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)

INDUSTRIAL BIOCHEMISTRY

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)**

1. The unit used to measure radiation dose in food irradiation is :

(A) Joule

(B) Volt

(C) Watt

(D) Gray (Gy)

2. Extrinsic factors affecting food preservation include :

(A) pH

(B) Nutrient composition

(C) Water activity

(D) Temperature and storage environment

3. Intrinsic factors affecting food spoilage include :

(A) pH and nutrient composition of food

(B) Storage temperature

(C) Atmospheric humidity

(D) Packaging conditions

4. Pasteurization is designed to :

(A) Sterilize food completely

(B) Eliminate pathogenic microorganisms while preserving quality

(C) Remove all enzymes

(D) Increase shelf-life indefinitely

5. Water activity (aw) is a critical factor in food preservation because it :

(A) Determines colour stability

(B) Controls microbial growth and enzymatic reactions

(C) Determines fat content

(D) Influences only texture

6. Hydrogenation of vegetable oils is industrially performed to :

(A) Increase unsaturation

(B) Reduce viscosity only

(C) Enhance protein content

(D) Convert unsaturated fatty acids into saturated fats

7. Lipid peroxidation in food systems leads to :

(A) Increased nutritional value

(B) Development of rancidity and off-flavors

(C) Stabilization of fats

(D) Increased moisture content

8. Food irradiation is an effective preservation method because it primarily :

(A) Denatures proteins irreversibly

(B) Causes DNA damage in microorganisms, preventing replication

(C) Removes oxygen from food systems

(D) Enhances enzymatic activity

9. Non-enzymatic browning differs from enzymatic browning because it :

(A) Is purely chemical and independent of enzyme activity

(B) Requires enzymes like polyphenol oxidase

(C) Occurs only at low temperatures

(D) Requires microbial activity

10. The Maillard reaction, a key non-enzymatic browning process in foods, involves the interaction between reducing sugars and :

(A) Lipids

(B) DNA bases

(C) Amino groups of proteins or amino acids

(D) Minerals

11. Downstream purification using chromatography is based on differences in :

(A) Size, charge, or affinity

(B) Temperature

(C) Pressure

(D) Volume

12. Genetic engineering improves industrial strains by :

(A) Reducing yield

(B) Enhancing productivity and specificity

(C) Decreasing stability

(D) Increasing contamination

13. Cellulases are important in biofuel industries because they :

(A) Degrade proteins

(B) Break DNA

(C) Oxidize lipids

(D) Convert cellulose into fermentable sugars

14. Centrifugation separates particles based on differences in :

(A) Charge

(B) Molecular weight only

(C) Density under centrifugal force

(D) pH

15. Cheese production involves microbial fermentation that primarily results in :

(A) Oxidation of fats

(B) Conversion of lactose to lactic acid

(C) Protein synthesis

(D) Lipid polymerization

16. One of the major challenges during scale-up of bioprocesses is :

(A) Oxygen transfer limitations

(B) Maintaining sterility

(C) pH control

(D) Temperature measurement

17. Biopesticides are advantageous because they :

(A) Persist longer in environment

(B) Are eco-friendly and target-specific

(C) Increase toxicity

(D) Accumulate in food chain

18. Amylases catalyze the breakdown of :

(A) Cellulose
(B) Lipids
(C) Starch into sugars
(D) Proteins

19. Sonication is commonly used for :

(A) Sterilization of media
(B) Mechanical disruption of cells
(C) Filtration of broth
(D) Product drying

20. Ethanol fermentation is primarily carried out by :

(A) *Escherichia coli*
(B) *Aspergillus niger*
(C) *Bacillus subtilis*
(D) *Saccharomyces cerevisiae*

21. Biofertilizers contribute to soil fertility mainly by :

(A) Increasing soil temperature
(B) Enhancing nutrient availability (e.g., nitrogen fixation)
(C) Reducing water content
(D) Increasing pesticide levels

22. Secondary metabolites such as antibiotics are typically produced :

(A) During stationary phase under nutrient limitation
(B) During exponential growth phase
(C) Only in anaerobic conditions
(D) Only in genetically modified organisms

23. Lipases catalyze reactions involving :

(A) Hydrolysis of peptide bonds
(B) RNA polymerization
(C) DNA cleavage
(D) Hydrolysis of ester bonds in lipids

24. Nisin, widely used in food preservation, belongs to the class of :

(A) Bacteriocins with antimicrobial activity
(B) Enzymes
(C) Hormones
(D) Lipids

25. Polyhydroxybutyrate (PHB) is best described as :

(A) A storage polysaccharide
(B) A biodegradable polyester
(C) A protein polymer
(D) A lipid molecule

