the system for successful fermentation

(D) Filter the product

49. Airlift bioreactors do not require:

(A) Agitators

(B) Baffles

(C) Spargers

(D) Gas flow

50. The main difference between stirred and airlift bioreactors is in:

(A) Sterility

(B) Mode of oxygen supply

(C) Culture medium

(D) Type of inoculum

51. In aerobic bioprocesses, molecular oxygen is primarily required to:

(A) Support oxidative metabolism and cellular respiration

(B) Maintain pH stability of the medium

(C) Stabilize intracellular enzymes

(D) Prevent microbial contamination

52. The volumetric mass transfer coefficient, commonly used to describe oxygen transfer efficiency, is denoted as:

(A) Km

(B) Vmax

(C) V/Vm

(D) KLa

53. Which of the following parameters significantly influences the volumetric mass transfer coefficient (KLa) in a bioreactor?

(A) Agitation speed and mixing intensity

(B) Temperature of the medium

(C) Oxygen solubility in the liquid phase

(D) All of these

54. Oxygen transfer in liquid fermentation systems primarily depends on:

(A) Chemical composition of the substrate

(B) Gas-liquid interfacial area and concentration gradient of oxygen

(C) Size of microbial cells

(D) Final product concentration

55. A higher KLa value in a bioreactor indicates:

(A) Reduced oxygen availability to cells

(B) Enhanced efficiency of oxygen transfer into the culture medium

(C) Decrease in microbial growth rate

(D) Lower mechanical energy input

56. Which parameter is most directly used to monitor oxygen availabifity and demand in a bioprocess in real time?

(A) Biological oxygen demand (BOD)

(B) Total organic carbon (TOC)

(C) Chemical oxygen demand (COD)

