



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

Discipline : Water Science and Technology

Discipline Code : 22

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. 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
- Handwritten calculation: $46 = \frac{100}{0.46} = 217.39$ (approx. 222)
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
 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. The science which deals with snow and ice is known as
 a) Cryology
 b) Glaciology
 c) Limnology
 d) Potamology
32. Which is the odd one of the following?
 a) Snow
 b) Sleet
 c) Rain
 d) Hail
33. The most commonly used formula for computing return period is
 a) California formula
 b) Hazen's formula
 c) Weibul's formula
 d) Beard's formula
34. The subsurface runoff is also known as
 a) Interflow
 b) Storm seepage
 c) Secondary base flow
 d) All of the above
35. Soil structure refers to which of the following?
 a) Arrangements of soil particles
 b) Proportion of sand, silt, clay
 c) Organic composition
 d) Profile depth
36. Why is sediment yield often less than soil erosion in a given drainage basin?
 a) Because streams usually cannot carry all of the sediment that is eroded
 b) Because sediment yield is totally unrelated to soil erosion
 c) Because streams naturally evolve towards a graded condition
 d) Because a stream's bed load usually exceeds its suspended load
37. What percentage area in India is drought prone?
 a) 40
 b) 50
 c) 60
 d) 70
38. The volume of water passing by per unit time is called the volume flow rate. What happens to the volume flow rate of the water as it passes from thick section to the thin section?
 a) It will decrease
 b) It will increase
 c) It won't change
 d) Cannot know
39. Isotherm is a line which joins the points of equal
 a) Rainfall depth
 b) Temperature
 c) Humidity
 d) Atmospheric pressure
40. Which of the following constituents found in ground water is most likely associated with agriculture land use?
 a) Nitrate
 b) Sulfate
 c) Arsenic
 d) Chromium

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.

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41. Soil having highest infiltration capacity
 a) Sandy clay loam
 b) Clay loam
 c) Loam
 d) Silty clay
42. A piezometer is inserted into the ground to a depth of 15 m. The ground elevation at the point of insertion is 880 m above the mean sea level (MSL). The distance from the ground surface to the water table in the piezometer is 5 m. What is the elevation head measured by the piezometer?
 a) 875 m
 b) 865 m
 c) 860 m
 d) 855 m
43. During which of the following does water move in a direction different from others?
 a) Percolation
 b) Transpiration
 c) Infiltration
 d) Precipitation
44. Climate is influenced by
 a) The amount of incoming solar radiation
 b) Earth's rotation
 c) The tilt of earth's axis
 d) The moon's gravity
45. Which of the following statements is false?
 a) Recharging of water is a slow process
 b) The water table moves down in a dry weather
 c) Water in a confined aquifer is under pressure
 d) Groundwater is stationary and does not move
46. The main difference between a suspension and a colloid is that
 a) In suspension, the particles eventually settle to the bottom
 b) In suspension, the solute is permanently dissolved in the solvent
 c) In colloids, the particles eventually settle to the bottom
 d) In colloids, the solute is permanently dissolved in the solvent
47. In the case of a water table well, the piezometer surface
 a) is above the ground level
 b) is below the water level in the well
 c) between the ground level and the water surface in the well
 d) below the water surface in the well
48. A 6 hour storm of uniform intensity and a total rainfall of 8 cm produced a runoff of 5 cm. What is the runoff produced by a 12-hour storm of uniform intensity and a total rainfall of 11 cm assuming ϕ -index to be same during both the storms?
 a) 5 cm
 b) 8 cm
 c) 9 cm
 d) 11 cm
49. Which of the following has the highest infiltration capacity?
 a) Forest land
 b) Grazed pasture
 c) Concrete pavement in airport
 d) Rocky land
50. The salinity in water
 a) Reduces the evaporation
 b) Does not affect evaporation
 c) Increases the evaporation
 d) Difficult to say
51. How is water stored in an aquifer?
 a) In an open underground lake
 b) In cracks and spaces in rocks
 c) In impermeable rock
 d) In wells and springs
52. For drinking water, the World Health Organization recommends a level of coliform bacteria colonies per 100 milliliters of water sample.
 a) 0
 b) 5
 c) 10
 d) 100
53. Evaporation through plants and from surrounding soil together is called
 a) Evaporation
 b) Transpiration
 c) Evapotranspiration
 d) All of the above
54. The permeability of an aquifer
 a) Increases with increase in temperature
 b) Increases with decrease in temperature
 c) is independent of temperature
 d) Decreases with decrease in temperature
55. The problem of flood routing through a reservoir may be approached using
 a) The law of conservation of mass
 b) Newton's second law
 c) The law of conservation of energy
 d) Darcy's law

