ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2010
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER FOR BIOINFORMATICS

Date: 24/11/2010
Total Marks: 100
Examination Time: 3 hours
Reading Time: 15 minutes

General Directions:

1. **This question paper contains 6 pages. You will be given 15 minutes to read the questions before you write the answers.**
2. **Section A, Part A should be answered on the question paper itself. Answers for Section A, Part B and Section B should be written on the separate answer sheets provided.**

SECTION A

PART A. MULTIPLE CHOICE QUESTIONS (30 marks)
Directions:
In this part there are thirty multiple choice questions each carrying 1 mark.
Each question is followed by four suggested answers. Tick/Circle the **ONE** that best answers the question

1. Dendritic cells (DC) of the innate immunity are
    a. Toll like receptors
    b. Antigen presenting cells
    c. Cytokines
    d. None of the above

2. In the process of DNA replication, genetic information of the cell is carried by
    a. tRNA
    b. sRNA
    c. mRNA
    d. all of the above

3. The translation of amino acid sequence to proteins is carried out by
    a. DNA polymerase
    b. Taq polymerase
    c. Ribosome
    d. RNase

4. Which of the following bacterium is used in transfection to create genetically modified plants or transgenic plants
    a. *Escherichia coli*
    b. *Agrobacterium tumefaciens*
    c. *Pseudomonas aeruginosa*
    d. *Enterococci* spp.

5. Which of the following cells contain nuclear membrane
    a. Prokaryotic cells
    b. Eukaryotic cells
    c. None of the above
    d. Both a and b

6. The following nucleic acids are double stranded
    a. DNA
    b. RNA
    c. mRNA
    d. None of the above

7. In conventional polymerase chain reaction (PCR), the *Taq polymerase* enzyme is obtained from a thermophilic bacteria called
    a. *Borkhoderia pseudomaliae*
    b. *Thermus aquaticus*
    c. *Acinetobacter baumannii*
    d. None of the above

8. The restriction enzymes that digest the DNA sequences from the terminal ends (3’ or 5’ end) are called as
    a. Exonucleases
    b. Endonucleases
    c. Polymerases
    d. RNase

9. Which of the following divalent cation is most important for the efficiency of thermostable polymerase in PCR reaction
    a. Ca^{++}
    b. Na^{++}
    c. Mg^{++}
    d. Zn^{++}

10. In a PCR reaction, the temperature at which the primer bind to the template DNA is called as
    a. Denaturation temperature
    b. Boiling temperature
    c. Annealing temperature
    d. Extension time

11. The electrophoretic separation of DNA is based on the principle of differences in
    a. Molecular charge of DNA
    b. Valency
    c. Shape of DNA
    d. None of the above

12. Which of the following immune cells produce antibodies
    a. Macrophage
    b. T-cells
    c. B-cells
    d. Natural Killer (NK) cells

13. Which of the following is the first immunoglobulins to appear following an infection
    a. IgG
    b. IgM
    c. IgD
    d. IgE

14. Which of the following leads to memory cells
    a. T-cells
    b. Macrophages
    c. B-cells
    d. Neutrophils

15. The following method is used to determine the evolutionary relationship of organisms
    a. Monogamy tree
    b. Phylogenetic tree
    c. Organogram
    d. Paternity tree

16. In blast database, Blastn is used to search for
    a. Protein sequences
    b. Aminoacid sequences
    c. Nucleotide sequences
    d. All of above

17. Multiple sequence alignment is used to
    a. Predict nucleotide similarity
    b. Predict bacterial identity
    c. Predict protein sequence
    d. None of the above

18. For epidemiological purpose, which of the following genetic tools would you prefer
    a. Bacterial DNA Genotyping
    b. Antibiogram typing
    c. Species identification
    d. Genus identification

19. Which of the following immunity is non-specific
    a. Innate immunity
    b. Acquired immunity
    c. Both
    d. None of them

20. Immune cells like T-cells recognize foreign antigens through
    a. Recognition of auto-antigens
    b. Differentiation of self and non-self antigens
    c. Recognition of antibodies
    d. None of the above

21. Magic table in SQL is:
    a. Primary and Foreign key
    b. Insert and Delete Commands
    c. Stored procedures
    d. DDL

22. How many different trees are possible with 10 nodes?
    a. 10
    b. 100
    c. 1014
    d. 1024

23. Run Time Memory Allocation is:
    a. Static memory allocation
    b. Physical memory allocation
    c. Dynamically allocating memory
    d. Virtual memory allocation

24. Shell scripting is mostly used to:
    a. Program operating system of Windows, UNIX, etc.
    b. Program command line of an operating system
    c. All of above
    d. None of above

25. The slow executing speed of shell can be resolved by:
    a. Echo command
    b. Environmental variables
    c. Exit command
    d. Using pipeline and filter commands

26. Sh command makes your program to:
    a. Initiate the interpreter
    b. Run within the shell
    c. Run as a separate shell
    d. Display value of a variable

27. Abstraction in OOP enables:
    a. The class to get its specific class of inheritance
    b. Different classes and objects to send messages to each other
    c. a sub class to act like a parent class
    d. None of above

28. UML lacks implementation of Polymorphism on message arguments:
    a. False
    b. True

29. The following in OOP defines action which a particular object will perform:
    a. Polymorphism
    b. Method
    c. Class
    d. Instance

30. Parametric polymorphism can be used:
    a. Only once
    b. Only twice
    c. Thrice
    d. Any number of times

PART B. WRITE SHORT ANSWERS (20 marks)

Directions:

In this part there are four short answer questions each carrying 5 marks each. All the questions must be attempted.

1. You are given the following nucleotide sequence.
   3'- AATTCCGGAACATGTTAACGATATCGGCCA- 5'

   How will you use this sequence to determine the matches of this sequence to the sequence in the Gena Bank database? Describe the sequence analysis tools you would probably use to find and match the sequence.

2. What is a phylogenetic tree? Describe its uses in evolutionary biology?

3. What are the different types of shells available in UNIX? Define at least 5 popular shells available in UNIX.

4. What is a DBMS? Discuss at least 5 differences between a DBMS and a File System.

SECTION B

General Direction:
*In this section there are two questions based on case studies. Choose **ANY** one question from the questions below and write your answer to the chosen question very carefully.* **(50 marks)**

1. For example, you believe that the extract of *Cordyceps sinensis* has an antiviral activity against H1N1 2009 swine origin flu and hypothesize that it acts by inhibiting certain viral enzyme, the neuraminidase. Design your own experiment to prove your hypothesis assuming that the neuraminidase enzyme structure is available as simulation software. Remember to use bioinformatics (dry lab simulation experiments and molecular docking model) and wet lab where necessary and assume that you have the best of the facility to perform the experiments.

OR

2. Electronic Health Record (EHR) also called computerized patient record is a complete record of patient encounters that allows automation and streamlining of the workflow in a healthcare setting.

    a. Design a simple work flow of possible patient encounters in a hospital starting from registration and exiting from pharmacy. Based on this hospital work flow design and assuming similar implementation in hospitals in different locations, discuss on suitable system architectures for EHR in terms of data model, network architecture and user interfaces.

    b. Discuss advantages and disadvantages of an EHR.

    c. Discuss at least 3 international standards for EHR in terms of patient privacy, disease coding and communications protocols.

**********GoodLuck**********