Group A

(Answer *any three* questions)

1. Let us consider a data set for which the frequency for each of the first three consecutive natural numbers (1, 2, 3) is the number itself. Calculate the mean, median and the mode of the data.

[5]

2. Consider a set of observations with mean 14 and variance 9. Suppose the observations are transformed as follows:

   A number c is subtracted from each observation and then the difference is divided by a number d (where, $d < 0$). If the mean and the variance of the transformed observations are 2 and 3, respectively obtain the values of c and d.

[5]

3. Consider the following paired observations on two variables X and Y:

X	2	-3	1	0	3	-2	-1
Y	-2	-3	-1	0	-3	-2	-1

   Show that X and Y are uncorrelated. Is this a contradiction to the fact that X and Y seem to be mathematically related?

[5]

4. The regression line of Y on X is given by

$$1.5\,Y + 3X - 4.5 = 0.$$

   Explain whether the correlation coefficient between X and Y is positive, negative, or zero. Is it possible to generate the regression line of X on Y by inverting the above equation? Justify your answer.

[3+2]

Group B

(Answer any five questions)

1. (a) What is host plant resistance?
   (b) Mention the different mechanisms by which a plant can impart resistance against a pest.
   (c) What is the principal difference between horizontal and vertical resistance?
   (d) Which one, in your opinion, is more effective, provide justification?
   (e) Is it possible to genetically develop a rice variety resistant to insects, nematodes and drought at the same time?
   (f) Name two biotechnological tools for crop improvement.
   (g) What do you mean by biomagnification?

   [2+3+2+2+2+2+2]

2. (a) What is biological control?
   (b) Why biological control is preferred over chemical pest management?
   (c) Differentiate between parasite and predator. Give examples.
   (d) Why *Bacillus thuringiensis* has been successfully employed as a biocontrol agent of insect pest?
   (e) In a classical biological control program, foreign explorations are conducted to collect natural enemies of the target pest. Host specificity testing of the collected natural enemies, under both choice and no-choice conditions, is a crucial first step before they can be released in the field. If you are tasked to conduct such an experiment, what are the logical steps that you would undertake? - explain briefly with justification.

   [2+3+2+2+6]

3. (a) Define entomopathogens with example.

(b) In a choice test experiment, a plant pathogenic nematode was inoculated at equidistance between a susceptible host and resistant host. After 21 days, susceptible host was observed to be most affected. What could be the possible reasons behind this?

(c) What is the difference between primary and secondary metabolites in plants?

(d) Give examples of both kind of metabolites.

(e) What are the roles of secondary metabolites?

[2+3+3+2+5]

4. Consider that you have 50 tomato lines. Your task is to screen the germplasms against the root knot nematode *Meloidogyne incognita* to identify the one showing highest resistant against the pest. Answer the following question:

(a) What would be the experimental approach to achieve this research objective? Write briefly and provide logic.

(b) Do you need any control? If yes, what could be the characteristics of the control germplasm, resistant or susceptible? Justify your choice.

(c) Once the resistant germplasm has been identified, a follow up research question could be to understand the molecular mechanisms of resistance. What molecular techniques do you think could be employed to achieve this objective? Provide brief justification.

[6+4+5]

5. (a) Numerous microorganisms reside within living plant cells without generating any symptomatic response. What are these microorganisms called?

(b) What are the possible ecological interactions these microorganisms have with plants?

(c) What roles these microorganisms play?

(d) What are the necessary steps for isolation and identification of one such bacteria?

(e) Define metagenomics.

[2+2+5+5+1]

6. Write short notes (any five)

(a) Central dogma

(b) Transgenic crops

(c) Ecological niche

(d) Conservation agriculture

(e) Different growth phases of Bacteria

(f) Oxidative decarboxylation of pyruvic acid

[5 × 3]

7. (a) What is enzyme inhibition?

(b) Explain different types of enzyme inhibition with examples.

(c) Distinguish between apoenzyme and holoenzyme.

(d) Which strand of the DNA act as the template stand during transcription?

(e) Write down the differences between prokaryotic and eukaryotic replication.

[2+4+2+1+6]