099/23

Question Booklet Alpha Code

A

Question Booklet Sl. No.

Total Number of Questions : 100   **Time : 90 Minutes**

Maximum Marks : 100

A

INSTRUCTIONS TO CANDIDATES

1. The Question Paper will be given in the form of a Question Booklet. There will be four versions of Question Booklets with Question Booklet Alpha Code viz. **A, B, C** & **D**.

2. The Question Booklet Alpha Code will be printed on the top left margin of the facing sheet of the Question Booklet.

3. The Question Booklet Alpha Code allotted to you will be noted in your seating position in the Examination Hall.

4. If you get a Question Booklet where the alpha code does not match to the allotted alpha code in the seating position, please draw the attention of the Invigilator IMMEDIATELY.

5. The Question Booklet Serial Number is printed on the top right margin of the facing sheet. If your Question Booklet is un-numbered, please get it replaced by new Question Booklet with same alpha code.

6. The Question Booklet will be sealed at the middle of the right margin. Candidate should not open the Question Booklet, until the indication is given to start answering.

7. Immediately after the commencement of the examination, the candidate should check that the Question Booklet supplied to him/her contains all the 100 questions in serial order. The Question Booklet does not have unprinted or torn or missing pages and if so he/she should bring it to the notice of the Invigilator and get it replaced by a complete booklet with same alpha code. This is most important.

8. A blank sheet of paper is attached to the Question Booklet. This may be used for rough work.

9. **Please read carefully all the instructions on the reverse of the Answer Sheet before marking your answers.**

10. Each question is provided with four choices **(A), (B), (C)** and **(D)** having one correct answer. Choose the correct answer and darken the bubble corresponding to the question number using Blue or Black Ball Point Pen in the OMR Answer Sheet.

11. **Each correct answer carries 1 mark and for each wrong answer 1/3 mark will be deducted. No negative mark for unattended questions.**

12. No candidate will be allowed to leave the examination hall till the end of the session and without handing over his/her Answer Sheet to the Invigilator. Candidates should ensure that the Invigilator has verified all the entries in the Register Number Coding Sheet and that the Invigilator has affixed his/her signature in the space provided.

13. Strict compliance of instructions is essential. Any malpractice or attempt to commit any kind of malpractice in the Examination will result in the disqualification of the candidate.

1. If 2 and 3 are the eigen values of a square matrix of order 2, express A^2 in terms of A and I.

   A) $5A - 6I$ B) $2A - 3I$ C) $2A + 3I$ D) $5A + 6I$

2. If α and β are the eigen values of $\begin{pmatrix} 3 & -1 \\ -1 & 5 \end{pmatrix}$, form the matrix whose eigen values are α^3 and β^3.

   A) $\begin{pmatrix} 38 & 50 \\ 50 & 138 \end{pmatrix}$ B) $\begin{pmatrix} -38 & 50 \\ 50 & -138 \end{pmatrix}$

   C) $\begin{pmatrix} 38 & -50 \\ -50 & 138 \end{pmatrix}$ D) $\begin{pmatrix} 3 & -1 \\ -1 & 5 \end{pmatrix}$

3. The value of the integral $\int\limits_{1+i}^{2+4i} z^2 dz$ along the straight line joining $1 + i$ and $2 + 4i$ is

   A) $-\dfrac{86}{3} - 6i$ B) $-\dfrac{85}{3} + 6i$

   C) $\dfrac{86}{3} - 6i$ D) $-\dfrac{86i}{3} - 6i$

4. Find the value of $\dfrac{\partial^2 z}{\partial x \partial y}$, if $z^3 - xz - y = 0$.

   A) $-\dfrac{\left(3z^2 + x\right)}{(3z^2 - x)^3}$ B) $\dfrac{3z^2 + x}{(3z^2 - x)^3}$

   C) $\dfrac{3z + x}{(3z^2 - x)^3}$ D) $-\dfrac{(3z^2 + x)}{(3z^2 - x)^2}$

5. The general solution of $xdy - ydx = 0$ is

   A) $y = cx$ B) 0 C) $x + y = c$ D) none of these

6. A unit normal to $xy^3z^2 = 4$ at the point $(-1, -1, 2)$ is

   A) $\vec{i} + 3\vec{j} - \vec{k}$ B) $-\dfrac{1}{\sqrt{11}}(\vec{i} + 3\vec{j} - \vec{k})$

   C) $\dfrac{1}{\sqrt{11}}(\vec{i} + 3\vec{j} - \vec{k})$ D) $(\vec{i} - 3\vec{j} - \vec{k})$

A

7. Find the constants a, b, c, if $\vec{F} = (x + 2y + az)\vec{i} + (bx - 3y - z)\vec{j} + (4x + cy + 2z)\vec{k}$ is irrotational.

