



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

Discipline : Seed Science and Technology

Discipline Code : 20

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. rufipugon*
 - 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
- Troposphere
 - Mesosphere
 - Ionosphere
 - Ozonosphere
26. Which of the following elements is common to all proteins and nucleic acids?
- Sulphur
 - Magnesium
 - Nitrogen
 - Phosphorous
27. Silt has intermediate characteristics between
- Sand and loam
 - Clay and loam
 - Loam and gravel
 - Sand and clay
28. Certified seed is produced from
- Nucleus seed
 - Breeder seed
 - Foundation seed
 - Truthful seed
29. Seedless banana is an
- Autotriploid
 - Autotetraploid
 - Allotriploid
 - Allotetraploid
30. Which one of the following is used to test the goodness-of-fit of a distribution?
- Normal test
 - t-test
 - Chi-square test
 - F-test
31. Seed quality assurance involves
- Seed industry development
 - Varietal development
 - Seed sector reforms
 - All of the above
32. Which one repellent is used against termites?
- Oil of citronella
 - DDT
 - Pentachlorophenol
 - Bordeaux mixture
33. Sequence of 3-generations system of seed in India is
- Breeder seed, foundation seed and certified seed
 - Certified seed, nucleus seed and breeder seed
 - Commercial seed, certified seed and foundation seed
 - Foundation seed, labeled seed and certified seed
34. Seed replacement rate is
- Maximum in hybrid seed
 - 40% in cotton seed
 - Minimum in cross-pollinated seed
 - None of the above
35. New Seed Bill 2004 proposes
- Provision of self certification
 - Voluntary registration of varieties
 - Compulsory certification
 - None of the above
36. Tick the odd man out
- Seed Science Research
 - Seed Tech News
 - Seed Research
 - Seed Science and Technology
37. Indian Seeds Act was passed in parliament in
- 1966
 - 1968
 - 2004
 - 2010
38. Central Seed Testing Laboratory, an apex laboratory of Govt. of India, is presently located at
- IARI, New Delhi
 - NSRTC, Varanasi
 - NBPGR, New Delhi
 - FRI, Dehradun
39. An example of 'Vitamin A' rich transgenic plant is
- Bt cotton
 - Golden rice
 - Flav saur tomato
 - Vaccinated potato
40. Isogenic lines are produced by
- Sib mating
 - Recurrent back crossing
 - Random mating
 - Selfing
41. Tick the odd man out:
- PRA
 - Lesser grain beetle
 - Almond moth
 - Grain moth

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.

31. Seed quality assurance involves
- Seed industry development
 - Varietal development
 - Seed sector reforms
 - All of the above
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 - Random mating
 - Selfing
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- PRA
 - Lesser grain beetle
 - Almond moth
 - Grain moth

42. Restriction endonucleases are so called because they
- Restrict nuclear activity
 - Cleave DNA molecules into smaller pieces
 - Synthesize DNA
 - Breakdown DNA molecules at random
43. Which one is not the milestone in Indian seed certification system?
- Establishment of National Seeds Corporation
 - Publication of minimum seed certification standards
 - Publication of national catalogue of various notified and denotified varieties under Section 5 of the Seeds Act
 - Fixing the uniform prices for breeder seed
44. The diagrammatic representation of chromosome of a species is called
- Banding pattern
 - Karyotype
 - Ideogram
 - Ideotype
45. The generic name of honeybee is
- Apis*
 - Daphnia*
 - Limulus*
 - Leptocarisa*
46. β -oxidation takes place at
- Matrix of mitochondria
 - Cell cytoplasm
 - Inner mitochondrial membrane
 - Ribosomes
47. Which of the following enzymes catalyses the tetrazolium staining reaction?
- Peroxidase
 - Amylase
 - Dehydrogenase
 - All of the above
48. Development of fruit on unfertilized flower is called
- Plant embryony
 - Parthenocarpy
 - Saprophytic budding
 - None of the above
49. Ability of microscope to distinguish between two closely placed points is
- Limit of resolution
 - Resolving power
 - Magnification
 - Resolution
50. Which one is not a gas of greenhouse?
- CH_4
 - H_2O
 - N_2O
 - CO_2
51. Hotspot is related to
- Niche
 - Biodiversity
 - Ecological pyramids
 - Ecological efficiency
52. Micropropagation is
- Germination of seed with cotyledons above the soil
 - Germination of seed with cotyledons remain in soil
 - A technique to obtain new plants by cultivating the cells or tissues in culture medium
 - To manufacture hormones
53. Mustard seed is an example of
- Albuminous dicot seed
 - Albuminous monocot seed
 - Ex albuminous dicot seed
 - Ex albuminous monocot seed
54. Indent cylinder separator working principle is based on
- Seed length
 - Seed weight
 - Seed breadth
 - Specific gravity
55. Rain favours pollination in
- Cardamom
 - Nutmeg
 - Pepper
 - Clove
56. The test required for granting protection of a new variety under PPV&FRA 2001 is
- DUS
 - VCU
 - GOT
 - All of the above
57. The calorific values of carbohydrates, proteins and fats are
- 4.1 K.cal/g, 5.65 K.cal/g and 9.45 K.cal/g
 - 5.65 K.cal/g, 10 K.cal/g and 2.3 K.cal/g
 - 3.1 K.cal/g, 9 K.cal/g and 6 K.cal/g
 - None of the above
58. A seed lot will be eligible for extension of the validity period
- For initial nine months only
 - For one year only
 - For two years only
 - As long as it conforms to the prescribed seed standards
59. Seed fail to germinate under unfavourable environment is termed as
- Orthodox seed
 - Recalcitrant seed
 - Quiescent
 - Hard seed