56. A formula used to determine the distribution of head through an aquifer is
- Darcy's equation
 - Poiseuille's equation
 - Laplace's equation
 - Richard's equation
57. How much of earth's water is fresh water?
- 97%
 - 50%
 - 3%
 - 1%
58. What is the best definition of georeferencing?
- The process of assigning coordinates from a known reference system to spatial data
 - The process of matching address locations with street data
 - The process of assigning datum and spheroid to the data
 - The process of transferring geographic coordinates from one projection to another
59. All the feature classes in a feature dataset must have
- Same source data
 - Same projection
 - Same field types
 - a) and b) of the above
60. In standard False Colour Composite (FCC), some water bodies appear in cyan colour which could be because of
- Large depth only
 - Shallowness only
 - Turbidity only
 - Shallowness or turbidity
61. What will happen to the velocity of water as it passes from a relatively thick section of pipe to a relatively thin section of pipe?
- It will increase
 - It will slow down
 - The velocity won't change
 - Can't say
62. The probability that a T_r year flood occurs in any year is
- $\frac{1}{T_r}$
 - $\left(\frac{1}{T_r}\right)^2$
 - $\log\left(\frac{1}{T_r}\right)$
 - e^{-T_r}
63. For a given storm, the average depth of rainfall over an area
- Decreases with increase in area
 - Increases with increase in area
 - has no relation with area
 - Decreases with decrease in area
64. The average equivalent ratio of (Ca+Mg) to HCO_3 is
- Lower in the high-land river waters than that in the low-land river waters
 - Higher in the high-land river waters than that in the low-land river waters
 - Double in the low-land river waters as compared with that in the high-land river waters
 - More than double in the low-land river waters as compared with that in the high-land river waters
65. Based on PET, available water holding capacity of soils and both moisture and the thermal classifications, the climate of India has been divided into how many zones?
- 10
 - 8
 - 6
 - 4
66. The areas covering northern Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh and northern part of Andhra Pradesh fall under
- Humid climate
 - Sub-humid climate
 - Pre-humid climate
 - Semi sub-humid climate
67. The cereal production on account of climate change is likely to decline
- Every where in the world
 - Only in the developed countries
 - Only in the developing countries
 - Both in the developed and developing countries
68. Meteorological drought in the area is defined as a situation where the actual rainfall decreases by more than
- 40 percent of the normal rainfall
 - 30 percent of the normal rainfall
 - 25 percent of the normal rainfall
 - 20 percent of the normal rainfall
69. The evaporation from the semi-dry soil, which occurs 1-5 days after an irrigation, depends on
- Climatic factors
 - Type of the soil
 - Characteristics of the crop
 - Hydraulic conductivity of the soil

70. The peak period evapotranspiration is required for

- a) Determining irrigation water supply
- b) Evaluating the performance of an irrigation project
- c) Planning an irrigation system
- d) Developing irrigation schedules

71. Stokes' law is valid only when the Reynold number is

- a) Between 1 and 10
- b) Does not considerably exceed 1
- c) Considerably less than 1
- d) Does not exceed 1

72. The major role of water user's association in a canal irrigated command at present is to

- a) Decide on season's water allocation
- b) Consult and look to the irrigations departments for water supply
- c) Ensure that outlets and structures are not tempered with
- d) Distribute water below outlets

73. The efficiency of Decision Support System (DSS) is the

- a) Measure of the skill of the decision maker
- b) Degree to which goals are achieved
- c) Success in developing the linkages between the objects
- d) Measure of the use of inputs

74. The main difficulty in developing an expert system for planning and operating water resource systems is associated with the

- a) Effective manipulation of large knowledge bases
- b) Effective manipulation of large databases
- c) Complexities of the changes on the programmes
- d) Lack of availability of input data

