

This Question Booklet contains
16 printed pages

PGMC

A
Seal Sticker

Total Marks : 100
Time : 100 Minutes

Question
Booklet
Code :

A

Candidate's
Seat No. :

Candidate's Signature _____ Block Supervisor's Signature _____

DO NOT OPEN QUESTION BOOKLET UNTIL INSTRUCTED.

INSTRUCTIONS FOR CANDIDATE:

1. Check Number printed on your OMR SHEET and Question Paper with your SEAT No. before answering the questions. Consult block supervisors in case the above mentioned numbers do not match with your seat number.
2. There are total 100 questions. For answer of each question A, B, C, D, E options are given in OMR SHEET. In OMR SHEET, there is "E" option. "E" option is for "Not Attempted". If candidate do not wish to answer the question he/she should select "E" option (Not Attempted). All questions are compulsory.

For Example:

Which state of India has the longest sea shore ?

A ☐ B ☐ C ☒ D ☐ E ☐

(A) Maharashtra (B) Tamilnadu
(C) Gujarat (D) Andhra Pradesh

In this example, the right answer is (C). Therefore, the Circle of (C) has been darkened (encoded). Candidate should not give the answer "Gujarat" in writing.

The options once darkened/answered by candidate cannot be changed.

3. Candidates are not permitted to leave examination hall during examination.
4. Candidates must strictly enter SEAT NO. in the designated space provided in OMR SHEET as well as Question Paper neatly as soon as they receive the OMR SHEET & Question Paper.
5. Candidates must not write name or put any identification sign/symbol on OMR SHEET. In such case strict disciplinary action will be taken against candidate & will be considered disqualified/ineligible. Only Seat No. must be

entered at designated space provided in OMR SHEET.

6. Both, Candidate's & Supervisor's signature must be done on Certificate of OMR SHEET. Unsigned OMR SHEET would not be considered for evaluation.
7. Candidates are not permitted to use or carry with them any kind of literature, guide, hand written notes, or printed books, mobile phone, pagers, smart watches, camera or any electronic gadgets to examination hall.
8. Use of only Non-scientific / Non-programmable calculator shall allow during examination.
9. Candidates are not permitted to talk/discuss in the Examination Hall. Any candidate found violating supervisor's instructions will be disqualified.
10. Candidates must fully darken circle A, B, C, D and E accordingly with Blue / Black ball pen. If answers are marked with any other coloured ball pen, pencil, white ink (whitner), any corrections are done by candidate by means of blade or rubber or whitner will not be considered for evaluation.
11. Candidates may carry QP with them after Examination.
12. **For correct answer 1 (One) marks will be given.**

If candidate gives more than one option as answer for one question in answer sheet (OMR SHEET), or gives wrong answer then the candidate will be allotted Zero (0) marks.

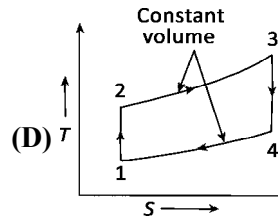
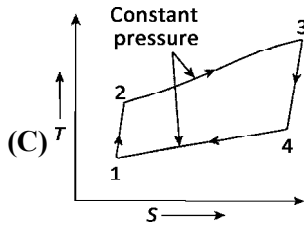
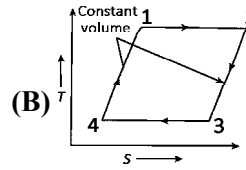
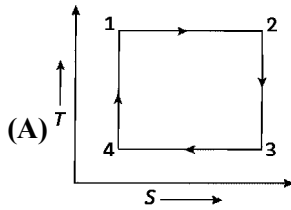
If candidate does not want to answer a particular question and marks (E) or leave the option without encoding on OMR sheet, then no minus marks will be given.

Submit the OMR SHEET to the block supervisor after completion of examination without fail before leaving examination hall, failure to do so will result in disqualification of the candidature for the examination and disciplinary action will be taken against such candidate.