A) 4, 2, 1   B) 4, – 2, – 1

C) – 4, 2, 1   D) 4, 2, – 1

8. If $u = \dfrac{y^2}{x}$ and $v = \dfrac{x^2}{y}$, find $\dfrac{\partial(u, v)}{\partial(x, y)}$.

A) 3   B) – 3

C) $x + y$ D) $x - y$

9. The value of $\displaystyle\int_C \dfrac{dz}{z - 2}$, where C is a circle given by $|z - 2| = 1$ is

A) $4\pi i$ B) $- 2\pi i$

C) $2\pi i$ D) $- 4\pi i$

10. How should f(x) be defined at x = – 5, x = 0 and x = 5 in order that the Fourier series will converge to f(x) for $- 5 \le x \le 5$? $\left(\text{Where } f(x) = \begin{cases} 0, -5 < x < 0 \\ 3, 0 < x < 5 \end{cases} \right)$

A) $f(x) = \begin{cases} \dfrac{5}{2}, x = -5 \\ 0, -5 < x < 0 \\ \dfrac{5}{2}, x = 0 \\ 3, 0 < x < 5 \\ \dfrac{5}{2}, x = 5 \end{cases}$ B) $f(x) = \begin{cases} \dfrac{1}{2}, x = -5 \\ 0, -5 < x < 0 \\ \dfrac{1}{2}, x = 0 \\ 3, 0 < x < 5 \\ \dfrac{1}{2}, x = 5 \end{cases}$

C) $f(x) = \begin{cases} -\dfrac{3}{2}, x = -5 \\ 0, -5 < x < 0 \\ -\dfrac{3}{2}, x = 0 \\ 3, 0 < x < 5 \\ -\dfrac{3}{2}, x = 5 \end{cases}$ D) $f(x) = \begin{cases} \dfrac{3}{2}, x = -5 \\ 0, -5 < x < 0 \\ \dfrac{3}{2}, x = 0 \\ 3, 0 < x < 5 \\ \dfrac{3}{2}, x = 5 \end{cases}$

A

11. Air at 300 K flows over a 4 m long and 1.8 m wide surface of a plate with velocity of 5 m/s. The length of the surface beyond which the flow remains turbulent is

    [For air, K = 0.02 W/mK, P_r = 0.717, $\gamma = 1.7 \times 10^{-5}$ m^2/s]

    A) 1.5 m

    B) 1.7 m

    C) 2.2 m

    D) 4 m

12. Choose the correct option from the following statements for compressible flow of fluid.

    A) The higher the particle Mach number, the more slender the Mach cone

    B) The lower the particle Mach number, the more slender the Mach cone

    C) The lower the particle Mach number, the less or more slender can be the Mach cone

    D) None of the above

13. In fully turbulent flow through a rough pipe, the friction factor 'f' is a function of

    [Where Re is Reynolds number and $\in/D$ is relative roughness]

    A) 'Re' and '$\in/D$'

    B) 'Re' only

    C) Independent of 'Re' and '$\in/D$'

    D) '$\in/D$' only

14. Match the dimensionless number given in List – I to the type of force which are one of the constituents describing these numbers in List – II.

List – I	List – II
a. Weber number	1. Pressure force
b. Froude number	2. Surface tension force
c. Euler number	3. Elastic force
d. Mach number	4. Gravity force

	a	b	c	d
A)	2	1	4	3
B)	2	4	1	3
C)	1	2	4	3
D)	4	2	3	1

A

15. The typical operating characteristic curve for fan with backward curved blades are shown in figure below. Match the correct option.
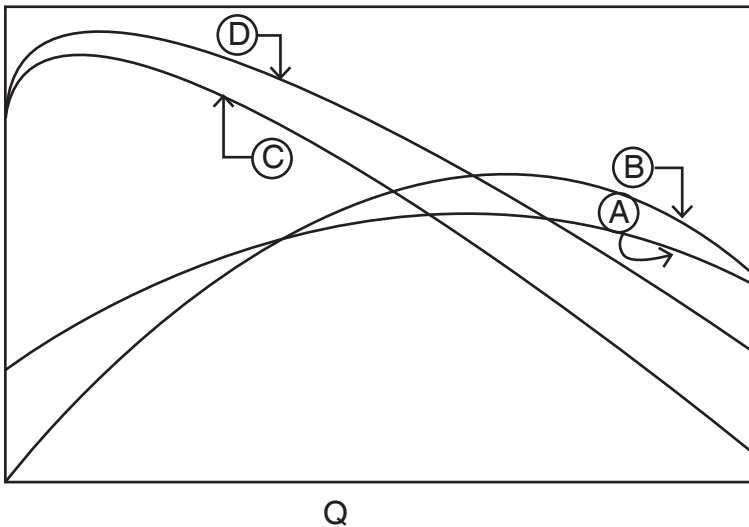
Q

	List – I		List – II
a.	Curve A	i.	Total pressure
b.	Curve B	ii.	Shaft power
c.	Curve C	iii.	Total efficiency
d.	Curve D	iv.	Fan static pressure

	a	**b**	**c**	**d**
A)	ii	iii	iv	i
B)	iii	ii	i	iv
C)	iv	iii	ii	i
D)	ii	iv	i	iii

16. Total pressure on the top of a closed cylindrical vessel of diameter 'd' completely filled with water when rotated about its vertical axis is directly proportional to

