PHDCE/PHDME/PHDEE

Entrance Test for

00472

Ph.D. (CIVIL, MECHANICAL, ELECTRICAL ENGINEERING) Programme - 2016

Time : 3 hours   *Maximum Marks : 100*

Instructions :

Please read the following instructions carefully :

1. *There are two parts of the paper ; Part A and Part B. Each part has 50 multiple choice questions (MCQ). Total number of questions is 100.*

2. *Part A consists of questions on Research Methodology. The Part A is common to Civil, Mechanical and Electrical Engineering and is compulsory to all.*

3. *Part B has three sub-parts having 50 MCQs in each sub-part.*

    (i)   Part B-I :   Civil Engineering

    (ii) Part B-II : Mechanical Engineering

    (iii) Part B-III : Electrical Engineering

    A candidate has to attempt questions from any one sub part related to his/her discipline.

4. *There is no negative marking for wrong answer.*

Part - A
(Compulsory and Common)
(Common To Civil, Mech, Electrical)
Mathematics, Statistics and Reasoning

1. A single die is thrown twice. What is the probability that the sum is neither 8 or 9 ?

(1) $\dfrac{1}{9}$ (2) $\dfrac{5}{36}$ (3) $\dfrac{1}{4}$ (4) $\dfrac{3}{4}$

2. Match the items in **Column I** and **Column II**.

Column I		Column II
P.	Gauss-Seidel Method	(i) Interpolation
Q.	Forward Newton-Gauss Method	(ii) Non-Linear differential equations
R.	Runge-Kutta Method	(iii) Numerical integration
S.	Trapezoidal Rule	(iv) Linear algebraic equations

(1) P → (i), Q → (iv), R → (iii), S → (ii)
(2) P → (i), Q → (iv), R → (ii), S → (iii)
(3) P → (i), Q → (iii), R → (ii), S → (iv)
(4) P → (iv), Q → (i), R → (ii), S → (iii)

3. What is the value of a, if $B = \begin{pmatrix} 1 & 4 \\ 2 & a \end{pmatrix}$ is a singular matrix ?

(1) 5   (2) 6   (3) 7   (4) 8

4. A box contains 20 defective items and 80 non-defective items. If two items are selected at random without replacement, what will be the probability that both items are defective ?

(1) $\dfrac{1}{5}$ (2) $\dfrac{1}{25}$ (3) $\dfrac{20}{99}$ (4) $\dfrac{19}{495}$

5. If $f(x) = \dfrac{2x^2 - 7x + 3}{5x^2 - 12x - 9}$, the $\lim\limits_{x \to 3} f(x)$ will be :

(1) $-\dfrac{1}{3}$ (2) $\dfrac{5}{18}$ (3) 0   (4) $\dfrac{2}{5}$

6. If $A = \begin{pmatrix} 5 & 3 & 2 \\ 0 & 4 & 1 \\ 0 & 0 & 3 \end{pmatrix}$ then $|A| = $?

(1) 30   (2) 40   (3) 50   (4) 60

7. If two coins are tossed simultaneously, the probability of getting at least one head is :

(1) $\dfrac{1}{8}$ (2) $\dfrac{3}{8}$ (3) $\dfrac{1}{4}$ (4) $\dfrac{3}{4}$

8. The Blasius equation, $\dfrac{d^3 f}{d\eta^3} + \dfrac{f}{2}\dfrac{d^2 f}{d\eta^2} = 0$, is a :

(1) Second order non-linear ordinary differential equation.

(2) Third order non-linear ordinary differential equation.

(3) Third order linear ordinary differential equation.

(4) Mixed order non-linear ordinary differential equation.

9. The modulus of the complex number $\left[\dfrac{3 + 4i}{1 - 2i}\right]$ is :

(1) 5   (2) $\sqrt{5}$ (3) $\dfrac{1}{\sqrt{5}}$ (4) $\dfrac{1}{5}$

10. $\displaystyle\lim_{\theta \to 0} \dfrac{\tan\theta}{\theta}$ is equal to :

(1) 0   (2) $\sin\theta$ (3) ∞ (4) 1

11. The area enclosed between the straight line $y = x$, and the parabola $y = x^2$ in the x-y plane is :

(1) $\dfrac{1}{6}$ (2) $\dfrac{1}{4}$ (3) $\dfrac{1}{3}$ (4) $\dfrac{1}{2}$

12. In IGNOU, suppose there are 1000 study centres. Now, to start a new centre, it is required to determine how crowded the study centres are. It is to be done by random sampling of the data. For this following two methods may be applied.
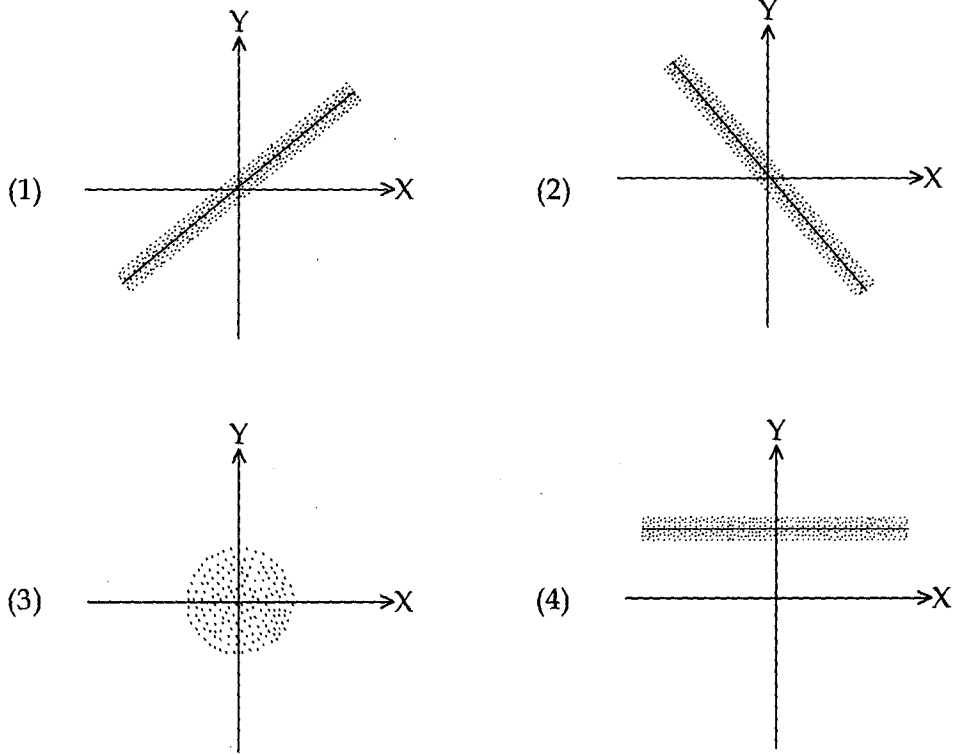
Method A : Randomly visit 100 Study Centres and check each one, if it is crowded or not.

Method B : Call up 1000 randomly chosen IGNOU students and ask them if their study centre is crowded. (Assume that students give you authentic information.)

