



Booklet No. :

**ME - 15**

# Mechanical Engineering

Duration of Test : 2 Hours

Max. Marks : 120

Hall Ticket No.

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Name of the Candidate : \_\_\_\_\_

Date of Examination : \_\_\_\_\_ OMR Answer Sheet No. : \_\_\_\_\_

\_\_\_\_\_  
Signature of the Candidate

\_\_\_\_\_  
Signature of the Invigilator

## INSTRUCTIONS

1. This Question Booklet consists of **120** multiple choice objective type questions to be answered in **120** minutes.
2. Every question in this booklet has 4 choices marked (A), (B), (C) and (D) for its answer.
3. Each question carries **one** mark. There are no negative marks for wrong answers.
4. This Booklet consists of **16** pages. Any discrepancy or any defect is found, the same may be informed to the Invigilator for replacement of Booklet.
5. Answer all the questions on the OMR Answer Sheet using **Blue/Black ball point pen only**.
6. Before answering the questions on the OMR Answer Sheet, please read the instructions printed on the OMR sheet carefully.
7. OMR Answer Sheet should be handed over to the Invigilator before leaving the Examination Hall.
8. Calculators, Pagers, Mobile Phones, etc., are not allowed into the Examination Hall.
9. No part of the Booklet should be detached under any circumstances.
10. The seal of the Booklet should be opened only after signal/bell is given.

ME-15-A



**MECHANICAL ENGINEERING (ME)**

1. A system of  $n$  simultaneous equations  $AX = 0$  in  $n$  unknowns has nontrivial solution if  
(A)  $|A| \neq 1$       (B)  $|A| < n$       (C)  $|A| = 0$       (D)  $A^{-1}$  exists

2. One eigen vector of the matrix  $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$  is  $X =$

- (A)  $\begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$       (B)  $\begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}$       (C)  $\begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$       (D)  $\begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}$

3. The shortest distance of the plane  $lx + my + nz = p$  from the origin is

- (A)  $\frac{p}{\sqrt{l^2 + m^2 + n^2}}$       (B)  $\frac{p}{\sqrt{l + m + n}}$   
(C)  $\frac{1}{\sqrt{l^2 + m^2 + n^2}}$       (D) 0

4. If  $C$  is the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ , then the value of  $\frac{1}{2} \oint_C (xdy - ydx)$  is

- (A)  $\pi ab$       (B)  $\frac{\pi ab}{2}$       (C)  $ab^2$       (D)  $\pi a^2 b$

5. The value of  $\frac{1}{D^2 - 4} \sin^2 x$  is

- (A)  $-\frac{1}{4} \sin^2 x$       (B)  $\frac{1}{8} + \cos 2x$       (C) none      (D)  $(-1)\frac{1}{8} + \frac{1}{16} \cos 2x$

6. The Laplace transform of  $e^{2x} x^2$  is

- (A)  $\frac{1}{(s-2)^3}$       (B)  $\frac{1}{(s+2)^3}$       (C)  $\frac{2}{(s-2)^3}$       (D)  $\frac{2}{(s+2)^3}$

7. The residue of the function  $f(z) = \frac{z^2}{(z-1)^2(z+2)}$  at the pole  $z = -2$  is

- (A)  $\frac{5}{9}$       (B)  $-\frac{1}{2}$       (C)  $\frac{4}{9}$       (D) 0