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- The diagram shows a hydraulic circuit. A pump (circle with a triangle) is connected to a reservoir (diamond with a line). The pump output goes to a 3/2-way solenoid valve A. Valve A has two positions: one leading to a 3/2-way solenoid valve B, and another leading to a 3/2-way solenoid valve C. Valve B has two positions: one leading to the top port of a double-acting hydraulic cylinder, and another leading to the bottom port. Valve C has two positions: one leading to the top port of the cylinder, and another leading to the bottom port. The cylinder's other ports are connected to the reservoir. The cylinder has a red piston rod. Solenoid valves B and C are shown in their default (de-energized) positions.

- [Contd.]**

8. Which one of the following diagrams represents Otto cycle on temperature (T)-entropy (s) plane?



9. Which one of the following events would reduce the volumetric efficiency of a vertical compression ignition engine?

- (A) Inlet valve closing after bottom dead centre
(B) Inlet valve closing before bottom dead centre
(C) Inlet valve opening before top dead centre
(D) Exhaust valve closing after top dead centre

10. One tonne refrigerating machine means that

- (A) one tonne of ice when melts from and at 0°C in 24 hours, the refrigeration effect produced is equivalent to 211 kJ/min.
(B) one tonne of refrigerant is used
(C) one tonne of water can be converted into ice
(D) one tonne is the total mass of the machine

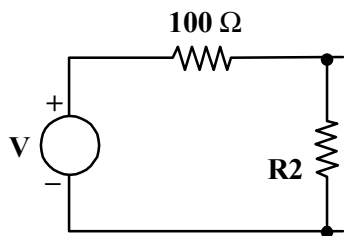
11. The compressor efficiency of a reciprocating air compressor is given by

- (A) Indicated power / Isothermal power (B) Isothermal power / Brake power
(C) Isothermal power / Indicated power (D) Brake power / Isothermal power

12. Forward curved impeller vane has a blade exit angle of

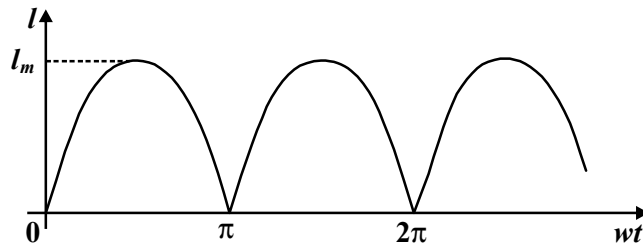
- (A) more than 90° (B) less than 90°
(C) equal to 90° (D) between 45° to 90°

13. By using the voltage divider circuit of following fig., it is desired to obtain $3/4$ V. Find R_2 , given $R_1 = 100 \Omega$.



- (A) 100Ω (B) 200Ω
(C) 300Ω (D) 400Ω

14. The most efficient method of increasing the speed of a DC shunt motor is
 (A) armature control (B) flux control
 (C) ward leonard (D) tapped field
15. Find the average value of the full-wave rectified sine wave shown in following figure:



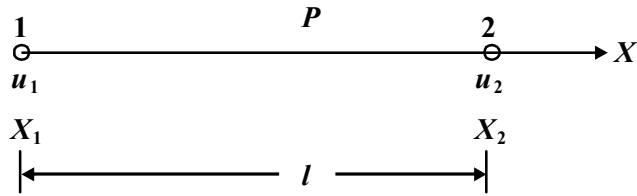
- (A) $I_m / 2\pi$ (B) π / I_m
 (C) $I_m \pi$ (D) I_m / π
16. In a transformer, the flux phasor
 (A) leads the induced emf phasor by 90°
 (B) lags the induced emf phasor by 90°
 (C) is in phase with the induced emf phasor
 (D) is in phase opposition to the induced emf phasor
17. A Zener diode
 (A) is useful as an amplifier
 (B) has a negative resistance
 (C) has a high forward voltage
 (D) has a sharp breakdown at low reverse voltage
18. An SCR consists of
 (A) five PN junctions (B) four PN junctions
 (C) three PN junctions (D) two PN junctions
19. An op-amp has
 (A) very small input resistance and very large output resistance
 (B) very small input resistance and very small output resistance
 (C) very large input resistance and very small output resistance
 (D) very large input resistance and very large output resistance
20. The race-around condition is avoided by using
 (A) JK flip-flop (B) D flip-flop
 (C) SR flip-flop (D) master-slave JK flip-flop
21. The characteristic equation for a system is given as $2s^3 + s^2 - 3s + 10 = 0$. State why the system is stable or unstable?
 (A) Stable because no root is in the right half of s-plane.
 (B) Unstable because there are two roots in the right half of s-plane.
 (C) Stable because all the roots are in left side of s-plane.
 (D) Unstable because one root is in right half of s-plane.