26. Xanthan gum production is industrially carried out using :

(A) Saccharomyces cerevisiae
(B) Bacillus subtilis
(C) Xanthomonas campestris
(D) Aspergillus niger

27. Proteases are extensively used in detergent formulations because they :

(A) Hydrolyze starch

(B) Oxidize lipids

(C) Break down protein-based stains

(D) Degrade DNA

28. Gene dosage effect in recombinant strains primarily influences :

(A) Protein folding

(B) Number of gene copies leading to increased expression

(C) mRNA degradation

(D) Ribosomal activity

29. The initial step in downstream processing typically involves :

(A) Product crystallization

(B) Product packaging

(C) Chromatographic purification

(D) Cell separation (e.g., centrifugation)

30. Overproduction of industrial metabolites such as amino acids is often achieved through :

(A) Use of wild-type strains

(B) Gene amplification and metabolic engineering

(C) Nutrient starvation

(D) Low aeration conditions

31. In a chemostat, if dilution rate (D) exceeds the maximum specific growth rate (μmax), the system will result in :

(A) Stable biomass concentration

(B) Increased product formation

(C) Washout of cells

(D) Stationary phase

32. A higher kLa value in bioreactors is desirable because it :

(A) Decreases oxygen solubility

(B) Increases viscosity

(C) Reduces biomass growth

(D) Enhances oxygen transfer rate

33. Non-Newtonian behaviour in fermentation broths arises mainly because :

(A) Presence of dissolved gases

(B) Interaction of microbial cells and polymers affecting viscosity

(C) Temperature fluctuations

(D) pH variation

34. The stationary phase in batch culture is primarily due to :

(A) Excess substrate availability

(B) Nutrient depletion and waste accumulation

(C) High oxygen concentration

(D) Low cell density

35. Hydraulic conductivity is an important parameter in packed bed systems and refers to :

(A) Ease of fluid flow through porous media

(B) Heat transfer capability

(C) Biomass productivity

(D) Oxygen solubility

36. Metabolic flux analysis (MFA) provides insights into :

(A) Gene expression levels

(B) Enzyme kinetics only

(C) Distribution of metabolic pathway fluxes

(D) Protein folding mechanisms

37. Stoichiometric coefficients in biochemical reactions are used to :

(A) Determine reaction rate constants

(B) Represent molar relationships among reactants and products

(C) Estimate enzyme activity

(D) Measure oxygen demand

38. Maintenance energy in microbial systems is defined as energy required for :

(A) Cell division and DNA replication

(B) Cellular homeostasis and survival without growth

(C) Protein synthesis only

(D) Secondary metabolite production

39. Increasing agitation speed in a stirred tank reactor primarily affects :

(A) Substrate concentration

(B) pH control mechanisms

(C) Biomass yield directly

(D) Oxygen transfer and mixing efficiency

40. A fermenter has kLa = 180 h^{-1}, saturation DO (C*) = 9 mg/L, and actual DO (CL) = 3 mg/L. Calculate the oxygen transfer rate (OTR).

(A) 900 mg/L/h

(B) 1080 mg/L/h

(C) 720 mg/L/h

(D) 540 mg/L/h

41. During gas-liquid mass transfer in fermenters, the major resistance is generally attributed to :

(A) Liquid film resistance surrounding bubbles

(B) Gas-phase diffusion

(C) Solid-liquid interface

(D) Reactor wall interactions

42. Fed-batch fermentation is widely used in industrial biotechnology primarily because it :

(A) Eliminates oxygen transfer limitations

(B) Prevents substrate inhibition and catabolite repression

(C) Ensures constant biomass concentration

(D) Reduces reactor volume requirements

43. The biomass yield coefficient (Yx/s) is an important stoichiometric parameter. What does a higher Yx/s value indicate ?

(A) More substrate is consumed per unit biomass

(B) Increased product formation

(C) Efficient conversion of substrate into biomass

(D) Higher maintenance energy requirement

44. The Monod equation describes microbial growth kinetics. Which statement best reflects its limitation ?

(A) It assumes substrate inhibition at all concentrations

(B) It ignores maintenance energy requirements

(C) It applies only to anaerobic systems

(D) It includes temperature dependency explicitly

45. Reynolds number is a dimensionless parameter used to characterize fluid flow. Which regime is typically associated with Re > 4000 in bioreactors ?