8. If a random variable  $X$  has the PDF  $f(x) = (1-p)^{x-1} p, x=1,2,\dots$  and  $0 < p < 1$ . Then the mean of  $X$  is  
 (A)  $p+1$  (B)  $p^2 + p$  (C)  $p$  (D)  $1$
9. Monthly-breakdowns of a computer is a random variable having Poisson distribution with mean  $2.0$ . The probability that the computer will function for a month without a breakdown is  
 (A)  $e^{0.2}$  (B)  $e^{-0.2}$  (C)  $0.2$  (D)  $0$
10. The condition for convergence of iteration scheme  $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$  is  
 (A)  $f''(x_n)f(x_n) \leq [f'(x_n)]^2$  (B)  $f'(x_n) < 1$   
 (C)  $f'(x_n) > 1$  (D)  $f''(x_n)f(x_n) \geq [f'(x_n)]^2$
11. Instantaneous center of a body rolling without sliding on a straight surface lies  
 (A) At the point of contact  
 (B) On the common tangent at the point of contact  
 (C) On the common normal at the point of contact  
 (D) At infinity
12. A stone of mass  $m$  is attached to a string of length  $l$  is rotated in vertical circle at constant speed. The tension in the string will be  
 (A) Maximum at the point of contact  
 (B) Minimum when the stone is at half way down from the top  
 (C) Maximum when the stone is quarter way down from the top  
 (D) Maximum at the bottom of the circle
13. A wheel of mass  $m$  and radius  $r$  is in accelerated rolling motion without slipping under a steady torque  $T$ . If the co-efficient of friction between the two surfaces is  $\mu$ , then the normal force acting on the surface by the wheel is  
 (A)  $0$  (B)  $mg$  (C)  $\frac{T}{r}$  (D)  $T$
14. The co-efficient of restitution of a perfectly elastic impact is  
 (A)  $0$  (B)  $1$  (C)  $2$  (D) Infinite
15. An automobile of mass  $m$  accelerates uniformly starting from rest. If the engine supplies constant power  $P$ , which of the following relations is correct ?  
 (A)  $v = \left(\frac{Pt}{m}\right)^{2/3}$  (B)  $v = \left(\frac{2Pt}{m}\right)^{2/3}$  (C)  $v = \left(\frac{2Pt}{m}\right)^{1/2}$  (D)  $v = \left(\frac{Pt}{m}\right)^{3/2}$
16. A ball of mass of  $10^{-2}$  kg strikes on a wall and returns back in the same direction. If its speed changes from  $20$  m/s to  $10$  m/s, the magnitude of impulse acting on the bullet is  
 (A)  $0.1$  Ns (B)  $0.3$  Ns (C)  $30$  Ns (D)  $1$  Ns

17. A swinging pendulum eventually stops because its energy is finally converted into  
 (A) Kinetic energy (B) Heat energy  
 (C) Potential energy (D) Electromagnetic energy
18. A solid sphere of mass  $M$ , rolling down an inclined plane has a velocity  $v$  along the plane. Total kinetic energy will be  
 (A)  $\frac{1}{2}Mv^2$  (B)  $\frac{1}{5}Mv^2$  (C)  $\frac{7}{10}Mv^2$  (D)  $\frac{1}{7}Mv^2$
19. A material with same properties in all directions is called  
 (A) Homogeneous material (B) Isotropic material  
 (C) Elastic material (D) Crystalline material
20. The energy absorbed in a body when it is strained to elastic limits is known as  
 (A) Strain energy (B) Hysteresis (C) Resilience (D) Toughness
21. Poisson's ratio for an incompressible material is  
 (A) Cannot be determined (B) Infinite  
 (C) 1 (D) Zero
22. If a shaft is rotating at  $N$  rpm with a Torque  $T$  Nm, the power transmitted to the shaft in Watts is  
 (A)  $\frac{2\pi NT}{60}$  (B)  $\frac{2\pi NT}{750}$  (C)  $\frac{2\pi NT}{4500}$  (D)  $\frac{2\pi NT}{550}$
23. For a cantilever beam,  $\frac{dM}{dx} = \text{constant}$  for the whole length. The shape of the shear force diagram is  
 (A) rectangle (B) triangle (C) parabola (D) hyperbola
24. A thin cylinder of diameter  $d$ , length  $L$  and thickness  $t$  is subjected to internal pressure  $P$ . What is the ratio of longitudinal strain to hoop strain in terms of Poisson's ratio ( $1/m$ )  
 (A)  $\frac{m-2}{2m+1}$  (B)  $\frac{m-2}{2m-1}$  (C)  $\frac{2m-2}{m-1}$  (D)  $\frac{2m+1}{m-1}$
25. A bar of circular cross section has a uniformly varying diameter from  $D$  to  $2D$ . If extension in the bar due to a tensile force is calculated assuming it as a cylindrical bar of mean diameter, the Percentage error in the calculation will be close to  
 (A) 10 (B) 25 (C) 33 (D) 50
26. If  $E$  is the Young's modulus of a material, the minimum value of bulk modulus of elasticity is  
 (A)  $\frac{E}{2}$  (B)  $\frac{E}{3}$  (C)  $\frac{E}{4}$  (D)  $\frac{E}{5}$

