Roll No. .....

Question Booklet Number

O. M. R. Serial No.

M. Sc. (Biochemistry) (Fourth Semester) EXAMINATION, 2025-26

(Old Syllabus Effective from 2022)

(Only Back Paper Students)

BIOCHEMICAL ENGINEERING AND FERMENTATION TECHNOLOGY

Paper Code							
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Questions Booklet Series
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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.

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 हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page) **(शेष निर्देश अन्तिम पृष्ठ पर)**

(Only for Rough Work)

1. Fermentation is defined as :

(A) Oxidation of glucose

(B) Reduction of glucose

(C) Conversion of sugars into alcohol/acid by microorganisms

(D) Protein synthesis

2. Yield coefficient ($Y_{x/s}$) represents :

(A) Product formed per substrate

(B) Biomass formed per substrate consumed

(C) Substrate consumed per biomass

(D) Oxygen consumed per biomass

3. The main limitation in large-scale fermentation is :

(A) Oxygen transfer

(B) Temperature

(C) pH

(D) Cost

4. Aseptically means :

(A) Sterile handling

(B) Heating

(C) Cooling

(D) Mixing

5. Contamination leads to :

(A) Increased yield

(B) Product loss

(C) Better growth

(D) No effect

6. The residence time is :

(A) Volume/flow rate

(B) Flow rate/volume

(C) Time/volume

(D) Biomass/time

7. Washout occurs when :

(A) $D > \mu$

(B) $\mu > D$

(C) $D = 0$

(D) $\mu = 0$

8. Bioprocess control includes :

(A) pH control

(B) Temperature control

(C) DO control

(D) All of the above

9. Feedback control uses :

(A) Past data

(B) Current error

(C) Future prediction

(D) Random data

10. Feedforward control is based on :

(A) Disturbance prediction

(B) Error

(C) Feedback

(D) Output only

11. The main objective of fermentation is :

(A) Waste removal

(B) Product formation

(C) Heat generation

(D) Oxygen consumption

12. Scale-down models are used for :

(A) Laboratory study of large-scale issues

(B) Industrial production

(C) Sterilization

(D) Mixing

13. The lag phase is characterized by :

(A) Rapid cell division

(B) No cell division but metabolic activity

(C) Cell death

(D) Constant growth

14. The most important nutrient limitation in fermentation is often :

(A) Carbon

(B) Nitrogen

(C) Oxygen

(D) Minerals

15. Which fermenter is used for viscous media ?

(A) Airlift fermenter

(B) Stirred tank fermenter

(C) Packed bed reactor

(D) Fluidized bed reactor

16. Oxygen transfer rate (OTR) depends on :

(A) Agitation

(B) Aeration

(C) Surface area

(D) All of the above

17. The stationary phase occurs when :

(A) Nutrients are abundant

(B) Growth equals death rate

(C) Cells are not active

(D) Temperature decreases

18. Downstream processing refers to :

(A) Sterilization

(B) Fermentation

(C) Product recovery and purification

(D) Inoculum preparation

19. Foam formation in fermenters is controlled by :

(A) Antifoaming agents

(B) Enzymes

(C) Buffers

(D) Antibiotics

20. The dilution rate (D) is defined as :

(A) Volume/time

(B) Flow rate/volume

(C) Biomass/time

(D) Substrate/time

21. Fed-batch fermentation involves :

(A) Continuous removal

(B) Constant removal

(C) No nutrient addition

(D) Periodic addition of nutrients of cells

22. The death phase is due to :

(A) Excess nutrients

(B) Toxic product accumulation

(C) High oxygen

(D) Low agitation

23. The main organism used in ethanol fermentation is :

(A) *E. coli*

(B) *Aspergillus niger*

(C) *Saccharomyces cerevisiae*

(D) *Bacillus subtilis*

24. The main purpose of agitation is to :

(A) Increase pH

(B) Improve mixing and oxygen transfer

(C) Decrease temperature

(D) Kill microorganisms

25. Airlift fermenters are advantageous because :

(A) High shear stress

(B) Low energy consumption

(C) High contamination

(D) Complex design

26. The term 'bioreactor' refers to :

(A) Vessel for biological reactions

(B) A chemical reactor

(C) Storage tank

(D) Heating system

27. Which parameter affects enzyme activity in fermentation ?

(A) Temperature

(B) pH

(C) Substrate concentration

(D) All of the above

28. In continuous culture, cells are :

(A) Removed continuously

(B) Not removed

(C) Killed

(D) Frozen

29. The primary metabolite is produced during :

(A) Lag phase

(B) Log phase

(C) Stationary phase

(D) Death phase

30. Secondary metabolites are produced during :

(A) Log phase

(B) Lag phase

(C) Stationary phase

(D) Death phase

31. The purpose of a sparger in a fermenter is to :

(A) Mix nutrients

(B) Supply air/oxygen

(C) Control pH

(D) Remove foam

32. The Reynolds number indicates :

(A) Heat transfer

(B) Oxygen level

(C) Flow pattern (laminar/turbulent)

