Post Graduate School
Indian Agricultural Research Institute, New Delhi

Examination for Admission to Ph.D. Programme 2013-2014

Discipline : Seed Science and Technology

Discipline Code : 21 Roll No. | | | | | | | |

Please Note:

(i) This question paper contains **13** 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. Who is the present Chairman of Protection of Plant Varieties and Farmers' Right Authority (PPV&FRA)?
a) Dr. R.R. Hanchinal
b) Dr. P.L. Gautam
c) Dr. S. Nagarajan
d) Dr. Swapan K. Datta

2. Which among the following is another name for vitamin B_{12}?
a) Niacin
b) Pyridoxal phosphate
c) Cobalamin
d) Riboflavin

3. The largest share in India's farm export earning in the year 2011-12 was from
a) Basmati rice
b) Non-basmati rice
c) Sugar
d) Guar gum

4. The National Bureau of Agriculturally Important Insects was established by ICAR in _____, was earlier known as _____.
a) Bangalore; PDBC
b) New Delhi; National Pusa Collection
c) Ranchi; Indian Lac Research Institute
d) New Delhi; NCIPM

5. The most important sucking pests of cotton and rice are respectively
a) *Nilaparvata lugens* and *Aphis gossypii*
b) *Aphis gossypii* and *Thrips oryzae*
c) *Amrasca biguttula biguttula* and *Scirtothrips dorsalis*
d) *Thrips gossypii* and *Orseolia oryzae*

6. Which of the following microorganism causes fatal poisoning in canned fruits and vegetables?
a) *Aspergillus flavus*
b) *Penicillium digitatum*
c) *Clostridium botulinum*
d) *Rhizoctonia solani*

7. The cause of the great Bengal Famine was
a) Blast of rice
b) Brown spot of rice
c) Rust of wheat
d) Karnal bunt of wheat

8. Actinomycetes belong to
a) The fungi
b) Eukaryote
c) *Mycelia sterilia*
d) None of the above

9. A virus-free clone from a virus infected plant can be obtained by
a) Cotyledonary leaf culture
b) Axenic culture
c) Stem culture
d) Meristem tip culture

10. Which of the following is not an objective of the National Food Security Mission?
a) Sustainable increase in production of rice, wheat and pulses
b) Restoring soil fertility and productivity at individual farm level
c) Promoting use of bio-pesticides and organic fertilizers
d) Creation of employment opportunities

11. Agmarknet, a portal for the dissemination of agricultural marketing information, is a joint endeavour of
a) DMI and NIC
b) DMI and Ministry of Agriculture
c) NIC and Ministry of Agriculture
d) DMI and Directorate of Economics and Statistics

12. The share of agriculture and allied activities in India's GDP at constant prices in 2011-12 was
a) 14.1%
b) 14.7%
c) 15.6%
d) 17.0%

13. The average size of land holding in India according to Agricultural Census 2005-06 is
a) 0.38 ha
b) 1.23 ha
c) 1.49 ha
d) 1.70 ha

14. 'Farmers First' concept was proposed by
a) Paul Leagans
b) Neils Rolling
c) Robert Chamber
d) Indira Gandhi

15. In the year 2012, GM crops were cultivated in an area of
a) 150 million hectare in 18 countries
b) 170 million hectare in 28 countries
c) 200 million hectare in 18 countries
d) 1.70 million hectare in 28 countries

16. The broad-spectrum systematic herbicide glyphosate kills the weeds by inhibiting the biosynthesis of
a) Phenylalanine
b) Alanine
c) Glutamine
d) Cysteine

17. At harvest, the above ground straw (leaf, sheath and stem) weight and grain weight of paddy crop are 5.5 and 4.5 tonnes per hectare, respectively. What is the harvest index of paddy?
a) 45%
b) 50%
c) 55%
d) 100%

18. Crossing over between non-sister chromatids of homologous chromosomes takes place during
a) Leptotene
b) Pachytene
c) Diplotene
d) Zygotene

