NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

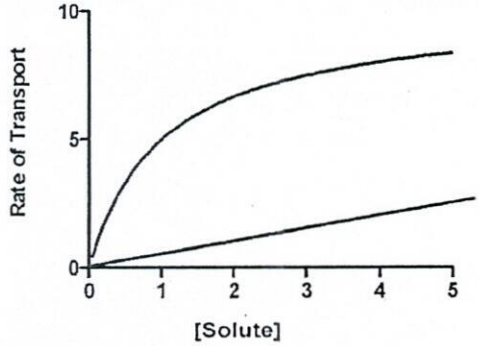
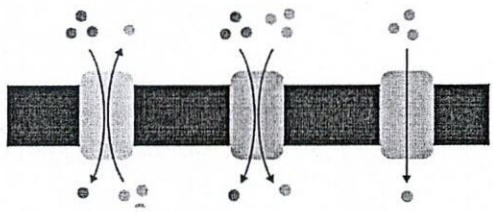
Course Code: BTC301
Course Name: CELL BIOLOGY AND GENETICS

Full Marks: 25
Time: 90 Minutes

Instructions: Attempt any 4 questions from Q2-6; Q1 is compulsory

Question No.	Body of the Question	Marks	Mapped CO
1	a) Which of the following cells do not reside in the extracellular matrix? Please check all applicable. i) Mesenchymal stem cells ii) Fibroblasts iii) adipose cells iv) Hepatocytes b) At a physiological condition; cholesterol would increase/decrease the durability and increase/decrease the permeability of the plasma membrane. c) Which subcellular fraction of mature hepatocyte would be most likely to contain the enzymes for the elongation of long chain fatty acids? i) Plasma membrane ii) Nucleus iii) Endoplasmic reticulum iv) Lysosome d) Which among the following is incorrect about vacuoles? i) Vacuoles are fluid filled membrane bound sacs ii) They consist of water and sap consisting of minerals, sugars, amino acids and proteins etc. iii) The function of vacuoles differs from one organism to other iv) Vacuoles in plants are not membrane bound and therefore they occupy most of the cell e) Arrange the following sequence of extracellular signalling in the correct order? i) Transport of signal to a target ii) Start of signal transduction pathways iii) Signalling cell synthesize and release signalling molecules iv) Binding of the signal to the specific receptor	1*5 = 5	CO1

Course Outcomes
CO1: To understand the basic organization of cells and organisms and the tools needed to study them
CO2:To understand the basic processes of the cell machinery, cell-cell interaction and the eukaryotic cell cycle.
CO3: To apply the knowledge of cell process regulation and cell cycle in understanding the use of a cell as a biological tool for manufacturing biomolecules.
CO4: To learn the fundamentals of Genetics and its applications.
CO5: To solve problems associated with genetic diseases and their transmission from one generation to the next

2	a) What do you mean by the term facilitated diffusion? How is it different from a simple diffusion? b) The graph below shows the rate of transport of a solute molecule. Which graph (s), in your opinion would better explain a facilitated diffusion and which a simple diffusion? Explain your rationale. If you do not agree with any of the graphs, also elaborate.  	2+3	CO2
3	a) In which part of the mitochondria would the electron transport chain take place? Do you expect this part of the organelle to have a higher protein or lipid content? b) Could you point out two evidence in support of the "endosymbiosis" origin theory of mitochondria?	3+2	CO1
4	a) Can you name the three types of transporters as indicated in the figure alongside? Give one example each. b) Could you explain the workings of the Na+/K+ pump? 	3+2	CO2
5	a) Explain the term catastrophe as applicable for microtubules. b) A mutation in which of the two proteins is more likely to effect the functionality of flagella – Dynein or Myosin ? Explain your rationale.	3+2	CO2
6	a) Read the following statements about intracellular receptors and point out which statement (s) are true, if any. i) They usually bind to hydrophobic ligands ii) They may be located either in the cytosol or nucleus iii) When bound to their ligand, they regulate gene expression. b) Contrast endocrine signaling with synaptic signaling.	3+2	CO2

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-term Examination, 2023-24

Course Code: BTC302 Full Marks: 25

Course Name: Microbiology & Bioprocess Technology Time: 90 Minutes

Instructions: **Answer any Two (02) questions from section – A.**
Answer any Two (02) questions from Section – B.