22. Which one of the following statements is correct? An electronic voltmeter is more reliable as compared to multimeter for measuring voltages across low impedance because
- (A) its sensitivity is high.
 (B) it offers high input impedance.
 (C) it does not alter the measured voltage.
 (D) its sensitivity and input impedance are high and do not alter the measured value.
23. Snubber circuit is used for
- (A) overvoltage protection (B) overcurrent protection
 (C) dv/dt protection (D) All of the above
24. If 8085 microprocessor adds 87H and 79H then the content of register A is
- (A) 00H (B) 10H
 (C) 01H (D) 11H
25. How many address lines are necessary on the chip of 2K (2048) byte memory?
- (A) 8 (B) 10
 (C) 12 (D) 11
26. Chvorinov's Rule states that total solidification time is proportional to which one of the following quantities?
- Where A = surface area of casting, H_f = heat of fusion, T_m = melting temperature, and V = volume of casting.
- (A) $(A/V)^n$ (B) $H_f T_m$
 (C) V/A (D) $(V/A)^2$
27. Which of the following qualifies as a precision casting process?
- (A) investment casting (B) ingot casting
 (C) sand casting (D) shell molding
28. Which of the following are advantages and characteristics of hot working relative to cold working?
- (i) fracture of work part less likely, (ii) increased strength properties, (iii) isotropic mechanical properties, (iv) less overall energy required, (v) lower deformation forces required, and (vi) more significant shape changes are possible.
- (A) ii, iii, v, vi (B) i, iii, v, vi
 (C) iii, iv, v, vi (D) i, ii, v, vi
29. The maximum possible draft in a rolling operation depends on which of the following parameters?
- (A) roll velocity (B) roll diameter
 (C) stock thickness (D) strain
30. Johnson's formula is associated with which of the four bulk deformation processes ?
- (A) Bar and wire drawing (B) Forging
 (C) Extrusion (D) Rolling
31. Type of welding best suited for joining two stainless steel foils of thickness 0.1 mm is
- (A) MIG (B) TIG
 (C) Plasma arc (D) GAS

32. Upon which of the following parameters does the current intensity in arc welding depend?
- (A) Stability of arc
(B) Thickness of parent metals
(C) Gap between the electrodes and parent metals
(D) Electrode diameter
33. According to the Merchant equation, an increase in rake angle would have which of the following results, all other factors remaining the same?
- (A) decrease in power requirements (B) decrease in friction angle
(C) decrease in shear plane angle (D) increase in cutting temperature
34. A roughing operation generally involves which one of the following combinations of cutting conditions?
- v = cutting speed, mm/s ; f = feed, mm ; and d = depth of cut, mm
- (A) high v , f , and d (B) high v , low f and d
(C) low v , high f and d (D) low v , f , and d
35. Which of the following cutting tools cannot be used on a turret lathe?
- (A) cut-off tool (B) drill bit
(C) broach (D) threading tool
36. The basic milling machine is which one of the following:
- (A) bed type (B) knee-and-column
(C) profiling mill (D) universal milling machine
37. A planing operation is best described by which one of the following:
- (A) a single point tool moves linearly past a stationary workpiece
(B) a tool with multiple teeth moves linearly past a stationary workpiece
(C) a workpiece is fed linearly past a rotating cutting tool
(D) a workpiece moves linearly past a single-point tool
38. Calculate the allowances, for following dimensions of mated parts on hole basis system.
- | | | | |
|------|-----------|-------|-----------|
| Hole | 38.500 mm | Shaft | 38.475 mm |
| | 38.525 mm | | 38.445 mm |
- (A) 0.035 (B) 0.030
(C) 0.025 (D) 0.08
39. V anvil micrometer is used to measure
- (A) The diameter of the objects that have odd number of symmetrical or evenly spaced features
(B) Screw thread minor diameter
(C) Chip thickness
(D) Screw thread pitch
40. Which one of the following processes would be appropriate to drill a hole with a square cross section, 0.25 inch on a side and 1-inch deep in a steel workpiece?
- (A) Abrasive jet machining (B) EDM
(C) Chemical Milling (D) Laser Beam Machining