27. A solid shaft of diameter 100 mm, length 100 mm is subjected to a torque  $T$ . The maximum shear stress developed in the shaft is  $60 \text{ N/mm}^2$ . If a through hole of 50 mm diameter is made throughout the length of the shaft, What must be the torque applied to keep the shear stress same as before ?
- (A)  $\frac{15T}{16}$                       (B)  $\frac{3T}{4}$                       (C)  $\frac{11T}{12}$                       (D)  $\frac{7T}{8}$
28. The component of acceleration parallel to the velocity of the particle, at a given instant is
- (A) Radial component                      (B) Tangential component  
(C) Coriolis component                      (D) Net acceleration
29. If the ratio of length of connecting rod to the crank radius increases, then
- (A) Primary unbalanced forces will increase  
(B) Primary unbalanced forces will decrease  
(C) Secondary unbalanced forces will increase  
(D) Secondary unbalanced forces will decrease
30. A body of mass  $m$  and radius of gyration  $k$  is replaced by two masses  $m_1$  and  $m_2$  located at distances  $h_1$  and  $h_2$  from the center of gravity of the original body. The condition for an equivalent dynamic system is
- (A)  $h_1 + h_2 = k$                       (B)  $h_1^2 + h_2^2 = k^2$                       (C)  $h_1 h_2 = k^2$                       (D)  $\sqrt{h_1 h_2} = k^2$
31. The speed of an engine with a fly wheel varies from 210 rad/s to 190 rad/s. If the corresponding change in Kinetic energy is 400 Nm, the inertia of the flywheel is
- (A)  $0.10 \text{ kgm}^2$                       (B)  $0.20 \text{ kgm}^2$                       (C)  $0.30 \text{ kgm}^2$                       (D)  $0.40 \text{ kgm}^2$
32. In a 4 stroke IC engine, the turning moment diagram during the compression stroke is
- (A) Positive throughout  
(B) Negative throughout  
(C) Positive during major portion of the stroke  
(D) Negative during major portion of the stroke
33. The number of pairs of teeth in contact in a gear and pinion if arc of contact is 31.4 mm and module is 5 are
- (A) 3                      (B) 4                      (C) 2                      (D) 5
34. The degrees of freedom of a planar linkage with 8 links and 9 simple revolute joints is
- (A) 1                      (B) 2                      (C) 3                      (D) 4
35. For an involute gear, the ratio of base circle diameter to pitch circle diameter is ( $\phi$  is the pressure angle)
- (A)  $\cos \phi$                       (B)  $\sin \phi$                       (C)  $\text{cosec } \phi$                       (D)  $\sec \phi$
36. The ratio of maximum damping co-efficient to the critical damping co-efficient is called
- (A) Magnification factor                      (B) Logarithmic decrement  
(C) Damping factor                      (D) Damping co-efficient

37. In a vibration isolation system, if  $\frac{\omega}{\omega_n} = \sqrt{2}$ , where  $\omega$  = forced vibration frequency and  $\omega_n$  = natural frequency, then transmissibility is  
 (A)  $>1$  (B)  $<1$  (C)  $=1$  (D) 0
38. Which of the following causes whirling of shafts ?  
 (A) Non-homogeneity of shaft materials (B) Mis-alignment of bearings  
 (C) Fluctuation of speed (D) Internal damping
39. If the governing equation of a vibrating system is  $7 \frac{d^2x}{dt^2} + 49x = 0$ , the natural frequency is  
 (A) 7 Hz (B) 49 Hz (C)  $\sqrt{7}$  Hz (D) 9 Hz
40. A system with natural frequency 100 Hz has a damping factor of 0.6. The frequency of the damped system is  
 (A) 60Hz (B) 80Hz  
 (C) 100Hz (D) cannot be determined
41. In a forced vibration system with viscous damping, the amplitude is maximum when  
 (A) Forced frequency is equal to natural frequency  
 (B) Forced frequency is slightly less than natural frequency  
 (C) Forced frequency is slightly greater than natural frequency  
 (D) zero
42. If the static deflection of a shaft with a flywheel is 4 mm. Considering acceleration due to gravity is  $10 \text{ m/s}^2$ , the critical speed in rad/s is  
 (A) 50 (B) 20 (C) 10 (D) 5
43. A single degree of freedom spring mass damper system is undergoing critically damped vibrations. If mass is 5 kg and stiffness of spring is 20 N/m, the viscous damping co-efficient is  
 (A) 10 Ns/m (B) 20 Ns/m (C) 4 Ns/m (D) 8 Ns/m
44. A material under fatigue fails  
 (A) at elastic limit (B) below elastic limit  
 (C) at yield point (D) below yield point
45. Which of the following relation results in a conservative estimate with same factor of safety ?  
 (A) Gerber relation (B) Soderberg relation  
 (C) Goodman relation (D) Euler relation
46. A cotter joint is capable of transmitting  
 (A) Twisting moment (B) Bending moment  
 (C) Axial and compressive load (D) Only compressive load

