



Post Graduate School
Indian Agricultural Research Institute, New Delhi
Examination for Admission to Ph.D. Programme 2011-2012

Discipline : Plant Genetic Resources

Discipline Code : 16

Roll No

Please Note:

- (i) This question paper contains 12 pages. **Please check whether all the pages are printed in this set.** Report discrepancy, if any, **immediately** to the invigilator.
- (ii) **There shall be NEGATIVE marking for WRONG answers in the Multiple Choice type questions (No. 1 to 130) which carry one mark each. For every wrong answer 0.25 mark will be deducted.**

PART - I (General Agriculture)

Multiple choice questions (No. 1 to 30). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.

1. Which of the following crops have been approved for commercial cultivation in India?
 - a) Bt cotton and Bt brinjal
 - b) Bt cotton and Golden Rice
 - c) Bt maize and Bt cotton
 - d) Bt cotton only
2. This year (2010-11) the expected food grain production in India is
 - a) 212 million tonnes
 - b) 220 million tonnes
 - c) 235 million tonnes
 - d) 250 million tonnes
3. The genome of which of the following crops is still not completely sequenced?
 - a) Rice
 - b) Soybean
 - c) Sorghum
 - d) Wheat
4. According to the Approach Paper to the 12th Five Year Plan, the basic objective of the 12th Plan is
 - a) Inclusive growth
 - b) Sustainable growth
 - c) Faster, more inclusive and sustainable growth
 - d) Inclusive and sustainable growth
5. To address the problems of sustainable and holistic development of rainfed areas, including appropriate farming and livelihood system approaches, the Government of India has set up the
 - a) National Rainfed Area Authority
 - b) National Watershed Development Project for Rainfed Areas
 - c) National Mission on Rainfed Areas
 - d) Command Area Development and Water Management Authority
6. Which of the following sub-schemes are not covered under the Rashtriya Krishi Vikas Yojana?
 - a) Extending the Green Revolution to eastern India
 - b) Development of 60,000 pulses and oilseeds villages in identified watersheds
 - c) National Mission on Saffron
 - d) National Mission on Bamboo
7. The minimum support price for the common variety of paddy announced by the Government of India for the year 2010-11 was
 - a) ₹ 1030
 - b) ₹ 1000
 - c) ₹ 980
 - d) ₹ 950
8. According to the Human Development Report 2010 of the United Nations, India's rank in terms of the human development index is
 - a) 119
 - b) 134
 - c) 169
 - d) 182

9. Which of the following does not apply to SRI method of paddy cultivation?
- Reduced water application
 - Reduced plant density
 - Increased application of chemical fertilizers
 - Reduced age of seedlings
10. Which organic acid, often used as a preservative, occurs naturally in cranberries, prunes, cinnamon and cloves?
- Citric acid
 - Benzoic acid
 - Tartaric acid
 - Lactic acid
11. Cotton belongs to the family
- Cruciferae
 - Anacardiaceae
 - Malvaceae
 - Solanaceae
12. Photoperiodism is
- Bending of shoot towards source of light
 - Effect of light/dark durations on physiological processes
 - Movement of chloroplast in cell in response to light
 - Effect of light on chlorophyll synthesis
13. Ergot disease is caused by which pathogen on which host?
- Claviceps purpurea* on rye
 - Puccinia recondita* on wheat
 - Drechlera sorokiniana* on wheat
 - Albugo candida* on mustard
14. Rocks are the chief sources of parent materials over which soils are developed. Granite, an important rock, is classified as
- Igneous rock
 - Metamorphic rock
 - Sedimentary rock
 - Hybrid rock
15. Which one of the following is a *Kharif* crop?
- Pearl millet
 - Lentil
 - Mustard
 - Wheat
16. The coefficient of variation (C.V.) is calculated by the formula
- $(\text{Mean}/\text{S.D.}) \times 100$
 - $(\text{S.D.}/\text{Mean}) \times 100$
 - $\text{S.D.}/\text{Mean}$
 - $\text{Mean}/\text{S.D.}$
17. Which of the following is commonly referred to as muriate of potash?
- Potassium nitrate
 - Potassium chloride
 - Potassium sulphate
 - Potassium silicate
18. Inbred lines that have same genetic constitution but differ only at one locus are called
- Multi lines
 - Monohybrid
 - Isogenic lines
 - Pure lines
19. For applying 100 kg of nitrogen, how much urea would one use?
- 45 kg
 - 111 kg
 - 222 kg
 - 333 kg
20. The devastating impact of plant disease on human suffering and survival was first realized by epidemic of
- Brown spot of rice in Bengal
 - Late blight of potato in USA
 - Late blight of potato in Europe
 - Rust of wheat in India
21. The species of rice (*Oryza*) other than *O. sativa* that is cultivated is
- O. rufipogon*
 - O. longisteminata*
 - O. glaberrima*
 - O. nivara*
22. The enzyme responsible for the fixation of CO_2 in mesophyll cells of C-4 plants is
- Malic enzyme
 - Phosphoenol pyruvate carboxylase
 - Phosphoenol pyruvate carboxykinase
 - RuBP carboxylase
23. Which one of the following is a 'Vertisol'?
- Black cotton soil
 - Red sandy loam soil
 - Sandy loam sodic soil
 - Submontane (Tarai) soil
24. What is the most visible physical characteristic of cells in metaphase?
- Elongated chromosomes
 - Nucleus visible but chromosomes not
 - Fragile double stranded loose chromosomes
 - Condensed paired chromosomes on the cell plate