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47. The shape functions for two noded bar/truss element is



(A) $\left[\frac{x_2 - x_1}{l} \quad \frac{x_2 + x_1}{l} \right]$

(B) $\left[\frac{x - x_2}{l} \quad \frac{x - x_1}{l} \right]$

(C) $\left[\frac{x_2 - x}{l} \quad \frac{x_1 - x}{l} \right]$

(D) $\left[\frac{x_2 - x}{l} \quad \frac{x - x_1}{l} \right]$

48. Which of the following sentence is incorrect regards to Abrasive Jet Machining (AJM) process?

- (A) The power consumption in the AJM process is high.
- (B) The AJM process has the capability to machine heat sensitive and brittle Materials.
- (C) Sharp corners of intricate parts can be machined.
- (D) The AJM process doesn't demand any change in the tool.

49. The material removal rate of in ultrasonic machining is inversely proportional to

- (A) frequency of oscillation
- (B) static stress on tool
- (C) mean radius of grit
- (D) surface fracture strength

50. A fixed zero in CNC machine tool is a location on a machine table generally at

- (A) The center of the table
- (B) Left hand lower corner of the table
- (C) Right hand lower corner of the table
- (D) Right hand top corner of the table

51. What would be the size of the homogeneous matrix used to represent a frame relative to fixed reference frame in robot?

- (A) 4×4
- (B) 3×4
- (C) 4×3
- (D) 3×3

52. A point $p(2,3,4)^T$ is attached to a rotating frame of the robot. The frame rotates 90° about the x-axis of the reference frame. Find the coordinates of the point relative to the reference frame after the rotation.

(A) $\begin{bmatrix} 2 \\ -4 \\ 3 \end{bmatrix}$

(B) $\begin{bmatrix} 3 \\ -4 \\ 2 \end{bmatrix}$

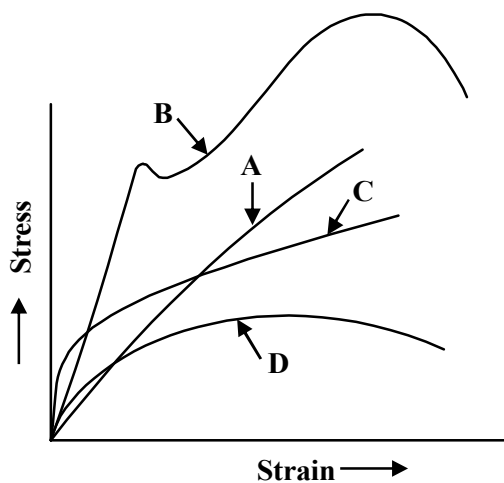
(C) $\begin{bmatrix} 4 \\ -8 \\ 6 \end{bmatrix}$