19. The term 'Heterosis' was coined by
a) G.H. Shull
b) W. Bateson
c) T.H. Morgan
d) E.M. East

20. When a transgenic plant is crossed with a non-transgenic, what would be the zygosity status of the F_1 plant?
a) Homozygous
b) Heterozygous
c) Hemizygous
d) Nullizygous

21. The highest per capita consumption of flowers in the world is in
a) The USA
b) India
c) Switzerland
d) The Netherlands

22. Which of the following is a very rich source of betalain pigment?
a) Radish
b) Beet root
c) Carrot
d) Red cabbage

23. Dog ridge is
a) Salt tolerant rootstocks of mango
b) Salt tolerant rootstocks of guava
c) Salt tolerant rootstocks of grape
d) Salt tolerant rootstocks of citrus

24. Which of the following micronutrients are most widely deficient in Indian soils?
a) Zinc and boron
b) Zinc and iron
c) Zinc and manganese
d) Zinc and copper

25. Which of the following fertilizers is not produced in India?
a) DAP
b) Urea
c) Muriate of potash
d) TSP

26. What is the estimated extent of salt affected soils in India?
a) 5.42 mha
b) 7.42 mha
c) 11.42 mha
d) 17.42 mha

27. Which of the following is not a feature of watershed?
a) Hydrological unit
b) Biophysical unit
c) Socio-economic unit
d) Production unit

28. Correlation coefficient 'r' lies between
a) 0 and 1
b) -1 and 1
c) -1 and 0
d) 0 and ∞

29. For the data 1, -2, 4, geometric mean is
a) 2
b) 4
c) $-\frac{7}{3}$
d) -2

30. The relationship between Arithmetic mean (A), Harmonic mean (H) and Geometric mean (G) is
a) $G^2=AH$
b) $G=\sqrt{A+H}$
c) $H^2=GA$
d) $A^2=GH$

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. Phytin - a salt of inositol hexaphosphoric acid, is localised in
a) Globoid inclusions inside the protein bodies
b) Cell vacuoles
c) Spherosomes
d) Oleosomes

32. During seed development, if the mechanical tissue develops from the outer epidermis of the outer integument, then the seed is called as
a) Exotestal
b) Mesotestal
c) Endotestal
d) Exotegmic

33. Who found that a peculiar regularity exists in the ratios of nitrogenous bases of double stranded DNA?
a) James Watson and Francis Crick
b) Rosalind Franklin
c) Erwin Chargaff
d) Waclaw Szybalski

34. Which one of the following classes of plant hormones is used as a substitute for low temperature (pre-chilling) seed treatment?
a) Cytokinin
b) Gibberellins
c) Ethylene
d) Auxins

35. PEG is used in
a) Disintegration of spindle fibers
b) Dissolution of cell wall
c) Fusion of plant protoplasts
d) Induction of mutation

36. "Hot water" seed treatment for management of bacterial leaf blight of rice is done at
a) 43^oC for 20 minutes
b) 53^oC for 30 minutes
c) 59^oC for 20 minutes
d) 62^oC for 30 minutes

37. The entire process of aerobic respiration occurs in
a) Cytosol
b) Mitochondria
c) Mitochondria and cytosol
d) Mitochondria and peroxisomes

38. The osmotic pressures of 0.1M sucrose and 0.1M glucose are the same because
a) These compounds have different molecular weights
b) Both are carbohydrates
c) Both are present in same concentration
d) Glucose is reducing sugar while sucrose is non-reducing sugar

39. Pre-chilling is generally used to overcome chemical dormancy in seeds. The temperature range for pre-chilling is
a) Zero to 8^oC
b) 15 to 20^oC
c) 20 to 25^oC
d) 25 to 30^oC

40. In germinating oil seeds, β-oxidation machinery operates in
a) Oleosomes
b) Glyoxysomes
c) Lysosomes
d) Mitochondria

41. The first naturally occurring cytokinin was isolated from
a) DNA of herring sperm
b) Endosperm of coconut milk
c) Immature corn seeds
d) DNA of human's liver