25. All weather phenomena like rain, fog and mist occur in
 a) Troposphere
 b) Mesosphere
 c) Ionosphere
 d) Ozonosphere
26. Which of the following elements is common to all proteins and nucleic acids?
 a) Sulphur
 b) Magnesium
 c) Nitrogen
 d) Phosphorous
27. Silt has intermediate characteristics between
 a) Sand and loam
 b) Clay and loam
 c) Loam and gravel
 d) Sand and clay
28. Certified seed is produced from
 a) Nucleus seed
 b) Breeder seed
 c) Foundation seed
 d) Truthful seed
29. Seedless banana is an
 a) Autotriploid
 b) Autotetraploid
 c) Allotriploid
 d) Allotetraploid
30. Which one of the following is used to test the goodness-of-fit of a distribution?
 a) Normal test
 b) t-test
 c) Chi-square test
 d) F-test
31. Which country represent maximum plant species richness?
 a) India
 b) China
 c) Brazil
 d) Australia
32. The Ramsar Convention is an international treaty for the conservation and utilization of
 a) Wetlands
 b) Dry lands
 c) Rain forests
 d) Wild life
33. The Swalbard Global Seed Vault is located at
 a) Sweden
 b) St. Petersburg
 c) Norway
 d) Finland
34. Variation in diversity among plant populations is influenced most by
 a) Breeding systems
 b) Geographic range
 c) Mode of reproduction
 d) Taxonomic status
35. Which of the following characters is recorded in nominal scale?
 a) Harvest index
 b) Days to flower
 c) Flower colour
 d) Susceptibility to pests
36. Genetic heterogeneity is a common phenomenon in
 a) Modern varieties
 b) Clonally propagated crops
 c) Inbreds
 d) Farmer landraces
37. Kiwi fruit originated in
 a) New Zealand
 b) Indonesia
 c) Myanmar
 d) China
38. Cassava (*Manihot esculenta*) is a native to
 a) Indian
 b) Africa
 c) Papua New Guinea
 d) South America
39. 'Conservation Agriculture' forms a component of
 a) Sustainable agriculture
 b) Extensive agriculture
 c) Intensive agriculture
 d) Organic farming
40. The headquarters of UPOV is located at
 a) Sweden
 b) France
 c) Germany
 d) Geneva (Switzerland)
41. RFLP can be categorized as
 a) PCR-based marker
 b) Hybridization based marker
 c) Molecular marker based on PCR followed by hybridization
 d) Sequencing of DNA chip based markers

PART – II (Subject Paper)

Multiple choice questions (No. 31 to 130). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.

