 **ST. JOSEPH’S UNIVERSITY, BANGALORE-27**

**M.Sc. ZOOLOGY – 2nd SEMESTER**

**SEMESTER EXAMINATION: APRIL 2024**

**(Examination conducted in May/June 2024)**

**ZO8222 - DEVELOPMENTAL AND EVOLUTIONARY BIOLOGY**

**(For current batch students only)**

**Time-2 hrs Max Marks - 50**

**This paper contains TWO printed pages and FOUR parts.**

**Note: Draw neat labeled diagrams wherever necessary. Indicate the question numbers clearly.**

# PART A

## Fill in the blanks: 5 X 1=5

1. Rapid cell division during cleavage requires a significant amount of energy and metabolic pathways such as glycolysis and oxidative phosphorylation are upregulated to meet the increased metabolic demands of dividing cells. These pathways generate \_\_\_\_\_\_\_\_\_\_\_.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_ is a major factor that regulates aggregation of like cells and controls positioning during gastrulation.
3. The \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ of molecular evolution suggests that most evolution at the molecular level is not adaptive.
4. Evolution can be thought of as a two-step process \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_ by drift or selection.
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ are involved in determining the body plan and the identity of body segments during development.

# PART B

## Write short notes on the following: 5 x 2=10

1. In a fate map of a Xenopus blastula, just before gastrulation begins, the top portion of the embryo will become ectoderm (skin and nerve), the central portion will become mesoderm (bone, muscle, and blood), and the lowest portion will become endoderm (gut). How is it that the endoderm and mesoderm on the outside in the fate map, end up on the inside in the embryo after gastrulation?
2. What are the key cellular processes that drive neurulation?
3. Explain the concept of cell commitment in developmental biology.
4. What is the Fst? How would you use it to determine if populations are completely or partially isolated?
5. What is the molecular clock concept? How would you use it in phylogenetics?

# PART C

## Answer ANY THREE of the following: 3 X 5=15

1. Discuss the role of key maternal effect genes in establishing AP polarity in Drosophila embryos. How do these genes contribute to the formation of morphogen gradients along the AP axis?
2. Evaluate the significance of thyroid hormones, specifically thyroxine (T4) and triiodothyronine (T3), in orchestrating metamorphic changes in amphibians.
3. What is frequency dependent selection? Differentiate between positive and negative frequency dependent selection with an example.
4. **R = h2 X S.** What does the expression convey about evolutionary processes?
5. Briefly discuss the kinds of reproductive isolating mechanisms that would evolve in a) sympatric free spawning marine species (e.g., sea urchins) and b) a terrestrial internally fertilizing sympatric species (e.g., birds).

# PART D

## Give a comprehensive account to ANY TWO of the following: 2 X 10=20

1. Evaluate the evolutionary transitions and innovations in limb development that have occurred over vertebrate evolutionary history, such as the evolution of tetrapod limbs from fish fins and the adaptation of wings for flight in birds.
2. Discuss the evolutionary adaptation in fetal membrane structures in human development and their implications for reproductive strategies, embryonic development, and offspring survival.
3. Two closely related species of mice have different coat colors that match their environment (soil color). People assume that this was a result of natural selection. Design an experiment to test this assumption (without harming mice). Substantiate your experimental design.

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