60. Indian minimum seed certification standards does not prescribe standards for
- Most of the field crops
 - Most of the vegetable crops
 - Most of the medicinal crop plants
 - All the major spice crops
61. Assessment of seed quality may be made without destroying the seed is
- X-ray radiography
 - Standard germination test
 - Vigour test
 - Tetrazolium test
62. The sequence of one strand of DNA is 5'ATGCATGC3'. What is the complementary sequence of other strand?
- TACGTACG
 - ATGCATGC
 - GATGCATC
 - TACGATGC
63. All the flowering plants are divided into two groups - monocots and dicots; based on seed structure by
- Hutchinson
 - Engler and Prantal
 - Bentham and Hooker
 - Cronquist
64. The chromosome number of trisomic brinjal is
- 23
 - 24
 - 25
 - 26
65. Heterosis is
- Hybrid weakness
 - Hybrid weakness and vigour
 - Hybrid vigour
 - Neither weakness nor vigour of hybrid
66. Stomata open during day due to
- Accumulation of K^+ ions and sugar
 - High pH
 - Osmotic effect of ions present in guard cells
 - None of the above
67. Harrington's thumb rule works better between
- 1-5% moisture contents
 - 5-14% moisture contents
 - 14-25% moisture contents
 - 15-35% moisture contents
68. A minimum thickness of polythene sheets required for moisture resistance is
- 20 gauge
 - 300 gauge
 - Over 1000 gauge
 - None of the above
69. Cell sap is
- Living content of the cell
 - Living content of the cytoplasm
 - Non-living content of the protoplasm
 - Non-living content of the vacuole
70. Accelerated ageing test is generally conducted to determine the
- Seed conductivity
 - Seed germination
 - Seed vigour
 - Seed hidden insects
71. Power to notify varieties of seeds in Seeds Act fall under
- Section-4
 - Section-5
 - Section-6
 - Section-7
72. Varietal maintenance is
- To maintain the true-to-type of seed purity
 - To produce foundation seed
 - To produce PUSA seed
 - Most inconvenient and not easy to follow
73. Most critical factors for seed germination are
- Moisture and temperature
 - Oxygen and light
 - Moisture and light
 - Temperature and light
74. International Seed Testing Association was born during
- 1869
 - 1924
 - 1960
 - 1973
75. Inflorescence in wheat is known as
- Ear
 - Head
 - Spike
 - All of the above
76. The class of seed, which is generally used in seed multiplication chain is
- Breeder seed
 - Truthfull labeled seed
 - PUSA seed
 - Commercial seed
77. What is the sequence of coating of seed by insecticide, fungicide and rhizobium?
- Fungicide-Insecticide-Rhizobium
 - Insecticide-Rhizobium-Fungicide
 - Rhizobium-Fungicide-Insecticide
 - Rhizobium-Insecticide-Fungicide