75. Remote sensing may be used to carry out ground water investigations by performing

- a) Geohydromorphological maps
- b) Hydrogeomorphological maps
- c) Geomorphologic maps
- d) Geohydrological maps

76. Major irrigation projects includes

- a) Only surface water based schemes irrigating more than 10,000 ha area
- b) Only surface water based schemes irrigating more than 20,000 ha area
- c) Both the surface and ground water based schemes irrigating more than 10,000 ha area
- d) Both the surface and ground based schemes irrigating more than 20,000 ha area

77. The major reason for the gap between the created and the utilized irrigation potential under the medium and major irrigation projects as reported by the Committee set up by the Ministry of Irrigation and Power in 1972 was

- a) Non-availability of field channels
- b) Use of unreliable data for designing and constructing irrigation network
- c) Excessive seepage losses in the canal network
- d) Absence of water users' associations

78. One of the several limitations of the Kostiakov's equation used for determining infiltration rate of water into soil is that it does not fit well for

- a) Small values of elapsed time
- b) Large values of elapsed time
- c) Coarse-textured soil
- d) Fine-textured soil

79. If the depth of water in an earthen channel is increased, the percent seepage loss in the channel will increase

- a) Proportionally with the increase in the carrying capacity of the channel
- b) Proportionally less than the increase in the depth
- c) Proportionally more than the increase in the depth
- d) Proportionally with the increase in the depth

80. The applicability of the Darcy's law in any soil

- a) Depends upon soil texture
- b) Depends on soil structure
- c) Depends both on soil texture and soil structure
- d) is independent of soil texture and soil structure

81. The total flow rate of water in a saturated soil is proportional to the

- a) Radius of the pores
- b) Square of the radius of the pores
- c) Third power of the radius of the pores
- d) Fourth power of the radius of the pores

82. The initial weight of a $2 \times 2 \text{ m}^2$ lysimeter after irrigating a crop was measured as 6.35 tonnes and its weight 10 day after irrigation was found to be 6.15 tonnes. If the volume of the drainage water collected was 100 litres, the average value of the daily evapotranspiration of the crop will be

- a) 2.75 mm
- b) 2.50 mm
- c) 2.25 mm
- d) 2.00 mm

83. A water sample with a CaCO_3 concentration of 150 mg/litre may be classified as
- Soft
 - Moderately soft
 - Hard
 - Moderately hard
84. The spacing between tiles for sub-surface drainage in a silty-clay loam is
- Less than that in a clay soil
 - Greater than that in a clay-loam
 - Greater than that in a sandy-loam
 - Less than that in a clay-loam
85. If the field capacity of a soil is 30 percent, moisture before irrigation is 20 percent, apparent specific gravity of the soil is 1.6, root zone depth 1 m and daily consumptive use is 8 mm, the irrigation interval is
- $$\frac{30 - 20}{1.6} \times 1.6 = \frac{10}{1.6} \times 1.6 = 6.25$$
- 25 days
 - 20 days
 - 15 days
 - 10 days
86. The water availability to the plants in a soil
- Remains the same over the entire range of water availability
 - Depends upon the water table level depth
 - Remains the same upto the critical soil moisture level
 - Decreases with the water potential
87. If surface irrigation system is designed such that the advance phase of water front takes only 25 percent of the total irrigation time in a soil, the infiltration rate of which is inversely proportional to the square root of the elapsed time, the water application efficiency of the system can be expected to be more than
- 90 percent
 - 80 percent
 - 70 percent
 - 60 percent
88. The design and management studies in surface irrigation systems are carried out to increase
- Water use efficiency
 - Application efficiency
 - Storage efficiency
 - Distribution efficiency
89. In a perfectly designed check basin system of irrigation
- Recession phase is more important than the depletion phase
 - Depletion phase is more important than the recession phase
 - Either of the two phases are equally important
 - None of the two phases are important
90. Water storage efficiency is the ratio between
- Water stored in the root zone and the water applied to the field
 - Water used by the plant and water stored in the root zone
 - Water stored in the root zone and the water holding capacity of the root zone
 - Water released from the root zone and water stored in the root zone
91. The friction loss per unit length in a lateral pipe with the same size as that of the main pipe of a pressurized irrigation system
- is more than that in the main pipe
 - Remains the same as that in the main pipe
 - Increases with the number of the cutlets in the lateral pipe
 - is less than that in the main pipe
92. The groundwater flow into a well is governed by a Dupuit assumption which states that the flow velocity is proportional to the
- Sine of the hydraulic gradient
 - Cosine of the hydraulic gradient
 - Tangent of the hydraulic gradient
 - Cotangent of the hydraulic gradient
93. Out of the four surface geophysical methods, the most widely applied method for groundwater investigation is the
- Gravity method
 - Seismic reflection method
 - Seismic refraction method
 - Resistivity method
94. One of the most widely accepted soil and water conservation practices for watersheds with slopping agricultural lands is
- Contour and graded bunding
 - Buffer strip cropping
 - Contour cultivation
 - Land leveling
95. The moisture content in a field has to be raised from 12 percent to 20 percent through irrigation. If the apparent specific gravity of the soil is 1.5 and the root zone depth is 50 cm, the depth of water to be added would be
- $$\frac{20 - 12}{1.5} \times 1.5 \times 50 = 10 \times 1.5 \times 50 = 750 \text{ mm}$$
- 5 cm
 - 6 cm
 - 7 cm
 - 8 cm
96. The velocity of a particle traveling with water through a sediment basin is inversely proportional to the
- Flow rate
 - Length of the basin
 - Depth of the basin
 - Concentration of the sediment