42. Which of the following indicators is not suitable for sustainable management of PGR *ex situ*?
- No. of accessions in genebanks
 - Country distribution of genebanks
 - Collection health, accession viability
 - No. and frequency of landraces and area planted to them
43. Small population size during regeneration drifts out
- Rare alleles
 - Less adaptive alleles
 - Better adapted alleles
 - Common alleles
44. Regeneration maintains the genetic identity of germplasm accessions by
- Producing seeds from few selected plants
 - Random bulking of seeds from large no. of plants
 - Taking care of breeding systems and accordingly controlled pollination
 - Taking selfed seeds irrespective of breeding systems
45. Which of the following life traits is usually irrelevant for crops and is least associated with genetic differences?
- Mode of reproduction
 - Breeding system
 - Seed dispersal mechanism
 - Geographic range
46. Which of the following answers is wrong in the statement "Characters recorded in germplasm characterization are"
- Qualitative
 - Environmentally stable
 - Mono- to oligogenic
 - Not so easily manipulative
47. The 'HOPE' breeding system was developed for broadening genetic variation in order to obtain parental inbred lines for production of commercial hybrids in
- Wheat
 - Potato
 - Maize
 - Sugarcane
48. Which devastating disease resulted in efforts for large-scale base broadening of the crops?
- Northern corn leaf blight
 - Southern corn leaf blight
 - Grassy stunt virus
 - Late blight of potato
49. Which of the following statements is false?
- On average, 50% of a plant species' loci are polymorphic and the mean genetic diversity is 15%
 - Within an average population, 34% of the loci are polymorphic and the mean genetic diversity is 11%
 - Genetic variation at polymorphic loci is partitioned such that most (78%) of the diversity is found within populations, while smaller fraction (22%) accounts for population differentiation
 - Within an average population, 10% of the loci are polymorphic and the mean genetic diversity is 50%
50. Global distribution of species richness
- Increases with decreasing latitude
 - Decreases with decreasing latitude
 - Increases with increasing altitude
 - Decreases with seasonality in precipitation
51. In which of the following pairs, the priority for *in situ* conservation and ecogeographic surveys are mismatched?
- Groundnut – Latin America
 - Oil palm – Africa, Latin America
 - Rubber – Amazonia
 - Coffee – Europe
52. SINGER database is related to germplasm collections of
- USDA
 - CGIAR
 - AVRDC
 - EU
53. Which of the following is not true in the context of molecular characterization (marker diversity) of germplasm accessions?
- Information on ancestry or breeding history of population
 - Indicators of recency of bottle necks in population size
 - Prevalence of outcrossing/level of gene flow
 - Variation in environmental adaptation
54. Which of the following strategies is the best one for selecting core entries from a group?
- Constant strategy
 - Proportional strategy
 - Logarithmic strategy
 - Diversity dependent strategy
55. For which founder crops, Fertile Crescent is not rich in wild progenitors?
- Emmer wheat
 - Barley
 - Lentil
 - Rice

56. The seminal article "Search for new genes" was written by which Indian author?
- M.S. Swaminathan
 - B.P. Pal
 - V.L. Chopra
 - None of the above
57. India is not a signatory to which of the following treaty/convention?
- International Convention for the Protection of New Varieties of Plants (UPOV)
 - Patent Cooperatory Treaty (PCT)
 - Budapest Treaty
 - Berne Convention
58. Indian Gene Centre holds diversity in which oil seed crops?
- Groundnut and sunflower
 - Rapeseed-mustard and sesame
 - Safflower and sunflower
 - Safflower and groundnut
59. A species is categorized as endemic because it is
- Exotic and established
 - Kept in captivity for breeding
 - Exclusively found in a particular zone
 - Extinct due to calamity
60. As per original concept, what percentage of national collections of a crop species is represented in core collection?
- 20%
 - 10%
 - 5%
 - 1%
61. Perilla in North-east India is used as
- Fruit
 - Cereal
 - Oilseed
 - Fiber
62. Which of the following is not included in characterization traits?
- Seed pattern
 - Flower colour
 - Isozyme pattern
 - Protein content
63. Global Environment Facility (GEF) was established in
- 1990
 - 1991
 - 1995
 - 2001
64. Asian *Vigna* species do not include
- Mungbean
 - Urd bean
 - Cowpea
 - Rice bean
65. The import of seed and planting material is regulated by
- Material Transfer Agreement
 - The Seed Act
 - Plant Food and Seed Order
 - Global Plan of Action
66. Which of the following is not a cryoprotectant?
- Dimethyl sulphoxide
 - Proline
 - Glycerol
 - Polyethylene glycol
67. Callus is the
- Undifferentiated and unorganised tissue
 - Least differentiated and unorganised tissue
 - Differentiated and unorganised tissue
 - Undifferentiated and organised tissue
68. Agar, a commonly used gelling agent is obtained from
- Blue green algae
 - Green algae
 - Red algae
 - Brown algae
69. Encapsulation-dehydration technique involves encapsulation of explant in
- Potassium alginate beads
 - Sodium alginate beads
 - Ammonium alginate beads
 - Calcium alginate beads
70. 'Tofu' derived from the fermentation of seed protein with *Rhizopus oryzae*, is a product of
- Lablab bean
 - Bambara bean
 - Soybean
 - Cluster bean
71. Safflower seeds are source of
- Vegetable fat
 - Drying oil
 - Semi-drying oil
 - Non-drying oil
72. Which of the following crop is not an underutilized crop in India?
- Rice bean
 - Amaranths
 - Buckwheat
 - Mustard
73. Northern blotting technique is used for
- RNA analysis
 - DNA analysis
 - Protein analysis
 - Polysaccharide analysis