78. An orthodox seed can
- Tolerate dehydration and freezing
 - Tolerate dehydration but not freezing
 - Tolerate freezing but not desiccation
 - None of the above
79. Which of the following is not an unsaturated fatty acid?
- Palmitic acid
 - Oleic acid
 - Linoleic acid
 - Erucic acid
80. The ratio of A+T/G+C in DNA is
- Always equal to 1
 - Mostly equal to 1
 - Rarely equal to 1
 - Has not been worked out so far
81. Function of centriole is
- Formation of spindle fibre
 - Formation of nucleolus
 - Initiation of cell division
 - Formation of cell plate
82. The chemical substance in the cork cell wall is
- Lignin
 - Chitin
 - Cutin
 - Suberin
83. Mendel carried out his investigation on garden pea during
- 1851-1859
 - 1856-1864
 - 1865-1874
 - 1870-1875
84. Maize has 10 pairs of chromosomes. How many linkage groups will be present, if all the genes are mapped?
- 10
 - 15
 - 20
 - 40
85. Ganga-2 is the hybrid of
- Rice
 - Cotton
 - Maize
 - Wheat
86. The chemical generally used for diplodization is
- Gibberellic acid
 - 2-4 D
 - Indol acetic acid
 - Colchicine
87. One of the international organizations not involved in seed quality evaluation is
- ISTA
 - OECD
 - AOSA
 - Biodiversity International
88. Grow-out test is conducted to determine
- Moisture content
 - Germination
 - Seed vigour
 - Genetic purity
89. Multiplication of germination percentage with seeding dry weight on the day of final count is known as
- Germination index
 - Rate of seed germination
 - Vigour index
 - Germination energy
90. High seed leachate conductivity is indicative of
- High seed vigour
 - Low seed vigour
 - Purity of seed
 - Viability of seed
91. Crossing over occurs at
- Two-strand stage
 - Three-strand stage
 - Four-strand stage
 - None of the above
92. Who founded cell theory?
- Robert Hooks
 - Von Mohl and Nageli
 - Schwann and Schleiden
 - Grew and Malpigi
93. A plant bearing both male and female flowers in different nodes is termed
- Dioecious
 - Monoecious
 - Polygamous
 - Hermaphrodite
94. Tripping, a process of pollination is found in
- Cereals
 - Fodder legumes
 - Oilseeds
 - Trees
95. Self-incompatibility favours
- Autogamy
 - Allogamy
 - Xenogamy
 - None of the above

96. Hard seededness can be released by
 a) GA_3
 b) Hot water
 c) Scarification
 d) All of the above
97. *Argemone maxicana* is an objectionable weed in
 a) Bread wheat
 b) Barley
 c) Indian mustard
 d) Lentil
98. Which of the following favours out-crossing?
 a) Protandry
 b) Protogyny
 c) Gynoecey
 d) All of the above
99. Objectionable weed in wheat is
 a) *Echinochloa* spp.
 b) *Avena fatua*
 c) *Cuscuta* spp.
 d) *Phalaris minor*
100. Which of the following conditions are not required to be fulfilled for a plant variety protection in India?
 a) An old variety known to public
 b) Mostly similar to all other known varieties
 c) A high seed cost of the variety
 d) None of the above
101. Which one of the following is natural antioxidant?
 a) Alpha tocopherol
 b) Alanine
 c) Ceamine
 d) Thyradoxin
102. When gynoecium is present on the top most position of the thalamus, the flower is known as
 a) Inferior
 b) Epigynous
 c) Perigynous
 d) Hypogynous
103. Pests and pathogens during storage affect the following seed quality
 a) Genetic purity
 b) Physical purity
 c) Germination
 d) All of the above
104. *Streptomyces scabies* belongs to the group
 a) Streptomyces
 b) Viruses
 c) Bacteria
 d) MLO
105. The common fungicide 'Thiram' belongs to the group
 a) Dithiocarbamate
 b) Copper compound
 c) Sulphur fungicides
 d) Mercuric compounds
106. Tapetum play an important role in
 a) Pollen wall formation
 b) Fertilization
 c) Meiotic division
 d) Mitotic division
107. Weight determination is made on 1000 seeds singly or
 a) 8 replicates of 100 seeds each
 b) 4 replicates of 100 seeds each
 c) 3 replicates of 100 seeds each
 d) 5 replicates of 200 seeds each
108. Moisture content in seed is
 a) Physical quality of seed
 b) Genetic quality of seed
 c) Physiological quality of seed
 d) Phytosanitary quality of seed
109. High quality seed are the results of good production practices, which include
 a) Proper maintenance of genetic purity
 b) Good growing condition
 c) Proper timing and method of harvesting
 d) All of the above
110. Which of the following seed contains highest oil concentration?
 a) Peanut
 b) Coconut
 c) Sunflower
 d) Soybean
111. Which of the following factors does not affect the quality of seed?
 a) Damaged seed coat
 b) Sunlight
 c) Poor seed storage
 d) Seed-borne fungi
112. Which of the following practices will reduce seed viability?
 a) Moisture content above 13% in seed
 b) Poor storage condition (wet and warm)
 c) Excessive landing of seed
 d) All of the above
113. If the weight of the working sample for physical purity analysis is 2 g, the seed sample and its components be weight up to
 a) One decimal = 0.0 only
 b) Two decimal = 0.00 only
 c) Three decimal = 0.000 only
 d) Four decimal = 0.0000 only

