MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. END SEMESTER EXAMINATIONS

NOVEMBER 2019

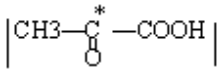
SUBJECT: [BIO 4007] Metabolic Engineering [PE5]

Date of Exam: **26/11/2019** Time of Exam: **2-5 pm** Max. Marks: **50**

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitable assumed

1A.	Describe group translocation process with an emphasis on phosphotransferase system	**5**
1B.	Comment on the following: (i) feedback repression (ii) Gene dosage and (iii) catabolite repression	**3**
1C	Brief about anaplerotic pathways with examples	**2**
2A.	Create a metabolic model for of *Penicillium chrysogenum* using matrix notation, define the stoichiometric model on C-mole basis, and summarize the overall cellular metabolism by employing pseudo-steady state assumptions for ATP, NADH and NADPH. Finally derive a linear rate equation for an aerobic process without metabolite formation. **Note:** The operational P/O ratio is between 0.5 and 2.5; Y_{xATP} is between 50 and 150 (mmoles ATP (g DW)$^{-1}$); mATP is between 4 and 6 (mmoles ATP (g DW h)$^{-1}$) **The overall stoichiometry:** *biomass + 0.139 CO_2 + 0.458 NADH - 1.139CH_2O – 0.20NH_3 – 0.004 H_2SO_4 - 0.010 H_3PO_4 – Y_{xATP} ATP - 0.243 NADPH = 0 The elemental composition of *biomass is: $\mathbf{CH_{1.81}O_{0.58}N_{0.20}S_{0.004}P_{0.010}}$	**10**

3A.	Draw a hypergraph to describe the oxidative deamination and trans-deamination reactions.	**4**
3B.	Illustrate the FFL motifs of both coherent and incoherent classes. Also describe the type in each class that is predominant in biological networks	**3**
3C.	Schematically illustrate the open and closed metabolic networks. Also illustrate the partitioning of internal reactions (vi), the exchange reactions (bi), the internal compounds (xi), and the external compounds (ci) in the total stoichiometric matrix.	**3**
4A.	Comment on the general structure of metabolic network and describe about the properties of the network	**5**
4B.	Differentiate feedback repression and feedback inhibition	**2**
4C.	Represent the stoichiometric (S) matrices for (i) reversible conversion of CP=PC, (ii) biomolecular association C+P=CP, (iii) a cofactor coupled reaction C+AP=CP+A	**3**
5A.	An animal was injected with radioactive pyruvate labeled with ^{14}C in the carbonyl group (*).  After a few minutes, the carbon dioxide exhaled by the animal was trapped and found to be highly radioactive. Analyze the series of enzyme-catalyzed reactions and confirm whether the labelled ^{14}C appears in the exhaled CO_2?	**10**