74. A major use of embryo culture is in
- Induction of somaclonal variation
 - Overcoming hybridization barrier
 - Production of alkaloids
 - Clonal propagation
75. It will not be any advantage to produce seedless fruits in
- Mango
 - Watermelon
 - Pomegranate
 - Oranges
76. Cloves are obtained from
- Erupted styles
 - Inflorescence
 - True fruit
 - Unopened flower buds
77. The organization which has published 'Red Data Book' is
- International Union for Conservation of Nature and Natural Resources
 - National Environmental Engineering Research Institute
 - National Wildlife Action Plan
 - Convention on International Trade in Endangered Species of Wild Fauna ad Flora
78. Regulations governing movement of diseased plant material in the country are called
- Crop protection
 - Plant regulation
 - Plant quarantine
 - Rotation
79. An orthodox seed is one which can
- Tolerate dehydration and low temperature
 - Tolerate low temperature but not dehydration
 - Tolerate dehydration but not low temperature
 - Does not tolerate either
80. Cartagena Protocol relates to
- Bulk import
 - Import of transgenics
 - Import of germplasm
 - Import of varieties
81. Tolerance limit for a quarantine pest is
- Zero
 - 5%
 - 10%
 - 10-20%
82. For import of seed/planting material for research purposes, two mandatory requirements are
- Phytosanitary certificate and undertaking
 - Import permit and undertaking
 - Import permit and phytosanitary certificate
 - Import permit and letter of approval
83. Mitochondrial DNA is inherited from
- Male parent only
 - Female parent only
 - One half from male and one half from female parent
 - From male and female parent in a random ratio
84. Which of the following crops is not a mandate crop of ICRISAT?
- Chickpea
 - Groundnut
 - Pigeonpea
 - Common bean
85. Potato originated in
- Blue Mountains
 - Nilgiris
 - Himalayas
 - Andes
86. Hidden infestation in seeds is caused by
- Mites
 - Thrips
 - Bugs
 - Bruchids
87. For genetic screening DNA profile specific for an individual is generated by a technique known as
- DNA mutation
 - DNA fingerprinting
 - DNA footprinting
 - DNA restriction
88. Passion fruit is native to
- Brazil
 - USA
 - Ethiopia
 - Mexico
89. The "Crop & Man" was written by
- J.G. Hawkes
 - J.R. Harlan
 - R.W. Allard
 - J.T. Williams
90. Khejri (*Prosopis cineraria*) is an important plant of
- Rajasthan
 - Uttarakhand
 - North-eastern Region
 - Western Ghats
91. Which of the following genebank is the oldest one?
- VIR, Russia
 - NSSL, USA
 - IPK, Germany
 - Nordic, Sweden