(D) $\begin{bmatrix} 6 \\ -8 \\ 4 \end{bmatrix}$

53. Which of the following statement is correct regarding the robot degeneracy?
- (A) Degeneracy occurs when the robot loses a degree of freedom
 - (B) Degeneracy occurs when the robot's joints reach their physical limits
 - (C) A robot may become degenerate in the middle of its workspace if the z-axes of two similar joints become colinear.
 - (D) All of the above
54. The fifth order polynomial trajectory planning of the robot requires to
- (A) specify the initial positions, velocities, and accelerations
 - (B) specify the ending positions, velocities, and accelerations
 - (C) specify the initial and ending positions, velocities, and accelerations
 - (D) specify the initial and ending positions, and velocities
55. Suppose a stiff cardboard carton weighing 10 kg is held in robot gripper using friction against two opposing fingers. The coefficient of friction between the finger contacting surfaces and the carton surface is 0.25. The orientation of the carton is such that the weight of the carton is directed parallel to finger surfaces. A fast work cycle is anticipated SO that 'g' factor of 3.0 is applied to calculate the required gripper force. Determine the required gripping force for this condition.
- (A) 3 kg
 - (B) 30 kg
 - (C) 60 kg
 - (D) 90 kg
56. For an eight-bit image $x[m, n]$, the transformation $y[m, n] = 255 - x[m, n]$ will yield a/an
- (A) dark image
 - (B) negative of the input image
 - (C) bright image
 - (D) output image same as the input image
57. The number of bits necessary to represent a 256×256 image with 256 gray level is
- (A) 524288
 - (B) 324288
 - (C) 224288
 - (D) 124288
58. Below are the pixel values in a 5×5 gray-level image:
- | | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 1 | 2 |
| 4 | 5 | 2 | 3 | 3 |
| 3 | 3 | 5 | 4 | 4 |
| 1 | 3 | 2 | 3 | 5 |
| 2 | 1 | 3 | 1 | 3 |
- What is the value of the marked pixel after applying a 3×3 median filter?
- (A) 1
 - (B) 2
 - (C) 3
 - (D) 4
59. The operator which can be used to detect edges in an image is
- (A) logarithm
 - (B) gradient
 - (C) exponential
 - (D) average
60. The images at different levels of a Laplacian pyramid is similar to that of the output of a
- (A) Low-pass filtered image
 - (B) High-pass filtered image
 - (C) Band-pass filtered image
 - (D) Band-reject filtered image

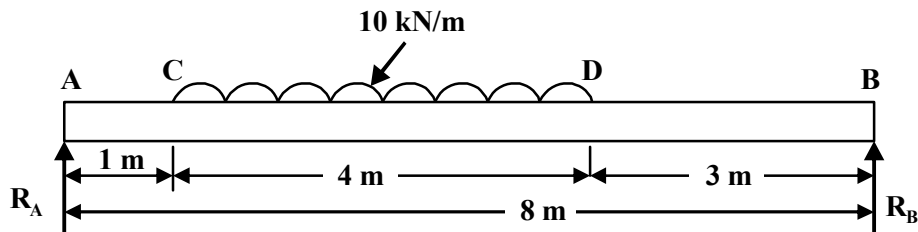
61. A factory manufactures two products *A* and *B* on three machines *X*, *Y*, and *Z*. Product *A* requires 10 hours of machine *X* and 5 hours of machine *Y* and one hour of machine *Z*. The requirement of product *B* is 6 hours, 10 hours and 2 hours of machine *X*, *Y* and *Z* respectively. The profit contribution of products *A* and *B* are Rs. 23/- per unit and Rs. 32 /- per unit respectively. In the coming planning period the available capacity of machines *X*, *Y* and *Z* are 2500 hours, 2000 hours and 500 hours respectively. Find the optimal product mix for maximizing the profit. For above LPP which of the following option is most suitable?
- (A) No. of decision variables are three, total no. of constraints are three, three slack variables are required to convert inequality into equality during solution
- (B) No. of decision variables are two, total no. of constraints are four, three slack variables are required to convert inequality into equality during solution
- (C) No. of decision variables are two, total no. of constraints are three, three slack variables are required to convert inequality into equality during solution
- (D) No. of decision variables are three, total no. of constraints are four, three slack variables and one artificial variable is required to convert inequality into equality during solution
62. The total number of allocation in a basic feasible solution of transportation problem of $m \times n$ size is equal to
- (A) $m \times n$ (B) $(m / n) - 1$
- (C) $m + n + 1$ (D) $m + n - 1$
63. To convert balanced maximization assignment problem into minimization problem
- (A) deduct smallest element in the matrix from all other elements
- (B) all elements of the matrix are deducted from the highest element in the matrix
- (C) deduct smallest element in any row from all other elements of the row
- (D) deduct all elements of the row from highest element in that row
64. A machine operator has to perform two operations, turning and threading, on a number of different jobs. The time required to perform these operations in minutes for each job is given. Determine the order in which the jobs should be processed in order to minimize the total time required to complete all the jobs.
- | jobs | 1 | 2 | 3 | 4 | 5 | 6 |
|--------------------|---|----|---|---|---|----|
| Time for turning | 3 | 12 | 5 | 2 | 9 | 11 |
| Time for threading | 8 | 10 | 9 | 6 | 3 | 1 |
- (A) 6, 3, 5, 2, 1, 4 (B) 4, 1, 3, 2, 5, 6
- (C) 4, 6, 3, 2, 5, 1 (D) 4, 3, 2, 1, 5, 6
65. The following is not discussed in group replacement policy:
- (A) Failure Probability (B) Cost of individual replacement
- (C) Present worth factor series (D) Loss due to failure
66. In the PERT method of network analysis, the Expected Time or Average Time t_E is calculated by, where, Likely time is represented by t_L , Pessimistic time is represented by t_P , and Optimistic time is represented by t_O
- (A) $t_E = (t_O + 4t_L + t_P) / 6$ (B) $t_E = (t_O - 4t_L + t_P) / 6$
- (C) $t_E = (t_O + 6t_L + t_P) / 6$ (D) $t_E = (t_O + 4t_L - t_P) / 6$