97. Hydraulic ram is an impulse pump and is specially suitable for
- Coastal areas
 - Humid areas
 - Hilly areas
 - Alluvial areas

98. During puddling, the soil is subjected to stress in wet range, the non-capillary pore space is destroyed. In this situation, the apparent specific volume of soil is
- Increased
 - Reduced
 - Homogenized
 - Same as before puddling

99. Water hammer occurs in a pipe when the flowing fluid expresses a sudden reduction in
- Pressure
 - Pipe diameter
 - Velocity
 - Pipe roughness

100. A typical small watershed project concentrates first on
- Water conservation
 - Water harvesting
 - Land treatment
 - Forest cover

101. Isohyets are drawn by
- Joining rain gauge stations
 - Drawing lines of equal rainfall for a given duration
 - Orthogonal lines joining rain gauge stations
 - Lines of equal elevations

102. Flood routing is the computation of
- Direction of the flood flow
 - Inflow hydrograph, when the outflow hydrograph is known
 - Outflow hydrograph, when the inflow hydrograph and storage properties are known
 - Storage, when the outflow hydrograph is known

103. It is a thumb rule that for every 2 lps discharge, the border width can be fixed approximately
- 1.0 m
 - 1.5 m
 - 2.0 m
 - 2.5 m

104. Flow in an irrigation channel is assumed as
- Gradually varied
 - Spatially varied
 - Uniform
 - Rapidly varied

105. The velocity distribution across a pipe flowing full is
- Triangular
 - Parabolic
 - Uniform
 - Semi-circular

106. In a season, 150 mm of irrigation water of an electrical conductivity of 1.4 dS^{-1} was applied on one hectare land. The salt added to the area would be (in kg)
- 1318
 - 1344
 - 1434
 - 1813

107. A practical method of determination of crop ET is through experimentation on
- Small pots
 - Field plot
 - Non weighing lysimeter
 - Weighing lysimeter

108. For a small watershed, the runoff is found to be linearly related with rainfall (both in mm) with a slope of 0.25 and an intercept of -1.0. For this watershed to produce runoff, the rainfall must exceed
- 10 mm
 - 8 mm
 - 6 mm
 - 4 mm

109. Saline lands are mostly found in the region which are
- Temperate
 - Arid and semi-arid
 - Unirrigated
 - Humid

110. In ground water recharge through a tubewell, the recharge rate
- Decreases with time
 - Increases with time
 - Remains constant
 - Fluctuates around a mean

111. Centrifugal pumps are used when suction lift is
- Less than 9 m
 - Equal to 15 m
 - Equal to 20 m
 - Greater than 20 m