42. In maize, fertilization took place between a female parent having colourless endosperm and the male parent having yellow endosperm. The endosperm of hybrid seed obtained was yellow. This phenomena is known as
a) Over dominance
b) Paternal influence
c) Xenia
d) Metaxenia

43. For every gene in the plant that confers resistance, there is a corresponding gene in the pathogen that confers avirulence. This gene-for-gene hypothesis put forth by Harold H. Flor was based on the studies on the inheritance of pathogenicity in
a) Hollyhock rust
b) Flax rust
c) Pea rust
d) Cedar apple rust

44. Among which of the following plant species does self-pollination never occur either naturally or artificially?
a) *Zea mays* L.
b) *Mangifera indica* L.
c) *Gossypium hirsutum* L.
d) *Carica papaya* L.

45. The Hardy-Weinberg equation is expressed as $p^2+2qp+q^2=1$, where 'p' and 'q' stands for
a) Frequency of heterozygotes
b) Frequency of alleles in population
c) Gene frequencies in population
d) Genotype frequencies in population

46. Which of the following concepts was first introduced by Toshio Murashige?
a) Gene Libraries
b) Single Cell Protein (SCP)
c) Synthetic Seed
d) C-DNA

47. Photomorphogenic responses are most evident in germinating seedlings. The most effective wavelength for this phenomenon is
a) 560 nm
b) 660 nm
c) 680 nm
d) 730 nm

48. The growth of pollen tube in the pistil is an example of positive chemotropism. This chemotropic movement is in response to
a) Potassium gradient
b) Calcium gradient
c) Magnesium gradient
d) Phosphorus gradient

49. Cross between F_1 heterozygote and the homozygous recessive parent is called as
a) Poly cross
b) Test cross
c) Top cross
d) Reciprocal cross

50. In wheat, maize and rice
a) Perisperm is fused with seed coat
b) Pericarp is fused with seed coat
c) Perisperm and seed coat are separate
d) Pericarp and seed coat are separate

51. Perisperm is present in the seeds of
a) Coffee
b) Castor
c) Pumpkin
d) Wheat

52. "Florigen" that induces flowering is made up of which two classes of hormones?
a) Gibberellin and cytokinin
b) Gibberellin and anthesin
c) Cytokinin and abscisic acid
d) Cytokinin and anthesin

53. Filiform apparatus is found in the
a) Egg cell
b) Suspensor
c) Endosperm
d) Synergids

54. Dormancy caused by seed coat impermeability to water and gases can be broken by
a) Scarification
b) Stratification
c) Low temperature
d) Abscisic acid

55. Perisperm in the seed is a
a) Persistent endosperm
b) Persistent nucellus
c) Persistent hypostase
d) Persistent epistase

56. Plant breeders are interested in apomixis because it
a) Enlarges genetic variability
b) Improves seed set
c) Yields clonal progeny
d) Shortens the life cycle

57. Which one of the following pathogens infect unfertilized ovary in pearlmillet?
a) *Claviceps purpurea*
b) *Claviceps fusiformis*
c) *Claviceps paspali*
d) *Claviceps africana*

58. Which among the following is considered as an agent to pollinate the female flower in oak tree?
a) Bate
b) Wind
c) Insect
d) Squirrels

59. Which of the following dyes is used in testing the viability of protoplasts?
a) Evans blue
b) Trypan blue
c) Fluroscein diacetate
d) Brilliant blue

60. Which one of the following statements is not correct?
a) In maize, the mature seed is exalbuminous
b) In orchids, the embryo has no cotyledons
c) In corn, the embryo contains young leaves while in the seed
d) In almond, the fruit is drupe

61. Which among the following defines a situation where the pollen grains from the anther of a flower is transferred to the stigma of another flower on the same plant?
a) Xenogamy
b) Geitonogamy
c) Autogamy
d) Herkogamy