(D) Dissolved oxygen (DO) concentration

57. The primary purpose of agitation in a bioreactor is to:

(A) Sterilize the medium

(B) Cool the system

(C) Enhance oxygen and nutrient distribution

(D) Increase pressure

58. In anaerobic bioreactors, which gas is commonly sparged to maintain oxygen-free conditions?

(A) Nitrogen

(B) Carbon dioxide

(C) Air or oxygen

(D) Methane

59. Computer-aided process control in bioprocessing is primarily used for:

(A) Reducing fermentation time only

(B) Automated monitoring and control of critical process parameters

(C) Replacing biological systems with mechanical systems

(D) Inducing genetic mutations in microorganisms

60. In bioreactor control systems, pH is most commonly regulated by:

(A) Bubbling carbon dioxide gas

(B) Controlled addition of acid or base solutions

(C) Exposure to ultraviolet radiation

(D) Adjusting temperature conditions

61. Mass transfer limitation can lead to:

(A) Higher product yield

(B) Enhanced heat transfer

(C) Oxygen starvation in cells

(D) Cell size reduction

62. Which component monitors temperature in a bioreactor?

(A) Spectrophotometer

(B) Thermocouple or RTD sensor

(C) Flow meter

(D) Conductivity probe

63. Which type of control system uses feedback to maintain a set value?

(A) Batch control

(B) Open-loop control

(C) Feedback (closed-loop) control

(D) Manual override

64. The gas-liquid mass transfer in bioreactors is often enhanced by:

(A) Using smaller bubbles via spargers

(B) Reducing stirrer speed

(C) Increasing reactor height only

(D) Reducing temperature

65. Dissolved oxygen sensors usually work based on:

(A) Refractometry

(B) Fluorescence quenching or polarography

(C) Colorimetry

(D) Heat dissipation

66. Which of the following instruments is used to measure oxygen transfer rate?

(A) pH meter

(B) Rotameter

(C) Conductivity meter

(D) Clark-type electrode

67. What is the typical unit of KLa in a bioprocess?

(A) g/L

(B) h^{-1}

(C) % per minute

(D) mM/hr

68. An example of a bioprocess parameter controlled using PID controllers is:

(A) Cell morphology

(B) Nutrient formula

(C) Dissolved oxygen level

(D) Genetic sequence

69. Which of the following best defines mass transfer in bioprocesses?

(A) Transport of signals

(B) Movement of solutes or gases between phases

(C) Enzyme transformation

(D) Heating and cooling

70. The mass transfer coefficient (kL) depends on:

(A) Reactor pressure

(B) Presence of antibiotics

(C) Light exposure

(D) Mixing and diffusion rate

71. A rise in temperature generally:

(A) Reduces microbial activity

(B) Increases oxygen solubility

(C) Increases oxygen demand and decreases solubility

(D) Stops mass transfer

72. The effectiveness of oxygen transfer can be limited by:

(A) Low pH

(B) Large bubble size

(C) High inoculum volume

(D) Product formation

73. Which parameter is not usually automated in a standard bioreactor control system?

(A) pH

(B) DO

(C) Viscosity

(D) Temperature

74. Alcoholic fermentation is primarily carried out by yeast species known as:

(A) *Saccharomyces cerevisiae*

(B) *Zymomonas mobilis*

(C) *Aspergillus niger*

(D) Lactobacillus plantarum

75. Which of the following enhances both mixing and oxygen transfer?

(A) Cooling coils

(B) Sparger and impeller

(C) Foam breaker

(D) Drain valve

76. Downstream processing refers to:

(A) Upstream culture development

(B) Genetic engineering

(C) Product recovery and purification

(D) Media preparation

77. The first step in downstream processing is usually:

(A) Drying

(B) Chromatography

(C) Cell harvesting or broth clarification

(D) Crystallization

78. Which of the following is not typically a downstream processing step?

(A) Inoculum development

(B) Filtration

(C) Extraction

(D) Purification

79. A common method for cell separation is:

(A) Fermantation

(B) Chromatography

(C) Centrifugation

(D) Lyophilization

80. Which method is commonly used for protein purification?

(A) Distillation

(B) Ion exchange chromatography

(C) Evaporation

(D) Lyophilization

81. Single Cell Proteins (SCPs) are rich in:

(A) Lipids

(B) Vitamins

(C) Polysaccharides

(D) Proteins

82. Ethanol is typically produced by the fermentation of sugars using:

(A) *Pseudomonas*

(B) *Bacillus*

(C) Both of these

(D) None of these

83. Amylase is an enzyme that breaks down:

(A) Lipids

(B) DNA

(C) Starch

(D) Proteins

84. Lactic acid is industrially produced by:

(A) *Aspergillus niger*

(B) *Clostridium botulinum*

(C) *Lactobacillus species*

(D) *E. coli*

85. Effluent treatment is important in bioprocessing to:

(A) Reduce productivity

(B) Prevent contamination of media

(C) Minimize environmental hazardous impact

(D) Increase foam formation

86. Which of the following is *not* typically used in protein precipitation?

(A) Ammonium sulfate

(B) Ethanol

(C) Acetone

(D) Glucose

87. In cell disruption, which method uses mechanical force?

(A) Solvent extraction

(B) High-pressure homogenization

(C) pH denaturation

(D) Precipitation

88. A key challenge in downstream processing is:

(A) Media formulation

(B) Inoculum selection

(C) Product purification from complex mixtures

(D) Equipment sterilization

89. Which technique is used for concentrating fermentation products?

(A) Precipitation

(B) Chromatography

(C) Evoporation

(D) Inoculation

90. The purpose of effluent treatment is to remove:

(A) Media components

(B) Microbial biomass

(C) Toxic and hazardous substances

(D) Product precursors

91. In bioprocess industries, effluent discharge must comply with standards established by:

(A) Environmental regulatory authorities

(B) Food safety laboratories

(C) World Health Organization exclusively

(D) Patent regulatory bodies

92. In downstream processing, "clarification" refers to:

(A) Sterilization of fermentation broth

(B) Removal of suspended solids via filtration or centrifugation

(C) Enhancement of microbial metabolism

(D) Addition of nutrients to medium

93. In a typical downstream processing sequence, the final step involves:

(A) Broth clarification

(B) Product purification

(C) Product formulation and stabilization

(D) Solvent extraction

94. Which of the following is a highly efficient industrial method for drying microbial biomass?

(A) Ultraviolet drying

(B) Spray drying

(C) Chromatographic drying

(D) Solvent evaporation drying

95. Which fermentation-derived product is commonly associated with probiotic formulations?

(A) Amylase enzyme

(B) Single Cell Protein (SCP)

(C) Lactic acid and lactic acid bacteria

(D) Ethanol

96. Effluent with high Biological Oxygen Demand (BOD) indicates:

(A) Low organic load and clean water

(B) High level of biodegradable organic matter and microbial activity

(C) Presence of radioactive contaminants

(D) High salinity of water

97. In downstream processing of proteins, the most commonly employed initial recovery method is:

(A) Ultraviolet irradiation

(B) Liquid-liquid extraction

(C) Precipitation (e.g., salting out)

(D) Dry heat sterilization

98. Lactic acid fermentation is metabolically classified as:

(A) Aerobic respiration

(B) Anaerobic fermentation

(C) Photoautotrophic metabolism

(D) Thermophilic metabolism

99. In industrial ethanol fermentation, the primary carbon source utilized by microorganisms is:

(A) Glucose

(B) Sucrose

(C) Both glucose and sucrose

(D) No defined carbon source

100. Single Cell Protein (SCP) production commonly utilizes which group of microorganisms as biomass sources?

(A) Algae

(B) Yeasts

(C) Bacteria and filamentous fungi

(D) All of these

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Rough Work / रफ कार्य

4. Four alternative answers are mentioned for each question as – A, B, C & D in the question booklet. The candidate has to choose the correct answer and mark the same in the OMR Answer-Sheet as per the direction :

Example :

Question :

Q. 1 (A) ● (C) (D)

Q. 2 (A) (B) ● (D)

Q. 3 (A) ● (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.
6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.
7. Before writing anything on the OMR Answer Sheet, all the Instructions given in it should be read carefully.
8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.
9. There will be no negative marking.
10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.
11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.
12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

Impt. On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question booklet, then after showing it to the invigilator, get another question booklet of the same series.

4. प्रश्न–पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर– A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से एक सही उत्तर छाँटना है। उत्तर को OMR आन्सर–शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

उदाहरण :

प्रश्न :

प्रश्न 1 (A) ● (C) (D)

प्रश्न 2 (A) (B) ● (D)

प्रश्न 3 (A) ● (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उत्तर निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
6. सभी उत्तर केवल ओ. एम. आर. उत्तर–पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर–पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
7. ओ. एम. आर. उत्तर–पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।
8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न–पुस्तिका ले जा सकते हैं।
9. निगेटिव मार्किंग नहीं है।
10. कोई भी रफ कार्य, प्रश्न–पुस्तिका के अन्त में, रफ–कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।
11. परीक्षा–कक्ष में लॉग–बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।
12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्ण : प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न–पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न–पुस्तिका प्राप्त कर लें।