92. Where is the Millennium seed genebank is located?
 a) USA
 b) UK
 c) China
 d) Australia
93. Exchange of genes among the populations through seeds and pollens is known as
 a) Founder effect
 b) Genetic drift
 c) Gene flow
 d) Genetic bottleneck
94. Internal Transcribed Spacer (ITS) region is
 a) Coding region
 b) Non-coding region
 c) Used at intra-specific and inter-specific level
 d) Both b) and c) are correct
95. Colchicine obtained from which part of the plant?
 a) Root
 b) Shoot apex
 c) Seeds and bulbs
 d) Leaf
96. A group within a species having unique physical characteristics genetically adopted to particular environment conditions is refer as
 a) Ecospecies
 b) Ecotype
 c) Coenospecies
 d) Biotype
97. Microsatellite or SSR marker is
 a) Dominant
 b) Co-dominant
 c) Recessive
 d) Both a) and b) of the above
98. Which is natural system of classification?
 a) Linnaeus
 b) Bessey's
 c) Benthum and Hooker's
 d) Engler and Prantl's
99. A distinct monocot characters shown by monocot families is
 a) Hypogynous flower
 b) Actinomorphic flower
 c) Trimerous flower
 d) Bisexual flower
100. The molecular scissors used to cut DNA into specific genes of interest are called
 a) Exonucleases
 b) Restriction endonucleases
 c) Ligases
 d) Polymerases
101. A red or orange dye used in dyeing silks is obtained from the pulp that surrounds the seeds of
 a) *Semecarpus anacardium*
 b) *Emblica officinalis*
 c) *Bixa orellana*
 d) *Aegle marmelos*
102. Which of the following pairs is correctly matched?
 a) Pistia - Sciophyte
 b) Lemma - Xerophyte
 c) Rhizophora - Halophyte
 d) Casuarina - Hydrophyte
103. Somaclonal variation can be advantageous because
 a) There are chromosomal abnormalities
 b) Monosomics are produced
 c) Enrichment of genetic diversity occurs
 d) It gives high genetic uniformity
104. Headquarter of World Agroforestry Center is located at
 a) Lima, Peru
 b) Cali, Colombia
 c) Cotonou, Benin
 d) Nairobi, Kenya
105. Botanical name of Manila tamarind is
 a) *Tamarindus indica*
 b) *Pithecellobium dulce*
 c) *Salvadora persica*
 d) *Capparis decidua*
106. Centre of origin of *Citrus medica* is
 a) China
 b) India
 c) Australia
 d) South Africa
107. A multipurpose legume which provides fodder, vegetable and gum
 a) *Cicer aietinum*
 b) *Cajanus cajan*
 c) *Cyamopsis tetragonolobus*
 d) *Lens culinaris*
108. Botanical name of foxtail millet is
 a) *Setaria italica*
 b) *Paspalum scrobiculatum*
 c) *Panicum miliaceum*
 d) *Panicum miliare*
109. In tobacco leaves, the rawness and bitter taste of the leaf are eliminated and fine aroma is developed after
 a) Flue curing
 b) Desucking
 c) Fermentation
 d) Priming

110. Which one of the following is not among the 'New World Crops'?
- Maize
 - Common bean
 - Tomato
 - Wheat
111. In litchi fruit, which part is edible?
- Aril
 - Baculum
 - Caruncle
 - Epiblast
112. Which one of the following species is used for the extraction of Geranium oil?
- Cymbopogon flexuosus*
 - Pelargonium graveolens*
 - Rosa damascena*
 - Schleicheria trijuga*
113. Periderm includes
- Phelloderm, collenchyma and cortex
 - Phellem, cambium and cortex
 - All the tissues between epidermis and pith
 - Phellogen, phellem and phelloderm
114. Sunflower is the native crop of
- Russia
 - Brazil
 - China
 - USA
115. Indian rose wood tree is a common name of
- Acacia
 - Shorea
 - Dalbergia
 - Eucalyptus
116. Which of the following crop has polyphyletic origin?
- Maize
 - Wheat
 - Okra
 - Common bean
117. For which of the following crops, Indian Gene Centre is not rich in wild relatives?
- Vigna*
 - Cajanus*
 - Arachis*
 - Abelmoschus*
118. Highest amount of vitamin C (~100 mg per 100 g) is found in
- Sprouted legumes
 - Indian gooseberry fruit (*Emblica officinalis*)
 - Citrus fruits
 - Seabuckthorn (*Hippophae rhamnoides*)
119. Amino acids absent in pulses are
- Methionine and alanine
 - Alanine and cysteine
 - Methionine and cysteine
 - Lysine and tryptophan
120. The ITPGRFA establishes a multilateral exchange of PGR of
- 64 crops
 - 52 crops
 - 32 crops
 - 29 crops
121. Which one of the following pairs is not correctly matched?
- | Drug | Part of the plant giving the drug |
|--------------|-----------------------------------|
| a) Colchicin | Bulb |
| b) Digitoxin | Leaves |
| c) Ephedrin | Entire plant |
| d) Cocaine | Roots |
122. When you consume coconut meat, coconut milk or popcorn you are eating which part of developing seed?
- Endosperm
 - Pericarp
 - Mesocarp
 - Nucellus
123. In protogyny the female organ is receptive
- Before the male is mature
 - After the male is mature
 - Both mature simultaneously
 - Male is ready before the female is receptive
124. In Citrus, fruit type is
- Pepo
 - Hesperidium
 - Drupe
 - Berry
125. In seed spices fruit is schizocarp where each carpel is botanically called
- Pericarp
 - Mericaip
 - Mesocarp
 - Endocarp
126. In agamospermy
- Embryo does not arise from embryo sac
 - Embryo arise from embryo sac
 - Embryo does not from
 - Embryo arise from seed coat
127. Family of minute flowering plants
- Lemnaceae
 - Apiaceae
 - Umbelliferae
 - Poaceae

