Name:

Enrolment No:

UPES

End Semester Examination Dec – 2024

Program Name: BSc Microbiology **Semester : III**
Course Name: Microbial Physiology and Metabolism **Time : 3 hrs**
Course Code: HSMB2032 **Max. Marks : 100**
Nos. of page(s): 3

Instructions:

1) Answer all the questions after carefully going through the instructions.
2) Support answers with flow-charts and labelled diagrams wherever necessary.
3) **Candidates are allowed to use scientific calculator.**

S. No.	Section A Short answer questions/ MCQ/T&F (20Q x 1.5M = 30 Marks)	Marks	COs
Q 1	Identify macromolecule(s) which are most abundant in cultures of *E coli* as percentage of dry weight: (a) Polysaccharide and lipopolysaccharides (b) Proteins (c) Lipids (d) DNA and RNA	1.5	CO1
Q2	Identify the trace metal that can limit growth of phototrophs in oceans and aquatic systems: (a) Mg (b) Na (c) K (d) Fe	1.5	CO1
Q3	The pentose phosphate pathway is an example of: (a) Anabolic pathway (b) Catabolic pathway (c) Amphibolic pathway (d) Oxidative phosphorylation	1.5	CO1
Q4	Identify the strongest electron donor: (a) $FAD.H_2$ (b) O_2 (c) CH_4 (d) $NADH + H^+$	1.5	CO2

Q5	State the difference between aerobic and anaerobic respiration.	**1.5**	**CO1**
Q6	State the difference between catabolism and anabolism.	**1.5**	**CO1**
Q6	Identify (a) electron donor and (b) electron acceptor in the following redox reaction: $C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O$ + Energy	**1.5**	**CO3**
Q7	**State True or False:** Flow of electrons from O_2 to $NADH+H^+$ is spontaneous.	**1.5**	**CO3**
Q8	Define autotrophs and heterotrophs.	**1.5**	**CO1**
Q9	Mention the final electron acceptor to conserve energy during dissimilatory reduction of Fe/Mn oxides.	**1.5**	**CO4**
Q10	Identify growth factor(s) from below examples: (a) Folic acid (b) F420 and F430 (c) Riboflavin (d) All of the above	**1.5**	**CO3**
Q11	MacConkey agar is an example of: (a) Selective media (b) Differential media (c) Selective differential media (d) Defined media	**1.5**	**CO2**
Q12	Define Photoheterotrophic metabolism with an example.	**1.5**	**CO2**
Q13	An enzyme which can reduce CO_2 to glyceraldehyde 3-phosphate is _____.	**1.5**	**CO2**
Q14	State the purpose of carboxysomes in oxygenic prokaryotes.	**1.5**	**CO3**
Q15	NADPH is a coenzyme that donates hydride ions in substrate reducing reactions. Identify hydride ion from below: (a) H^- (b) H_2 (c) H^+ (d) H	**1.5**	**CO3**
Q16	Define "great plate count anomaly."	**1.5**	**CO1**
Q17	State the difference between oxygenic and anoxygenic phototrophs.	**1.5**	**CO2**
Q18	**State True or False:** Reverse TCA cycle is an example of catabolic pathway.	**1.5**	**CO3**
Q19	Define C and energy source for Chemolithoautotrophs with an example.	**1.5**	**CO3**
Q20	Define Cardinal temperatures.	**1.5**	**CO1**
Section B (4Qx5M=20 Marks)			
Q1	Describe various methods for measurements of microbial growth.	**5**	**CO2**
Q2	Explain the various microbial growth phases in a batch culture.	**5**	**CO3**

<table>
<tr><td>Q3</td><td>Discuss the oxygen requirements of mircorganisms in details with help of a labelled diagram.</td><td>5</td><td>CO2</td></tr>
<tr><td>Q4</td><td>Discuss the working principle of anaerobic culturing using Gas-Pak method with help of a labelled diagram.</td><td>5</td><td>CO4</td></tr>
<tr><td colspan="4">Section C
(2Qx15M=30 Marks)</td></tr>
<tr><td>Q 1</td><td>An experiment was performed to test the effect of temperatures on growth of bacterial strain X. Optical density (OD) of strain X growing in batch cultures was recorded at 600 nm at various time intervals and tabulated as below. Consider the grey highlighted rows in below-table as exponential phase of growth.
<table>
<tr><th>Time (Hours)</th><th colspan="3">OD @ 600 nm</th></tr>
<tr><th></th><th>37°C</th><th>55°C</th><th>65°C</th></tr>
<tr><td>0</td><td>0.2</td><td>0.2</td><td>0.2</td></tr>
<tr><td>6</td><td>0.18</td><td>0.22</td><td>0.22</td></tr>
<tr><td>12</td><td>0.18</td><td>0.25</td><td>0.28</td></tr>
<tr><td>24</td><td>0.2</td><td>0.34</td><td>0.4</td></tr>
<tr><td>36</td><td>0.25</td><td>0.45</td><td>0.55</td></tr>
<tr><td>48</td><td>0.28</td><td>0.62</td><td>0.75</td></tr>
<tr><td>60</td><td>0.25</td><td>0.82</td><td>0.88</td></tr>
<tr><td>72</td><td>0.15</td><td>0.88</td><td>0.92</td></tr>
<tr><td>96</td><td>0.1</td><td>0.92</td><td>0.98</td></tr>
</table>
(a) Explain how temperature affects growth of microrganisms. (3 Marks)
(b) Mention temperature classes of microroganisms with examples. (3 marks)
(c) Calculate specific growth rates and generation times of strain X at different temperatures and interpret the temperature requirements. (3 Marks)
(d) Discuss in detail molecular adapatations of microbial life in the cold and at high temperatures. (6 Marks)</td><td>15</td><td>CO4</td></tr>
<tr><td>Q2</td><td>(a) Describe the distinct features of the ED pathway with a schematic. (10 Marks)
(b) Compare the energetic yields of this pathway with glycolysis and comment on the archaeal variants of this pathway.(5 Marks)</td><td>15</td><td>CO3</td></tr>
<tr><td colspan="4">Section D
(2Qx10M=20 Marks)</td></tr>
<tr><td>Q1</td><td>Explain the concept of redox-tower and terminal electron acceptors with regards to degradation of organic matter in sediments.</td><td>10</td><td>CO3</td></tr>
<tr><td>Q2</td><td>Describe in detail the different phases of pentose-phosphate pathway and explain their utility for cellular metabolism.</td><td>10</td><td>CO4</td></tr>
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