Indian Association for the Cultivation of Science

(Deemed to be University under *de novo* Category)

Master's/Integrated Master's-PhD Program/Integrated Bachelor's-Master's Program/PhD Course

End-Semester (Sem- UGII) Examination-Spring 2023

Subject: Biochemistry,Genetics and evolution *Subject Code(s): BIS1201*

Full Marks: 50 *Time Allotted: 3 h*

Part A.

1. A) Let's suppose that pigmentation in a species of insect is controlled by a single gene existing in two alleles, D for dark and d for light. The heterozygote Dd is intermediate in colour. In a heterogeneous environment, the allele frequencies are D = 0.7 and d = 0.3. This polymorphism is maintained because the environment contains some dimly lit forested areas and some sunny fields. During a hurricane, a group of 1000 insects is blown to a completely sunny area. In this environment, the fitness (W) values are DD = 0.3, Dd = 0.7, and dd = 1.0. Calculate the **allele frequencies** in the next generation.
   B) Human beings carrying the dominant allele T can taste the substance "X" In a population in which the frequency of this allele is 0.4, what is the frequency that a particular taster is homozygous?

   3+2=5

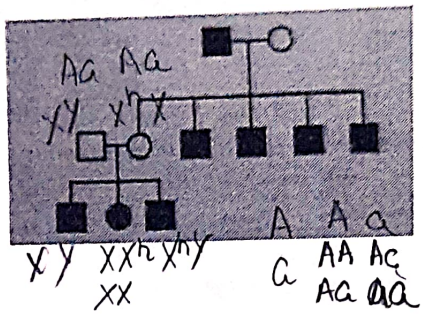
2. A) Demonstrate mathematically (using a pedigree model) that inbreeding co-efficient (F) in half-sib mating.
   B) Write the one advantage of inbreeding.
   C) What is the molecular mechanism of development of **Phenylketonuria?**

   2+1+2=5

3. A) A woman with type O blood gave birth to a baby, also with type O blood. The woman stated that a man with type AB blood was the father of the baby. Is there any merit to her statement?

B) What is inbreeding depression?

C) State the most likely mode of inheritance for this disease with a **brief** explanation



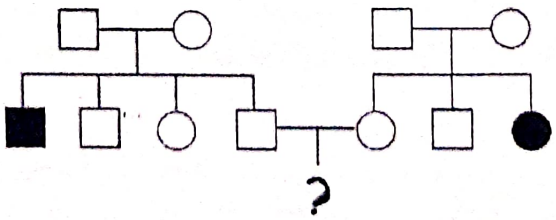
2+1+2=5

4. A) Let us imagine a population of 80 adult rats resides in a grassland area, and the frequency of the F3 allele among these rats is 0.70. Another population of rats is found in hilly areas, and there, the frequency of the F3 allele is 0.5. During the moment of severe food scarcity, 20 of the rats from the hilly area migrate to the grassland region in search of food and join the grassland population. What will be the allele frequency of F3 in the grassland population after migration?

After selection

B) In some regions of West Africa, the frequency of the HB_S allele is 0.2. If this frequency is the result of a dynamic **equilibrium** due to the superior fitness of HB_SHB_A heterozygotes, and if HB_SHB_S homozygotes are **essentially lethal**, what is the intensity of selection against the HB_AHB_A homozygotes?

C) If the given pedigree is autosomal recessive the find out the probability of the (?) marked individual of being affected.



3+1+1=5

Part B.

5. Explain with proper justification.

A) Which cells in our body utilize glycolytic NADH to produce more ATP than the other cells and how? 4

B) Cancer cells remain in a hypoxic condition and it has been observed that the cancer cells produce lactic acids. Can you predict which metabolic pathway usually cancer cells adopt to generate ATP? 3

C) In an experimental set up a batch of mice is fed only glucose and another set of mice is fed only fat (oil). Can you predict which set of mice will survive longer and why? 2

D) High ketone levels make your blood too acidic. This is a serious condition called ketoacidosis. A person is on a ketogenic diet and faced the ketoacidosis condition and the doctor found that the person has defective succinate Co A transferase. So what could be the reason behind his ketoacidosis condition? 3

E) Why beta-oxidation is termed as beta-oxidation? calculate the energy in ATP term of complete beta-oxidation of palmitate (C16:0) 4

F) What are Glucogenic and Ketogenic Amino Acid? Give examples of each. 2

G) How vitamin B6 facilitates transamination reaction? 3

H) Why FADH2 produces less ATP than NADH? 3

I) What are the electron carriers in the electron transport chain? What is the basic difference in their nature? 3

J) Why do doctors recommend a low carbohydrate diet and vigorous exercise to reduce body weight? Explain from a metabolic point of view. 3