(D) pH level

33. The most important factor in scaling up fermentation is :

(A) Color of medium

(B) Oxygen transfer

(C) Vessel shape only

(D) Microbial size

34. Batch fermentation is characterized by :

(A) Continuous addition of nutrients

(B) Recycling of cells

(C) Removal of product continuously

(D) No addition/removal during process

35. Immobilized cell systems are used to :

(A) Increase contamination

(B) Enhance reuse of cells

(C) Decrease yield

(D) Kill cells

36. The pH in fermentation is controlled using :

(A) Buffers or acid/base addition

(B) Temperature

(C) Pressure

(D) Oxygen

37. The main carbon source in fermentation media is :

(A) Nitrogen

(B) Glucose

(C) Oxygen

(D) Minerals

38. The main nitrogen source is :

(A) Ammonium salts

(B) Glucose

(C) Oxygen

(D) Water

39. The term ‘inoculum’ refers to :

(A) Final product

(B) Starter culture

(C) Waste

(D) Medium

40. Aseptic conditions are necessary to :

(A) Increase contamination

(B) Prevent contamination

(C) Increase temperature

(D) Reduce agitation

41. The maintenance coefficient represents :

(A) Growth rate

(B) Oxygen level

(C) Substrate used for maintenance

(D) pH change

42. The doubling time is inversely related to :

(A) Growth rate

(B) pH

(C) Temperature

(D) Substrate

43. Oxygen solubility decreases with :

(A) Increase in temperature

(B) Decrease in temperature

(C) Increase in pressure

(D) Increase in agitation

44. The KLa represents :

(A) Growth rate

(B) Oxygen transfer coefficient

(C) pH constant

(D) Yield

45. The exponential phase in microbial growth is also called :

(A) Lag phase

(B) Death phase

(C) Log phase

(D) Stationary phase

46. The main disadvantage of batch culture is :

(A) High contamination

(B) Low productivity

(C) Difficult control

(D) High cost

47. The main advantage of continuous culture is :

(A) Low yield

(B) Constant product formation

(C) High contamination

(D) No control

48. The fed-batch process helps to :

(A) Avoid substrate inhibition

(B) Increase contamination

(C) Stop growth

(D) Reduce oxygen

49. Heat sterilization follows :

(A) First-order kinetics

(B) Zero-order

(C) Second-order

(D) Random

50. Foam is problematic because it :

(A) Increases oxygen

(B) Causes contamination and loss

(C) Increases yield

(D) Improves mixing

51. Baffles in fermenters are used to :

(A) Prevent vortex formation

(B) Reduce mixing

(C) Increase foam

(D) Reduce oxygen

52. Impellers are used for :

(A) Heating

(B) Mixing

(C) Cooling

(D) Sterilization

53. The Monod equation relates :

(A) Enzyme activity and pH

(B) Microbial growth rate and substrate concentration

(C) Oxygen transfer rate

(D) Temperature and growth

54. The yield coefficient $Y_{p/x}$ means :

(A) Product per biomass

(B) Biomass per product

(C) Substrate per biomass

(D) Oxygen per biomass

55. The critical oxygen concentration is :

(A) Maximum oxygen

(B) Minimum oxygen for growth

(C) Zero oxygen

(D) Excess oxygen

56. The main gas used in aerobic fermentation is :

(A) Nitrogen

(B) CO_2

(C) Oxygen

(D) Hydrogen

57. The Arrhenius equation relates :

(A) Temperature and reaction rate

(B) pH and growth

(C) Oxygen and yield

(D) Pressure and growth

58. The specific substrate consumption rate is :

(A) qs

(B) μ

(C) D

(D) KLa

59. Product inhibition leads to :

(A) Increased growth

(B) Reduced growth

(C) No change

(D) Infinite growth

60. The specific growth rate (μ) is maximum during :

(A) Lag phase

(B) Stationary phase

(C) Log phase

(D) Death phase

61. Filtration is used for :

(A) Sterilization

(B) Separation

(C) Mixing

(D) Heating

62. Centrifugation separates on the basis of :

(A) Density

(B) Temperature

(C) pH

(D) Oxygen

63. Chromatography is used in :

(A) Sterilization

(B) Purification

(C) Mixing

(D) Cooling

64. Drying methods include :

(A) Spray drying

(B) Freeze drying

(C) Both (A) and (B)

