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University Examinations 2023/2024

THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE DATA SCIENCE

CDS 3351: COMPUTATIONAL SYSTEMS BIOLOGY

DATE: APRIL 2024 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) Define System Biology and explain its working principles. (5 Marks)
b) Discuss the practical applications of System Biology in Life Sciences. (5 Marks)
c) Explain the concepts and principles of Microarray technology. (5 Marks)
d) Describe the process of Microarray data analysis. (5 Marks)
e) Discuss the role of Bioinformatics in System Biology. (5 Marks)
f) Analyze the significance of cellular and population-level systems biology in synthetic biology, genetic networks modeling, and evolutionary dynamics. (5 Marks)

QUESTION TWO (20 MARKS)

a) Introduce the concept of Mathematical Modelling in System Biology. (4 Marks)
b) Discuss Static Networks in the context of Network Biology. (4 Marks)

c) Explain the reconstruction process of Biological Networks. (4 Marks)

d) Describe Dynamic Modelling techniques applied to Biological Systems. (4 Marks)

e) Discuss the methods for solving Ordinary Differential Equations (ODEs) and Parameter Estimation in System Biology. (4 Marks)

QUESTION THREE (20 MARKS)

a) Define Constraint-based Modelling and its significance in Metabolic Networks. (4 Marks)

b) Explain the perturbations to Metabolic Networks and their implications. (4 Marks)

c) Describe the concept of Elementary Modes in Metabolic Networks. (4 Marks)

d) Discuss the applications of Constraint-based Modelling in Metabolic Flux Analysis. (4 Marks)

e) Analyze the Modelling of Regulation in Metabolic Networks. (4 Marks)

QUESTION FOUR (20 MARKS)

a) Introduce the concept of Host-pathogen Interactions. (4 Marks)

b) Discuss the dynamics of Host-pathogen Interactions in Biological Systems. (4 Marks)

c) Explain the concept of Robustness in Biological Systems. (4 Marks)

d) Analyze the factors contributing to the Robustness of Biological Systems. (4 Marks)

e) Discuss the implications of Host-pathogen Interactions and Robustness in System Biology research. (4 Marks)

QUESTION FIVE (20 MARKS)

a) Define Evolutionary Systems Biology and its scope. (4 Marks)

b) Discuss models of pattern formation in Population-level systems. (4 Marks)

c) Explain the role of cell-cell communication in Evolutionary Systems Biology. (4 Marks)

d) Analyze the evolutionary dynamics of Genetic Networks. (4 Marks)

e) Discuss the applications of Evolutionary Algorithms in System Biology research. (4 Marks)