   A) d

   B) d^2

   C) d^3

   D) d^4

17. The maximum hydraulic efficiency of an impulse turbine having angle of blade tip at outlet, 'ϕ' is given as

   A) $\dfrac{1-\cos\phi}{2}$

   B) $\dfrac{1+\cos\phi}{2}$

   C) $1+\cos\phi/2$

   D) $\dfrac{1+\sin\phi}{2}$

18. Choose the true statement from the following options.

    A) Parameters of the laminar boundary layer vary as $Re_X^{-1/3}$

    B) Parameters of the turbulent boundary layer vary as $Re_X^{-1/5}$

    C) Laminar boundary layer develops more rapidly than turbulent boundary layer

    D) None of the above

19. When the boundary layer on the cylinder becomes turbulent, the drag coefficient is reduced by a factor of about

    A) 16   B) 8   C) 4   D) 2

20. The universal velocity distribution for turbulent flow in a channel is well represented by

    [Where u^* is frictional velocity $= \sqrt{C\omega/\rho}$]

    A) $\dfrac{u}{u^*} = 2.5\ln\dfrac{yu^*}{\gamma} + 5.0$

    B) $\dfrac{u}{u^*} = 5\ln\dfrac{yu^*}{\gamma} + 3.0$

    C) $\dfrac{u^*}{u} = 5.75\ln\dfrac{yu^*}{\gamma} - 5.5$

    D) $\dfrac{u}{u^*} = \dfrac{yu^*}{\gamma}$

21. Specific speed of a turbine and pump are (symbols have the usual meaning)

    A) $\dfrac{N\sqrt{Q}}{H^{3/4}}$ and $\dfrac{N\sqrt{P}}{H^{3/4}}$ respectively

    B) $\dfrac{N\sqrt{P}}{H^{5/4}}$ and $\dfrac{N\sqrt{Q}}{H^{5/4}}$ respectively

    C) $\dfrac{N\sqrt{P}}{H^{3/4}}$ and $\dfrac{N\sqrt{Q}}{H^{5/4}}$ respectively

    D) $\dfrac{N\sqrt{P}}{H^{5/4}}$ and $\dfrac{N\sqrt{Q}}{H^{3/4}}$ respectively

22. A laminar boundary layer occurs over a flat plate at zero incidence to the flow. The thickness of boundary layer at a section 1.5 m from leading edge is 2 mm. The thickness of boundary layer at a section 3 m from the leading edge will be

    A) 2.178 mm   B) 3.872 mm   C) 2.828 mm   D) 3.828 mm

A

23. The general form of expression for continuity equation in a Cartesian co-ordinate system for unsteady incompressible flow is given by

A) $\dfrac{\partial u}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial w}{\partial z} = 0$

B) $\dfrac{\partial \rho}{\partial t} + \dfrac{\partial}{\partial x}(\rho u) + \dfrac{\partial}{\partial y}(\rho v) + \dfrac{\partial}{\partial z}(\rho w) = 0$

C) $\dfrac{\partial}{\partial x}(\rho u) + \dfrac{\partial}{\partial y}(\rho v) + \dfrac{\partial}{\partial z}(\rho w) = 0$

D) $\dfrac{\partial u}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial w}{\partial z} = 1$

24. If a cylindrical boiler drum kept in the horizontal position is full of water, then the time taken to empty it completely depends upon

A) R^2 B) $R^{5/2}$ C) $R^{3/2}$ D) $R^{3/4}$

25. Power transmitted through a nozzle is maximum when the head loss due to friction in pipe is

A) $\dfrac{1}{3}$ the total head supplied at inlet of pipe

B) $\dfrac{2}{3}$ the total head supplied at inlet of pipe

C) $\dfrac{3}{4}$ the total head supplied at inlet of pipe

D) $\dfrac{3}{2}$ the total head supplied at inlet of pipe

26. In winter, a house need 198 MJ/hr heat requirement. For this purpose, how much amount of heat to be abstracted from outside by the heat pump if it is having 8.0 COP ?

A) 158400 kJ/hr   B) 162000 kJ/hr
C) 173250 kJ/hr   D) 180640 kJ/hr

27. The effectiveness of parallel flow heat exchanger is calculated by using the relation

A) $\dfrac{1 - \exp\left[NTU\,(1 - C)\right]}{1 - C}$

B) $\dfrac{1 - \exp\left[NTU\,(1 - C)\right]}{1 + C}$

C) $\dfrac{1 - \exp\left[NTU\,(1 + C)\right]}{1 + C}$

D) $\dfrac{1 - \exp\left[-NTU\,(1 + C)\right]}{1 + C}$

A

28. Identify the wrong statement.

    1. Reversed Carnot cycle is nothing but Carnot Refrigeration cycle.
    2. The efficiencies of all reversible heat engines operating the same two reservoirs are the same.
    3. The Carnot efficiency approaches unity when the low temperature reservoir goes more than the high temperature reservoir.
    4. Work is more valuable form of energy than heat.