Which of the above method is **correct** ?

(1) Only Method A   (2) Only Method B

(3) None of the two are correct   (4) Both Methods A and B

13. If the two random variables X and Y are negatively correlated (i.e. e<0). Then the scatter plot looks like :

(1) [scatter plot: positively sloped band through origin, X and Y axes]

(2) [scatter plot: negatively sloped band through origin, X and Y axes]

(3) [scatter plot: circular cloud near origin, X and Y axes]

(4) [scatter plot: horizontal band above X axis, X and Y axes]

14. For a particular project eight activities are to be carried out. Their relationships with other activities and expected durations are mentioned in the table below :

Activity	Predecessors	Duration (Days)
a	-	3
b	a	4
c	a	5
d	a	4
e	b	2
f	d	9
g	c, e	6
h	f, g	2

The critical path for the project is :

(1) a - b - e - g - h   (2) a - c - g - h   (3) a - d - f - h   (4) a - b - c - f - h

15. The matrix $A = \begin{pmatrix} 1 & 3 & 2 \\ 3 & 0 & 1 \\ 2 & 1 & 5 \end{pmatrix}$ is a :

(1) Symmetric   (2) Skew-symmetric

(3) hermitian   (4) Skew-hermitian

16. The cost function for a product in a firm is given by $5q^2$, where q is the amount of production. The firm can sell the product at a market price of ₹ 50 per unit. The number of units to be produced by the firm such that the profit is maximized is :

(1) 5   (2) 10   (3) 15   (4) 25

17. A political party orders an arch for the entrance to the ground in which the annual convention is being held. The profile of the arch follows the equation :

$y = 2x - 0.1\ x^2$.

Where y is the height of the arch in meters. The maximum possible height of the arch is :

(1) 8 m   (2) 10 m   (3) 12 m   (4) 14 m

18. If $\dfrac{\log x}{\log 5} = \dfrac{\log 36}{\log 6} = \dfrac{\log 64}{\log y}$, what are the values of x and y respectively ?

(1) 8, 25   (2) 25, 8   (3) 8, 8   (4) 25, 25

Directions for question numbers 19 and 20 :

Vandana is organising a carrom game, consisting of four players, on Sunday night. She has seven players to choose from : family members Munni, Vani, and Honey and friends Amit, Binny, Chinky and Dicky.

There must be at least two family members in the game to teach her friends the rules and strategies for the game to go smoothly. Each player must be able to play with all the other players.

But there are some limitations :

* Vani cannot play with Binny
* Honey cannot play with Dicky
* Dicky cannot play with Amit

19. If Dicky has the only carrom striker and must come, which of the other players must be invited ?

(1) Munni, Binny and Chinky   (2) Vani, Munni, and Chinky

(3) Vani, Munni, and Amit   (4) Vani, Munni, and Binny

20. If Honey cannot make it on Saturday night and Amit is invited then, which other three must receive the invitation ?

(1) Munni, Binny and Chinky   (2) Munni, Vani and Binny

(3) Munni, Vani and Chinky   (4) Munni, Vani and Dicky

21. Type-I Error occurs if _____.
    (1) the null hypothesis is rejected even though it is true
    (2) the null hypothesis is accepted even though it is false
    (3) both the null hypothesis as well as alternative hypothesis are rejected
    (4) none of the above

22. _____ is a preferred sampling method for the population with finite size.
    (1) Area sampling   (2) Cluster sampling
    (3) Purposive sampling   (4) Systematic sampling

23. The data of research is _____.
    (1) Qualitative only   (2) Quantitative only
    (3) Both (1) and (2)   (4) Neither (1) nor (2)

24. What are the two categories of errors used in Testing of Hypothesis ?
    (1) Type I and Type II errors   (2) Type 0 and Type I errors
    (3) Type 0 and Type II errors   (4) Type A and Type B errors

25. Random sampling is helpful as it is _____.
    (1) an economical method of data collection
    (2) free from personal biases
    (3) reasonably accurate
    (4) all the above

26. If the order of matrix A is $m \times p$. And the order of B is $p \times n$. Then the order of AB is :
    (1) $n \times p$ (2) $m \times p$ (3) $m \times n$ (4) $n \times m$

27. In a throw of dice what is the probability of getting number greater than 5 ?
    (1) 1/2   (2) 1/3   (3) 1/5   (4) 1/6

28. A simulation model uses the mathematical expressions and logical relationships of the :
    (1) real system   (2) computer model
    (3) performance measures (4) estimated inferences

29. Values for the probabilistic inputs to a simulation :
    (1) are selected by the decision maker.
    (2) are controlled by the decision maker.
    (3) are randomly generated based on historical information.
    (4) are calculated by fixed mathematical formulas.

30. A quantity that is difficult to measure with certainty is called a :
    (1) risk analysis   (2) project determinant
    (3) probabilistic input   (4) profit/loss process

31. The time variation of the position of a particle in rectilinear motion is given by, $x = 2t^3 + t^2 + 2t$. If v is the velocity and a the acceleration of the particle in consistant units, the motion started with :
    (1) $v = 0, a = 0$ (2) $v = 0, a = 2$ (3) $v = 2, a = 0$ (4) $v = 2, a = 2$

32. If point A is in equilibrium under the action of the applied forces the values of tension T_{AB} and T_{AC} are respectively :
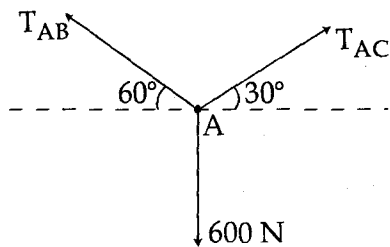
    (1) 520 N and 300 N   (2) 300 N and 520 N
    (3) 450 N and 150 N   (4) 150 N and 450 N

33. Find the odd one in the following :
    (1) Watt-day   (2) Calorie   (3) Coulomb Farad   (4) Electron volt

34. A man weighing 60 kg stands in an elevator. The force exerted by him on the floor of the elevator will be zero when :
    (1) the elevator goes up at a uniform speed.
    (2) it goes down at a uniform speed.
    (3) the cable of the elevator breaks and it falls freely.
    (4) the elevator goes up at an acceleration of 9.8 m/s².

35. A particle moves towards east from a point A to a point B at the rate of 4 km/hr, and then towards north from B to C at the rate of 5 km/hr. If AB = 12 km and BC = 5 km, then its average speed for its journey from A to C and resultant average velocity direct from A to C are respectively :
    (1) $\dfrac{17}{9}$ km/hr and $\dfrac{13}{9}$ km/hr.   (2) $\dfrac{13}{4}$ km/hr and $\dfrac{17}{4}$ km/hr.

    (3) $\dfrac{17}{4}$ km/hr and $\dfrac{13}{4}$ km/hr.   (4) $\dfrac{13}{9}$ km/hr and $\dfrac{17}{9}$ km/hr.

