



Post Graduate School  
Indian Agricultural Research Institute, New Delhi  
Examination for Admission to Ph.D. Programme 2013-2014

Discipline : Agricultural Engineering (*Soil and Water Conservation Engineering*)

Discipline Code : 03; *Sub code-02*

Roll No. 

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**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<sub>12</sub>?
  - 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  $\infty$
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. The system of linear equations has  
 $a + 3b + 4c = 11$   
 $2a + 6b + 8c = 22$   
 a) Unique solution  
 b) Many solution  
 c) No solution  
 d) Imaginary solution
32. The conjugate of a complex number  $a+bi$  is denoted by  
 a)  $b+ai$   
 b)  $b-ai$   
 c)  $\sqrt{a^2-b^2}$   
 d)  $a-bi$
33. Archimedes' principle is used in determining the  
 a) Shape of a solid  
 b) Surface area of an irregular solid  
 c) Centre of gravity of a floating body  
 d) Volume of an irregular solid
34. The torque can be measured using  
 a) Strain gauge  
 b) Alcometer  
 c) Durometer  
 d) Inclinator

35. The geographically distributed information can best be stored analyzed and printed by using the following software  
 a) MS Office  
 b) PRO Engineer  
 c) ILWIS  
 d) AUTOCAD
36. Closeness of the instrument output to the true value of measured quantity is known as  
 a) Precision  
 b) Resolution  
 c) Accuracy  
 d) Threshold
37. Indicate the value of  $(2+3i)(1-i)$   
 a)  $1+i$   
 b)  $1-i$   
 c)  $5-i$   
 d)  $5+i$
38. Force of attraction between similar particles is known as  
 a) Cohesion  
 b) Adhesion  
 c) Magnetism  
 d) Gravitation
39. The rate of change of volume of a ball with respect to its radius (r) is  
 a)  $\frac{4}{3} \pi r^3$   
 b)  $\frac{4}{3} \pi r^2$   
 c)  $4 \pi r^2$   
 d)  $\frac{3}{4} \pi r^2$
40. Coordinates of point which divides the line segments joining point A (0,0) and B(9,12) in the ratio 1:2 are  
 a) (-3,4)  
 b) (3,4)  
 c) (3,-4)  
 d) (4,-3)
41. The angle between the lines  $2x-y+5=0$  and  $3x+y+4=0$  is  
 a)  $30^\circ$   
 b)  $45^\circ$   
 c)  $60^\circ$   
 d)  $90^\circ$
42. The lines  $2x-3y=5$  and  $3x-4y=7$  are diameter of a circle of area 154 sq. units. Then the equation of the circle is  
 a)  $x^2+y^2+2x-2y=62$   
 b)  $x^2+y^2+2x-2y=47$   
 c)  $x^2+y^2-2x+2y=47$   
 d)  $x^2+y^2-2x+2y=62$

