M.Sc. 3rd Semester Examination, 2023

ZOOLOGY

PAPER—302.1 & 302.2

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

PAPER-302.1

(*Molecular Evolution*)

1. Answer any *two* questions from the following : 2×2

   (*a*) Assume that the mutation rate to a lethal recessive allele, such as that for Tay-Sachs disease, is 10^{-5}. What is the equilibrium frequency of the allele ?

(*b*) What do you mean by heterosis ? Give example.

(*c*) Why human a globin sequence and horse α-globin sequence are much similar than human α and β globin sequence ?

(*d*) What do you mean by Founder effect ? Give example.

2. Answer any *two* questions from the following : 4×2

(*a*) In a region where industrial pollution has been under control for a number of years, the fitness of *Biston betularia* moths is 0.47 for the dark form and 1 for the light form, calculate the change in allele frequency Δp, after one generation of selection when (1) $p = 0, 10$ and (2) $p = 0.90$. 4

(*b*) In a situation where equilibrium between

selection and mutation occurs, what will be the frequency of a recessive gene where mutation rate is 10^{-6} and $S = 0.1$. 4

(*c*) (*i*) Write the principle of parsimony.

(*ii*) How many distinct rooted, bifurcating phylogenetic trees could show the evolutionary relationships among three different organisms ? 1 + 3

(*d*) Assuming that ten generations have elapsed since the African ancestors came to US. Calculate average number of gene flow per generation between US Blacks and Caucasian from Claxton, Georgia using the frequencies of R^t.
Blacks (Africa) = 0.066; Blacks (Clarton Georgia) = 0.109; Caucasians = 0.429. 4

3. Answer any *one* question from the following : 8×1

(*a*) Among 12, 387 adult individuals examined

in Nigeria, 29 were Hb^SHb^S homozygotes, 2993 were Hb^AHb^S heterozygotes and 9365 were Hb^AHb^A homozygotes. The population is at Hardy-Weinberg equilibrium with respect to this locus, zygotes will be produced in the frequency p^2, $2pq$, q^2. Selection had operated completely by the time. Estimate observed frequency, expected frequency, survival efficiency (observed/expected), relative fitness and allelic equilibrium frequency.

(*b*) Consider the following 5 way multiple alignment of hypothetical homologous sequences. Generate a distance matrix that describes the pairwise relationship of all the sequences presented. Use the UPGMA method to generate a tree that describes the relationship between the sequences.

A : G C C A A C G C A T G T T A G C T C A A G C
B : G C C A A C G C A T G C A A A C T C A A G C
C : G G C A A C G C A T G T A T A C T A G A G C
D : G C T A A C G T A C G C A T G T C A A C A C
E : G C T G G T G T A T A C A T G T A C A A G C

PAPER-302.2

(*Microbiology*)

4. Answer any *two* questions from the following : 2×2

(*a*) How is Bioluminescence of bacteria related to Quorum sensing ?

(*b*) What is generation time of bacteria ? What is pure culture ?

(*c*) State the uniqueness of Bergey's manual.

(*d*) Mention the difference between Eubacteria *and Archaebacteria.*

5. Answer any *two* questions from the following : 2×4

(*a*) Depict the ultrastructure of typical gramnegative bacterial cell wall.

(*b*) Exemplify the mechanisms of chemotaxis.

(*c*) Describe the 5-kingdom classification system.

(*d*) State the role of soil microbes in the ecosystem.

6. Answer any *one* question from the following : 1×8

(*a*) (*i*) Illustrate the patterns of colonization of different types of bacteria in liquid culture media based on their oxygen requirement. How can anaerobic bacteria be cultivated ? $3 + 1$

(*ii*) Summarize the classification of virus on the basis of host preference. Give an example each. 4

(*b*) Write short notes on (any *four*) : 2×4

(*i*) Mesosomes.

(*ii*) Enriched and enrichment media.

(*iii*) Dimorphism in fungi.

(*iv*) Biofilm.

(*v*) S-R variation.

(*vi*) Archaeal and Bacterial flagella.

[Internal Assessment – 10 Marks]