Qn No.	SECTION – A (Marks=13)	Marks	Mapped CO
1	What is fluorochrome? Give examples of two fluorochrome dyes. Briefly write on working principle of Fluorescence Microscope.	2+1+3.5	CO1
2	Describe the structure of bacterial cell membrane with diagram. Explain the statement – "Archaeal cell membrane is different from bacterial cell membrane".	4+2.5	CO1
3	Briefly write on bacterial conjugative plasmid and the bacterial conjugation process. What is episome? Give example of an episome.	4+1.5+1	CO1, CO3
4	What is growth factor? Name the different types of growth factors? Briefly write on Photolithoautotrophic and chemolithoautotrophic microorganisms.	1+1.5+4	CO2, CO3
	SECTION – B (Marks=12)		
5	What are industrial strains? Why is strain development important in industrial microbes? What are the precautions to be taken for production of microbial cell derived insulin?	**2+2+2**	CO4
6	What is sterilization? How does it influence the industrial production of bioproduct? Why is continuous sterilization process advantageous than the batch sterilization process?	**1.5+2+2.5**	CO4, CO5
7	How is the specific death rate related to temperature? Discuss the role of diammonium phosphate in media preparation for fermentation? An infinite time is required to achieve sterile conditions: Comment.	**2+2+2**	CO5
8	What are cryoprotective agents? Give two examples? How does it work? With example define secondary metabolites?	**1+1.5+1.5+2**	CO3, CO4

COURSE OUTCOMES

CO1: To develop knowledge on different types of microorganisms including viruses and microscopy for the visualization of microorganisms, their characteristic features as well as internal and external structures and their functions.

CO2: To impart an understanding on microbial classification and taxonomy, microbial community and interactions, microbial nutrition, nutritional types, growth media, growth in different systems, and control of microorganisms using various physical and chemical treatments including antimicrobial drugs.

CO3: To develop knowledge on microbial metabolism, energy transduction mechanisms, and microbial genetics

CO4: To acquire experimental know how of microbial production of various industrial products such as alcohol, antibiotics, amino acids, vitamins exopolysaccharides, enzymes, etc. from industrial strains.

CO5: To illustrate the upstream and downstream processing for product recovery and purification.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: BTC 303 Full Marks: 25

Course Name: BIOCHEMISTRY AND ENZYME TECHNOLOGY Time: 90 Minutes

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	The E$^{o\prime}$ values for the NAD^+/NADH and pyruvate/lactate conjugate redox pairs are -0.32 and -0.19 V respectively; a) Which conjugate pair has the greater tendency to lose electrons? Explain. b) Which is the stronger oxidizing agent. Explain. c) Beginning with 1M concentration of each reductant and product at pH 7, in which direction will the following reaction proceed? Pyruvate + NADH + H^+ $\leftrightarrow$ lactate + NAD^+ d) What is the standard free energy change ($\Delta G^{o\prime}$) at 25 ºC for the conversion of pyruvate to lactate? e) What is the equilibrium constant (K'eq) for this reaction?	0.5 0.5 1 1 1	CO1
2	What are the metabolic fates of pyruvate and mention the biological significance?	3	CO2
3	Why might such a relatively complicated molecule as ATP be selected as an energy currency in living cells?	2	CO2
4	With reference to glycolysis and gluconeogenesis, answer the following questions: a) The irreversible reactions of glycolysis along with their enzymes. b) What are the bypass steps in gluconeogenesis for these reactions? c) Write the overall equation for glycolysis and gluconeogenesis.	1.5 1.5 1	CO2
5	Write the structure of two polar amino acids?What happens if you notice a change in the type pf amino acid in the primary structure of a protein.	1+2	CO2
6	What is the starting compound for the De Novo purine biosynthesis. Name the intermediate formed which will lead to the synthesis of AMP and GMP. What is significance of Tm of DNA?	3	CO4
7	What inference can be drawn from the Ramachandran plot of a polypeptide chain .Define denaturation of protein.	2+1	CO2
8	What are the different functions of Nucleotides ? Which amino acids are involved in Nucleotide biosynthesis?	1+2	CO1