114. Hard seeds are common in
- Fabaceae
 - Malvaceae
 - Cannaceae
 - All of the above
115. The seed sector in India is governed by
- Seeds Act 1966
 - Seed Control Order 1983
 - Protection of Plant Varieties & Farmers' Right Act
 - All of the above
116. Physiological quality of seed comprises of
- Germination, seedling vigour and seed health
 - Germination, moisture and inert-matter
 - Germination, weed seed and cultivar purity
 - All of the above
117. Crop-seed multiplication ratio in paddy is
- 1:10
 - 1:20
 - 1:50
 - 1:100
118. Caffeine is used as a stimulant and found in the seeds of
- Coffea arabica*
 - Coffea robusta*
 - Cola nitida*
 - All of the above
119. In seeds, food is stored in
- Cotyledons
 - Endosperm
 - Perisperm
 - All of the above
120. Seed processing can improve
- Physical purity
 - Genetic purity
 - Moisture
 - All of the above
121. Which of the following methods will be used for sampling of chaffy seeds?
- Hand halving
 - Mechanical divider
 - Random cup
 - Spoon
122. Pre-drying in paddy is recommended in seed testing when
- Seed lot is spoilt by rain in transit
 - Seed sample (submitted) is too large
 - Seed grinding is prescribed for moisture determination
 - Moisture content is >15%
123. Who developed the Brick-gravel test for vigour?
- Matthews & Bradnock (1968)
 - Perry (1984)
 - Roberts (1972)
 - Hiltner (1917)
124. The International Seed Testing Association (ISTA)
- Prescribes seed quality standards
 - Recommends seed testing protocols
 - Enforces international legislation on seed testing
 - Regulates seed quarantine internationally
125. For a seed lot having 18% m.c., the safe temperature limit for drying is
- <30°C
 - <40°C
 - <50°C
 - <60°C
126. Isolation distance for certified seed production of wheat from the wheat field showing high level of incidence of loose smut
- 3 m
 - 50 m
 - 100 m
 - 150 m
127. Which of the state do not have seed certification agency?
- Maharashtra
 - Andhra Pradesh
 - Bihar
 - Tamil Nadu
128. What should be the maximum height of the stack for safe seed storage in godown?
- 9'
 - 12'
 - 15'
 - 18'
129. What moisture equilibrium onion seed attained, if stored at 25°C and 45% RH?
- 6.0%
 - 8.0%
 - 9.5%
 - 11.2%
130. What is the total duration of protection for field crops under PPV&FRA - 2001?
- 9 years
 - 12 years
 - 15 years
 - 18 years

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. Match the scientists with which they were associated

- | | |
|-----------------------|-----------------------------|
| i) P. Maheshwari | a) Indian national genebank |
| ii) R.S. Paroda | b) Seed testing |
| iii) M.S. Swaminathan | c) Search for genes |
| iv) B.P. Pal | d) Embryology |
| v) Amir Singh | e) Green revolution |