62. Epigeal germination occurs in
a) Castor
b) Garden pea
c) Corn
d) Gram

63. Ethylene is used to overcome seed dormancy. Which of the following is used as precursor in synthesis of ethylene?
a) Threonine
b) Aspartic acid
c) Lysine
d) Methionine

64. Which of the following inorganic substances has a great effect on pollen germination and pollen tube growth?
a) Copper
b) Zinc
c) Boron
d) Molybdenum

65. Restriction enzymes are used in genetic manipulation because
a) They always tend to join different DNA fragments
b) They can cleave DNA at a specific target sites
c) They can cut DNA at variable sites
d) They are proteolytic enzymes which can degrade harmful enzymes

66. Phytochrome pigment is sensitive to red and far-red light region of the visible spectrum. The activation of phytochrome is caused by
a) Conversion of Pr to Pfr form through the effect of red light
b) Repression of Pr form through the effect of far-red light
c) Equal proportion of red and far-red lights at same fluence rate
d) Presence of red and far-red lights at different fluence rates

67. Which among the following is an example of a co-dominant marker used in genetic fingerprint?
a) AFLP marker
b) SSR marker
c) RAPD marker
d) ISSR marker

68. Which of the following cellular organelles can be described as the "stomach of the cell"?
a) Mitochondria
b) Polysomes
c) Endoplasmic reticulum
d) Lysosome

69. Chitosan, a deacetylated form of chitin is used in seed treatment as
a) Micronutrient
b) Osmoticum
c) Inert matter
d) Biopesticide

70. Emasculation can be avoided in which type of flower?
a) Protandrous
b) Protogynous
c) Hermaphrodite
d) All of the above

71. Mating between individuals that are closely related by ancestry is called as
a) Genetic assortive mating
b) Genetic disassortive mating
c) Random mating
d) Phenotypic assortive mating

72. In a natural situation, seedling development starts with
a) Photomorphogenesis
b) Skotomorphogenesis
c) Embryogenesis
d) Desiccation

73. The Central Potato Research Institute's GM potato which is rich in lysine content is developed by insertion of gene from
a) Corn
b) Chickpea
c) Pigeonpea
d) Amaranthus

74. A polyploid developed through hybridization between two or more species followed by chromosome doubling is called
a) Autopolyploid
b) Allopolyploid
c) Aneuploid
d) Species differentiation

75. RiceTech faced international outrage over allegations of biopiracy involving Basmati rice. The patent battle won by India is which form of IPR?
a) Novelty
b) Trade Mark
c) Geographical Indication
d) Industrial Design

76. The center of origin of crops, namely, Lima bean, upland cotton, sweet potato, pepper, papaya, cherry tomato, grain amaranth is
a) The Fertile crescent
b) Central Asiatic center
c) South American center
d) South Mexican and Central American center

77. Which of the following bacteria is associated with the seed gall nematode (*Anguina* sp.) responsible for "Ear cockel of wheat"?
a) *Erwinia carotovora*
b) *Clavibacter tritici*
c) *Clavibacter michiganense*
d) *Pseudomonas syringae*

78. Hidden infestation in seeds can be established by
a) Roentgenography
b) Hillner test
c) Standard germination test
d) T_2 test

79. Dehydrogenase activity is a good index of biological activity of seed. It plays role in
a) Cell division
b) Synthesis of cell organelles
c) Carbon metabolism
d) Respiration

80. Which among the following is not a osmoticum generally used in seed priming?
a) Mannitol
b) PEG 4000
c) EDTA
d) KCl

81. The "Hub and Spoke" model put forth by Prof. M.S. Swaminathan relates to
a) Agroprocessing linkages
b) Human resource management
c) Village community seed banks
d) Permafrost seed storage

82. The XII National Seed Seminar organized by Indian Society of Seed Technology from June 8-10, 2013 shall be held at
a) University of Agricultural Sciences, Bangalore
b) Indian Agricultural Research Institute, New Delhi
c) Tamil Nadu Agricultural University, Coimbatore
d) Punjab Agricultural University, Ludhiana