47. A Hooke's joint is used to connect  
 (A) Coplanar and non-parallel shafts (B) Non-coplanar and non-parallel shafts  
 (C) Co-planar and parallel shafts (D) Non-coplanar and parallel shafts
48. The bearing characteristic number in case of Hydrodynamic bearing depends upon  
 (A) Length, width and load (B) Length, width and speed  
 (C) Viscosity, speed and load (D) Viscosity, speed and bearing pressure
49. While deriving Lewis equation, it is assumed that tangential tooth load acts on the  
 (A) Pitch point (B) Tip of the tooth  
 (C) Root of the tooth (D) Whole face of the tooth
50. When a shaft transmits power through gears, the shaft experiences  
 (A) Torsional stresses only  
 (B) Bending stresses only  
 (C) Constant bending and varying torsional stresses  
 (D) Varying bending and constant torsional stress
51. The SI unit of dynamic viscosity is  
 (A)  $\text{m}^2/\text{s}$  (B)  $\text{m}/\text{s}^2$  (C)  $\text{Ns}/\text{m}^2$  (D)  $\text{N}/\text{m}^2$
52. A lubricating oil of viscosity 10 Poise is filled between two parallel plates that are 0.5 cm apart. If the relative velocity between the plates is 2 m/s, then shear stress developed in lubricating oil is  
 (A)  $20 \text{ N}/\text{m}^2$  (B)  $200 \text{ N}/\text{m}^2$  (C)  $40 \text{ N}/\text{m}^2$  (D)  $400 \text{ N}/\text{m}^2$
53. What is the pressure inside a soap bubble over the atmospheric pressure, if the diameter is 1 cm ?  
 (A)  $0.2 \text{ N}/\text{m}^2$  (B)  $0.1 \text{ N}/\text{m}^2$  (C)  $20 \text{ N}/\text{m}^2$  (D)  $10 \text{ N}/\text{m}^2$
54. The density of a liquid changes from  $250 \text{ kg}/\text{m}^3$  to  $251 \text{ kg}/\text{m}^3$ , when the pressure on the liquid changes from 4 MPa to 4.5 MPa. What is the average value of bulk modulus of the liquid over the given pressure range ?  
 (A) 250 MPa (B) 125 MPa (C) 62.5 MPa (D) 12 MPa
55. A tank with four equal vertical faces of width  $w$  and height  $h$  is filled with a liquid. If the force on any vertical side is equal to the force at the bottom, the value of  $h/t$  is  
 (A) 2 (B) 1.414 (C) 1 (D) 0.5
56. Buoyant force is  
 (A) Lateral force acting on a submerged body  
 (B) Resultant force acting on a submerged body  
 (C) Vertical force acting on a body due to fluid surrounding it  
 (D) Vertical force acting on a submerged body