67. If one solid phase splits into two solid phases on heating, the reaction is
 (A) Eutectic (B) Eutectoid
 (C) Peritectic (D) Peritectoid
68. Which of the following option is incorrect regarding the hardening process of steel?
 (A) Chemical composition of steel largely determines the hardening temperature.
 (B) Larger parts or parts with variable thickness of sections are heated at a very slow rate.
 (C) The hardening characteristics is independent of surface condition of the steel.
 (D) The properties of hardened steel depend to a large extent on the nature of austenite.
69. The annealing of pure copper is carried out at
 (A) about 600°C (B) about 1000°C
 (C) about 250°C (D) About 1200°C
70. Which of the following is not a non-destructive testing method?
 (A) Creep test (B) Magnetic particle inspection
 (C) Eddy Current Inspection (D) Liquid penetration inspection
71. The relation between modulus of elasticity (E), modulus of rigidity (C) and bulk modulus (K) is given by
 (A) $E = \frac{3KC}{C+9K}$ (B) $E = \frac{9KC}{C+3K}$
 (C) $E = \frac{C+9KC}{3KC}$ (D) $E = \frac{C+3K}{9KC}$
72. The stress and strain curves for four different materials are shown in the following figure. Identify the curve for cast iron material B A C D Strain



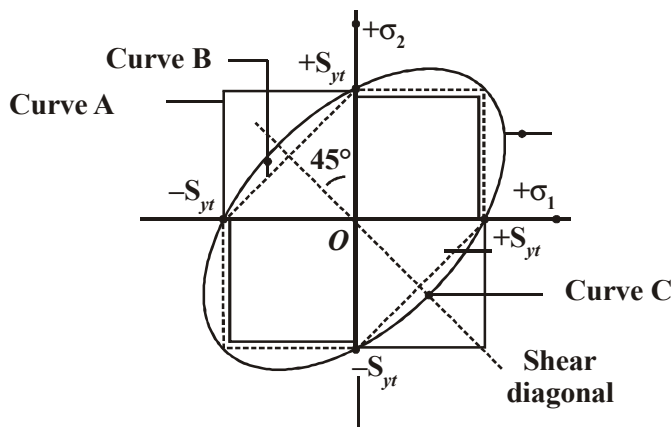
- (A) Curve D (B) Curve B
 (C) Curve C (D) Curve A
73. When a shaft with radius R and length L is subjected to twist, the relation between maximum shear stress (τ), modulus of rigidity of the shaft (C) and angle of twist (θ) is given by
 (A) $\frac{C\theta}{\tau} = \frac{R}{L}$ (B) $\frac{C\theta}{L} = \frac{\tau}{R}$
 (C) $\frac{C\theta}{R} = \frac{\tau}{L}$ (D) $\frac{C}{L\theta} = \frac{\tau}{R}$