83. One of the objective of Rashtriya Krishi Vikas Yojana (RKVY) is
a) Direct cash subsidy for agriculture inputs
b) Improve the seed replacement rate through scientific management
c) Capacity building to strengthen seed testing facilities
d) Establishment of National Seed Register

84. Which of the protocol/convention relates to bio-safety?
a) Nagoya Protocol
b) Montreal Protocol
c) Kyoto Protocol
d) Cartagena Protocol

85. Consider the following data:
i) The crop have moderate seed demand [M]
ii) The seed multiplication ratio/rate is greater than 1:100 [HM]
iii) The speed of genetic deterioration is slow [SD]
Suggest the appropriate seed multiplication model based on limited generation concepts.
a) BS $\rightarrow$ FS $\rightarrow$ CS
b) BS $\rightarrow$ FS(I) $\rightarrow$ FS(II) $\rightarrow$ CS
c) BS $\rightarrow$ FS $\rightarrow$ CS(I) $\rightarrow$ CS(II)
d) BS $\rightarrow$ FS(I) $\rightarrow$ FS(II) $\rightarrow$ CS(I) $\rightarrow$ CS(II)

86. Which of the following statements is false with respect to Field Counts conducted during Seed Crop Inspection?
a) It is necessary to take a minimum of 3 counts up to 2 ha of seed production and an additional count for every additional 2 ha
b) For a seed production area of above 6 to 8 ha, the minimum number of counts to be made is 8
c) Number of plants/heads per count in sunflower shall be 100
d) Number of plants/head per count in sorghum shall be 1000

87. Which among the following statements is false regarding Isolation Distance of solanaceous crop?
a) Minimum Isolation Distance is 200 mts for brinjal Foundation Class of Seeds
b) Minimum Isolation Distance is 400 mts for okra and capsicum Foundation Class of Seeds
c) Minimum Isolation Distance is 100 mts for tomato Foundation Class of Seeds
d) Minimum isolation distance is 20 mts for potato [vegetatively propagated] Foundation Class of Seeds

88. As per Indian Minimum Seed Certification Standards, the minimum permissible plants/heads affected by loose smut in wheat Foundation Class of Seeds shall be
a) 0.05%
b) 0.10%
c) 0.50%
d) 1.0%

89. Which among the following is considered as objectionable weed in Lucerne?
a) *Argemone mexicana*
b) *Chicorium intybus*
c) *Cuscutta* sp.
d) *Melilotus* sp.

90. Designated seed borne disease in brinjal/egg plant is
a) Ashy stem blight
b) Ascochyta blight
c) Phomopsis blight
d) Early blight

91. Which of the following upcoming events and places are correctly matched?
a) 30th ISTA Congress 2013 at New Delhi, India
b) Indian Seed Congress 2013 at Hyderabad, India
c) ISF World Seed Congress 2013 at Athens, Greece
d) ISF World Seed Congress 2014 at Antalya, Turkey

92. Which of the following statements is false?
a) The validity period shall be nine months from the date of test at the time of initial certification
b) The extension of validity period of certified seed shall be for a period of six months provided it confirms to the prescribed standards
c) The certification agency shall preserve the guard samples of seed lot for a period of four years in case of rejected seed lot from the date of communication of rejection
d) Under intercropping for production of certified seed class, the crops selected should belong to same genus and preferably with different maturity

93. Section 8A of the Seeds Act, 1966 pertains to
a) The Appellate Authority
b) The Certification Agency
c) Central Seed Committee
d) The Central Seed Certification Board

94. Provisions under Section-5 of the Seeds Act, 1966 pertains to
a) Power to notify kinds or varieties of seeds
b) Powers to specify minimum limits of germination and purity
c) Grant of certificate by certification agency
d) Revocation of certificate

95. Consider the following statements regarding sampling intensity
i) For seed lot having more than 6 and less than 30 containers, sampling shall be done in minimum of 10 containers or at least one in every five containers, which ever is greater.
ii) Seeds held in small containers such as tins or packets, a 1000 kg weight of seed are taken as the basic unit
iii) For seed lot up to 500 kg, a minimum of 5 primary samples must be taken.
Which of the above statements is true?
a) i only
b) ii only
c) iii only
d) i and iii