36. A train of 150 m length is going towards north at a speed of 10 ms^{-1}. A Parrot flies at the speed of 5 ms^{-1} towards south direction parallel to the railway track. The time taken by the parrot to cross the train is :
    (1)   15 sec.   (2)   12 sec.   (3)   10 sec.   (4)   8 sec.

37. Reliability is most simply known as which of the following ?
    (1)   Consistency or stability
    (2)   Appropriateness of interpretations on the basis of test scores
    (3)   Ways in which people are the same
    (4)   A rank order of participants on some characteristic

38. Analysis of covariance is :
    (1)   A statistical technique that can be used to help equate groups on specific variables.
    (2)   A statistical technique that can be used to control sequencing effects.
    (3)   A statistical technique that substitutes for random assignment to groups.
    (4)   Adjusts scores on the independent variable to control for extraneous variable.

39. To determine whether noise affects the ability to solve mathematics problems, a researcher has one group solving mathematics problems in a quiet room and another group solving mathematics problems in a noisy room. The group solving problems in the noisy room completes 15 problems in one hour and the group solving problems in the quiet room complete 22 problems in one hour. In the experiment the independent variable is _____ and the dependent variable is _____.
    (1)   The number of problems solved, the difficulty of the problems.
    (2)   The number of problems solved, the noise level in the room.
    (3)   The noise level in the room ; the number of problems solved.
    (4)   The noise level in the room ; the difficulty of the problems.

40. Which of the following terms refers to a statistical method that can be used to statistically equate groups on a pretest or some other variable ?
    (1)   Experimental control   (2)   Differential influence
    (3)   Matching   (4)   Analysis of covariance

41. The group that receives the experimental treatment condition is the _____.
    (1)   Experimental group   (2)   Control group
    (3)   Participant group   (4)   Independent group

42. Which of the following control techniques available to the researcher controls for both known and unknown variables ?
    (1)   Building the extraneous variable into the design
    (2)   Matching
    (3)   Random assignment
    (4)   Analysis of covariance

43. In an experimental research study, the primary goal is to isolate and identify the effect produced by the _____.

(1) Dependent Variable   (2) Extraneous Variable

(3) Independent Variable   (4) Confounding Variable

44. This type of design is one where all participants participate in all experimental treatment conditions :

(1) Factorial design   (2) Repeated measures design

(3) Replicated design   (4) Pretest - post - test control - group design

45. The written and unwritten rules that specify appropriate group behavior are called _____.

(1) Shared attitude (2) Shared beliefs (3) Shared values (4) Norms

46. Which of the following is a characteristic of qualitative research ?

(1) Design flexibility   (2) Inductive analysis

(3) Context sensitivity   (4) All of the above

47. Which of the following involves the studying of multiple cases in one research study ?

(1) Collective case study   (2) Single case study

(3) Instrumental case study (4) Intrinsic case study

48. Questionnaires can address events when its characteristics takes place :

(1) Combined footing

(2) Strap footing

(3) Cantilever footing

(4) Mat footing

49. Which of these is **not** a method of data collection ?

(1) Questionnaires (2) Interviews   (3) Experiments   (4) Observations

50. Secondary/existing data may include which of the following ?

(1) Official documents   (2) Personal documents

(3) Archived research data   (4) All of the above

Part - B - I
FOR CIVIL ENGINEERING

51. Consider the following statements :

    (i)   In the work-breakdown structure, top-down approach is adopted.

    (ii) Bar-chart depicts interdependencies of activities.

    (iii) Controlling can be better achieved in a milestone chart.

    Which of these statements are **correct** ?

    (1) (i) and (iii) only   (2) (i) and (ii) only

    (3) (ii) and (iii) only   (4) (i), (ii) and (iii)
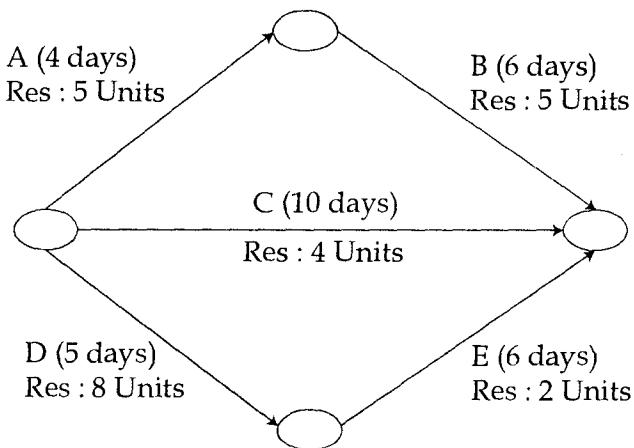
52. In PERT analysis, the time estimates of activities correspond to :

    (1) Normal distribution   (2) Poisson's distribution

    (3) β-distribution   (4) Binomial distribution

53. A machine costs ₹ 16,000. By constant rate of declining balance method of depreciation, its salvage value after an expected life of 3 years is ₹ 2,000. The rate of depreciation is :

    (1) 0.25   (2) 0.30   (3) 0.40   (4) 0.50

54. The activity duration (days) and resource requirements (units) are shown in the figure below :

A (4 days) Res : 5 Units
B (6 days) Res : 5 Units
C (10 days) Res : 4 Units
D (5 days) Res : 8 Units
E (6 days) Res : 2 Units

What is the maximum resource required in a day ?

   (1) 14 units   (2) 11 units   (3) 19 units   (4) 18 units

55. The earliest date and the latest date of events 3 and 10 are given in the figure below. Activity E is connecting both the events and its duration is 10 weeks. The independent float of the activity is :

Earliest Date = 20 weeks

Earliest Date = 40 weeks

Activity E

(3) ——————————→ (10)

Duration 10 weeks

Latest Date = 25 weeks

Latest Date = 45 weeks
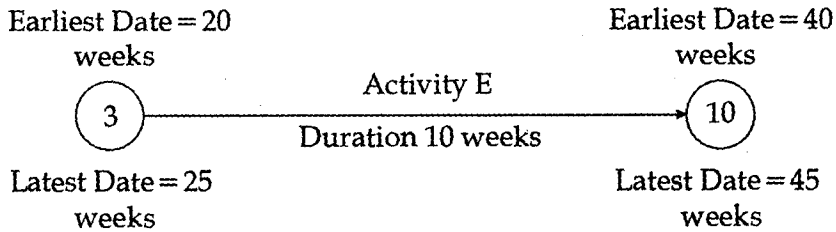
(1)   5 weeks   (2)   10 weeks   (3)   15 weeks   (4)   20 weeks

56. A simply supported beam is subjected to a couple somewhere in the span. Consider the following statements :

(i)   A rectangular shear force diagram would be produced for the beam.

(ii)   The bending moment diagram would be parabolic.

(iii) Both +ve and −ve bending moments which are maximum at the point of application of the couple would exist in the beam.

Which of these statements are **correct** ?