43. If  $f(x) = \left(\frac{\sin^m x}{\sin^n x}\right)^{m+n} \cdot \left(\frac{\sin^n x}{\sin^p x}\right)^{n+p} \cdot \left(\frac{\sin^p x}{\sin^m x}\right)^{p+m}$   
then  $f'(x)$  is equal to
- 0
  - 1
  - $\cos^{m+n+p} x$
  - $\sin^{m+n+p} x$
44. If  $y = \log \sqrt{\tan x}$ , then the value of  $\frac{dy}{dx}$  at  $x = \frac{\pi}{4}$  is
- $\infty$
  - 0
  - 1
  - $\frac{1}{2}$
45.  $x^y = e^{x^y}$ , then  $\frac{dy}{dx}$  is equal to
- $\frac{\log x}{(1+\log x)^2}$
  - $\frac{x-y}{(1+\log x)}$
  - $\frac{x-y}{(1+\log x)^2}$
  - $\frac{1}{1+\log x}$
46. The domain of the function  $f(x) = \log_{10}(\sqrt{x-4} + \sqrt{6-x})$  is
- (4,6)
  - [4,6]
  - [4,6)
  - (6,4)
47. Bernoulli's principles is based on the conservation of
- Mass
  - Momentum
  - Energy
  - None of these
48. The radius of sphere is changing at the rate of 0.1 cm/sec. The rate of change of its surface area when the radius is 200 cm is
- $8 \pi \text{ cm}^2/\text{sec}$
  - $12 \pi \text{ cm}^2/\text{sec}$
  - $160 \pi \text{ cm}^2/\text{sec}$
  - $200 \pi \text{ cm}^2/\text{sec}$
49. If  $\vec{a}$  is a non-zero vector of modulus  $a$  and  $m$  is a non-zero scalar, then  $\vec{m}\vec{a}$  is a unit vector, if
- $m = \pm 1$
  - $a = |m|$
  - $a = \frac{1}{|m|}$
  - $a = \frac{1}{m}$
50. A body starts from rest and moves in a straight line with uniform acceleration. The distance covered by it in second, fourth and eighth seconds are
- in A.P.
  - in G.P.
  - in the ratio 1:3:7
  - in the ratio 3:7:15
51. The maximum and minimum value of  $(3 \times 3)$  determinant whose element belong to  $\{0,1\}$  is
- 1,-1
  - 2,-2
  - 4,-4
  - None of these
52. There are 'n' persons sitting in a row. Two of them are selected at random. The probability that two selected persons are not together, is
- $\frac{2}{n}$
  - $1 - \frac{2}{n}$
  - $\frac{n(n-1)}{(n+1)(n+2)}$
  - None of these
53. The wavelength of emitted radiation is
- Directly proportional to the surface temperature
  - Directly proportional to the square of the surface temperature
  - Inversely proportional to the square of the surface temperature
  - Inversely proportional to the surface temperature
54. Unit of velocity potential is
- m/d
  - $m/d^2$
  - $m^2/d$
  - mm/d
55. Uniformity coefficient is
- $d_{60}/d_{10}$
  - $d_{60}/d_5$
  - $d_{60}/d_{30}$
  - $d_{30}/d_{60}$

56. Electron volt is unit of  
a) Charge  
b) Potential  
c) Energy  
d) Electric power
57. The dimensional formula for change in momentum is same as that for  
a) Force  
b) Impulse  
c) Acceleration  
d) Velocity
58. If the displacement of a particle is zero, then distance covered  
a) Must be zero  
b) Can not be zero  
c) Is negative  
d) May or may not be zero
59. Sudden fall of pressure at a place indicates  
a) Storm  
b) Rain  
c) Fair weather  
d) Cold wave
60. How does ploughing help in retaining sub-soil water?  
a) By creating capillaries  
b) By breaking capillaries  
c) By turning the soil upside down  
d) None of these
61. Reynold's number is defined as the ratio of  
a) Inertia force to gravity force  
b) Viscous force to gravity force  
c) Viscous force to elastic force  
d) Inertia force to viscous force
62. The topographical details of any area can be derived using the remote sensing data of the following type  
a) PAN data  
b) Multi-spectral band data  
c) Stereoscopic high resolution remote sensing data  
d) Multi-spectral multi-date data
63. The process of removing soluble constituents from the soil layer by action of percolating water is known as  
a) Diffusion  
b) Percolation  
c) Leaching  
d) Infiltration
64. A sodic soil has  
a)  $ESP > 15$ ,  $EC > 4$  ds/m  
b)  $ESP > 15$ ,  $EC < 4$  ds/m  
c)  $ESP < 15$ ,  $EC < 4$  ds/m  
d)  $ESP < 15$ ,  $EC > 4$  ds/m
65. A rectangular channel 40 cm wide is carrying a discharge of  $0.1 \text{ m}^3/\text{s}$  at a depth of 20 cm. State whether the flow is  
a) Critical  
b) Subcritical  
c) Supercritical  
d) None of these
66. Hydraulic conductivity of soil depends on  
a) Property of porous medium only  
b) Property of fluid only  
c) Property of porous medium and fluid  
d) None of these
67. The extreme alkali soil can be reclaimed by using  
a) Soil amendments like gypsum  
b) Nitrogen fertilizer  
c) Leaching of salts  
d) Green manuring
68. Percolation tanks are used for  
a) Storage of water to be used for irrigation and domestic purpose  
b) To increase the water carrying capacity of stream  
c) To hold the surface water for recharge  
d) Flood control
69. The dimensions of specific coefficient of an aquifer are  
a) L/T  
b)  $L^2$   
c)  $L^{-1}$   
d) Dimensionless
70. In case of submersible pump set, the motor is  
a) Completely submerged in water  
b) Partially submerged in water  
c) Not submerged in water  
d) Kept on the ground surface
71. If the value of  $dy/dx = 0$  in the dynamic equation of gradually varied flow, then the flow is  
a) Steady  
b) Uniform  
c) Laminar  
d) Non-uniform
72. The velocity distribution across a pipe flowing full is  
a) Uniform  
b) Triangular  
c) Parabolic  
d) Semicircular