57. Turbulent flow in rough pipes depends on  
 (A) Velocity of flow (B) Pipe diameter  
 (C) Type of fluid flowing (D) Pipe condition and diameter
58. For flow through a horizontal pipe, the pressure gradient opposite to the flow direction is  
 (A) Positive (B) Negative  
 (C) Cannot be determined (D) Depends on the fluid properties
59. Which of the following statements is correct ?  
 (A) Hydraulic grade line slopes upwards meeting the energy grade line at the exit of flow.  
 (B) Energy grade line lies above the hydraulic grade line and they are separated from each other by a vertical distance equal to velocity head.  
 (C) Hydraulic grade line and energy grade line are same.  
 (D) The hydraulic grade line slopes upwards meeting the energy grade at the exit of flow.
60. A Francis turbine is coupled to an alternator to generate electricity with a frequency of 50 Hz. If the alternator has 12 poles, the turbine should be regulated to run at which of the following speeds ?  
 (A) 250 rpm (B) 500 rpm (C) 600 rpm (D) 1000 rpm
61. A cylinder made of metal of conductivity 40 W/mK is to be insulated with a material of conductivity 0.1 W/mK. If the convective heat transfer co-efficient with the ambient atmosphere is 5 W/m<sup>2</sup>K, the critical radius of insulation is  
 (A) 2 cm (B) 4 cm (C) 8 cm (D) 50 cm
62. A large concrete slab 1m thick has one dimensional temperature distribution of  $T = 5 - 5x + 5x^2 + 15x^3$  (in °C) where x (in m) is the distance from one face of the wall. If the slab material has thermal diffusivity of  $2 \times 10^{-3} \text{ m}^2/\text{hr}$ . The rate of change of temperature at the other face of the wall is  
 (A) 0.1 °C/hr (B) 0.2 °C/hr (C) 0.3 °C/hr (D) 0.4 °C/hr
63. Transient heat conduction means  
 (A) Heat transfer is constant with respect to time  
 (B) Heat transfer is constant with respect to position  
 (C) The heat transfer is very negligible in the direction perpendicular to heat flow  
 (D) Heat transfer is very negligible in the direction of heat flow
64. Addition of a fin increases heat transfer only when  
 (A)  $\sqrt{\frac{hA}{kP}} = 1$  (B)  $\sqrt{\frac{hA}{kP}} > 1$  (C)  $\sqrt{\frac{hA}{kP}} < 1$  (D)  $1 < \sqrt{\frac{hA}{kP}} < 2$
65. A stagnant liquid film of 0.4 mm thickness is held between two parallel plates. The top plate is maintained at 40 °C and the bottom plate is maintained at 30 °C. If the thermal conductivity of the liquid is 0.14 W/mK then the steady state heat flux (in W/m<sup>2</sup>) assuming one dimensional heat transfer is  
 (A) 3.5 (B) 350 (C) 3500 (D) 7000



66. Grashoff's number is
- (A)  $\frac{\text{thermal diffusivity}}{\text{mass diffusivity}}$                       (B)  $\frac{\text{sensible heat}}{\text{latent heat}}$
- (C)  $\frac{\text{buoyancy force}}{\text{viscous force}}$                       (D)  $\frac{\text{inertial force}}{\text{surface tension force}}$
67. If the temperature of a solid surface changes from 27 °C to 327 °C, its emissive power will increase in the ratio of
- (A) 2 :1                      (B) 4 :1                      (C) 8 :1                      (D) 16 :1
68. Intensity of radiation at a surface in perpendicular direction is equal to
- (A) Product of emissivity of surface and  $\frac{1}{\pi}$
- (B) Product of emissivity of surface and  $\pi$
- (C) Product of emissive power of surface and  $\frac{1}{\pi}$
- (D) Product of emissive power of surface and  $\pi$
69. For a hemisphere, the solid angle is
- (A)  $2\pi$  radians    (B)  $\pi$  radians    (C)  $2\pi$  steradians    (D)  $\pi$  steradians
70. Select the correct statements :
- Flow configuration does not matter in a heat exchanger if
1. A liquid is evaporating
  2. A vapour is condensing
  3. Mass flow rate of one of the fluid is far greater
- (A) 1 and 2                      (B) 1 and 3                      (C) 2 and 3                      (D) 1, 2 and 3
71. In a new temperature scale, the boiling point and freezing point of water are given as 100 units and 300 units respectively. The reading of 0 units on the new scale corresponds to
- (A) 0 °C                      (B) 50 °C                      (C) 100 °C                      (D) 150 °C
72. For a mixture of solid, liquid and vapour phase of a pure substance, the number of intrinsic properties needed to describe the state are
- (A) 0                      (B) 1                      (C) 2                      (D) 3
73. The amount of thermodynamic work to be done to inflate a balloon of volume  $1\text{m}^3$  with an internal pressure of  $10^5$  Pa. The amount of work done upon the atmosphere by the balloon is
- (A) 0                      (B) 100 J                      (C) 1 kJ                      (D) 50 kJ