    A) 1 and 3   B) 2   C) 3   D) 4

29. Heat transfer coefficient for free convection in gases, forced convection in gases and vapours, and for boiling water lie, respectively in the ranges of

    A) $5 – 15$, $20 – 200$ and $3,000 – 50,000$ W/m^2K
    B) $5 – 50$, $200 – 5,000$ and $50,000 – 10^5$ W/m^2K
    C) $5 – 35$, $500 – 10,000$ and $10^5 – 10^6$ W/m^2K
    D) $5 – 100$, $200 – 1,000$ and a constant 10^6 W/m^2K

30. A thin plate 2 m long and 1 m width is placed in an air stream (density = 1.0 kg/m^3 and viscosity = 0.85×10^{-5} Pa.s) moving with a velocity of 1 m/s. What will be the type of flow over the plate ?

    A) Turbulent flow over the entire plate
    B) Laminar flow over the entire plate
    C) Upto 0.3 m length from the leading edge of the plate the flow is Laminar then the remaining plate length flow is Turbulent
    D) Upto 0.7 m length from the leading edge of the plate the flow is Laminar then the remaining plate length flow is Turbulent

31. A pipe carrying steam runs in a large room and is exposed to surrounding air at a temperature of 27°C. The pipe surface is subjected to 327°C. Find the loss of heat to surroundings due to thermal radiation. Assume pipe surface emissivity = 0.5.

    A) 2.50 kW/m^2 B) 3.44 kW/m^2 C) 4.82 kW/m^2 D) 5.68 kW/m^2

32. The Nusselt number for fully developed laminar flow in a tube under constant heat flux is equal to

    A) The product of Reynolds and Prandtl number
    B) 3.66
    C) 48/11
    D) The square root of heat transfer coefficient

A

33. The Clausius-Clapeyron equation is

A) $\ln\left(\dfrac{P_1}{P_2}\right) = \dfrac{\Delta H_{vap}}{R}\left(\dfrac{1}{T_2} - \dfrac{1}{T_1}\right)$

B) $\ln\left(\dfrac{P_2}{P_1}\right) = \dfrac{\Delta H_{vap}}{R}\left(\dfrac{1}{T_2} - \dfrac{1}{T_1}\right)$

C) $\ln\left(\dfrac{P_1}{P_2}\right) = \dfrac{\Delta H_{vap}}{R}\left(\dfrac{1}{T_1} - \dfrac{1}{T_2}\right)$

D) $\left(\dfrac{P_1}{P_2}\right) = \dfrac{\Delta H_{vap}}{R}\ln\left(\dfrac{1}{T_2} - \dfrac{1}{T_1}\right)$

34. Identify the correct statements with regard to Otto cycle.
    1. Its efficiency can be improved by using a working fluid of higher value of ratio of specific heats.
    2. It is not a reversible cycle.
    3. The practical way of increasing its efficiency is to increase the compression ratio.
    4. Carburetted gasoline engines working on Otto cycle can work with compression ratios more than 12.

    A) All are correct
    B) 1, 2 and 3 are correct
    C) 1, 2 and 4 are correct
    D) 2, 3 and 4 are correct

35. In steam turbines, the ratio of the enthalpy drop in the moving blades to the sum of the enthalpy drop in the moving and fixed blades is called
    A) Work done by the blade per kg of steam
    B) Stage efficiency
    C) Turbine compounding ratio
    D) Degree of reaction

36. In a regenerative feed heating cycle, the greatest economy is affected
    A) When steam is extracted only from the last stage of steam turbine
    B) When steam is extracted only from the first stage of steam turbine
    C) When steam is extracted from several places in different stages of steam turbine
    D) When steam is extracted from only one suitable point of steam turbine

37. Identify the wrong statement.

    1. The knocking tendency in CI engines increase with increasing the temperature of inlet air.
    2. To avoid knock in SI engine, the combustion chamber must have large bore.
    3. Detonation in SI engine occurs due to pre-ignition of change before spark is struck.
    4. Advancing the spark timing in spark ignition engines leads to reduce the knocking tendency.

    A) 1 and 2 are wrong
    B) 1, 2 and 4 are wrong
    C) 3 and 4 are wrong
    D) All are wrong

38. A Carnot refrigerator having the capacity of 15 tonnes. The higher temperature of the refrigerant in the system is 27°C and the lower temperature is –23°C. What is the work input value in MJ/hr ?