73. A unit hydrograph is the runoff hydrograph of unit
- Rainfall duration
  - Rainfall excess
  - Watershed area
  - Rainfall intensity
74. If the saturated hydraulic conductivity of a soil is 1 m/day, the rate of water transmission across a rectangular area 100 m long and 1 m height under a unit hydraulic gradient will be
- 1 m<sup>3</sup>/day
  - 10 m<sup>3</sup>/day
  - 100 m<sup>3</sup>/day
  - 1000 m<sup>3</sup>/day
75. While designing an earth dam, care should be taken so that the resultant of the forces
- Passes through the middle of the base
  - Meets the base within 2/3<sup>rd</sup> distance from the toe
  - Meets the base within 2/3<sup>rd</sup> distance from the heel
  - Passes the downstream at 1/3<sup>rd</sup> the height from the base
76. A Parshall Flume works on the principle of
- Hydraulic jump
  - Hydraulic drop
  - Uniform flow
  - Turbulent flow
77. Darcy's law is valid in a porous media flow if the Reynold number is
- <2000
  - >2000
  - <1
  - >10
78. The term 'VES', with reference to geohydrology, stands for
- Visibly Efficient Systems
  - Visibly Equitable Systems
  - Variable Echo Sounding
  - Vertical Electrical Sounding
79. A gypsum block is used as a
- Replacement of brick
  - Soil ameliorant
  - Dessicator
  - Device for soil moisture measurement
80. The infiltration rate curve after a long time becomes
- Vertical
  - Horizontal
  - Asymptotic to rate axis
  - Asymptotic to time axis
81. Sum of specific yield and specific retention is equal to the
- Porosity
  - Void ratio
  - Degree of saturation
  - Storage coefficient
82. The water harvesting scheme is recommended for
- Sandy soil having infiltration rate higher than rainfall intensity
  - Water-logged area
  - Area with relatively low slope with adequate provision of water storage
  - None of these
83. The understanding of soil-water-plant relationship is important for
- Tillage operation
  - Sowing of crops
  - Harvesting of crops
  - Design and management of irrigation system
84. The most accurate method of averaging precipitation over an area is
- Arithmetical averaging
  - Thiessen method
  - Grid point method
  - Isohyetal method
85. The stilling well for water stage recorder is used basically
- To protect the float
  - To protect the counter weight cables
  - To suppress fluctuations from surface waves in the stream
  - To keep away the silt content of water of the stream
86. The intrusion of salty ground water in any area is caused due to
- Lowering of water table
  - Raising of the water table
  - Application of irrigation water
  - Rain water flooding
87. If the speed of a centrifugal pump is doubled, the power required will be increased by
- 2 times
  - 4 times
  - 6 times
  - 8 times
88. In a soil if the porosity is 0.2, the void ratio will be
- 0.2
  - 0.25
  - 0.75
  - 0.8