74. Calculate reactions at support A and support B for the simply supported beam shown in following figure.



- (A) $R_A = 25 \text{ kN}$, $R_B = 15 \text{ kN}$ (B) $R_A = 15 \text{ kN}$, $R_B = 25 \text{ kN}$
 (C) $R_A = 50 \text{ kN}$, $R_B = 30 \text{ kN}$ (D) $R_A = 25 \text{ N}$, $R_B = 15 \text{ N}$

75. The plots of safe region for three theories of elastic failure on the σ_1 and σ_2 coordinate system are shown in following figure. Identify the correct statement



- (A) Curve A - Max. principal stress theory, Curve B - Distortion energy theory and Curve C- Max shear stress theory
 (B) Curve A -Max shear stress theory, Curve B - Max. principal stress theory and Curve C - Distortion energy theory
 (C) Curve A - Distortion energy theory, Curve B - Max shear stress theory and Curve C- Max. principal stress theory
 (D) Curve A - Max. principal stress theory, Curve B - Max shear stress theory and Curve C- Distortion energy theory
76. The fulcrum pin of the lever is subjected to
- (A) shear stress, compressive stress and crushing stress
 (B) tensile stress, shear stress and crushing stress
 (C) shear stress, bending stress and bearing pressure
 (D) torsional shear stress, bending stress and bearing pressure
77. The stresses induced in the cylinder having internal diameter D_i , wall thickness t , and internal pressure P_i are
- (A) Tangential stress $\sigma_t = (P_i D_i)/2t$ and longitudinal stress $\sigma_l = (P_i D_i)/4t$
 (B) Tangential stress $\sigma_t = (P_i D_i)/4t$ and longitudinal stress $\sigma_l = (P_i D_i)/2t$
 (C) Tangential stress $\sigma_t = (2P_i D_i)/t$ and longitudinal stress $\sigma_l = (P_i D_i)/t$
 (D) Tangential stress $\sigma_t = (t P_i)/2D_i$ and longitudinal stress $\sigma_l = (P_i t)/4D_i$

78. The Euler's equation to determine the critical load for the column is
 P_{cr} = critical load
 n = end fixity coefficient
 E = modulus of elasticity
 A = area of the cross-section
 l = length of the column
 k = least radius of gyration of the cross-section about its axis
- (A) $P_{cr} = \frac{n\pi^2 EA}{(l/k)^2}$ (B) $P_{cr} = \frac{n\pi^2 E}{(l/k)^2 A}$
- (C) $P_{cr} = \frac{n\pi^2 A}{(l/k)^2 E}$ (D) $P_{cr} = \frac{EA(l/k)^2}{n\pi^2}$
79. The maximum energy that can be stored in a body due to external loading upto the elastic limit is called
 (A) resilience (B) proof resilience
 (C) strain energy (D) modulus of resilience
80. The gradual tensile load is applied to the circular rod, the tensile stress induced in the bar is 10 N/mm^2 , $E = 2 \times 10^5 \text{ N/mm}^2$, volume of the bar is $2 \times 10^6 \text{ mm}^3$, determine strain energy absorbed by the rod.
 (A) 100 N mm (B) 1000 N mm
 (C) 500 N mm (D) 500 Nm
81. The horizontal tangents of a cubic polynomial $f(x) = \frac{x^3}{3} - 3x$ between $[-3, 3]$ are at
 (A) $x = \pm 1$ (B) $x = 0$
 (C) $x = \pm\sqrt{2}$ (D) $x = \pm\sqrt{3}$
82. The differential equation $Mdx + Ndy = 0$, where M and N are functions of x & y is an exact equation if
 (A) $\frac{\partial M}{\partial x} = -\frac{\partial N}{\partial y}$ (B) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$
 (C) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ (D) None of above
83. If $g(z)$ & $h(z)$ are analytic functions then
 (A) $\frac{g(z)}{h(z)}$ is analytic, whenever $h(z) \neq 0$ (B) $\frac{g(z)}{h(z)}$ is analytic, whenever $g(z) \neq 0$
 (C) $\frac{g(z)}{h(z)}$ is always analytic (D) None of above
84. Newton - Raphson method is also known as
 (A) Tangent method (B) Chord Method
 (C) Diameter Method (D) Secant Method