    A) 42
    B) 36
    C) 30
    D) 24

39. Helmholtz free energy (F) relation is

    A) $F = U + TS$
    B) $F = U - TS$
    C) $F = H + TS$
    D) $F = H - TS$

40. In hydrodynamic boundary layer, the energy, momentum and displacement thickness are observed to be 1/18, 1/15 and 1/3 respectively. The shape factor value will be

    A) 1.2
    B) 3
    C) 5
    D) 6

41. When trying to turn a key into a lock _____ is applied.

    A) Lever
    B) Coplanar force
    C) Couple
    D) Moment

42. A stone of mass m at the end of a string length l is whirled in a vertical circle at a constant speed. The tension in the string will be maximum when the stone is

    A) At the top of the circle
    B) Half-way down from the top
    C) Quarter was down from the top
    D) At the bottom of the circle

A

43. A 1 kg block is resting on a surface with coefficient of friction $\mu = 0.1$. A force of 0.8 N is applied to the block as shown in the figure. The friction force is
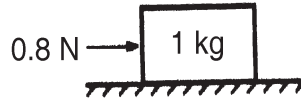
    A) 0.8 N   B) 0.98 N   C) 1.2 N   D) 0

44. 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 is the acceleration of the particle in consistent units, the motion started with

    A) $v = 0$, $a = 0$ B) $v = 0$, $a = 2$

    C) $v = 2$, $a = 0$ D) $v = 2$, $a = 2$

45. A circular solid disc of uniform thickness 20 mm, radius 200 mm and mass 20 kg, is used as a flywheel. If it rotates at 600 rpm, the kinetic energy of the flywheel, in Joules is

    A) 395   B) 790   C) 1,580   D) 3,160

46. The most suitable follower motion for high-speed engine is

    A) Uniform acceleration and deceleration

    B) Cycloidal

    C) Uniform velocity

    D) Simple harmonic motion

47. In a clock mechanism, the hours and minute hands are connected by _____ gear train.

    A) Compound   B) Simple

    C) Reverted   D) Epicyclic

48. If the ratio of length of connecting rod to the crank increases

    A) Secondary unbalanced force decrease

    B) Primary unbalanced force increase

    C) Primary unbalanced force decrease

    D) Secondary unbalanced force increase

A

49. If the air screw of an aeroplane rotates clockwise when viewed from the rear and the aeroplane takes a right turn, the gyroscopic effect will be

   A) Tend to raise the tail and depress the nose

   B) Tend to raise the nose and depress the tail

   C) Tilt the aeroplane about spin axis

   D) Do not spin on the axis

50. The locus of instantaneous centre of a moving body relative to a fixed body is known as the

   A) Surface centrode   B) Body centrode

   C) Moving centrode   D) Space centrode

51. In the mechanism given below, if the angular velocity of the eccentric circular disc is 1 rad/s, the angular velocity (rad/s) of the follower link for the instant shown in the figure.

   A) 0.05   B) 0.1
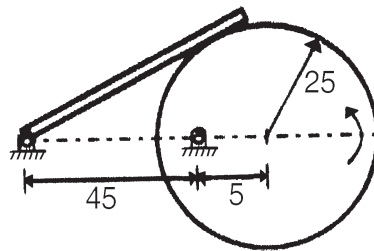
   C) 5.0   D) 10.0

52. A mass m attached to a spring is subjected to a harmonic force as shown in figure. The amplitude of the forced motion is observed to be 50 mm. The value of m (in kg) is

   A) 0.1   B) 1.0

   C) 0.3   D) 0.5

A
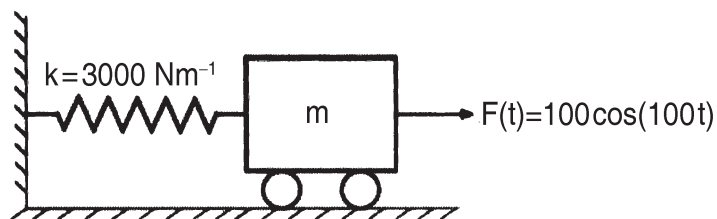
53. A rotating disc of 1 m diameter has two eccentric masses of 0.5 kg each at radii of 50 mm and 60 mm at angular positions of 0° and 150°, respectively. A balancing mass of 0.1 kg is to be used to balance the rotor. What is the radial position of the balancing mass ?

    A) 50 mm   B) 120 mm

    C) 150 mm   D) 280 mm

54. The mechanism used in a shaping machine is

    A) A closed 4-bar chain having 4 revolute pairs

    B) A closed 6-bar chain having 6 revolute pairs

    C) A closed 4-bar chain having 2 revolute and 2 sliding pairs

    D) An inversion of the single slider-crank chain

55. A vibrating machine is isolated from the floor using springs. If the ratio of excitation frequency of vibration of machine to the natural frequency of the isolation system is equal to 0.5, then transmissibility ratio of isolation is

    A) $\dfrac{1}{2}$ B) $\dfrac{3}{4}$

    C) $\dfrac{4}{3}$ D) 2

56. Consider the following statements regarding state of stress at a point :

    1. Number of components required to define the state of stress at a point are nine.

    2. Number of components required to define the state of stress at a point are twelve.

    3. Number of components required to define the state of stress at a point in equilibrium condition are six.

    4. Number of components required to define the state of stress at a point in equilibrium condition are sixteen.

    Which of the following statements is/are correct ?