132. Match the fruit with their edible part

- | | |
|-----------------|----------------|
| i) Coconut | a) Seed |
| ii) Litchi | b) Fleshy aril |
| iii) Mango | c) Juicy testa |
| iv) Pomegranate | d) Mesocarp |
| v) Cashewnut | e) Endosperm |

133. Match the name of the international centre with rich germplasm resource

- | | |
|-------------|---|
| i) ICRISAT | a) Wheat and maize |
| ii) CIP | b) Paddy |
| iii) ICARDA | c) Potato |
| iv) CIMMYT | d) Pearl millet, sorghum, chickpea, pigeonpea and groundnut |
| v) IRRI | e) Wheat, barley, faba bean, lentil, grass pea and chickpea |

134. Match the crops with their common diseases

- | | |
|---------------|-------------------|
| i) Potato | a) Brown spot |
| ii) Wheat | b) Blight |
| iii) Mustard | c) Powdery mildew |
| iv) Paddy | d) Loose smut |
| v) Garden pea | e) White rust |

135.

- | | |
|---------------------|--------------|
| i) Pure line theory | a) Maize |
| ii) Homeostasis | b) Johannsen |
| iii) Linkage | c) Jensen |
| iv) Jumping gene | d) Lerner |
| v) Multiline | e) Morgan |

136.

- | | |
|---------------------------|--------------|
| i) Heterosis | a) Shull |
| ii) Top-cross | b) Davenport |
| iii) Dominance hypothesis | c) Blackley |
| iv) U-triangle | d) Nagacheru |
| v) Colchicine | e) Davis |

137.

- | | |
|--------------|----------------|
| i) Rice | a) Varalaxmi |
| ii) Cotton | b) Pusa Sawani |
| iii) Okra | c) Pusa Vishal |
| iv) Mungbean | d) Swarna |
| v) Maize | e) Shaktiman 1 |

138.

- | | |
|-----------------------------|--------------------------|
| i) <i>Mangifera indica</i> | a) Aril |
| ii) <i>Litchi chinensis</i> | b) <i>Brassica napus</i> |
| iii) <i>Coffea arabica</i> | c) Asteraceae |
| iv) Canola | d) Intermediate seed |
| v) Safflower | e) Recalcitrant seed |

139.

- | | |
|--------------------------|--------------------------------|
| i) Lesser grain borer | a) Citrus |
| ii) Phosphotidyl choline | b) Equilibrium moisture |
| iii) Hysteresis | c) Calcium chloride |
| iv) Hygroscopic | d) <i>Rhizopertha dominica</i> |
| v) Polyembryony | e) Cellular membrane |

140.

- | | |
|-----------------------------|------------------------------|
| i) Seed dormancy | a) Liquid nitrogen |
| ii) Desiccation sensitivity | b) Matrix priming |
| iii) Invigoration | c) Recalcitrant seed |
| iv) Cryopreservation | d) <i>Phaseolus vulgaris</i> |
| v) Epigeal germination | e) Pre-chilling |

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. National Crop Research is the foundation of seed programme, comment upon.

142. A double cross hybrid crop in maize shows the relatively more variability than a single cross hybrid crop, explain the reasons.

143. During seed germination test, a seed analyst finds variation in germination values among replicates. 400 seeds (100×4) were used. Results are given. Explain whether values of replicates are within tolerance, using tolerance table value, given in parenthesis, if not, explain the reasons and give suggestion.

Replicate	1	2	3	4	& (Tolerance limit)
Example 1	90	85	92	82	(13)
Example 2	97	99	89	95	(9)

144. A seed grower has two small lots with different germination percentages, i.e., 90% and 64%. He wants to blend them and wish to get 86% germination. Advise the grower, what proportions of these two lots can be blended together to achieve the final seed lot with 86% germination?

145. ISTA Rules (2008) recommend the temperature and duration for moisture determination as under, using constant temperature oven-drying method.

Crop	Temperature	Duration of drying
Cotton	103°C	17 hr
Greengram	130°C	1 hr
Sorghum	130°C	2 hr
Soybean	103°C	17 hr
Tomato	130°C	1 hr
Wheat	130°C	2 hr

Why the different seeds are dried at different temperatures for different durations?

146. What is the principle of Tz test? Describe the important steps for Tz test of soybean.