85. If a matrix is given by $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{bmatrix}$ the determinant of A^{-1} is
- (A) 11 (B) 24
(C) 1/24 (D) 1/11
86. In rolling two fair dice, what is the probability of obtaining a sum greater than 3 but not exceeding 6?
- (A) $\frac{1}{6}$ (B) $\frac{1}{3}$
(C) $\frac{1}{2}$ (D) $\frac{1}{4}$
87. The eigenvalues of the matrix $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ are
- (A) 1, 1 (B) 2, 2
(C) 3, 3 (D) 0, 2
88. A necessary & sufficient condition that line integral $\oint_C \vec{F} \cdot d\vec{r} = 0$ in every close curve C is
- (A) $\text{div } \vec{F} \neq 0$ (B) $\text{curl } \vec{F} \neq 0$
(C) $\text{curl } \vec{F} = 0$ (D) $\text{div } \vec{F} = 0$
89. A box contains 5 red & 4 white marbles. Two marbles are drawn successively from the box. Without replacement and it is noted that second one is white. What is the probability that the first is also white ?
- (A) 3/8 (B) 4/5
(C) 5/4 (D) 8/3
90. Simpson's 1/3 rule gives exact value of the integral when the integrand is
- (A) Linear function (B) Quadratic function
(C) Cubic function (D) Polynomial of degree other than above
91. The differential equation $y = px + f(p)$ where $p = \frac{dy}{dx}$ is known as
- (A) Clairaut's equation (B) Wave equation
(C) Weierstrass equation (D) None of above
92. The value of $\oint_C (5z^4 - z^3 + 2) dz$ around a unit circle $|z| = 1$ is
- (A) 5 (B) 2
(C) 0 (D) -1

93. If the general solution of $\frac{d^2 y}{dx^2} - y = \sin x$ is given by $ae^x + be^{-x} - \frac{1}{2}\sin x$ then which part of it is complementary function?
- (A) $ae^x - \frac{1}{2}\sin x$ (B) $be^{-x} - \frac{1}{2}\sin x$
- (C) $-\frac{1}{2}\sin x$ (D) $ae^x + be^{-x}$
94. The number of solutions of the system of equation $Ax = 0$ where A is a singular matrix is
- (A) Infinity (B) 2
- (C) 1 (D) 0
95. If the probability of a defective bolt is 0.1, what is standard deviation of the distribution of defective bolt in total of 400?
- (A) 7 (B) 6
- (C) 5 (D) 4
96. The value of $y(1.2)$ for $y' = \frac{y}{x}$, where $y(1) = 1$ using Euler's method for $h = 0.2$ is
- (A) 1.2 (B) 1.1
- (C) 1.3 (D) 1
97. The equation $\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$ is called one dimensional _____ equation.
- (A) Transmission line (B) Heat
- (C) Wave (D) Laplace
98. Let $f(x, y, z) = c$ represent the equation of surface. Then unit normal vector to this surface is
- (A) $\text{div}(\text{grad } f)$ (B) $\text{curl}(\text{grad } f)$
- (C) $\frac{\text{grad } f}{|\text{grad } f|}$ (D) $\text{grad } f$
99. The Taylor series expansion of e^z about $z = a$ is given by
- (A) $e^a \sum_{n=0}^{\infty} \frac{(z+a)^n}{n!}, |z+a| < \infty$ (B) $e^a \sum_{n=0}^{\infty} \frac{(z-a)^n}{n!}, |z-a| < \infty$
- (C) $ae^a \sum_{n=0}^{\infty} \frac{(z+a)^n}{n!}, |z+a| > \infty$ (D) $e^a \sum_{n=0}^{\infty} \frac{(-z-a)^n}{n!}, |-z-a| > \infty$
100. Conditions for a function $f(x, y)$ to be maximum are ($r = f_{xx}, s = f_{xy}, t = f_{yy}$)
- (A) $f_x = 0 = f_y, rt < s^2, r < 0$ (B) $f_x = 0 = f_y, rt > s^2, r > 0$
- (C) $f_x = 0 = f_y, rt = s^2, r > 0$ (D) $f_x = 0 = f_y, rt > s^2, r < 0$