(A) Laminar flow

(B) Transitional flow

(C) Turbulent flow

(D) Static fluid condition

46. In an ideal plug flow reactor (PFR), which assumption is fundamentally valid for modeling biochemical reactions ?

(A) Complete radial and axial mixing

(B) No concentration gradient along reactor length

(C) No axial mixing with concentration gradient along flow direction

(D) Instantaneous reaction kinetics

47. In a chemostat, steady-state is achieved when :

(A) Dilution rate exceeds μmax

(B) Growth rate equals dilution rate

(C) Substrate concentration becomes zero

(D) Biomass concentration declines continuously

48. A pseudoplastic (shear-thinning) fluid such as a microbial broth shows which rheological behavior under increasing shear stress ?

(A) Viscosity increases proportionally

(B) Viscosity remains constant

(C) Viscosity decreases due to structural breakdown

(D) No change in flow characteristics

49. The volumetric oxygen transfer coefficient (kLa) is a critical parameter in aerobic fermentations. Which combination of factors most significantly enhances kLa in stirred tank reactors ?

(A) Increased viscosity and low agitation

(B) High aeration rate and vigorous agitation

(C) Low temperature and low pressure

(D) High biomass concentration only

50. In a continuous bioreactor operating under steady-state conditions, the accumulation term in the mass balance equation becomes negligible. Which of the following correctly describes this condition ?

(A) Input equals output with no net accumulation

(B) Biomass growth rate is zero

(C) Substrate concentration remains constant only in batch systems

(D) Oxygen transfer is absent

51. Drug-receptor interaction is best explained by :

(A) Lock-and-key model

(B) Fluid mosaic model

(C) Central dogma

(D) Induced mutation

52. Drug metabolism generally increases :

(A) Lipophilicity

(B) Water solubility

(C) Stability

(D) Toxicity

53. Drug distribution is influenced by :

(A) Blood flow

(B) Lipid solubility

(C) Protein binding

(D) All of the above

54. A drug dose of 400 mg with bioavailability of 0.25 results in systemic availability of :

(A) 50 mg

(B) 100 mg

(C) 150 mg

(D) 200 mg

55. Drug antagonism occurs when :

(A) Two drugs enhance each other

(B) Both drugs act independently

(C) One drug reduces the effect of another

(D) No interaction occurs

56. Enzyme induction results in :

(A) Reduced metabolism

(B) Increased drug metabolism

(C) No change

(D) Toxicity

57. MIC (Minimum Inhibitory Concentration) represents :

(A) Minimum drug concentration inhibiting microbial growth

(B) Maximum inhibition

(C) Minimum induction

(D) None of the above

58. Clearance of a drug refers to :

(A) Absorption rate

(B) Volume of plasma cleared of drug per unit time

(C) Distribution

(D) Binding

59. Therapeutic index is a measure of :

(A) Drug safety margin

(B) Drug metabolism

(C) Drug absorption

(D) Drug excretion

60. Drug efficacy depends on :

(A) Dose

(B) Receptor binding

(C) Metabolism

(D) All of the above

61. Prodrugs are compounds that :

(A) Are active drugs

(B) Become active after metabolic conversion

(C) Are toxic

(D) Are enzymes

62. Phase II reactions involve :

(A) Oxidation

(B) Hydrolysis

(C) Reduction

(D) Conjugation (e.g., glucuronidation)