    A) 1 and 3 only   B) 1 and 4 only

    C) 2 and 3 only   D) 2 and 4 only

57. State of plane stress at a point is given as : $\sigma_x = \sigma_y = 100$ MPa and $T_{xy} = 0$. The radius of Mohr's circle will be

   A) 50 units   B) 0   C) 100 units   D) None

58. A cantilever beam of diameter D, length L, cross-section A is subjected to a uniformly distributed load W and a concentrated load W_1 at a distance L_1 from free end will have maximum bending moment of

   A) $\dfrac{WL}{2} + W_1(L - L_1)$

   B) $\dfrac{WL^2}{2} + W_1 L_1$

   C) $\dfrac{W(L - L_1)}{2} + W_1(L - L_1)$

   D) $\dfrac{W(L - L_1)}{2} + \dfrac{W(L + L_1)}{2}$

59. Consider the following statements regarding point of contraflexure :

   1. Shear force is zero at the point of contraflexure.
   2. Bending moment is zero at the point of contraflexure.
   3. Bending moment changes its sign at the point of contraflexure.
   4. Shear force changes its sign at the point of contraflexure.

   Which of the following statements is/are correct ?

   A) 1 and 3 only   B) 1 and 4 only
   C) 2 and 3 only   D) 2 and 4 only

60. In terms of theoretical stress concentration factor (k_t) and the notch sensitivity 'q', the fatigue stress concentration factor (k_f), is expressed as

   A) $k_f = 1 + q (k_t + 1)$ B) $k_f = 1 + q (k_t - 1)$
   C) $k_f = q/(k_t - 1)$ D) $k_f = (k_t - 1)/q$

61. The state of stress at a point is given as :

   $\sigma_x = 100$ N/mm^2, $\sigma_y = 40$ N/mm^2 and $T_{xy} = 40$ N/mm^2

   If the yield strength S_y of the material is 300 MPa, the factor of safety using maximum shear stress theory will be

   A) 3   B) 2.5   C) 7.5   D) 1.25

62. The S-N curve for steel becomes asymptotic nearly at

   A) 10^6 cycles   B) 10^9 cycles
   C) 10^3 cycles   D) 10^4 cycles

A

63. For the bracket bolted as shown with 4 bolts P, Q, R and S. Which of the bolts are heavily loaded ?
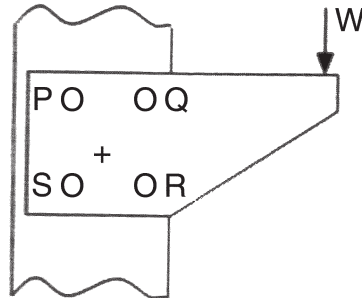
A) P and Q   B) P and S

C) S and Q   D) Q and R

64. The dynamic load factor or velocity factor c_v as proposed by AGMA for gears whose teeth are finished by hobbing or shaping, is given by

A) $c_v = 5.6 / (5.6 + \sqrt{1000})$

B) $c_v = 50 / (50 + \sqrt{2000})$

C) $c_v = 78 / (78 + \sqrt{2000})$

D) None of the above

65. Consider the following statements regarding use of splined shaft :

1. Transmitting power.

2. Holding a fly wheel rigidly in position.

3. Moving axially the gears mounted on it.

4. Mounting V-belt pulley on it.

Which of the following statements is/are correct ?

A) 1 and 3 only   B) 1 and 4 only

C) 2 and 3 only   D) 2 and 4 only

66. A helical coil spring with wire diameter 'd' and mean coil diameter 'D' is subjected to axial load. A constant ratio of 'D' and 'd' has to be maintained, such that the extension of the spring is independent of 'D' and 'd'. What is the ratio ?

A) D^3/d^4 B) d^3/D^4

C) $D^{4/3}/d^3$ D) $d^{4/3}/D^3$

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

	List – I		**List – II**
P.	Single-plate clutch	1.	Scooters
Q.	Multi-plate clutch	2.	Rolling mills
R.	Centrifugal clutch	3.	Trucks
S.	Jaw clutch	4.	Moped

Codes :

	P	Q	R	S
A)	1	3	4	2
B)	1	3	2	4
C)	3	1	4	2
D)	3	1	2	4

68. Which one of the following is the criterion in the design of hydrodynamic bearings ?
   A) Rating life
   B) Rotation factor
   C) Sommerfeld number
   D) Specific dynamic capacity

69. The value of bearing characteristic number corresponding to minimum coefficient of friction in hydrodynamic bearings is called
   A) Sommerfeld number
   B) Bearing modulus
   C) Friction variable
   D) Minimum film thickness and radial clearance ratio

70. In case of thin cylindrical shell, the volumetric strain is given by
   A) $\varepsilon_v = (p^2 d/2tE) \, (2.5 - 2/m)$
   B) $\varepsilon_v = (pd^2/2tE) \, (2.5 - 2/m)$
   C) $\varepsilon_v = (pd/4tE) \, (2.5 - 2/m)$
   D) $\varepsilon_v = (pd/2tE) \, (2.5 - 2/m)$

