CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

SECOND YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN HORTICULTURE

AGRI 221: PRINCIPLES OF GENETICS AND CYTOGENETICS

STREAMS: B.Sc (HORT) Y2S1   **TIME: 2 HOURS**

DAY/DATE: WEDNESDAY 5/12/2018   **11.30 A.M - 1.30 P.M.**

INSTRUCTIONS:
- **Answer ALL Questions in Section I and any TWO Questions in Section II**

SECTION I: [30 MARKS] - ANSWER ALL QUESTIONS

1. Explain the following terms: [8 Marks]
   (i) Genetic code
   (ii) Homologous chromosome
   (iii) Synaptonemal complex
   (iv) Submetacentric chromosome

2. According to some cytophotometric measures, the amount of DNA in a diploid sorghum is made up of 1.8 picograms (pg) or 1.8×10^{-12}g of DNA. How much DNA would be found in the following stages?   [6 Marks]
   (i) Prophase of mitosis
   (ii) Anaphase II of meiosis
   (iii) Prophase II of meiosis
   (iv) Metaphase I of meiosis
   (v) S stage of mitosis

3. (a) Using chromosomal manipulation, how would you synthesize an amphidiploids hexaploid variety?   [6 Marks]

   (b) Differentiate between mitosis and meiosis.   [6 Marks]

4. (a) The following three pairs of alleles exist in an organism, +/x, +/y and +/z. Each mutant allele is recessive to its wild-type allele (+). A testcross between heterozygous females and homozygous males yields the following results:

+++ 40   x++=0
++z=32   x+z=430
+y+=441   xy+=27
+yz=1   xyz=39

(b) List the classes that are parental types.   [1 Mark]

(c) List the classes that result of single and double crosses.   [2 Marks]

(d) How are the members of the allelic pairs distributed in the heterozygous females? [1 Mark]

(e) Give the sequence of the three genes.   [1 Mark]

(f) Calculate the map distance between;   [3 Marks]
   (i) The first and second genes
   (ii) The second and third genes

SECTION II: [40 MARKS] - ANSWER ANY TWO QUESTIONS.
5. (a) Discuss point mutations that occur in DNA sequence encoding protein.   [10 Marks]

 (b) In a tomato population, the proportion of purple stem individuals is 16%. Purple stem is due to a recessive allele. What is the allelic and genotypic frequency at equilibrium?
                      [10 Marks]

6. (a) Discuss aneuploidy.   [10 Marks]

 (b) Discuss the types of structural chromosomal aberrations, and give two examples of successful chromosome manipulation in distant hybridization.   [10 Marks]

7. A vegetable variety A01 is resistant to a viral disease caused by strain race 1, but it is susceptible to race 2. Another vegetable variety A02 is susceptible to race 1 of the pathogen but resistant to race 2. The F_1 hybrid of the two varieties is resistant to both races. In the F_2 the following segregation was observed;
   Resistant to 1 and 2: 220 plants
   Susceptible to 1 and 2: 106 plants
   Resistant to 1 and susceptible to 2: 131 plants
   Susceptible to 1 and resistant to 2:136 plants

(i) How many genes govern resistance to each race?   [2 Marks]

(ii) Suggest the expected segregation model and test the given data to determine whether it supports your suggested model, using Chi-square test at significant (α) level = 0.05. (Clearly show your working.
[18 Mark]

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