74. An ideal gas expands isothermally from volume  $V_1$  to  $V_2$  and then compressed to original volume  $V_1$  adiabatically. If initial pressure is  $P_1$  and final pressure is  $P_3$  and total work done by the gas is  $W$ , then  
 (A)  $P_3 > P_1, W > 0$  (B)  $P_3 < P_1, W < 0$  (C)  $P_3 > P_1, W < 0$  (D)  $P_3 = P_1, W = 0$
75. Air with enthalpy of 100 kJ/kg is compressed to a pressure and temperature where enthalpy becomes 200 kJ/kg. The loss of heat from compressor is 40 kJ/kg. Neglecting kinetic and potential energies, the energy required for air flow rate of 0.5 kg/s is  
 (A) 30 kW (B) 50 kW (C) 70 kW (D) 90 kW
76. If the time taken by a system to execute a process through a finite gradient is infinitely large, the process  
 (A) becomes reversible (B) remain irreversible  
 (C) become isothermal (D) is adiabatic
77. A Carnot cycle operates between two temperatures  $T_1$  and  $T_2$  ( $T_1 > T_2$ ). If  $\eta_1$  is the Carnot efficiency when  $T_1$  is raised by  $\Delta T$  and  $\eta_2$  is the Carnot efficiency when  $T_2$  is decreased by  $\Delta T$ , then which of the following is correct ?  
 (A)  $\eta_1 = \eta_2$  (B)  $\eta_1 > \eta_2$  (C)  $\eta_1 < \eta_2$  (D) Unpredictable
78. A reversible heat engine receives 6 kJ of heat from thermal reservoir at temperature of 800 K and 8 kJ from another heat source at a temperature of 600 K. If it rejects heat at a temperature of 100 K, the thermal efficiency of the engine is equal to  
 (A) 65% (B) 75% (C) 80% (D) 85%
79. An engine of thermal efficiency 30% is used to drive a refrigerator of COP of 5. What is the heat input into the engine for each MJ of energy removed from the cold body ?  
 (A) 420 kJ (B) 567.89 kJ (C) 666.67 kJ (D) 778.46 kJ
80. Find the loss of available energy associated with the transfer of 1000 kJ of heat from a constant temperature system of 600 K to another at 400 K, when the atmospheric temperature is 300 K  
 (A) 100 kJ (B) 150 kJ (C) 200 kJ (D) 250 kJ
81. 1kg of water at room temperature is brought into contact with a high temperature thermal reservoir. The entropy change in the universe is  
 (A) always positive  
 (B) equal to entropy change in the reservoir  
 (C) equal to zero  
 (D) equal to entropy change of water

82. For a system existing at a constant volume and constant temperature, which of the following parameter is criterion for equilibrium and stability of the system ?  
 (A) Entropy (B) Gibb's function  
 (C) Helmholtz function (D) Internal energy
83. Saturated liquid at a higher pressure  $P_1$  having  $h_{f1} = 1000$  kJ/kg is throttled to a lower pressure  $P_2$ . The enthalpy of saturated liquid and saturated vapour is 800 kJ/kg and 2800 kJ/kg respectively. The dryness fraction of vapour after throttling is  
 (A) 0.1 (B) 0.2 (C) 0.8 (D) 0.9
84. In Rankine cycle, regeneration results in higher efficiency because  
 (A) Pressure inside the boiler increases  
 (B) Heat is added before steam enters the low pressure turbine  
 (C) Average temperature of heat addition in the boiler increases  
 (D) Total work delivered by the turbine increases
85. The reheat cycle in steam power plant is mainly adopted to  
 (A) Improve thermal efficiency  
 (B) Decrease moisture content in low stage to a safe value  
 (C) Decreases the capacity of the condenser  
 (D) Remove the waste heat of boiler
86. Addition of Magnesium to cast iron increases its  
 (A) Hardness (B) Ductility and strength in tension  
 (C) Corrosion resistance (D) Creep resistance
87. For a rhombohedral lattice, which of the following relations is correct ?  
 (A)  $\alpha = \beta = \gamma = 90^\circ$  (B)  $\alpha = \beta = \gamma \neq 90^\circ$   
 (C)  $\alpha = \gamma = 90^\circ \neq \beta$  (D)  $\alpha \neq \gamma \neq \beta \neq 90^\circ$
88. Which of the following materials can be subjected to age hardening ?  
 (A) HSS (B) Aluminium (C) Pure iron (D) Stellite
89. The material property which depends only on crystal structure is  
 (A) Fatigue strength (B) Work hardening  
 (C) Fracture strength (D) Elastic constant
90. Repeatability of measuring instruments is  
 (A) The closeness with which the measurement can be read directly from a measuring instrument  
 (B) Difference between measured values and actual values  
 (C) Capacity to indicate the same reading again and again for a given measurement  
 (D) The smallest change that can be measured