(1)   (i) and (ii)   (2)   (i), (ii) and (iii)   (3)   (ii) and (iii)   (4)   (i) and (iii)

57. A loaded beam ABCD is shown in the figure below :

24 kN

W

A   B   C   D

EI = constant

|←2 m→|←————— 6 m —————→|←2 m→|
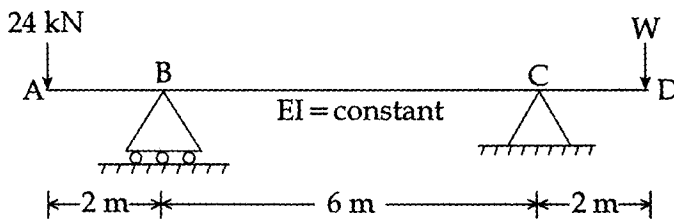
The magnitude of the reaction at C will be zero if the value of load W is :

(1)   4 kN   (2)   5 kN   (3)   6 kN   (4)   12 kN

58. Muller-Breslau principle is not applicable to get :

(1)   ILD for reaction at the ends of a simple beam

(2)   ILD for bending moment at a section

(3)   ILD for shear force at a section

(4)   Shear force and moment diagrams for the whole beam

59. The three hinged arch shown in the given figure will have value of H as :

80 kN
4 m
4 m
H →   H ←
⎟←—8 m—*—8 m—→⎟
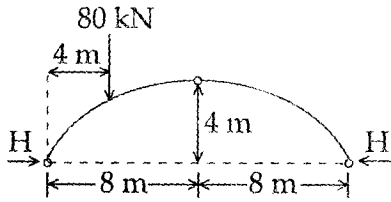
(1)   30 kN   (2)   40 kN   (3)   50 kN   (4)   10 kN

60. The rigid portal frame shown in the given figure will not have any side sway if :

I_2

I_1 I_1
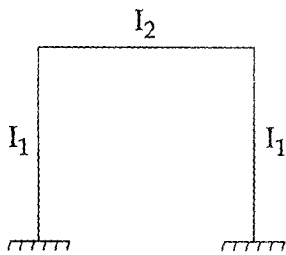
(1)   it is subjected to vertical loading only

(2) $I_2 = 2I_1$

(3)   loaded in any manner

(4)   the loading is symmetrical about its centreline

61. The force in the member BC is :

P
A
B 60°   60° C
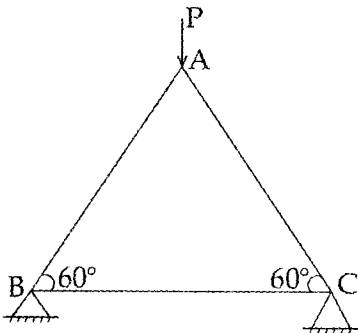
(1) $\dfrac{P}{2\sqrt{2}}$ (2) $\dfrac{P\sqrt{3}}{2}$ (3) $\dfrac{2P}{\sqrt{3}}$ (4)   Zero

62. A steel plate is 300 mm wide and 10 mm thick. A rivet of nominal diameter of 16 mm is driven into it. What is the net sectional area of the plate ?
    (1) 2825 mm^2 (2) 2840 mm^2 (3) 2760 mm^2 (4) 3000 mm^2

63. For a compression member having the same effective length about any cross-sectional axis, the most preferred section from the point of view of strength is :
    (1) a channel   (2) a single angle   (3) an I-section   (4) a circular tube

64. If the depth of neutral axis in a beam is more than the depth of critical axis, then the beam is called :
    (1) over reinforced beam   (2) under reinforced beam
    (3) balanced beam   (4) deep beam

65. A T-beam behaves as a rectangular beam of width equal to its flange, if its neutral axis :
    (1) coincides with centroid of tensile reinforcement
    (2) coincides with centroid of T-section
    (3) lies within the flange
    (4) lies in the web

66. Bentonite is a material obtained due to the weathering of :
    (1) limestone   (2) quarzite   (3) volcanic ash   (4) shales

67. The correct increasing order of the surface area of the given soil is :
    (1) Silt, Sand, Colloids, Clay   (2) Sand, Silt, Colloids, Clay
    (3) Sand, Silt, Clay, Colloids   (4) Clay, Silt, Sand, Colloids

68. Consistency as applied to cohesion soils is on :
    (1) density   (2) moisture content
    (3) shear strength   (4) porosity

69. Which of the following methods is most accurate for the determination of the water content of soil ?
    (1) Oven dry method   (2) Sand bath method
    (3) Calcium Carbide method   (4) Pycnometer method

70. The unit of the coefficient of consolidation is :
    (1) cm^2/gm   (2) cm^2/sec   (3) gm/cm^2/sec   (4) gm-cm/sec

71. Resistance load due to skin friction for a circular pile varies with :
    (1) L   (2) L^2 (3) D^2 (4) LD

72. In tri-axial compression test, the deviator stress is given by :
    (1) $\sigma_1 + \sigma_3$ (2) $\sigma_1 - \sigma_3$ (3) $\frac{1}{2}(\sigma_1 + \sigma_3)$ (4) $\frac{1}{2}(\sigma_1 - \sigma_3)$

73. Coulomb's theory of earth pressure is based on :
(1) the theory of plasticity
(2) the theory of elasticity
(3) empirical rules
(4) wedge theory

74. The earth pressure distribution due to surcharge load q per unit area is :
(1) Triangular
(2) Rectangular
(3) Parabolic
(4) Circular

75. If two footings are connected by a beam it is known as :
(1) Combined footing
(2) Strap footing
(3) Cantilever footing
(4) Unit footing

76. The road connecting a district headquarters of one state to the district headquarters of another bordering state is called :
(1) National Highway
(2) State Highway
(3) Major District Road
(4) Expressway

77. Width of a traffic lane is :
(1) 3.75 m
(2) 5.50 m
(3) 7.00 m
(4) 7.50 m

78. The primary object of providing camber is :
(1) easy drainage
(2) improved appearance
(3) easy separation of up and down traffic
(4) easy overtaking facility

79. The minimum super elevation provided is :
(1) 7%
(2) 10%
(3) not less than the grade of the road
(4) not less than camber at the section

80. In plains, the minimum length of transition curve is :

(1) $\dfrac{V^2}{R}$
(2) $\dfrac{V^2}{1.5\,R}$
(3) $\dfrac{2.7\,V^2}{R}$
(4) $\dfrac{V^2}{24\,R}$

81. A pavement is classified as flexible pavement or rigid pavement based on its :
(1) Wearing course
(2) Base course
(3) Sub - base
(4) Sub-grade

82. PCU equivalent for a bus may be taken as :
(1) 1.00
(2) 0.75
(3) 2.25
(4) 16.00

83. Throw of switch for a BG track is :
(1) 89 mm
(2) 91 mm
(3) 93 mm
(4) 95 mm

84. The maximum degree of curve on a BG track is :
(1) 10°
(2) 16°
(3) 20°
(4) 40°

85. The meteorological condition which influences the size and location of an airport is :
    (1) atmospheric pressure   (2) air density
    (3) wind direction   (4) all the above

86. Turbidity is the ability of water to :
    (1) scatter light
    (2) retain suspended solids
    (3) retain colloidal solids in suspension
    (4) detain dissolved solids