128. Custard apple belongs to family

- a) Apocynaceae
- b) Annonaceae
- c) Anacardiaceae
- d) Amaranthaceae

129. *Catharanthus roseus* is source of vinblastine and vincristine alkaloids which are

- a) Anti-malarial
- b) Anti-biotic
- c) Anti-tumour
- d) Anti-allergic

130. In Podophyllum, Podophyllum resin or podophyllin exists in

- a) Leaf and petiole
- b) Roots and rhizomes
- c) Flower and seed
- d) Stem and fruit

Matching type questions (No. 131 to 140); all questions carry equal marks. Choose the correct answer (a, b, c, d or e) for each sub-question (i, ii, iii, iv and v) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.

131.

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|-----------------|-----------------|
| i) Polyembryony | a) Quinine |
| ii) Roots | b) Palm oil |
| iii) Bark | c) Turmeric |
| iv) Rhizome | d) Sweet potato |
| v) Mesocarp | e) Orange |

132.

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|------------------------|-----------|
| i) Indigenous | a) Barley |
| ii) Recalcitrant seed | b) Wheat |
| iii) Poor man's timber | c) Litchi |
| iv) Amphidiploid | d) Mango |
| v) Oldest cereal | e) Bamboo |

133.

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|-----------------------------|---------------------|
| i) Ecosystem | a) M.S. Swaminathan |
| ii) Indian Vavilov | b) N. Myers |
| iii) Hot spots | c) S.L. Bahuguna |
| iv) Indian Green Revolution | d) H.B. Singh |
| v) Chipko movement | e) A. Tansley |

134.

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|----------------------|---|
| i) Arboretum | a) Total sum of genes of a species |
| ii) Herbarium | b) High diversity – High risk |
| iii) Hot spot | c) Collection of dried plant specimens |
| iv) Self-pollination | d) Low diversity |
| v) Gene pool | e) Botanical garden with trees and shrubs |

135.

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|--------------------------|--------------------------------|
| i) Genebank | a) <i>In situ</i> conservation |
| ii) Biosphere reserve | b) <i>Ex situ</i> conservation |
| iii) Agrobiodiversity | c) Community conservation |
| iv) Sacred grooves | d) Pest epidemics |
| v) Genetic vulnerability | e) On-farm conservation |

136.

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|---------------------------------------|--------------------------|
| i) Transmission genetics | a) Cell |
| ii) Molecular genetics | b) Active collection |
| iii) Quantitative/population genetics | c) Base collection |
| iv) Long-term storage | d) Individual population |
| v) Short-term storage | e) Mendelian population |

137.

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|-----------------------------------|------------|
| i) IPK | a) USA |
| ii) VIR | b) Germany |
| iii) NCGRP | c) UK |
| iv) Nordic | d) Russia |
| v) Commonwealth potato collection | e) Sweden |

138.

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|---------------|------------------|
| i) Coffee | a) Orchidaceae |
| ii) Chocolate | b) Papavaraceae |
| iii) Opium | c) Rubiaceae |
| iv) Vanilla | d) Sterculiaceae |
| v) Jackfruit | e) Moraceae |

139.

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|-------------------|----------------|
| i) Fertilization | a) Treub |
| ii) Triple fusion | b) Camerarius |
| iii) Pollination | c) Strasburger |
| iv) Chalazogamy | d) Nawaschin |
| v) Totipotency | e) Hoberkindt |

140.

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|--|---------------|
| i) Central Tobacco Research Institute | a) Shimla |
| ii) Central Soil Salinity Research Institute | b) Jhansi |
| iii) Central Potato Research Institute | c) Karnal |
| iv) Indian Grassland and Fodder Research Institute | d) Rajamundry |
| v) Central Institute of Arid Horticulture | e) Bikaner |

Short questions (No. 141 to 146); each question carries FIVE marks. Write answers, including computation / mathematical calculations if any, in the space provided for each question on the question paper itself.

141. Comment on the process involved in domestication of a crop from wild.

142. Describe the use of herbarium as a tool in plant taxonomic studies.

143. What is the protocol to predict the storage behaviour of unknown/new species?

144. Can *in vitro* methods of conservation replace the necessity of *in vivo* conservation of plant genetic resources? Comment.

145. Define cryopreservation. Highlight the importance of cryopreservation techniques in PGR conservation.

146. What is pest risk analysis? What is its significance in the international exchange/trade of agricultural commodities?