(D) None of the above

65. Lyophilization means :

(A) Heating

(B) Freeze drying

(C) Cooling

(D) Filtering

66. In a chemostat, growth rate is controlled by :

(A) Temperature

(B) pH

(C) Dilution rate

(D) Oxygen supply

67. The main purpose of sensors in bioreactors is :

(A) Decoration

(B) Monitoring parameters

(C) Heating

(D) Mixing

68. DO probe measures :

(A) pH

(B) Dissolved oxygen

(C) Temperature

(D) Pressure

69. Scale-up is based on :

(A) Geometry

(B) Oxygen transfer

(C) Power input

(D) All of the above

70. Shear stress affects :

(A) Medium

(B) Microbial cells

(C) Temperature

(D) Oxygen

71. The main disadvantage of airlift fermenter is :

(A) Poor mixing in viscous media

(B) High cost

(C) High contamination

(D) Low oxygen

72. Bubble column reactor has :

(A) No mechanical agitation

(B) High agitation

(C) No aeration

(D) No mixing

73. The key parameter in enzyme reactors is :

(A) Activity

(B) pH

(C) Temperature

(D) All of the above

74. Biofilms are :

(A) Free cells

(B) Attached cells

(C) Dead cells

(D) Enzymes

75. The maintenance energy is used for :

(A) Growth

(B) Cell survival

(C) Division

(D) Reproduction

76. Sterilization in fermentation is mainly done to :

(A) Increase product yield

(B) Remove contaminants

(C) Increase temperature

(D) Decrease pH

77. The death rate constant is denoted by :

(A) kd

(B) μ

(C) qs

(D) D

78. Heat exchangers are used for :

(A) Mixing

(B) Temperature control

(C) Sterilization

(D) Aeration

79. The fermentation medium must be :

(A) Sterile

(B) Cheap

(C) Nutrient-rich

(D) All of the above

80. Antibiotics are examples of :

(A) Primary metabolites

(B) Secondary metabolites

(C) Enzymes

(D) Proteins

81. Ethanol is a :

(A) Secondary metabolite

(B) Primary metabolite

(C) Enzyme

(D) Vitamin

82. The lag phase duration depends on :

(A) Inoculum size

(B) Medium

(C) Conditions

(D) All of the above

83. Oxygen uptake rate is :

(A) OUR

(B) OTR

(C) KLa

(D) μ

84. The heat generated in fermentation is due to :

(A) Microbial metabolism

(B) Oxygen

(C) pH

(D) Pressure

85. Bioreactor design must consider :

(A) Sterility

(B) Mixing

(C) Heat transfer

(D) All of the above

86. Turbulent flow improves :

(A) Mixing

(B) Oxygen transfer

(C) Heat transfer

(D) All of the above

87. The most commonly used sterilization method in fermentation media is :

(A) Filtration

(B) Radiation

(C) Autoclaving

(D) Dry heat

88. Laminar flow is :

(A) Smooth

(B) Chaotic

(C) Turbulent

(D) Random

89. The Reynolds number increases with :

(A) Velocity

(B) Viscosity decrease

(C) Density

(D) All of the above

90. The bioreactor must be :

(A) Leak-proof

(B) Sterile

(C) Controlled

(D) All of the above

91. Fermentation temperature depends on :

(A) Microorganism

(B) Product

(C) Medium

(D) All of the above

92. Exothermic reactions :

(A) Absorb heat

(B) Release heat

(C) No heat

(D) Neutral

93. Cooling systems are needed because fermentation is :

(A) Endothermic

(B) Exothermic

(C) Neutral

(D) Slow

94. The yield is affected by :

(A) Substrate

(B) Oxygen

(C) pH

(D) All of the above

95. The growth yield coefficient is :

(A) $Y_{x/s}$

(B) $Y_{p/x}$

(C) μ

(D) D

96. Product formation kinetics may be :

(A) Growth-associated

(B) Non-growth-associated

(C) Mixed

(D) All of the above

97. Which microbial enzyme is widely used in cheese production during fermentation ?

(A) Invertase

(B) Rennin (Chymosin)

(C) Amylase

(D) Pectinase

98. In the Monod equation, Ks represents :

(A) Maximum growth rate

(B) Substrate concentration at half μmax

(C) Yield coefficient

(D) Maintenance coefficient

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

(A) Volume of culture/flow rate

(B) Flow rate/volume of culture

(C) Biomass/volume

(D) Substrate/biomass

100. The Monod equation relates microbial growth rate to :

(A) Temperature

(B) Substrate concentration

(C) pH

(D) Oxygen concentration

(Only for Rough Work)

4. Four alternative answers are mentioned for each question as—A, B, C & D in the 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 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, उन्हें 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।