87. The content of total solids in drinking water shall not be greater than :
    (1) 50 mg/L   (2) 100 mg/L   (3) 500 mg/L   (4) 2000 mg/L

88. The minimum amount of D.O. desirable in any water body is not less than :
    (1) 1 mg/L   (2) 2 mg/L   (3) 3 mg/L   (4) 5 mg/L

89. BOD equation is :
    (1) $x = L_i (1 - 10^{-kt})$ (2) $x = L_T (1 - 10^{-kt})$
    (3) $K_T = K_{20} (1.047)^{T-20}$ (4) $x = K (1 - 10^{-kt})$

90. Out of the following, a water borne disease is :
    (1) Malaria   (2) Cancer
    (3) Dysentery   (4) Encephalitis

91. An average value of the domestic water demand for an Indian city is :
    (1) 135 lpcd   (2) 27 lpcd   (3) 500 lpcd   (4) 750 lpcd

92. Overflow rate of a sedimentation tank is :

    (1) $\dfrac{Q}{\text{Plan area}}$ (2) $\dfrac{Q}{\text{Area of longitudinal section}}$

    (3) $\dfrac{Q}{\text{Cross sectional area}}$ (4) $\dfrac{Q}{\text{Plan area} \times \text{Liquid depth}}$

93. Sewage is :
    (1) waste water from bathrooms
    (2) drainage from roads
    (3) waste water from kitchen
    (4) any waste water of domestic or industrial origin

94. A lamphole is helpful in :
    (1) illuminating sewer line   (2) cleaning sewer line
    (3) repairing   (4) testing sewers

95. Electrostatic Precipitator (ESP) removes :
   (1) gas borne particulate matter in air
   (2) turbidity
   (3) dissolved solids particles in water
   (4) none of the above

96. Which one of the following statements is the most appropriate :
   (1) The actual infiltration rate at any given time may be equal to infiltration capacity.
   (2) The actual prevailing rate of infiltration of water in the soil at any given time, is known as the infiltration rate.
   (3) When rainfall rate is less than the infiltration capacity, the infiltration rate is approximately equal to the rainfall rate.
   (4) All of the above.

97. Absolute humidity in air :
   (1) increases with increase of altitude.
   (2) decreases with increase of altitude.
   (3) initialy decreases with increase of altitude and thereafter it increases.
   (4) initialy increases with increase of altitude and thereafter it decreases.

98. Which of the following statements is **correct** ?
   (1) Porosity of acquifer material is the sum of specific yield and specific retention provided all pores are interconnecting.
   (2) Specific retention decreases with decrease in grain size of acquifer material.
   (3) Specific yield is the ratio of the volume of water that drains from the saturated material due to the capillary force to the total volume of acquifer material.
   (4) Specific retention is the ratio of volume of water that is retained by a saturated material when drained due to capillary force.

99. The is non-equillibrium equation $s (r, t) = \dfrac{Q}{4\pi T} \cdot W(u)$, may be valid for which of the following condition(s) ?
   (i) Wells in confined acquifer.
   (ii) Steady state flow towards partially penetrating wells.
   (iii) Unsteady state flow towards fully penetrating wells.
   (iv) Steady state flow towards fully penetrating unconfined acquifers.
   The **correct** answer is :
   (1) For conditions (ii) and (iii)
   (2) For conditions (i) and (iv)
   (3) For conditions (i) and (iii)
   (4) For condition (iv) only

100. An error of 1% in measuring the head of water over the crest of a triangular notch, produces an error, in the discharge rate, which is equal to :
   (1) 1%
   (2) 1.5%
   (3) 2.0%
   (4) 2.5%

FOR MECHANICAL ENGINEERING

51. A Cupola furnace can produce a maximum temperature of around :
    (1) 500°C   (2) 1000°C   (3) 1650°C   (4) 3250°C

52. The moisture content in the moulding sand varies between :
    (1) 2 and 8%   (2) 5 and 10%   (3) 10 and 15%   (4) 15 and 20%

53. Investment casting is useful for :
    (1) Large size castings
    (2) Very large size castings
    (3) Small size castings
    (4) Small size castings having intricate details

54. Thin aluminium sheets can be welded by :
    (1) MIG Welding   (2) TIG Welding
    (3) Resistance Welding   (4) Submerged arc Welding

55. A tool signature consists of :
    (1) Five elements   (2) Six elements
    (3) Seven elements   (4) Eight elements

56. The correct relationship between shear angle, ϕ; rake angle, α and chip thickness ratio, γ is :

    (1) $\cot\phi = \dfrac{\gamma \sin\alpha}{1 - \gamma \cos\alpha}$ (2) $\tan\phi = \dfrac{\gamma \sin\alpha}{1 - \gamma \cos\alpha}$

    (3) $\tan\phi = \dfrac{\gamma \cos\alpha}{1 - \gamma \sin\alpha}$ (4) $\tan\phi = \dfrac{\gamma \cos\alpha}{1 - \gamma \cos\alpha}$

57. The value of chip thickness ratio is :
    (1) Greater than 1   (2) Greater than 2
    (3) Less than 1   (4) Less than zero

58. Which of the following operations is also known as internal turning ?
    (1) Milling   (2) Tapping   (3) Boring   (4) Facing

59. Which of the following is least hard ?
    (1) Diamond   (2) Cubic boron nitride
    (3) Aluminium oxide   (4) Silicon Carbide

60. In EDM, better surface finish is obtained at :

    (1) High frequency and low discharge current

    (2) Low frequency and low discharge current

    (3) Low frequency and high discharge current

    (4) High frequency and high discharge current

61. For a Newtonian fluid :

    (1) shear stress is proportional to shear strain

    (2) rate of shear stress is proportional to shear strain

    (3) shear stress is proportional to rate of shear strain

    (4) rate of shear stress is proportional to rate of shear strain

62. In a two-dimensional velocity field with velocities u and v along the x and y directions respectively, the convective acceleration along the x-direction is given by :

    (1) $u\dfrac{\partial u}{\partial x} + v\dfrac{\partial u}{\partial y}$

    (2) $u\dfrac{\partial u}{\partial x} + v\dfrac{\partial v}{\partial y}$

    (3) $u\dfrac{\partial v}{\partial x} + v\dfrac{\partial u}{\partial y}$

    (4) $v\dfrac{\partial u}{\partial x} + u\dfrac{\partial u}{\partial y}$

63. A two-dimensional flow field has velocities along the x and y directions given by $u = x^2 t$ and $v = -2xyt$ respectively, where t is time. The equation of stream-line is :

    (1) $x^2 y = $ constant

    (2) $xy^2 = $ constant

    (3) $xy = $ constant

    (4) not possible to determine

64. A streamline and an equipotential line in a flow field :

    (1) are parallel to each other

    (2) are perpendicular to each other

    (3) intersect at an acute angle

    (4) are identical

65. Calculate the pressure due to a column of 0.3 m of water.

    Take, density of water, $\rho_\omega = 1000$ kg/m^3.