63. Phase I drug metabolism involves :

(A) Conjugation reactions

(B) Oxidation, reduction, hydrolysis

(C) Binding to receptors

(D) Storage

64. Biotransformation of drugs mainly occurs in :

(A) Liver

(B) Brain

(C) Heart

(D) Kidney

65. A drug has half-life of 6 hours. What fraction remains after 12 hours ?

(A) 1/2

(B) 1/4

(C) 3/4

(D) 1/8

66. Drug resistance in microbes can occur due to :

(A) Mutation

(B) Efflux pumps

(C) Enzymatic degradation

(D) All of the above

67. First-pass metabolism primarily occurs in :

(A) Kidney

(B) Heart

(C) Brain

(D) Liver

68. Bioavailability is defined as :

(A) Total drug dose

(B) Fraction of administered drug reaching systemic circulation

(C) Drug metabolism rate

(D) Drug elimination rate

69. Pharmacodynamics studies :

(A) Drug transport

(B) Drug metabolism

(C) Drug effects and mechanisms of action

(D) Drug elimination

70. Pharmacokinetics deals with :

(A) Drug effect on body

(B) Movement of drug through absorption, distribution, metabolism, excretion

(C) Drug synthesis

(D) Drug storage

71. Heavy metal removal in wastewater often uses :

(A) Adsorption and biosorption techniques

(B) Combustion

(C) Evaporation

(D) Radiation

72. Biosensors are devices that :

(A) Measure heat

(B) Detect biological or chemical substances using a biological element

(C) Detect light

(D) Detect sound

73. Landfills generate gases such as :

(A) Oxygen

(B) Hydrogen

(C) Nitrogen

(D) Methane

74. Effective biodegradation depends on :

(A) Microbial activity only

(B) Environmental factors only

(C) Substrate characteristics only

(D) All of the above

75. Septic tanks operate under :

(A) Aerobic conditions

(B) Anaerobic conditions

(C) Chemical reactions

(D) Physical processes

76. Bioleaching is used in industries to :

(A) Extract metals using microorganisms

(B) Produce proteins

(C) Degrade lipids

(D) Synthesize DNA

77. Chemical Oxygen Demand (COD) measures :

(A) Chemical oxidation of organic matter

(B) Biological oxidation

(C) Nitrogen content

(D) Carbon fixation

78. Eutrophication results from :

(A) Oxygen depletion

(B) Excess nutrient enrichment in water bodies

(C) Heat increase

(D) Light exposure

79. Phytoremediation involves :

(A) Use of bacteria

(B) Use of plants to remove pollutants

(C) Use of fungi

(D) Use of chemicals

80. Sludge digestion produces :

(A) Oxygen

(B) Nitrogen

(C) Methane and CO_2

(D) Hydrogen

81. Composting is considered an :

(A) Anaerobic process

(B) Chemical process

(C) Aerobic biodegradation process

(D) Physical process

82. Bioaugmentation refers to :

(A) Removal of microbes

(B) Addition of specific microorganisms to enhance degradation

(C) Killing microbes

(D) Increasing temperature

83. Wastewater treatment involves which stages ?

(A) Only primary

(B) Only chemical

(C) Only biological

(D) Primary, secondary, and tertiary treatment

84. Biosorption is a process in which :

(A) Pollutants are chemically oxidized

(B) Light degrades pollutants

(C) Heat removes contaminants

(D) Biological materials adsorb heavy metals

85. Anaerobic digestion of organic waste results in production of :

(A) Oxygen

(B) Methane-rich biogas

(C) Nitrogen gas

(D) Hydrogen peroxide

86. Integrated Pest Management (IPM) emphasizes :

(A) Exclusive chemical control

(B) Combination of biological, cultural, and chemical methods

(C) Only biological control

(D) Only physical removal

87. Biopesticides are preferred over chemical pesticides because they :

(A) Are biodegradable and environmentally safe

(B) Persist longer in environment

(C) Are more toxic

(D) Accumulate in food chain

88. Biological Oxygen Demand (BOD) is a measure of :

(A) Oxygen required by microbes to degrade organic matter

(B) Chemical oxidation capacity

(C) Nitrogen content

(D) Carbon dioxide production

89. The activated sludge process in wastewater treatment is primarily :

(A) Anaerobic

(B) Physical filtration

(C) Chemical oxidation

(D) Aerobic microbial degradation

90. Bioremediation is defined as the process of :

(A) Using chemicals to degrade pollutants

(B) Thermal degradation

(C) Physical removal of waste

(D) Using microorganisms to detoxify contaminants

91. Gamma irradiation used in food preservation commonly employs :

(A) UV radiation

(B) Radioisotopes such as Cobalt-60

(C) Infrared radiation

(D) Microwaves

92. Food safety regulations are primarily designed to :

(A) Improve taste

(B) Ensure consumer safety and quality standards

(C) Increase shelf life only

(D) Reduce cost

93. Freezing preserves food by :

(A) Killing all microorganisms

(B) Increasing enzymatic activity

(C) Slowing down microbial metabolism and enzymatic reactions

(D) Enhancing oxidation

94. Drying preserves food primarily by :

(A) Increasing water activity

(B) Reducing water availability for microbial growth

(C) Increasing enzyme activity

(D) Increasing oxygen levels

95. Rancidity in fats is mainly due to :

(A) Protein hydrolysis

(B) Oxidation of unsaturated fatty acids

(C) Sugar fermentation

(D) Water loss

96. Enzymatic browning in fruits is catalyzed by :

(A) Lipase

(B) Amylase

(C) Protease

(D) Polyphenol oxidase

97. The primary objective of food preservation techniques is to :

(A) Increase spoilage rate

(B) Reduce caloric value

(C) Extend shelf life and maintain safety

(D) Increase moisture content

98. Blanching of vegetables prior to freezing is carried out to :

(A) Increase microbial load

(B) Inactivate enzymes that cause spoilage

(C) Enhance oxidation

(D) Increase water activity

99. Antioxidants are added to food systems primarily to :

(A) Prevent oxidative damage to lipids

(B) Enhance microbial growth

(C) Increase protein synthesis

(D) Promote fermentation

100. Protein degradation in stored food leads to :

(A) Improved texture

(B) Spoilage and production of foul-smelling compounds

(C) Increased nutritional value

(D) Stabilization of food

(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।