Answer key
Life Sciences Sem II Paper II
Paper Code: 32188
Dated: 8.5.19

Q. 1. A) Fill in the blanks: (07)

1. Allele
2. XX/XY
3. Test Cross
4. Genotype
5. Dihybrid Cross
6. Female
7. Filial

B) Match the columns: Niloufer Kotwal (07)

Column A	Column B
a)	i)
b)	ii)
c)	iii)
d)	iv)
e)	v)
f)	vi)
g)	vii)

C) Define / Explain the following terms: Dr. Sree (06)

1.
2.
3.
4.
5.
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Q.2. A) Answer any one of the following: Dr. Shalini Rai (10)

1. In a plant, gene "T" is responsible for tallness and its recessive allele "t" for dwarfness and "R" is responsible for red colour flower and its recessive allele "r" of white flower colour. A tall and red flowered plant with genotype TtRr crossed with dwarf and red flowered ttRr. Show the cross with Punnet's Square and find out the percentage of dwarf - white flowered offspring from the above cross?

Ans:

1. Show the gamete formation
2. Draw the Punnet's square
3. Show the results of crosses for the trait
4. Identify the different phenotypes/genotype
5. With the ratio for different traits, find the percentage of asked trait.

2. What is Sex linked inheritance. Comment on the types of sex linked inheritance with suitable example.

1. Sex linkage or sex linked inheritance is the phenotypic expression of an allele related to the allosome (sex chromosome) of the individual. In autosomal chromosomes both sexes have the same probability of existing, but since humans have many more genes on the female X chromosome than on the male Y chromosome, these are much more common than Y-linked traits.

In mammals, the female is homogametic, with two X chromosomes (XX), while the male is the heterogametic sex, with one X and one Y chromosome (XY). Genes on the X or Y chromosome are called sex-linked. In ZW sex-determination system used by birds the opposite is true: the male is the homogametic sex (ZZ), and the female is heterogametic (ZW).

X-linked recessive traits are expressed in all heterogametics, but are only expressed in those homogametics that are homozygous for the recessive allele. For example, an X-linked recessive allele in humans causes haemophilia, which is much more common in males than females because they are hemizygous and therefore express the trait when they inherit one mutant allele. In contrast, a female must inherit two mutant alleles, a less frequent event since the mutant allele is rare in the population.

The incidence of recessive X-linked phenotypes in females is the square of that in males X-linked traits are maternally inherited from carrier mothers or from an affected father. Each son born to a carrier mother has a 50% probability of inheriting the X-chromosome carrying the mutant allele. There are a few Y-linked traits; these are inherited from father.

In classical genetics, a reciprocal cross is performed to test if a trait is sex-linked.

Q. 2. B) Answer any two of the following: Dr. Shalini Rai (10)

1. Write a note on Sickle cell Anemia.

Background information of Sickle cell anaemia

- About structure of haemoglobin
- Then mutation in Beta haemoglobin with change in one amino acid changes the structure of haemoglobin causing sickle cell anaemia
- How this change in gene becomes lethal in individuals with homozygous condition.

2. Pedigree for Sex Linked Inheritance,
   Only males are affected
   Trait does not skip a generation.

3. Describe briefly Sutton's Hypothesis.
   Sutton and Boveri proposed the Chromosomal theory of Inheritance independently. Sutton developed this hypothesis in "The Chromosomes in Heredity" (1903) and concluded that chromosomes contain hereditary units and that their behaviour during meiosis is random. His work formed the basis for the chromosomal theory of heredity. Sutton did his observations using grasshopper cells. His paper, in 1902, clearly showed that each chromosome is different, and meiosis reduces chromosome number in the gametes. Sutton's 1903 paper, *The Chromosomes in Heredity*, summarized and

discussed the importance of his conclusions. The paper even more strongly drew the connection between Mendel's laws of heredity and chromosomes.

4. In a heterozygous, heterozygous dihybrid cross, the following data was obtained: dominant for both traits: 570, dominant for trait 1 and recessive for trait 2: 185 dominant for trait 2 and recessive for trait : 190, recessive for both traits: 55 Perform a chi-square analysis to see if the data above agrees with the predicted outcome of this cross.
Note: (0.05 probability, the critical value for Chi-square analysis is 7.82).

Step to check Goodness of fit:

i. Set the null hypothesis

ii. Calculate the expected frequency (E)

iii. Calculate difference between Observed and expected frequency (O-E)

Square- $(O-E)^2$

iv. Summation of $(O-E)^2$

v. Compare calculated value of chi square with tabulated value at particular level of significance for specific degree of freedom.

vi. if chi calculated value is less that chi tabulated value then goodness of fit / null hypothesis is accepted otherwise rejected.

Q.3. A) Answer any one of the following: Niloufer Kotwal (10)

1.
2.

Q. 3. B) Answer any two of the following: Niloufer Kotwal (10)

1.
2.
3.
4.

Q.4. A) Answer any one of the following: Dr. Sree (10)

1.
2.

Q. 4. B) Answer any two of the following: Dr. Sree (10)

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2.
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Q.5. Answer any four of the following: (20)
(02 questions by each paper setter)

1. Explain Mendel's Law of Dominance.
2. **Law of Dominance of Mendel:** Mendel's Law of Dominance states that recessive alleles will always be masked by dominant alleles. Therefore, a cross between a homozygous dominant and a homozygous recessive will always express the dominant phenotype, while still having a heterozygous genotype. Law of Dominance can be explained easily with

the help of a mono hybrid cross experiment:- In a cross between two organisms pure for any pair (or pairs) of contrasting traits (characters), the character that appears in the F1 generation is called "dominant" and the one which is suppressed (not expressed) is called "recessive." Each character is controlled by a pair of dissimilar factors. Only one of the characters expresses. The one which expresses in the F1 generation is called Dominant. It is important to note however, that the law of dominance is significant and true but is not universally applicable.

3. Significance of "Test for Goodness of Fit" in Mendelian Inheritance

In research generally, it is often necessary to compare experimentally observed numbers of items in several different categories with numbers that are predicted on the basis of some hypothesis. For example, you might want to determine whether the sex ratio in some specific population of insects is 1:1 as expected or in certain experiments, numerical values are expected based on segregation ratios involved. However, in actual field experiments exact values may not be obtained due to in-viability of certain pollen grains, zygotes, no germination of some seeds, or even death of few plants after germination. This leads to some deviation between the actual results and the expected ones under a given hypothesis. The chi-square (X^2) test is an statistical test to determine whether the deviation is within the limits of experimental error or large enough to reject the hypothesis involved.

If there is a close match, then the hypothesis is upheld, whereas, if there is a poor match, then the hypothesis is rejected. As part of this process, a judgment has to be made about whether the observed numbers are a close enough match to those expected. Very close matches and blatant mismatches generally present no problem in judgment, but inevitably there are gray areas in which the match is not obvious. Genetic analysis often requires the interpretation of numbers in various phenotypic classes. In such cases, a statistical procedure called the χ^2 (chi-square) test is used to help in making the decision to hold onto or reject the hypothesis.

Formula can be also mentioned.

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