112. An average discharge of a pump 230 litres per minute irrigates $100 \text{ m} \times 100 \text{ m}$ wheat crop in 2 days and 2 hours, then what is the average depth of irrigation?
- 0.030 m
 - 0.040 m
 - 0.049 m
 - 0.069 m

$$\frac{230 \times 1000 \times 60 \times 50}{100 \times 100 \times 10^3}$$

$$= \frac{230 \times 3000}{1000000}$$

$$= \frac{690}{10} = 0.069 \text{ m}$$

113. Water year in India starts from the first day of
- January
 - March
 - April
 - June
114. The horizontal distance between the center of the pumping well and the point of zero draw down is
- Radius of influence
 - Effective length
 - Length of aquifer
 - Diameter of influence
115. The hydraulic gradient line indicates the variation of
- Velocity head in the flow direction
 - Piezometric head in the flow direction
 - Total energy head in the flow direction
 - Elevation head in the flow direction
116. A low drainage density of an area indicates
- High permeability of the terrain
 - Low permeability of the terrain
 - Dense network of streams
 - Number of First order streams are more
117. A canal is 80 km long with an average surface width of 15 m. If class A pan evaporation is 0.5 cm/d, volume of water evaporated in a month of 30 days in m³ is
- 1,75,000
 - 1,26,000
 - 18,000
 - 12,600
118. What size of electric motor is required for pumping 300 L/min against a head of 50 m, assuming a pump efficiency of 65%?
- 7.5 hp
 - 5 hp
 - 3 hp
 - 2 hp
119. The concept used to evaluate the sprinkler irrigation system is
- Uniform intensity
 - Uniformity coefficient
 - Coefficient of variation
 - Uniformity index
120. Hydraulically the most efficient irrigation channel section is
- Semi-circular
 - Trapezoidal
 - Rectangular
 - Elliptical

121. An unconfined aquifer of porosity 35% and specific yield 0.15, has an area of 100 km². The water table falls by 0.20 m during drought. The volume of water lost from storage in M m³ is
- 3.0
 - 4.25
 - 7.0
 - 10.5
122. The commonly used radioactive isotope is groundwater development is
- Uranium
 - Thorium
 - Tritium
 - Germanium
123. Rising limb of hydrograph is dependent on
- Storm and basin characteristics
 - Storm characteristics only
 - Basin characteristics only
 - Land use characteristics only
124. All watershed development works should start from
- Lower reaches of the watershed
 - Middle reaches of the watershed
 - Upper reaches of the watershed
 - From anywhere in the watershed
125. Which of the following designs you would adopt for an experiment with soil salinity levels as main treatment and drip irrigation amount levels as sub treatment?
- Completely randomized design
 - Randomized block design
 - Factorial randomized block design
 - Split plot design
126. For assessment of soil moisture in taking up rabi sowing in a dryland area of large extent, which of the following remote sensing data you would use?
- Far infrared (FIR)
 - Near infrared (NIR)
 - Microwave
 - Visible region
127. Number of observation wells required for study of ground water fluctuations in a drainage project area of 1,000 ha is
- 10
 - 20
 - 40
 - 100

$$B = \sqrt{19100}$$

$$100 \times 10^6 \times 0.20$$

$$80 \times 10^3 \times 15 \times 0.5 \times 10^{-2} \times 30$$

$$10^3 \times 12 \times 15$$

$$180^3$$

$$\frac{300}{60} \times \frac{50^2}{25 \times 65}$$

$$\frac{2 \times 10^3}{26 \times 3}$$

$$1.27 \times 10^2$$

$$10 \times 10^2$$

128. In rational method for computing the peak rate of runoff of watersheds, the factor 't' implies the
- Intensity of rainfall for 30 min duration
 - Intensity of rainfall for 1 hour duration
 - Intensity of rainfall for the duration equal to the time of concentration
 - Intensity of rainfall for the duration equal to half the time of concentration

129. A drought event occurs when the standard precipitation index (SPI)
- is continuously negative and reaches a value of -1
 - Reaches a value of zero
 - is continuously positive and reaches a value of +1
 - is continuously negative and reaches a value of -0.5

130. For conducting a drip irrigation experiment with six levels of irrigation, minimum how many replications have to be taken-up for successful statistical design?
- 2
 - 3
 - 4
 - 5

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.
- | | | |
|-----------------------|---|--------------------------|
| i) Groundwater dating | c | a) Ground water movement |
| ii) Rational method | e | b) Plant growth |
| iii) Thiessen polygon | d | c) Carbon-14 |
| iv) Well hydraulics | a | d) Rainfall |
| v) Crop coefficient | b | e) Flood |