    (1) 2943 N/m^2 (2) 2278 N/m^2 (3) 3232 N/m^2 (4) 3947 N/m^2

66. The stream function for a two dimensional flow is given by, $\psi = 2xy$. Calculate the velocity at the point P(2, 3).

    (1) 7.21 units   (2) 6.84 units   (3) 4.97 units   (4) 3.72 units

67. The separation of boundary layer takes place in case of :
    (1) negative pressure gradient   (2) positive pressure gradient
    (3) zero pressure gradient   (4) none of the above

68. Power transmitted through pipes will be maximum when :

    (1) head loss due to friction $= \dfrac{1}{2} \times$ [total head at the inlet of the pipe]

    (2) head loss due to friction $= \dfrac{1}{4} \times$ [total head at the inlet of the pipe]

    (3) head loss due to friction $=$ total head at the inlet of the pipe

    (4) head loss due to friction $= \dfrac{1}{3} \times$ [total head at the inlet of the pipe]

69. Froude's number is defined as the ratio of :
    (1) inertia force to viscous force   (2) inertia force to gravity force
    (3) inertia force to elastic force   (4) inertia force to pressure force

70. For the Laminar Flow through a circular pipe :
    (1) the maximum velocity = 1.5 times the average velocity
    (2) the maximum velocity = 2.0 times the average velocity
    (3) the maximum velocity = 2.5 times the average velocity
    (4) none of the above

71. Which of the following is generally **not** a continuous path robot ?
    (1) Welating robots   (2) Grinoling robots
    (3) Grinoling painting robots   (4) Pick and Place robots

72. What is the name of the info sent from robot sensor to robot controller ?
    (1) Pressure   (2) Signal   (3) Feedback   (4) Output

73. Which one of the following terms refers to the up-down motion of a robot arm ?
    (1) Yaw   (2) Lateral   (3) Pitch   (4) Elevate

74. What is the name of the space inside which a robot-unit operates ?
    (1) environment   (2) exclusion zone
    (3) exclusive zone   (4) work envelope

75. The number of movable joints in the base, the arm and effector of the robot determine :
   (1) Degree of Freedom
   (2) Flexibility
   (3) Operational limits
   (4) Payload capacity

76. In a CAD Package, mirror image of a 2D point P (5, 10) is to be obtained about a line which passes through the origin and makes an angle of 45° counter clockwise with the x-axis. The coordinates of the transformed point will be :
   (1) (7.5, 5)
   (2) (10, 5)
   (3) (7.5, −5)
   (4) (10, −5)

77. NC Contouring is an example of :
   (1) Continuous path positioning
   (2) Point to point positioning
   (3) Absolute positioning
   (4) Incremental positioning

78. For generating one patch we require :
   (1) A set of grid points on surface
   (2) A set of grid control
   (3) Four boundering curves defining surface
   (4) Two boundering curves and a set of grid control points

79. Which type of projection does not have the projection rays parallel to each other ?
   (1) axonometric projection
   (2) oblique projection
   (3) orthographic projection
   (4) perspective projection

80. Pixels can be arranged in irregular :
   (1) one dimensional grid
   (2) two dimensional grid
   (3) three dimensional grid
   (4) none of the above

81. Work sampling is applied for :
   (1) Estimation of the percentage utilization of machine tools.
   (2) Estimating the percentage of the time consumed by various job acitivities.
   (3) Finding out time standards, specially where job is not repetitive and where time study by stop watch method is not possible.
   (4) All of the above

82. Basic tool in work study is :
   (1) Graph paper
   (2) Process chart
   (3) Planning chart
   (4) Stop watch

83. The unit cost in case of batch production is _____ as compared to jobbing production.

(1) Same
(2) Low
(3) High
(4) Can not be compared

84. For a product layout the material handling equipment must :

(1) Have full flexibility
(2) Employ conveyor belts, trucks, tractors etc.
(3) Be a general purpose type
(4) Be designed as special purpose for a particular application

85. Which of the following layouts is suited for mass production ?

(1) Process layout
(2) Product layout
(3) Fixed position layout
(4) Plant layout

86. PERT has following time estimate :

(1) One time estimate
(2) Two time estimates
(3) Three time estimates
(4) Four time estimates

87. At the break-even point :

(1) Total cost is more than the sales revenue
(2) Total cost is less than the sales revenue
(3) Total cost is equal to sales revenue
(4) Fixed cost is equal to variable cost

88. The simplex method is the basic method for :

(1) Value analysis
(2) Operations research
(3) Linear programming
(4) Model analysis

89. The production cost per unit can be reduced by :

(1) Producing more with increased inputs
(2) Producing more with the same inputs
(3) Eliminating idle time
(4) Minimizing resource waste

90. An event is indicated on the network by :

(1) A straight line

(2) A number enclosed in a circle or a square

(3) A straight line with circles at the ends

(4) A dotted line

91. Body A is kept in contact with body B. Heat will flow from A to B, if :

(1) The heat content of A is greater than that of B.

(2) The temperature of A is greater than that of B.

(3) The specific heat of A is greater than that of B.

(4) The specific heat of A is lower than that of B.

92. Which one of the following will have least value of thermal conductivity ?

(1) Copper   (2) Silver   (3) Glass   (4) Air

93. Heat is transferred by conduction, convection and radiation in :

(1) insulated pipes carrying hot water

(2) refrigerator freezer coils

(3) melting of ice

(4) boiler furnace

. The temperature inside a furnace is measured by :

(1) Mercury thermometer   (2) Alcohol thermometer

(3) Gas thermometer   (4) Optical pyrometer

Pipes are insulated so that :

`1) They may not break under pressure.

`?) There is minimum corrosion.

`\ They can withstand higher fluid pressure.

Heat loss from the surface is minimized.

96. Baffles are provided in heat exchangers to :

    (1) remove dirt

    (2) increase heat transfer rate

    (3) provide better mechanical strength

    (4) reduce heat transfer rate

97. If the absorptivity plus reflectivity of a body equals 1, then the body is known as :

    (1) black body   (2) grey body   (3) opaque body   (4) white body

98. The critical radius of insulation for sphere is equal to :

    (1) $\dfrac{2k}{h}$ (2) kh (3) $\sqrt{kh}$ (4) $\dfrac{h}{k}$

99. Nusselt number is a function of :

    (1) Reynold's number and dynamic viscosity

    (2) Dynamic viscosity and Prandtl number

    (3) Prandtl number and Reynold's number

    (4) Reynold's number and thickness of boundary layer

100. The value of shape factor will be highest when :

    (1) The surfaces are further apart

    (2) The surfaces are closer

    (3) The surfaces are smaller and closer

    (4) The surfaces are larger and closer

Part - B - III
FOR ELECTRICAL ENGINEERING

51. If low voltage winding of a 400/230 V, I-phase, 50 Hz transformer is to be connected to a 25 Hz, the supply voltage should be :
    (1) 230 V   (2) 460 V   (3) 115 V   (4) 65 V

52. In a DC transmission line :
    (1) It is necessary for the sending end and receiving end to be operated in synchronism.
    (2) The effect of inductive and capacitive reactances are greater than in an AC transmission line of the same rating.
    (3) There are no effects due to inductive and capacitive reactances.
    (4) Power transfer capability is limited by stability considerations.