96. Which among the following statements is false with regard to sample reduction in the laboratory?
a) Boerner divider is suitable for all kinds of seeds, except for extremely chaffy seeds
b) Random cup method is not suitable for crops which are extremely chaffy and which bounce or roll
c) Spoon method is used only for samples of single small-seeded species
d) Hand halving method is followed for genera which are not chaffy

97. During estimation of moisture content, grinding is obligatory in
a) *Allium* sp.
b) *Gossypium* sp.
c) *Sesamum* sp.
d) *Capsicum* sp.

98. India is one among 58 countries participating in OECD Seed Schemes since 2008. There are seven seed schemes, namely,
1) Grasses and legumes
2) Crucifers and other oil or fiber species
3) Cereals
4) Beet
5) Maize and sorghum
6) Subterranean clover and similar species
7) Vegetables
India has voluntarily opted to participate in only 5 schemes which are they?
a) 1, 2, 3, 5 and 7
b) 1, 2, 3, 6 and 7
c) 1, 3, 4, 5 and 7
d) 1, 3, 4, 6 and 7

99. Which of the following definition is false?
a) In case of poaceae, broken florets or free caryopses which are equal to one-half the original size shall be considered as pure seed
b) Intact seed unit which are small, immature, shrivelled shall be considered as pure seed except that seeds of the Fabaceae and Brassicaceae with their entire seed coat removed shall form inert matter
c) Florets with fungal bodies such as ergot (*Claviceps purpurea*) entirely enclosed with in lemma and palea is considered as pure seed
d) Seeds of *Cuscuta* spp. which are either fragile or ashy gray to creamy white in colour shall be considered inert matter

100. During purity analysis, what should be the minimum number of decimal places recorded during weighing of purity components if the weight of working sample is 7 grams?
a) 0
b) 1
c) 2
d) 3

101. Which of the following species is used to test the phytoxicity for comparing substratum of unknown quality with one in stock of acceptable quality?
a) *Lepidium sativum*
b) *Glycine max*
c) *Capsicum annum*
d) *Sorghum bicolor*

102. Disinfection of seed before planting for germination is allowed in which of the following crop species?
a) *Oryza sativa*
b) *Beta vulgaris*
c) *Allium cepa*
d) *Triticum aestivum*

103. Under which of the following circumstances, the germination test shall be repeated using an appropriate method?
a) No dormancy is suspected
b) Seedling showing primary infection
c) The germination range does not comply to the norms of tolerances
d) No error in test condition

104. Which of the following private seed multinational companies have the tag line "Breeding Excellence"?
a) Nuziveedee Seeds
b) RASI Seeds
c) Monsanto Seeds
d) Mahyco Seeds

105. Which of the following is hybrid wheat variety released by Mahyco?
a) PRATHAM-7070
b) HYBRIDTECH
c) HYBRIDNOVA
d) HYBERY

106. Which of the following terms best describes the statement "the angle with the horizontal plane at which the seed material will stand when piled"?
a) Resilience
b) Angle of repose
c) Free settling velocity
d) Angle of friction

107. Below listed are the stages in product life cycle
i) Development
ii) Decline
iii) Introduction
iv) Maturity
v) Growth
vi) Withdrawal
Arrange the above stages in correct order.
a) i, iii, v, ii, iv and vi
b) i, ii, v, iii, iv and vi
c) i, iii, v, iv, ii and vi
d) i, v, iii, ii, iv and vi

108. At the end of standard germination test, the seed analyst found more than 5% of 'Fresh ungerminated seeds'. Under this condition, the seed analyst shall
a) Report the % of Fresh seeds as obtained during the test
b) Extend the test until they germinate
c) Determine the potential to germinate by dissection, T_2 or excised embryo tests
d) Repeat the whole test