89. The flow towards a sub-surface drain at mid-spacing is
- Vertical
  - Parallel
  - Radial
  - Horizontal
90. An Archimedean screw is
- A reverse threaded screw
  - A popular water lift
  - A device for lifting water from shallow and open water body
  - The item that helped Archimedes discover the law of buoyancy
91. The drainable porosity of soil is important parameter for designing
- Surface drainage system
  - Surface irrigation system
  - Drip irrigation system
  - Sub-surface drainage system
92. The secondary salinization in an irrigation command is caused by
- Heavy rainfall
  - Application of chemical fertilizer
  - Excessive irrigation leading to water-logging
  - Lack of irrigation
93. Under irrigated conditions, the flow towards sub-surface drain is
- Gradually varied
  - Spatially varied
  - Uniform
  - Non-steady
94. Local atmospheric pressure is measured by
- Hydrometer
  - Hygrometer
  - Barometer
  - Altimeter
95. The instrument used to measure the area of a map is known as
- Dumpy level
  - Theodolite
  - Planimeter
  - Current meter
96. A trapezoidal channel has a bottom width of 1 m, side slope 1:1 and depth 1 m. Its cross-sectional area will be
- $1 \text{ m}^2$
  - $2 \text{ m}^2$
  - $\sqrt{2} \text{ m}^2$
  - $4 \text{ m}^2$
97. Along the direction of flow, the base of a Parshall flume at the throat is
- Sloping downwards
  - Sloping upwards
  - Narrowed
  - Broadened
98. Distribution of irrigation water for a fixed duration and in proportion to the holding size is called
- Shejpali
  - Warabandi
  - Block system
  - Zonal system
99. In surge irrigation, water is applied
- Under pressure
  - Intermittently
  - Through pipes
  - In small plots
100. Multi-slot divisors are used for studying
- Wind effect on rainfall
  - Space distribution of rainfall
  - Drop size distribution of rainfall
  - Soil loss from experimental plots
101. When ground water flows into a stream to augment its discharge, the stream is called
- An influent stream
  - An effluent stream
  - A perennial stream
  - An ephemeral stream
102. A current meter is used to measure
- Alternating current
  - Direct current
  - Flow velocity in a canal
  - Discharge of water in a pipe
103. An electric analog model utilizes the similarity between
- The Darcy's law and the Kirchoff's law
  - The Darcy's law and the Ohm's law
  - The Darcy's law and the Coulomb's law
  - The Darcy's law and the Laplace's equation
104. Weibull's plotting position is defined as
- $p = \frac{n+1}{m}$
  - $p = \frac{m}{n+1}$
  - $p = \frac{m}{n} + 1$
  - $p = \frac{m+1}{n+1}$

