FIJI NATIONAL UNIVERSITY

COLLEGE OF AGRICULTURE, FISHERIES & FORESTRY

FINAL EXAMINATION TRIMESTER 1 2014

GPB 702 PRINCIPLES OF PLANT BREEDING

[Total Marks : 100]

Time Allowed : 3 hours plus 10 minutes reading time

Instructions : This paper consists of 8 pages.

Please check to see that your paper is complete.

Answer ALL questions in the answer booklet. Number your answers correctly in the answer booklet.

Write your student number on all the pages that you use including any additional sheet of paper.

Printed or written material is not allowed into the examination hall.

Mark values appear at the end of each question or part thereof.

Non-programmable calculators are permitted.

"MOBILE PHONES ARE STRICTLY NOT ALLOWED"

SECTION	DESCRIPTION AND MARK ALLOCATION
SECTION A	**30 Marks** Part 1 - Multiple Choice Questions – 10 Marks Part 2 – Matching – 10 Marks Part 3 – Fill in the Blanks – 10 Marks
SECTION B	Short Answer Questions – **40 Marks**
SECTION C	Long Answer Questions – **30 Marks**

SECTION A PART 1 MULTIPLE CHOICE [10 Marks]

Write the most appropriate answer of your choice in the answer booklet

1. In 1717, Thomas Fairchild was the first man to discover
   A. Pureline Theory
   B. Distant Hybridization
   C. Pedigree Selection
   D. Backcross breeding

2. Which one of the following is an example of inter-varietal transfer of simply inherited characters?
   A. Transfer of Plant height in closely related species
   B. Transfer of seed size from related species to cultivated species
   C. Transfer of seed coat colour in closely related species
   D. Transfer of disease resistance from related species to cultivated species

3. What percentage of homozygosis or homozygous individual would you get after 6 generations of selfing involving 4 pair of genes?
   A. 68%
   B. 75%
   C. 84%
   D. 94%

4. Various plant species exhibit different degrees of inbreeding depression. Which of the following crop shows high inbreeding depression?
   A. Maize
   B. Carrot
   C. Cucurbit
   D. Sunflower

5. In gametophytic system the stigma surface is plumose having elongated receptive cells which is commonly known as
   A. Wet stigma
   B. Dry stigma
   C. Pellicle
   D. Papillate

6. One way of overcoming self-incompatibility is by exposing the pistil to high temperature to induce pseudo fertility. Which of following temperature is correct?
   A. $70^{o}C$
   B. $65^{o}C$
   C. $60^{o}C$
   D. $55^{o}C$

7. Find out number of possible double crosses involving 8 parents.
   A. 112
   B. 210
   C. 56
   D. 28

8. Which of the following self-incompatibility mechanism is used by Cocoa?
   A. Pollen - stigma interaction
   B. Pollen tube - style interaction
   C. Pollen tube - ovule interaction
   D. None of the above

9. Where does meiosis occur in flowering plants?
   A. megasporocyte
   B. pollen tube
   C. microsporocyte
   D. megasporocyte and microsporocyte

10. What is typically the result of double fertilization in angiosperms?
   A. The endosperm develops into a diploid nutrient tissue
   B. A triploid zygote is formed
   C. Both a diploid embryo and triploid endosperm are formed
   D. Two embryos develop in every seed

PART 2 MATCHING [10 Marks]

Match the followings and write in space given in front of each.

List A	List B
1. Mass Selection	a. New variety is highly uniform
2. Detasseling	b. inbreeding
3. Genetic assortative mating	c. F_1 genotypic variation
4. Multiline variety	d. Progeny test is not usually carried out.
5. Pureline selection	e. prevents selfing
6. Backcross breeding	f. record keeping is key for selection
7. Pedigree selection	g. Source of genetic variability
8. Hybridization	h. result of top or double cross
9. Transgressive breeding	i. progeny increasingly similar to the recurrent parent
10. Land race	j. F_2 superior in one or two characters

PART 3 FILL IN THE BLANKS [10 Marks]

Fill in the blacks to complete the following statements. Write your answers in the answer booklet.

1. When crosses are made between two different species or between two different genera, they are generally termed as _____.

2. Improvement in the mean genotypic value of the selected families over the base population is known as _____.

3. To counter the objection on Vavilov's 'center of origin', **Zhukovsky**student of Vavilov has proposed '_____' theory.

4. _____ is characterized by nonfunctional pollen grains, while female gametes function normally.