109. Plant breeder's and farmer's rights are conferred as per following act
a) Seeds Act
b) Copyrights Act
c) Geographical Indication of Goods Act
d) PPV & FR Act

110. Directorate of Seed Research is located at
a) New Delhi
b) Kalimpong
c) Maubhanjan
d) Shimla

111. International Seed Testing Association is located at
a) Havana
b) Belgium
c) Zurich
d) Auckland

112. The import of seed and planting material is regulated by
a) MTA
b) The Seeds Act
c) Plant Food and Seed Order
d) New Seed Policy

113. Which of the following pairs is not correctly matched?
a) Cucurbits – self pollinated
b) French beans – self pollinated
c) Pea – self pollinated
d) Maize – cross pollinated

114. Which one of the following radiations is non-ionizing?
a) X-rays
b) UV light rays
c) Alpha rays
d) Gamma rays

115. A Vybrid is the progeny obtained from cross between
a) Two hybrid varieties
b) Two facultative apomicts
c) Two obligate apomicts
d) Two somatic hybrids

116. Castor hybrids in India are bring produced by utilising
a) Cytoplasmic male sterility
b) Self-incompatibility
c) Hand emasculation and pollination
d) Pistillateness of the seed parent

117. The maximum weight of a seed lot in case of groundnut crop as per IMSCS should not exceed beyond
a) 10,000 kg
b) 20,000 kg
c) 30,000 kg
d) 40,000 kg

118. Which one of the following is the minimum limit of germination percentage for certified seed of chickpea as per IMSCS?
a) 75
b) 80
c) 85
d) 90

119. Knee-bent symptom is an essential feature for classification as a normal seedling in germination test of
a) Soybean
b) Onion
c) Chickpea
d) All of the above

120. How many isolation blocks will be required for the seed production programme of double cross hybrids of maize, if all the three generations are being taken at the same place?
a) 3
b) 4
c) 7
d) 8

121. Whole embryo count method is used for the detection of
a) Karnal bunt of wheat
b) Ear cockle of wheat
c) Loose smut of wheat
d) Bunt of paddy

122. Intercropping is applicable to oilseed and pulse crops for the production of
a) Foundation seed only
b) Certified seed only
c) Foundation and certified seed
d) Breeder, foundation and certified seed

123. Specific gravity separator separates the seeds which are primarily
a) Similar in size and weight but different shape
b) Similar in texture but different shape
c) Similar in shape and size but different weight
d) Similar in colour but different weight

124. GEAC (Genetic Engineering Appraisal Committee) is an apex body, functioning under
a) Ministry of Agriculture
b) Ministry of Science and Technology
c) Ministry of Environment and Forests
d) Department of Biotechnology

125. Brick Gravel test is used to determine
a) Cold tolerance
b) Drought tolerance
c) Seedling vigour
d) Membrane permeability

126. The determination of seed moisture content through Low Constant Temperature Oven method requires drying temperature and duration of exposure (hours) at
a) 103 ± 2^{o}C for 24 ± 1 hours
b) 103 ± 2^{o}C for 17 ± 1 hours
c) 130 ± 2^{o}C for 17 ± 1 hours
d) 130 ± 2^{o}C for 1 ± 4 hours

127. The seed sample sent by a seed control/seed law enforcement officer for determining whether it meets the minimum seed certification standards or not, is referred to as
a) Service sample
b) Certification sample
c) Official sample
d) Personal sample

128. The numbers of basic and gametic chromosomes in *Triticum aestivum* L. are
a) 6 and 42
b) 7 and 42
c) 7 and 21
d) 14 and 28

129. What is the specification for the size and colour of breeder seed tag in India?
a) Size: 15 cm × 7.5 cm, Colour: Golden yellow
b) Size: 12 cm × 6 cm, Colour: Golden yellow
c) Size: 15 cm × 7.5 cm, Colour: White
d) Size: 12 cm × 8 cm, Colour: Golden yellow

130. Accelerated Ageing Test (AAT) is conducted at temperature (^oC) and relative humidity (RH) combination of
a) 100^oC and 100% RH
b) 80^oC and 80% RH
c) 50^oC and 50% RH
d) 40^oC and 100% RH

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.