53. If there are 'b' branches and 'n' nodes in any electrical circuit, the number of equations will be :
    (1) $n-1$ (2) b (3) $b-n-1$ (4) $b-n+1$

54. While testing cables, the galvanometer used should be initially short-circuited in order to protect it from sudden initial inrush currents as the cable have :
    (1) A low value of initial resistance
    (2) A low value of initial capacitance
    (3) A high value of initial capacitance
    (4) Both (1) and (2)

55. How many 200 W/ 220 V incandescent lamps connected in series would consume the same total power as a single 100 W/220 V incandescent lamp ?
    (1) Not possible   (2) 4   (3) 3   (4) 2

56. Match the items in List I with the items in List II and select the correct answer using the codes given below the lists :

List I		List II
To		**Use**
(a) Improve power factor	(i)	Shunt reactor
(b) Reduce the current ripple	(ii)	Shunt capacitor
(c) Increase the power flow in line	(iii)	Series capacitor
(d) Reduce the Ferranti effect	(iv)	Series reactor

Codes :
(1) (a) →(ii), (b) →(iii), (c) →(iv), (d) →(i)
(2) (a) →(ii), (b) →(iv), (c) →(iii), (d) →(i)
(3) (a) →(iv), (b) →(iii), (c) →(i), (d) →(ii)
(4) (a) →(iv), (b) →(i), (c) →(iii), (d) →(ii)

57. In cylindrical coordinates, equation $\dfrac{\partial^2 \psi}{\partial \rho^2} + \dfrac{1}{\rho} \dfrac{\partial \psi}{\partial \rho} + \dfrac{\partial^2 \psi}{\partial Z^2} + 10 = 0$ is called :

(1) Maxwell's equation
(2) Laplace's equation
(3) Poisson's equation
(4) Lorentz's equation

58. What is the major factor for determining whether a medium is free space, lossless dielectric, lossy dielectric, or good conductor ?
(1) Attenuation constant
(2) Constitutive parameters $(\sigma, \varepsilon, \mu)$
(3) Loss tangent
(4) Reflection coefficient

59. If the height of transmission tower is increased :
(1) the line capacitance will decrease but line inductance will remain unchanged.
(2) the line capacitance and inductance will not change.
(3) the line capacitance will increase but line inductance will decrease
(4) the line capacitance will decrease and line inductance will increase.

60. In a 3-phase power measurement by two wattmeter method, both the wattmeters had identical readings, The power factor of the load was :
(1) Unity
(2) 0.8 lagging
(3) 0.8 leading
(4) zero

61. What is the maximum value of a load which consume 500 kWh per day at a load factor of 0.40, if the consumer increases the load factor to 0.50 without increasing the maximum demand ?
(1) 52.08 kW
(2) 50.8 kW
(3) 4.5 kW
(4) 60 kW

62. If an induction machine is run at above synchronous speed, it acts as :
(1) A synchronous motor
(2) An induction generator
(3) An Induction motor
(4) None of the above

63. Pure inductive circuit takes power (reactive) from the ac line when :
(1) both applied voltage and current rise
(2) both applied voltage and current decrease
(3) applied voltage decreases but current increases
(4) none of these

64. With 100% inductive shunt compensation, the voltage profile is flat for :
(1) 100% loading of line
(2) 50% loading of line
(3) zero loading of line
(4) none of the above

65. For an existing ac transmission line, the string efficiency is 80%, if dc voltage is supplied for the same set-up, the string efficiency will be :
(1) 70%
(2) 80%
(3) 90%
(4) 100%

66. Match the items in **List I** with the items in **List II** and select the **correct** answer using the **codes** given below the lists :

	List I		List II
	Type of Transmission line		Type of Distance Relay Preferred
(a)	Short line	(i)	Ohm relay
(b)	Medium line	(ii)	Reactance relay
(c)	Long line	(iii)	Mho relay

Codes :

(1) (a) → (ii), (b) → (i), (c) → (iii)

(2) (a) → (iii), (b) → (ii), (c) → (i)

(3) (a) → (i), (b) → (ii), (c) → (iii)

(4) (a) → (i), (b) → (iii), (c) → (ii)

67. For a fixed value of complex power flow in a transmission line having a sending end voltage V, the real power loss will be proportional to :

(1) V (2) V^2 (3) $1/V^2$ (4) $1/V$

68. Base load plants usually have _____ capital cost, _____ operating cost and _____ load factor.

(1) high, high, high

(2) high, low, high

(3) low, low, low

(4) low, high, low

69. Power generation cost reduces as :

(1) diversity factor increases and load factor decreases

(2) diversity factor decreases and load factor increases

(3) both diversity factor as well as load factor decrease

(4) both diversity factor as well as load factor increase

70. A single phase load is supplied by a single voltage source. If the current flowing from the load to the source is $10 \angle -150°$A and if the voltage at the load terminal is $100 \angle 60°$ V, then the :

(1) load absorbs real power and delivers reactive power.

(2) load absorbs real power and absorbs reactive power.

(3) load delivers real power and delivers reactive power.

(4) load delivers real power and absorbs reactive power.

71. Match **List-I** (type of device) with **List-II** (characteristics/application) and select the **correct** answer using the **code** given below the lists :

	List-I		**List-II**
(a)	MOSFET	(i)	Turn off by negative gate pulse
(b)	GTO	(ii)	Bi-directional switching
(c)	UJT	(iii)	High speed switching
(d)	TRIAC	(iv)	Triggering circuit

Codes :

	(a)	(b)	(c)	(d)
(1)	(iii)	(i)	(iv)	(ii)
(2)	(iii)	(i)	(ii)	(iv)
(3)	(i)	(ii)	(iii)	(iv)
(4)	(i)	(ii)	(iv)	(iii)

72. In a three phase full wave ac to dc converter, the ratio of output ripple frequency to the supply voltage frequency is :

(1)   2   (2)   3   (3)   6   (4)   12

73. A triac is equivalent to two SCRs :

(1)   In parallel   (2)   In series

(3)   In inverse-parallel   (4)   None of the above

74. What will be the PIV for diode in the given circuit :

(1)   220 V   (2)   22 V   (3) $220\sqrt{2}V$ (4)   0

75. Identify the given symbols and choose the **correct** option :

	(i)	(ii)	(iii)
(1)	Diode	LED	Zener diode
(2)	Photodiode	Zener diode	Diode
(3)	LED	Diode	Zener diode
(4)	LED	Zener diode	Diode

76. Snubber circuit is used in thyristor circuits for :

(1) Triggering　　　　　　　　　　(2) dv/dt protection

(3) di/dt protection　　　　　　　　(4) phase shift

77. The main reason for connecting a pulse transformer at the output stage of thyristor triggering circuit is to :

(1) amplify the power of the triggering pulse

(2) provide electrical isolation

(3) reduce the turn ON time of thyristor

(4) avoid spurious triggering of the thyristor due to noise

78. The I-V characteristics for a triac in the first and third quadrants are essentially identical to those of _____ in its first quandrant.