Course Outcomes
CO1: Q1,Q8
CO2: Q2,Q3,Q4, Q5,Q7
CO4: Q6

11.09.2023

NITDGP/B.TECH/Reg/Odd/2023-24

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: BTC 501

Course Name: BIOCHEMICAl REACTION ENGINEERING AND BIOREACTOR DESIGN

Full Marks: 25

Time: 90 Minutes

Instructions: Answer all the questi

Question No.	Body of the Question	Marks	Mapped CO
1	Biomass is being produced in a 1000-liter CSTR with glucose as substrate. The microbial system follows a Monod relationship with $\mu_m = 0.4/hr$, $K_s = 1.5$ g/ litre and the yield factor $Y_{X/S} = 0.5$ g biomass/ g substrate consumed. If normal operation is with a sterile feed containing 10 g/litre glucose at a rate of 100 litre/hr: What is the cell concentration and specific biomass production rate (g/litre-hr) at steady state?	5	CO3
2	Explain with examples the applications of Fed-batch culture	5	CO3
3	a) Under steady state conditions, prove that Dilution Rate is equal to Specific Growth Rate in continuous culture, state all the assumptions used. b) Discuss Substrate-Product relationship in microbial growth kinetics with examples.	3 2	CO3 CO3
4	What are the cardinal/essential rules of Bioreactor design?	5	CO4
5	a) What are the important considerations for the operation of Valves, give their characteristic features? b) Describe the material of construction of Bioreactors, give their advantages and disadvantages.	3 2	CO4 CO4

Course Outcomes

CO1:

CO2:

CO3:

12.09.23

NITDGP/BTech/Reg/Odd/2023-24 170

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: BTC502
Course Name: Cell & Tissue Culture

Full Marks: 25
Time: 90 Minutes

Instructions: Answer all the questions.

Q. No.	Questions	Marks	Mapped CO
1	What are basic differences between conventional plant breeding and genetic engineering? What are the advantages of plant genetic engineering over plant breeding?	5	CO1
2	Differentiate between the following (At least 2 differences are to be stated): (a) Caulogenesis and Rhizogenesis (b) Dedifferentiation and Redifferentiation (c) Genetic mapping vs Physical mapping (d) Major genes vs Minor genes (e) Visible markers vs Molecular Markers	5	CO1
3	How to initiate the process of identifying the source of a new gene for resistance against a particular pathogen in any given crop plant? Discuss a strategy in a stepwise manner.	2.5	CO2
4	Name 4 biological products that can be produced using animal cell culture.	2	CO1
5	Nocodazole is an anticancer drug that prevents microtubule polymerization. How will it affect cells in interphase stage of cell-cycle and why?	3	CO1
6	What do you understand by "anchorage dependent growth"? How is it regulated?	3	CO1
7	Discuss the role of sugars in ECM.	1.5	CO1
8	Fill in the blanks with appropriate word/s: a) While _____ provides the tensile strength to the epithelial cells, in connective tissue the mechanical stress is borne by _____. b) Steroid hormones are extracellular signalling molecules. Receptors for steroid hormones are found in the _____ as these are _____ in nature. c) Laminin is a _____ found in _____.	0.5 X 6=3	CO1

Course Outcomes
CO1: Students will acquire knowledge on plant and animal cell and tissue growth conditions.
CO2: Students will be acquainted with plant and animal cell and tissue culture techniques in laboratory and industry setups.
CO3: Students will be proficient in applying basic understanding of plant and animal cell and tissue growth requirements in plant and animal tissue culture techniques.

