 PG/IS/ZOO/104.1 & 104.2/23

M.Sc. 1st Semester Examination, 2023

ZOOLOGY

PAPER – ZOO-104

Full Marks : 50

Time : 2 hours

Answer **all** questions

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 – ZOO-104.1

(*Cell Biology*)

[Marks : 20]

1. Answer any *two* of the following : 2 × 2

(*a*) What are the common fatty acid chains

in phosphoglycerids and why do these fatty acid chains differ in their number of carbon atoms by multiple of 2 ?

(*b*) What are the basis of microtubule polarity ?

(*c*) Mention the name of TM and Loops in a typical GPCR having more

(*i*) Hydrophobicity

(*ii*) Disulphide linkage.

(*d*) Why does CAM Kinase regarded as "Molecular memory device" ?

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

(*a*) Cdk 1 mutation at Tyr 15 is replaced by phenyl alanine shows premature entry into mitosis. Explain the phenomenon with proper diagram. 4

(*b*) State the function of GRB2, Thr 35 of G∝ subunit is replaced by valine. State its the consequences in cell signalling. 1 + 3

(*c*) What is the relation between MDM2 and p53 ? What is function of securin ? 2 + 2

(*d*) The membrane potential in animal cells depends on K^+ channels. Why K^+ channels are considered as non-gated channel ? How do K^+ channels are selective for K^+ versus Na^+, which is smaller than K^+ ? 2 + 2

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

(*a*) (*i*) State the role of CIP and INK4 family proteins in cell cycle regulation. 2

(*ii*) Cancer cells typically lose cell cycle control. Explain how the following

mutations, which are found in some cancer cells, lead to a bypass of these controls : 6 + 2

(*I*) Overexpression of cyclin D

(*II*) Loss of Rb function

(*III*) Loss of p16 function

(*IV*) Hyperactive E2F.

(*b*) (*i*) Describe the structure responsible for determining microtubule formation. 2

(*ii*) What is the function of A-Kinase associated protein (AKAP) in regulation of the function of PKA ? 3

(*iii*) State the role of G-Protein coupled receptor kinases (GRKs) in regulation of GPCR activation. 3

PAPER – ZOO-104.2

(*Cytogenetics*)

[Marks : 20]

4. Answer any *two* of the following : 2×2

(*a*) If two different mutations that produce the same phenotype can complement each other, what can you conclude about the locations of each mutation ?

(*b*) Which bacterial genetic transfer process does not require recombination with the bacterial chromosome ?

(*c*) In some cancer cells a specific gene has become duplicated many times. Is this gene likely to be an oncogene or a tumour suppressor gene ?

(*d*) Differentiate bacterial transformation from transduction.

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

(*a*) In a generalised transduction system using *p*1 phage, the donor is $pur^+ nad^+ pdx^-$ and the recipient is $pur^- nad^- pdx^+$. The donor allele pur+ is initially selected after transduction, and 50 pur+ transductants are then scored for the other alleles present. The results follow :

Genetype	Number of colorie
$nad^+ pdx^+$	3
$nad^+ pdx^-$	10
$nad^- pdx^+$	24
$nad^- pdx^-$	13
	50

(*i*) What is the cotransduction frequency for pur and nad ?

(*ii*) What is the cotransduction frequency for pur and pdx ?

(*b*) Consider the following genetic map showing 12 identifiable mutational sites :

1 2 3 4 5 6 7 8 9 10 11 12

One special mutant D1 tails to give *r*II$^+$ recombinant when crossed with mutants 1, 2, 3, 4, 5, 6, 7, 8, ; Another special mutant D2 tails to give *r*II$^+$recombinant when crossed with 5, 6, 7, 8, 9, 10, 11, 12. A third mutant D3 that gives *r*II$^+$ recombinant when crossed with D1 but not when crossed with D2. Define the areas of the gene and mention where D1, D2 and D3 lies.

(*c*) Draw a complementation map from the given complementation matrix for some of the mutant genes at the his-3 loans on Neurospora first chromosome.

	CD16	245	261	D566	1438
CD16	O	O	O	O	O
245	O	+	+	+	
261			O	+	+
D566				O	O
1438					O

O = no complementation

+ = complementation

(*d*) In a London population of cat, Searle scored both males and females for the yellow genotype and found the following.

Females–	$\frac{+/+}{277}$	$\frac{+/y}{54}$	$\frac{y/y}{7}$
Males –	311		42

What are the gene frequencies (p and q) and genotype frequencies is male and female of the cat polulation ?

(*Continued*)

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

(*a*) Hutt collected the following data from the families of Cornell University veterinary students.

Mating	Number of offsprings	
	Tasters	Nontasters
taster × taster	654	76
taster × non-taster	354	205
non-taster × non-taster	7(?)	98

Calculate whether this population is in equilibrium with respect to genotypic frequencies.

(*b*) (*i*) In a phage a set of delations is inter-crossed pairwise combination. The following results are obtained. + indicate wild type recombinant obtained and – indicate no recombinant obtained. 5

	1	2	3	4	5
1	–	+	–	+	–
2	+	–	+	+	–
3	–	+	–	–	–
4	+	+	–	–	+
5	–	–	–	+	–

Construct a deletion map. If this was a complementation map instead of a deletion map, how many discrete complementation region would be indicated ?

(*ii*) An autosomal recessive condition affects 1 in 10,000 in a randomly mating population. What is the approximate frequency of carriers in this population ? Calculate allele frequency and genotype frequency in this case. 3

[Internal Assessment — 10 Marks]