(1) Transistor　　(2) UJT　　(3) SCR　　(4) None of the above

79. Figure shows a thyristor with the standard termination of anode (A), cathode (K), gate (G) and the different junctions named J1, J2 and J3. When the thyristor is in reverse blocking mode :
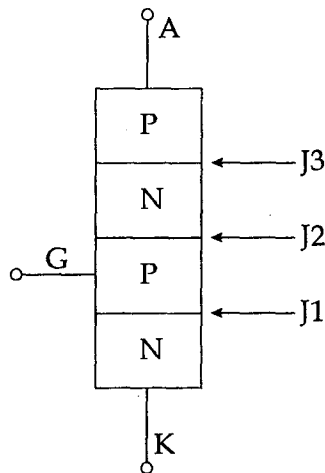

(1) J1 and J2 are forward biased and J3 is reverse biased

(2) J1 and J3 are reverse biased and J2 is forward biased

(3) J1 is forward biased and J2 and J3 are reverse biased

(4) J1, J2 and J3 are all forward biased

80. The latching current in the below circuit is 4mA. The minimum width of the gate pulse required to turn on thyristor is :

0.1 H

100 V
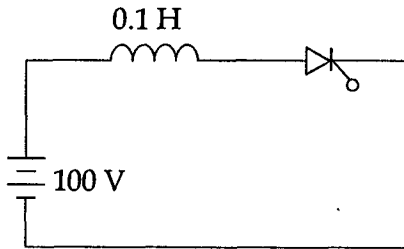
(1)   6 s   (2)   1 s   (3)   2 s   (4)   4 s

81. The high frequency hum in the transformer is mainly due to :
(1)   laminations not being sufficiently tight
(2)   magnetostriction
(3)   oil of the transformer
(4)   tank walls

82. In transformers, which of the following statements is valid ?
(1)   In an open circuit test, copper losses are obtained while in short circuit test, core losses are obtained.
(2)   In an open circuit test, current is drawn at high power factor.
(3)   In a short circuit test, current is drawn at zero power factor.
(4)   In an open circuit test, current is drawn at low power factor.

83. A 500 kVA, 3-phase transformer has iron losses of 300 W and full load copper losses of 600 W. The percentage load at which the transformer is expected to have maximum efficiency is :
(1)   50.0%   (2)   70.7%   (3)   141.4%   (4)   200.0%

84. For a single phase capacitor start induction motor which of the following statements is valid ?
(1)   The capacitor is used for power factor improvement.
(2)   The direction of rotation can be changed by reversing the main winding terminals.
(3)   The direction of rotation cannot be changed.
(4)   The direction of rotation can be changed by interchanging the supply terminals.

85. A synchronous generator is feeding a zero power factor (lagging) load at rated current. The armature reaction is :
(1)   magnetizing   (2)   demagnetizing
(3)   cross-magnetizing   (4)   ineffective

86. On the torque/speed curve of the induction motor shown in the figure four points of operation are marked as W, X, Y and Z. Which one of them represents the operation at a slip greater than 1 ?
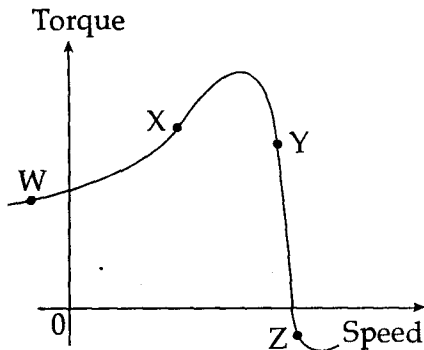
(1) W   (2) X   (3) Y   (4) Z

87. The dc motor, which can provide zero speed regulation at full load without any controller is :

(1) series   (2) shunt

(3) cumulative compound   (4) differential compound

88. A three phase, salient pole synchronous motor is connected to an infinite bus. It is operated at no load on normal excitation. The field excitation of the motor is first reduced to zero and then increased in reverse direction gradually. Then the armature current :

(1) Increases continuously

(2) First increases and then decreases steeply

(3) First decreases and then increases steeply

(4) Remains constant

89. A three-phase 440 V, 6 pole, 50 Hz, squirrel cage induction motor is running at a slip of 5%. The speed of stator magnetic field to rotor magnetic field and speed of rotor with speed of stator magnetic field are :

(1) zero, −50 rpm   (2) zero, 955 rpm

(3) 1000 rpm, −50 rpm   (4) 1000 rpm, 955 rpm

90. A three-phase synchronous motor connected to ac mains is running at full load and unity power factor. If its shaft load is reduced by half, with field current held constant, its new power factor will be.

(1) unity   (2) leading

(3) lagging   (4) dependent on machine parameters

91. Velocity error constant of a system is measured when the input to the system is :

(1) a unit step function
(2) a unit ramp function
(3) a unit impulse function
(4) a unit parabolic function

92. The Type-0 system has :

(1) 1 pole at origin
(2) 2 poles at origin
(3) No pole at origin
(4) simple pole at origin

93. The range of K for which the system $s^3 + 3s^2 + 3s + K = 0$ becomes stable.

(1) $0 < K < 9$
(2) $K < 0$
(3) $9 < K < \infty$
(4) None of these

94. Natural frequency of a unity feedback control system of transfer function $G(s) = \dfrac{10}{s(s + 1)}$ is :

(1) 3.16 rad/sec
(2) 0.5 rad/sec
(3) 4.6 rad/sec
(4) None of these

95. In R-H criterion, if there are changes of sign in the elements of first column, then the number of sign changes indicates :

(1) the number of roots with negative real parts.
(2) the number of roots with positive real parts.
(3) the number of pair of roots of opposite sign.
(4) the number of pair of roots of same sign.

96. The settling time for the system whose characteristic equation $s^2 + 2s + 8 = 0$ is :

(1) 4 sec
(2) 5 sec
(3) 2 sec
(4) 6 sec

97. The given characteristic polynomial $s^4 + s^3 + 2s^2 + 2s + 3 = 0$ has :

(1) Zero root in RHS of s-plane
(2) one root in RHS of s-plane
(3) two roots in RHS of s-plane
(4) three roots in RHS of s-plane

98. The phase angle for the transfer function, $G(jw) = \dfrac{1}{(1 + jwT)^2}$ at corner frequency is :

(1) 45 degrees
(2) -45 degrees
(3) -90 degrees
(4) 90 degrees

99. The transfer function of a system is given as $\dfrac{100}{s^2 + 20s + 100}$, the system is :

    (1)   An over damped system   (2)   An under damped system

    (3)   A critically damped system   (4)   An unstable system

100. For a stable system :

    (1)   The gain crossover occurs earlier than phase crossover.

    (2)   The phase crossover occurs earlier than gain crossover.

    (3)   The gain crossover and phase crossover frequencies are very near to each other.

    (4)   The gain crossover and phase crossover frequencies are equal.

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