Crop	Edible plant part
i) Cauliflower	a) Top leaves
ii) Knol-khol	b) Swollen axillary buds
iii) Sprouting broccoli	c) Swollen stem
iv) Brussels sprouts	d) Curd
v) Kale	e) Flower head

132.

Effect	Cause
i) Femaleness	a) $AgNO_3$
ii) Dormancy	b) Auxin
iii) Maleness	c) ABA
iv) Bolting and flowering	d) Cyclocel
v) Anti-gibberellin	e) Ethylene

133.

Chemicals	Belongs to class/group
i) DDT	a) Ectoparasiticide
ii) Thiram	b) Organophosphate
iii) Malathion	c) Neonicotinoid
iv) Azardirectin	d) Organochlorine
v) Imidachloprid	e) Limonoid

134. Match the journal/publication with the frequency of publication

i) Seed Science Research	a) Annually
ii) Seed Science & Technology	b) Monthly
iii) Seed Testing Rules	c) Biannual
iv) Seed Research	d) Quarterly
v) Plant Variety Journal of India	e) Trimonthly

135.

Class of seed	Tag label colour
i) Basic seed	a) Dark yellow
ii) Pre-basic seed	b) Red
iii) Certified 1st Generation	c) White
iv) Certified 2nd Generation	d) Blue
v) Standard Seed	e) White with a diagonal violet stripe

136.

Hybrid/variety	Crop
i) JS 335	a) Rice
ii) PRH-10	b) Carrot
iii) Pusa Vishal	c) Okra
iv) Pusa Rudhira	d) Soybean
v) Arka Abhay	e) Mungbean

137.

Scientific name	Common name
i) *Setaria italica*	a) Prosomillet
ii) *Paspalum scrobiculatum*	b) Little millet
iii) *Panicum miliaceum*	c) Pearl millet
iv) *Panicum miliare*	d) Foxtail millet
v) *Pennisetum glaucum*	e) Kodo millet

138.

Equipment	Principle/separation based on
i) Air-screen machine	a) Seed length
ii) Gravity separator	b) Degree of roundness
iii) Indented disc separator	c) Aspiration scalping grading
iv) Magnetic separator	d) Seed unit weight
v) Spiral separator	e) Seed surface texture

139.

Scientists	Test/concept
i) Ellis and Roberts (1980)	a) Ferric chloride test
ii) Louis C. Millard (1912)	b) Seed nomographs
iii) Hiltner (1917)	c) Seed deterioration
iv) Hardin (1980)	d) Seed priming
v) Heydecker (1978)	e) Brick gravel test

140.

Seed test/parameters	Units
i) Microbial population	a) % dry weight
ii) Conductivity	b) $\mu Scm^{-1}g^{-1}$
iii) ODV	c) Cfu
iv) Enzyme assay	d) $\mu molmin^{-1}gm^{-1}$
v) Moisture content	e) No. per kg

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. Explain critically the role of free radicals and oxidative damages on seed quality during seed ageing.

142. What are the major differences that you have observed in Seeds Act of 1966 and New Seed Bill? Enlist salient differences and explain how compulsory registration will help to streamline the seed trade and to weed out duplicate hybrids from the market?

143. Lower seed replacement rate is an impediment in popularization of new hybrids. Explain, what would be your plan to improve seed and varietal replacement rates to fast-track the horizontal spread of new varieties and hybrids?

144. Define seed dormancy. What are the different types of seed dormancy and how to break them? Also, distinguish between seed vigour and viability.

145. Discuss Harrington's thumb rules and its implications for seed storage. Write briefly on the utility of psychrometric charts in seed drying. List parameters that are part of psychrometric charts.

146. Is Indian law 'Protection of Plant Varieties and Farmers' Rights Act, 2001' is a *sui-generis* system or we have enacted it because India is a signatory to UPOV Convention? Enlist criteria for protection of plant varieties in India.