91. For interference fit, the lower limit of the shaft must be  
 (A) Greater than the upper limit of hole  
 (B) Lesser than the upper limit of the hole  
 (C) Greater than the lower limit of the hole  
 (D) Lesser than the lower limit of the hole
92. A hole specified as  $20_{-0.000}^{+0.050}$  mm, has a mating shaft with clearance fit of minimum clearance of 0.01mm. The tolerance on the shaft is 0.04. The maximum clearance in mm between hole and shaft is  
 (A) 0.04                      (B) 0.05                      (C) 0.10                      (D) 0.11
93. An expendable pattern is used in  
 (A) Slush casting    (B) Squeeze casting  
 (C) Centrifugal casting                                      (D) Investment casting
94. Fluidity of cast iron in casting a component is greatly influenced by  
 (A) Carbon content of molten metal  
 (B) Melting temperature of molten metal  
 (C) Inoculants addition  
 (D) Pouring temperature of molten metal
95. In green sand moulding, uniform ramming leads to  
 (A) Less chance of gas porosity  
 (B) Uniform flow of molten metal in to the mould cavity  
 (C) Greater dimensional stability in casting  
 (D) Less sand expansion type casting defect
96. A spherical molten metal drop of radius 4 mm was found to solidify in 10 seconds. A drop of 8 mm will solidify in  
 (A) 14.14 s                      (B) 20 s                      (C) 18.30 s                      (D) 40 s
97. A rolling mill requires 30 kW per roll. Assuming a power loss of 5 kW, the total power required for the mill is  
 (A) 35 kW                      (B) 25 kW                      (C) 65 kW                      (D) 55 kW
98. Which of the following is correct for upset forging ?  
 (A) Causes a steadily applied pressure instead of impact force  
 (B) Used to force the end of a heated bar into a desired shape  
 (C) Two halves of rotating die open and close rapidly while impacting the end of the heated tube or shell  
 (D) Reduced diameter of a bar and in the process making it longer

99. Hot working operation is carried at  
 (A) Near plastic stage temperature  
 (B) Below recrystallization temperature  
 (C) Above recrystallization temperature  
 (D) Above Curie temperature
100. Which of the following processes improves fatigue strength ?  
 (A) Spinning (B) Shot peening (C) Hemming (D) Lancing
101. In an arc welding operation, the voltage and current are 25 V and 300 A respectively. If the arc heat transfer efficiency is 0.85 and welding speed 8 mm/s, the net heat input (in J/mm) is  
 (A) 64 (B) 797 (C) 1103 (D) 79700
102. Drooping characteristics are used in manual welding operation to  
 (A) keep voltage constant when arc length changes  
 (B) Current constant when arc length changes  
 (C) Temperature in the arc constant  
 (D) Weld pool red-hot
103. Which of the following statements is correct ?  
 (A) No flux is used in gas welding of mild steel  
 (B) Borax is the commonly used flux coating on welding electrodes  
 (C) Laser beam welding employs a vacuum chamber and thus avoids use of a shielding method  
 (D) Alternating current can be used for GTAW process
104. Too low welding current in arc welding would result in  
 (A) Excessive piling up of weld metal, poor penetration, wasted electrodes  
 (B) Excessive spatter, under cutting along edges, irregular deposits, wasted electrodes  
 (C) Too small bead, weak weld and wasted electrodes  
 (D) Excessive piling up of weld metal, over planning without penetration of edges, wasted electrodes
105. In a turning operation, if feed is doubled, to keep the same surface finish, the nose radius should be  
 (A) Halved (B) Kept unchanged  
 (C) Doubled (D) Made four times
106. Which of the following statements about EDM are correct ?  
 (A) No relative motion occurs between tool and workpiece  
 (B) No tool wear occurs  
 (C) No power is consumed during metal cutting  
 (D) No direct contact occurs between tool and workpiece

107. If  $\phi$  is the shear angle,  $\beta$  is the friction angle and  $\alpha$  is the rake angle, which of the following statements is correct according to Merchant's analysis ?