71. Which of the following statements are true in the case of Gray Cast Iron ?
   i. It has high compressive strength.
   ii. It has self-damping property.
   iii. It forms continuous chips while machining.
   A) Only ii
   B) Only i and ii
   C) i, ii and iii are correct
   D) Only i and iii

A

72. Cooling rate faster than critical cooling rate in iron carbon system (TTT diagram) will form
    A) Pearlite
    B) Austenite
    C) Martensite
    D) Bainite

73. Which of the following welding is best suited for aluminium ?
    A) TIG
    B) MIG
    C) Submerged welding
    D) Gas welding

74. Which of the following is a single point cutting tool operation carried out in milling machine ?
    A) Gang milling
    B) Plain milling
    C) Straddle milling
    D) Fly cutting

75. Match the correct pairs :

Process	**Characteristics**
P. Extrusion	1. Squeezing out of material through hole
Q. Forging	2. Application of sudden blows
R. Spinning	3. High speed rotation for shaping

    A) P-1, Q-2, R-3
    B) P-3, Q-2, R-1
    C) P-1, Q-3, R-2
    D) None of these

76. N001 G21 G90 G92 X0 Y-50.0 Z0;

    N002 G00 X20 Y30;

    A portion of CNC part programme is given above. Which of the following function is possible using these codes ?
    A) linear interpolation to the point (20, 30) in absolute coordinates
    B) linear interpolation to the point (0, –50, 0) in absolute coordinates
    C) rapid movement to the point (20, 30) in absolute coordinates
    D) rapid movement to the point (20, 30) in incremental coordinates

77. De-energized state of a normal relay is represented in PLC ladder logic diagram using
    A) normally open contact
    B) normally closed contact
    C) latching contact
    D) none of the above

A

78. Match the correct pairs :

Processes	Function of fluid used
P. EDM	1. Abrasive action
Q. USM	2. Prevents electric cond.
R. ECM	3. Electrolyte

A) P-1, Q-2, R-3   B) P-3, Q-2, R-1

C) P-3, Q-1, R-2   D) P-2, Q-1, R-3

79. A spherical drop of molten metal of radius 5 mm was found to solidify in 20 seconds. A similar drop of radius 10 mm will solidify in

A) 20 sec   B) 50 sec   C) 60 sec   D) 80 sec

80. Compound rest is a part in lathe used to

A) hold work piece   B) hold the tool

C) turn the tool for angular cuts   D) move the carriage

81. In a shaping machine, a work piece with 600 mm × 600 mm surface is to be machined. Return to cutting time ratio is 2 : 3, cutting speed is 6 m/min and feed is 2mm/double stroke. What is the minimum possible machining time required for complete one pass over surface ?

A) 50 min   B) 40 min   C) 30 min   D) 60 min

82. For checking the flatness of a surface which of the following instruments can be used ?

   i. Dial gauge

   ii. Autocollimator

   iii. Plug gauge

A) only ii   B) only i and ii

C) only i and iii   D) all i, ii and iii

83. The main objective of honing operation is

A) mass removal of material

B) to improve the accuracy of surface

C) to improve the surface finish

D) to remove the marks on machined surface

A

84. Which of the following are the different types of CMM ?
    i. Bridge type
    ii. Grantry type
    iii. Cantilever type
    A) Only ii
    B) Only i and ii
    C) All i, ii and iii
    D) Only i and iii

85. Carbonyl process in powder metallurgy is used as
    A) Atomization operation
    B) Sintering operation
    C) Compacting operation
    D) Blending operation

86. Under the assumption that the quality characteristic follows a normal distribution, the standard deviation of the relative range $W = R/\sigma$ is estimated as d_3 for a specified sample size 'n'. The upper control limit of R chart is given as D_4 where its value is

    A) $1+3\dfrac{d_3}{d_2}$
    B) $1+3\dfrac{d_2}{d_3}$
    C) $1-3\dfrac{d_2}{d_3}$
    D) $1-3\dfrac{d_3}{d_2}$

87. A multiple sampling plan has the parameters as follows :
    N – Lot size
    n_1 – First sample
    n_2 – Second sample
    n_3 – Third sample
    Using the notation P_{a_1}, P_{a_2} and P_{a_3} as the probabilities of accepting the lot on 1st, 2nd and 3rd samples respectively if rectifying inspection is employed, the ATI is given as

    A) $n_1 P_{a_1} + n_2 P_{a_2} + n_3 P_{a_3} + N(1 - P_{a_1} - P_{a_2} - P_{a_3})$
    B) $n_1 + (N - n_1) P_{a_1} + (N - n_2) P_{a_2} + (N - n_3) P_{a_3}$
    C) $n_1 (1 - P_{a_1}) + n_2 (1 - P_{a_2}) + n_3 (1 - P_{a_3}) + N(1 - P_{a_1} - P_{a_2} - P_{a_3})$
    D) $n_1 P_{a_1} + (n_1 + n_2) P_{a_2} + (n_1 + n_2 + n_3) P_{a_3} + N(1 - P_{a_1} - P_{a_2} - P_{a_3})$

88. If the reliability $R(t + T) = R(t)$, the reliability can be modelled by the following distribution
    A) Lognormal with decreasing failure rate
    B) Weibull with increasing failure rate
    C) Exponential distribution
    D) Normal distribution

A

89. The expected time to complete a project is estimated to be 42 weeks with a standard deviation of 2 weeks. What is the probability of completing the project by the scheduled time, if the scheduled time is given as 48 weeks ?