- 132.
- | | | |
|-------------------------|---|----------------------|
| i) Hyetograph | c | a) Infiltration |
| ii) Capillary zone | e | b) Remote sensing |
| iii) Field capacity | a | c) Rainfall |
| iv) Land use/Land cover | b | d) Irrigation |
| v) Duty | d | e) Above water table |

- 133.
- | | | |
|----------------------|---|------------------------|
| i) Infrared | e | a) Agronomical measure |
| ii) Contour bunding | a | b) Drought |
| iii) Reverse osmosis | d | c) Evaporation |
| iv) Aridity index | b | d) Water-quality |
| v) Lysimeter | c | e) Surface water body |

134. Match the objective with the soil conservation practice
- | | | |
|---------------------------|---|--------------------------------------|
| i) Contour farming | d | a) To prevent sheet and rill erosion |
| ii) Strip farming | e | b) To perform soil manipulation |
| iii) Conservation tillage | b | c) To provide the ponding of water |
| iv) Contour trenching | z | d) To filter soil out of rain water |
| v) Terracing | a | e) To hold water and prevent runoff |

- 135.
- | | | |
|--|----------|------------------------|
| i) A well completed in unconfined aquifer | indicate | a) Piezometer |
| ii) A well extended to confined aquifer | indicate | b) Water table |
| iii) A real water existence level | | c) Phreatic surface |
| iv) An imaginary pressure line | | d) Well loss |
| v) Difference between in the well and outside the well | | e) Piezometric surface |

- 136.
- | | | |
|--------------------------------|---|-------------------------|
| i) Coshuton wheel silt sampler | d | a) Hydraulic jump |
| ii) Drop structure | e | b) Surface drainage |
| iii) Mole plough | c | c) Sub-surface drainage |
| iv) Chute structure | a | d) H-flume |
| v) Bedding | b | e) Apron |

- 137.
- | | | |
|--------------------------|---|----------------------|
| i) Leakage factor | e | a) L/T |
| ii) Hydraulic resistance | c | b) L ² /T |
| iii) Discharge | d | c) L |
| iv) Water diffusivity | b | d) L ³ /T |
| v) Infiltration | a | e) T |

- 138.
- | | | |
|--------------------------|------|---|
| i) Darcy's equation | c | a) Conservation of mass |
| ii) Manning's equation | d | b) Conservation of energy |
| iii) Continuity equation | a | c) Reynolds's number < 0.2 |
| iv) Bernoulli's equation | b | d) Apparent velocity of flow |
| v) Stokes' law | a, c | e) Dimensionally non-homogeneous equation |

- 139.
- | | | |
|-----------------------|---|------------------------|
| i) Unconfined aquifer | b | a) Hard rock area |
| ii) Confined aquifer | c | b) Screen well |
| iii) Perched aquifer | e | c) Piezometric surface |
| iv) Open well | d | d) Phreatic surface |
| v) Bore well | a | e) False aquifer |

- 140.
- | | | |
|---------------------|---|-------------------------|
| i) Remote sensing | e | a) Rainfall > 600 mm |
| ii) GIS | c | b) Rainfall < 600 mm |
| iii) GPS | d | c) Thematic integration |
| iv) Contour bunding | b | d) Precision farming |
| v) Graded bunding | a | e) SPOT |

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. Describe how global warming is affecting the environment?

142. Determine irrigation time of a check basin with 12 m × 50 m size which is irrigated with a stream size of 25 lps to achieve an irrigation depth of 8 cm at the tail end of the basin in a soil with cumulative infiltration of $Y=1.1 t^{0.45}$, where Y is the depth of infiltration in centimeters and t is the elapsed time in minutes. The advance function of the water front for the given stream size is represented by $l=7.5 t^{0.6}$, where l is the advance length in metres and t, is the time of advance in minutes.

12 []² Q = 25 lps d = 8 cm

143. Define sodium-adsorption ratio (SAR) and discuss in brief, the classification of water based on this.

144. Discuss in brief, 'warabandi' in a canal command areas for water allocation.

145. What is conjunctive use of water for irrigation? Why is conjunctive water use advocated for adoption in canal command areas?

146. Convert Poiseuille's law for capillary flow into Darcy law.