- (A)  $2\phi + 2\beta - \alpha = \frac{\pi}{4}$                       (B)  $2\phi + \beta - \alpha = \frac{\pi}{2}$   
(C)  $2\phi + \beta - 2\alpha = \frac{\pi}{4}$                       (D)  $2\phi + \beta - \alpha = \frac{\pi}{4}$

108. Which of the following property is not a characteristic of Ceramic tools ?

- (A) High hardness  
(B) High compressive strength  
(C) High thermal conductivity  
(D) High brittleness

109. The demand and forecast for February are 12000 and 10275 respectively. Using single exponential smoothing method, forecast for the month of March is (smoothing co-efficient = 0.25)

- (A) 431                      (B) 9587                      (C) 10706                      (D) 13000

110. In forecasting using moving average method, the number of periods of data is independent of

- (A) Criteria of accuracy                      (B) Impulse response  
(C) Noise damping                      (D) Total number of sales

111. Market demand for springs is 8,00,000 per annum. A company purchases these springs in lots and sells them. The cost of making a purchase order is ₹ 1200. The cost of storage of springs is ₹ 120 per stored piece per annum. The Economic order Quantity is

- (A) 400                      (B) 2828                      (C) 4000                      (D) 8000

112. Which of the following is a correct statement for graphical method in linear programming ?

- (A) A point in the feasible region is not a solution to the problem  
(B) One of the corner points of the feasible region is not the optimum solution  
(C) Any point in the positive quadrant does not satisfy the non-negativity constraint  
(D) The lines corresponding to different values of objective functions are parallel

113. For a standard transportation linear program with  $m$  sources and  $n$  destinations and total supply equaling total demand, an optimal solution (lowest cost) with the smallest number of non-zero  $x_{ij}$  values (amounts from source  $i$  to destination  $j$ ) is desired. The best upper bound for this number is

- (A)  $mn$                       (B)  $2(m+n)$                       (C)  $m+n$                       (D)  $m+n-1$

114. The expected time in an activity is based on the assumption that activity follows  
 (A) Poisson distribution (B) Binomial distribution  
 (C) Beta distribution (D) Alpha distribution
115. A maintenance facility has Poisson arrival rates, negative exponential service time and operates on a 'first come first serve' queue method. Break downs occur on an average of 3 per day with a range of 0 to 8. The maintenance crew can service an average of 6 machines per day with a range of 0 to 7. The mean waiting time for an item to be serviced would be  
 (A)  $\frac{1}{6}$  day (B)  $\frac{1}{3}$  day (C) 1 day (D) 3 days
116. A manufacturing firm has a fixed cost of ₹ 18,000. The variable cost consists of ₹ 8 per unit and selling price is ₹ 13. Find the number of pieces to be produced to break even  
 (A) 1800 (B) 2400 (C) 3600 (D) 5400
117. In an assembly line when workstation times are unequal, the overall production rate of an assembly line is determined by the  
 (A) Fastest station time  
 (B) Slowest station time  
 (C) Average station time  
 (D) Average of slowest and fastest station times
118. There are five jobs which are to be processed on a workpiece in a sheet metal shop. The processing times for each of them are given below :
- | Job             | A | B  | C  | D  | E  |
|-----------------|---|----|----|----|----|
| Processing time | 4 | 17 | 14 | 19 | 11 |
- According to shortest processing time rule, the average number of jobs in the system each day is  
 (A) 1.23 (B) 2.44 (C) 3.89 (D) 4.84
119. What are the key functions of a master schedule ?  
 (1) To generate material and capacity requirements  
 (2) To maintain valid priorities  
 (3) An effective capacity utilization  
 (4) Planning the quantity and timing of output over the intermediate time horizons  
 Select the correct answers from the above options  
 (A) 1, 2 and 3 (B) 2, 3 and 4 (C) 1, 3 and 4 (D) 1, 2 and 4
120. Which of the following layout is suitable for low demand and high variety product ?  
 (A) Group layout (B) Process layout  
 (C) Product layout (D) Static layout

**SPACE FOR ROUGH WORK**