A) 0.9973 B) 0.9545

C) 0.9987 D) 0.6827

90. An $\bar{X}$ – control chart has shown a point above the control limit (UCL) during the monitoring period. The quality engineer suspected the process and finally could not find any assignable cause for the above situation. Finally, he concluded that this is a false alarm. The false alarm probability depends on

A) Sample size only

B) Sample size and sampling interval

C) Control limit coefficient only

D) Control limit coefficient and shift parameter

91. The primal LP is given as follows :

$$\text{Min } Z = x_1 + 2x_2$$

S.T. $2x_1 + 4x_2 \leq 160$

$x_1 - x_2 = 30$

$x_1 \geq 10$

and $x_1, x_2 \geq 0$

The dual of the problem is :

A) Min $W = -2y_1 - 2y_2$

S.T. $2y_1 + 4y_2 \geq 160$

$y_1 - y_2 = 30$

$y_1 \leq 10$

and $y_1, y_2 \geq 0$

B) Max $W = -2y_1 - 2y_2$

S.T. $2y_1 + 4y_2 \geq 160$

$y_1 - y_2 = 30$

$y_1 \geq 10$

$y_1, y_2 \geq 0$

C) Max $W = -160y_1 + 30y_2 - 30y_3 + 10y_4$

S.T. $-2y_1 + y_2 - y_3 + y_4 \leq 1$

$-4y_1 - y_2 + y_3 \leq 2$

$y_1, y_4 \geq 0$

and y_2, y_3 unrestricted in sign

D) Max $W = -160y_1 + 30y + 10y_4$

S.T. $-2y_1 + y + y_4 \leq 1$

$-4y_1 - y \leq 2$

$y_1, y_4 \geq 0$

y unrestricted in sign

92. Two machines are located at the coordinates (–d, 0) and (d, 0). A new machine is located at the coordinate (x, y) and the level curves are found to be confocal ellipses with foci located at the two existing machines. The measure of distance between the new and existing facilities is

    A) Euclidean
    B) Rectangular
    C) Mahalanobis
    D) Discontinuous or intermittent

93. Which of the following ASME symbols used in recording techniques has a different representation in two handed process charts ?

    A)
    B)
    C)
    D)

94. A sample plotted above UCL or below LCL of a control chart is considered bad since it may represent the out-of-control situation for a process. But, a quality engineer was happy to see a point below the LCL and spent a lot of time to find the reason for the same. The quality engineer is using

    A) an $\overline{X}$ – chart
    B) an X – chart
    C) a CUSUM chart
    D) p-chart

95. Find the option which contains a fake selective inventory technique.

    A) XYZ, HML, VED, ABC
    B) ABC, VED, SOS, FSN
    C) VED, FSN, GOLF, HML
    D) ABC, SDE, VED, HMT

96. After a pilot study, the number of observations (n) to be taken in a work sampling technique is given by the formula

    $$n = \frac{X^2}{Y^2} \frac{(1-\bar{p})}{\bar{p}}$$

    For a confidence level of 95% and accuracy of ± 3% the values of X and Y are respectively

    A) 3 and 3
    B) 4 and 3
    C) 1.96 and 0.03
    D) 1.96 and 0.09

A

97. A firm uses simple exponential smoothing with $\alpha = 0.2$ to forecast demand. The forecast for the month of January was 400 units, whereas actual demand turned out to be 450 units. The forecast for the month of February is

A) 400　　　　　　　　　　　　　　B) 410

C) 420　　　　　　　　　　　　　　D) 440

98. The first cost of a road laying machine is Rs. 80,00,000. Its salvage value after five years is Rs. 5,00,000. The length of the road that can be laid by the machine during its life time is 75,000 km. In its third year of operation, the length of road laid is 10,000 km. Find the depreciation of the equipment for that year from the below options :

A) 10 lakhs　　　　　　　　　　　B) 5 lakhs

C) 8 lakhs　　　　　　　　　　　　D) 3 lakhs

99. A firm has a fixed cost of Rs. 50,000/-, selling price per unit Rs. 50/- and variable cost per unit Rs. 25. Present level of production is 3500 units. If the fixed cost is changed from Rs. 50,000/- to Rs. 60,000, the change in break even point is by _____ units.

A) 2000　　　　　　　　　　　　　B) 2400

C) 1100　　　　　　　　　　　　　D) 400

100. In six sigma concept, the defectives number of 3.4 ppm is achieved by allowing a shift in the mean by

A) 1σ　　　　　　　　　　　　　B) 1.5σ

C) 3.0σ　　　　　　　　　　　　D) 6.0σ

_____

Space for Rough Work