105. The formula  $Q=CiA$  is used to estimate the
- Peak flow rate of runoff
  - Average flow rate of runoff
  - Cumulative flow of runoff
  - Instantaneous rate of runoff
106. A submersible pump is required when one of the following is too high
- Suction lift
  - Delivery head
  - Diesel cost
  - Water demand
107. The pump efficiency, motor efficiency and drive efficiency of a centrifugal pump set are 80%, 90% and 75%, respectively. The overall efficiency of the pump set is
- 50%
  - 54%
  - 75%
  - 90%
108. The peak of unit hydrograph is the discharge per unit of
- Total rainfall
  - Watershed area
  - Rainfall duration
  - Rainfall excess
109. A rainfall of 5.0 mm recorded between 14.00 h and 14 h 15 min has occurred with an intensity of
- 5 mm/h
  - 10 mm/h
  - 20 mm/h
  - 50 mm/h
110. Graded bunds are used in
- Low rainfall areas for soil conservation
  - Low rainfall areas for water conservation
  - Low rainfall areas for soil and water conservation
  - Relatively high rainfall areas for safe removal of excess rainfall
111. A soil is categorised as 'Group C' soil. It has
- Very low infiltration rate
  - Low infiltration rate
  - Moderate infiltration rate
  - High infiltration rate
112. The main cause of sheet erosion is
- Raindrop splash
  - Strong winds
  - Tillage
  - Cultivation of cereal crops
113. In the universal soil loss equation (USLE), the soil erodibility factor  $K$
- is a measure of the susceptibility of soil particles to detachment and transport
  - Slope length gradient factor
  - Crop management factor
  - Rainfall-runoff factor
114. Permeability is measure of
- Available soil moisture
  - Porosity
  - Water holding and transmitting capacity
  - Ability to transmit water
115. The difference between observed total rainfall hyetograph and the excess rainfall hyetograph is termed as
- Soil moisture storage
  - Abstractions
  - Ground water recharge
  - Detention storage
116. A soil has available water capacity 200 mm per meter of soil depth. For a crop root zone depth of 1.5 m the depth of applied irrigation water should not exceed
- 20 cm
  - 30 cm
  - 40 cm
  - 60 cm
117. In arid and semi-arid region, the additional irrigation is needed to
- Control the temperature
  - Soften the soil for plant roots penetration
  - Control soil salinity
  - For ground water recharge
118. Open channel flow takes place
- Under pressure
  - Under gravity
  - Both pressure and gravity
  - None of these
119. Atmometer is used to measure
- Rainfall
  - Wind velocity
  - Evaporation
  - None of these
120. Why the dam of water reservoir is thick at bottom?
- Quantity of water increases with depth
  - Density of water increases with depth
  - Pressure of water increases with depth
  - None of these



121. The hydraulic head in salt water is 30.0 m above the reference level that coincides with the bottom of the piezometer. Mass density of the saline ground water is  $1025 \text{ kg/m}^3$ . The length of the column of fresh water is
- 30.75 m
  - 3.075 m
  - 35.20 m
  - 40.00 m
122. Water level in a well is 6.8 m from the surface. The most suitable pump to lift the water is
- Axial flow pump
  - Submersible pump
  - Reciprocating pump
  - Horizontal centrifugal pump
123. The equation  $t_c = KL^{0.77}/S^{-0.385}$  is
- Boussinesque equation
  - St. Venant equation
  - Kirpich formula
  - Darcy's equation
124. For a channel cross section and discharge the specific energy in a channel section is a function of
- Velocity only
  - Depth of flow and velocity
  - Depth of flow only
  - None of these
125. For a critical flow with velocity 'v' and hydraulic depth 'D'
- $\frac{v}{2g} = D$
  - $v^2 = gD$
  - $v^2 = 2gD$
  - None of these
126. Chezy formula assumes that
- The force resisting the flow per unit area of the stream bed is proportional to the velocity
  - The effective component of the gravity force causing the flow is equal to the total force of resistance
  - The force resisting the flow per unit area of the stream bed is inversely proportional to the velocity
  - None of these
127. Abstractions includes
- Interception by vegetation above the surface
  - Interception by vegetation before surface runoff begins
  - Interception by vegetation above the ground, depression storage and infiltration
  - Depression storage and infiltration

128. In hydrologic routing
- Flow is calculated as a function of space only
  - Flow is calculated as a function of time alone at given location
  - Flow is calculated as a function of time and space
  - Flow is calculated as a function of depth at given location
129. Geometric similarity among watersheds is described by
- Comparing the land use pattern in watersheds
  - Comparing the slope and soil type in watersheds
  - Time of concentration for watersheds located in same region
  - Quantitative study of land forms in watersheds
130. In case of saturation overland flow theory
- Soil is saturated from above by infiltration
  - Soil is saturated from below by sub-surface flow
  - Entire watershed contributes to overland flow
  - The top of the watershed contributes to overland flow

**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) Ernst             | a) Confined aquifer                     |
| ii) Theis            | b) Fresh water - Saline water interface |
| iii) Ghyben-Herzberg | c) Infiltration                         |
| iv) Ficks            | d) Drainage                             |
| v) Kostikov          | e) Concentration gradient               |

- 132.
- |                            |                  |
|----------------------------|------------------|
| i) Transmissivity          | a) $T$           |
| ii) Leakage factor         | b) $L^2 T^{-1}$  |
| iii) Hydraulic resistance  | c) $M^0 L^0 T^0$ |
| iv) Hydraulic conductivity | d) $L T^{-1}$    |
| v) Specific yield          | e) $L$           |

133.