5. Self-incompatibility and sterility are the two mechanisms which encourage _____.

6. The phenomenon when a molecule is able to exist in more than one chemical form is known as _____**.**

7. The concept of purelinetheory was proposed by _____ on the basis of his studies with beans variety called Princess.

8. According to dominant hypothesis, in heterozygous state, the deleterious effects of recessive alleles are _____ by their dominant alleles.

9. A _____ is a group of plants produced through asexual reproduction from a single plant.

10. _____ are individuals having more than two genomes which are dissimilar.

SECTION B SHORT ANSWER QUESTIONS [40 Marks]
[Each question is worth 2 marks and all the questions are compulsory]

1. Define the following terms:
   a) Male sterility
   b) Self-incompatibility
   c) Mutation
   d) Hybrid

2. Describe in detail the applications of wide hybridization in crop improvement.

3. Compare and contrast pedigree method and bulk method of breeding.

4. What are four pre-requisite for backcross breeding?

5. List merits and demerits of Multiline varieties.

6. List two effects of inbreeding and categorize degree of inbreeding depression.

7. List four kinds of hybrid with example.

8. Define hardy-Weinberg law and hardy-Weinberg equilibrium.

9. Define General Combining Ability and Specific Combining Ability.

10. List the uses and limitations of mutation breeding.

11. What are polyploids and describe the classification based on ploidy.

12. List the applications of allopolyploids in crop improvement.

13. What is plant introduction and explain the types.

14. Describe various steps in hybridization program.

15. Describe the various difficulties in interspecific hybrids.

16. Define combination and transgressive breeding.

17. Describe male sterility and morphological features of male sterility.

18. Briefly explain detection, maintenance and transfer of apomixis.

19. Compare and contrast pure line and mass selection methods of breeding.

20. Describe the features of off season nursery.

SECTION C **LONG ANSWER QUESTIONS** **[30 Marks]**

Given below is the data on crop yield (g/plant) of eight parent varieties of maize grown in RBD replicated four times. The parents were crossed and 6 hybrids were evaluated. The average yields of random samples of 8 plants per plot in all four replications are presented below.

Variety / Treatment	R I (x)	R II (x)	R III (x)	R IV (x)
P_1	50	55	50	53
P_2	60	64	62	60
P_3	58	56	60	62
P_4	65	60	63	70
P_5	53	50	50	55
P_6	50	55	55	58
P_7	65	60	70	65
P_8	72	72	70	72
P_2 X P_7	70	70	71	72
P_4 X P_7	68	65	70	68
P_1 X P_8	70	71	65	68
P_2 X P_8	69	70	67	70
P_4 X P_8	78	75	76	78
P_5 X P_8	70	73	75	70
Commercial check	75	73	72	72

Hint:

a. Correction Factor = $\frac{GT^2}{n}$

b. F = $\frac{GMS}{EMS}$

c. $\sigma^2 e$ = EMS

d. $\sigma^2 g = \frac{(GMS - EMS)}{r}$

e. $\sigma^2 p = \sigma^2 g + \sigma^2 e$

f. $h^2BS = \frac{\sigma^2 g}{\sigma^2 p}$

f. standard error of difference = $\frac{\sqrt{2\ X\ EMS}}{r}$

g. CD = S. Ed x table 't' value

h. t value (d.f) at 1% = 3.527 (obtained from standard table)

ANOVA for crop yield in maize.

Source of variation	**Degrees of Freedom (df)**	**Sum of Squares (SS)**	**Mean Sum of Squares (MSS)**	**Expectation**
Replication (r)	(r-1)	RSS = $\sum_{j=1}^{r} \frac{RT_j^2}{g} - CF$	RMS = $\frac{RSS}{(r-1)}$	
Varieties (g)	(g-1)	GSS = $\sum_{i=1}^{g} \frac{T_i^2}{r} - CF$	GMS = $\frac{GSS}{(g-1)}$	$\sigma^2 e + \sigma^2 g$
Error (r x g)	(g-1) (r-1)	ESS = $TSS - RSS - GSS$	EMS = $\frac{ESS}{(g-1)(r-1)}$	$\sigma^2 e$
Total	rg-1	TSS = $\sum_{i=1}^{g}\sum_{i=1}^{r} x_i^2 - CF$		

1. Complete the ANOVA table using the data from parent line.
    a) Calculate and complete the ANOVA table [11 marks]
    b) Estimates of variance and heritability [4 marks]
    c) Test of significance [2 marks]
    d) Interpretation [3 marks]

2. Calculate the different types of heterosis and interpret the results. Which hybrid cross is superior? [10 marks]

THE END