13.09.2023

NITDGP/BTECH/Reg/Odd/2023-24

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: BTC503 Full Marks: 25

Course Name: BIOSEPARATION AND BIOCHEMICAL ANALYSIS Time: 90 Minutes

Instructions: Answer all the questions.

<table>
<tr><th>Question No.</th><th>Body of the Question</th><th>Marks</th><th>Mapped CO</th></tr>
<tr><td>1</td><td>Determine whether any inhibitor is being removed by the following purification sequence for a microbial enzyme. Justify your answer. (You must generate the complete purification table and show the calculations for at least Step 3.)
<table>
<tr><th>Purification Step</th><th>Sample volume (ml)</th><th>Enzyme concentration (U/ml)</th><th>Protein concentration (mg/ml)</th></tr>
<tr><td>Step 1</td><td>700</td><td>23</td><td>1.2</td></tr>
<tr><td>Step 2</td><td>140</td><td>105</td><td>2.2</td></tr>
<tr><td>Step 3</td><td>45</td><td>265</td><td>2.22</td></tr>
</table></td><td>4</td><td>CO1</td></tr>
<tr><td>2</td><td>The bacterial ribosome (70S) is composed of two asymmetric subunits, the 30S and the 50S subunits. With the help of the mathematical expression for sedimentation coefficient, explain why the sedimentation coefficients of the two subunits do not add up to give a value of 80S for the total ribosome (which is actually 70S as mentioned above).</td><td>1.5</td><td>CO3</td></tr>
<tr><td>3</td><td>What are the two conventions for calculating RCF for preparative rotors? What are the advantages and disadvantages of both?</td><td>3</td><td>CO3 & CO4</td></tr>
<tr><td>4</td><td>A suspension of particles is to be centrifuged at 8000g for 20 min for complete sedimentation. What is the absolute (actual) value of the centrifugal field? What would be the g-force (RCF) required if one wishes to finish the job within 10 min sedimentation time?
OR
A protein was subjected to ultracentrifugal analysis at a rotor speed of 70,000 rpm and a temperature of 20°C. Using the technique of sedimentation velocity, measurements were taken of the radial position r of the sedimenting protein boundary as a function of centrifugation time t. From these data the following equation was obtained:
$\log_{10} r - \log_{10} r_0 = 1.23 \times 10^{-5} t$
The protein was found to have an average diffusion coefficient</td><td>4</td><td>CO3 & CO5</td></tr>
</table>

Course Outcomes

CO1: To learn the concepts of separation including purification sequence and its monitoring and the properties of proteins underlying bioseparations.

CO2: To learn techniques of biochemical analysis of biomolecules.

CO3: To learn and analyze, mathematically wherever applicable, the various unit operations in bioseparation.

CO4: To understand the design aspects of unit operations in bioseparation.

CO5: To solve problems of bioseparations including industrial bioseparations.

	of $5x10^{-11}$ m^2s^{-1}, and a partial specific volume of $0.8x10^{-3}m^3kg^{-1}$. Calculate the relative molecular mass of the protein. Density of water at 20°C is 998 kg m^{-3}. R=8.314 $JK^{-1}mol^{-1}$.		
5	What is a glycosidic linkage? Give example of a sugar molecule where 1,2 glycosidic linkage is present. What is a peptide linkage present in a protein? Give examples of amino acids containing indole ring, hydroxyl group and thiol group.	1+1+1+1.5=4.5	CO2
6	What is ion-exchange chromatography? Give examples of anion and cation-exchange chromatography. Write down the basic principles of Gel-filtration chromatography. How can you purify a GST-fused protein using affinity chromatography?	2+2+2+2=8	CO2