- |                      |                       |
|----------------------|-----------------------|
| i) Rational formula  | a) Ranking            |
| ii) Darcy's law      | b) Runoff             |
| iii) Curve number    | c) Peak flow rate     |
| iv) Weibull's method | d) Filter design      |
| v) Granulometry      | e) Hydraulic gradient |

134.

- |                     |                         |
|---------------------|-------------------------|
| i) Salinity         | a) Machinery            |
| ii) Compaction      | b) Water harvesting     |
| iii) Leveling       | c) Groundwater recharge |
| iv) Pond            | d) Leaching             |
| v) Percolation tank | e) Earth work           |

135.

- |          |  |
|----------|--|
| i) pH    | a) Measure of replaceable Na               |
| ii) EC   | b) Measure of Na with respect to Ca and Mg |
| iii) CEC | c) Measure of salinity                     |
| iv) SAR  | d) Measure of soil reaction                |
| v) ESP   | e) Measure of replaceable cations          |

136.

- |               |                 |
|---------------|-----------------|
| i) Work       | a) Kilo-Watt-hr |
| ii) Power     | b) Newton       |
| iii) Momentum | c) kg.m/s       |
| iv) Force     | d) Watt         |
| v) Energy     | e) Erg          |

137.

- |                            |                                     |
|----------------------------|-------------------------------------|
| i) Augor hole method       | a) Anisotropy                       |
| ii) Hanging column         | b) Non-homogeneous                  |
| iii) Inflow-outflow method | c) Drainable porosity               |
| iv) Directional difference | d) Seepage loss                     |
| v) Spatial difference      | e) Saturated hydraulic conductivity |

138.

- |                  |                   |
|------------------|-------------------|
| i) Water         | a) Lines          |
| ii) Land         | b) Curved surface |
| iii) Cone        | c) Variation      |
| iv) Spatial      | d) Volume         |
| v) Equipotential | e) Area           |

139. Match the laws with the corresponding properties/activities

- |                             |                       |
|-----------------------------|-----------------------|
| i) Horton's law             | a) Fluid viscosity    |
| ii) Stokes' law             | b) Stream order       |
| iii) Darcy's law            | c) Ground water flow  |
| iv) Fick's law of diffusion | d) Momentum           |
| v) Newton's law             | e) Salt concentration |

140. Match the following expressions

- |                               |                             |
|-------------------------------|-----------------------------|
| i) Entrance resistance        | a) Sprinkler irrigation     |
| ii) Coefficient of uniformity | b) Subsurface tile drainage |
| iii) Saltation                | c) Critical flow            |
| iv) Hydraulic jump            | d) Wind erosion             |
| v) Seepage                    | e) Phreatic line            |

**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 FAO Penman-Monteith equation for calculation of reference evapotranspiration.

142. The data on the ratio of subsurface drain discharge and hydraulic head plot as an approximate straight line on an arithmetic graph paper with a slope of  $0.002 \text{ m}^{-1} \text{ day}^{-1}$ . The spacing (S) between the drains is 40 m. Assuming a steady state condition, calculate the value of saturated hydraulic conductivity.

143. Explain the procedure to generate intensity duration frequency curves (IDF Curves) and give an example of use of IDF Curve.

144. Two pipes, one circular and one square, have the same cross-sectional area. Which has the larger hydraulic radius and by what percentage?

145. With the help of specific energy curve derive the criteria for critical flow.

146. a) Show that for irrotational flow  $\nabla^2\Psi=0$ .

b) If the stream function of a flow is  $\Psi=2xy$ , what is the velocity at position  $x=2$ ,  $y=5$ ?