

Seat No. _____

SUB: MECHANICAL ENGINEERING (ME)

Time: 1 Hour 30 minutes

Instructions:

1. Ensure that all pages are printed.
2. Use Black ball pen only
3. Change in option is not allowed
4. There is no negative marking
5. Use of non-programmable scientific calculator is allowed.

1.	A stone of mass 'm' at the end of the string of 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 way down from the top	D	at the bottom of the circle
2.	A circular solid disc of uniform thickness 20 mm, radius 200 mm and mass 20 kg is used as flywheel. If it rotates at 600 rpm, the kinetic energy of flywheel is			
	A	395 J	B	790 J
	C	1580 J	D	3160 J
3.	The coefficient of restitution of a perfectly plastic impact is			
	A	0	B	1
	C	2	D	∞
4.	During inelastic collision of two particles, which one of the following is conserved?			
	A	Total linear momentum only	B	Total kinetic energy only
	C	Both linear momentum and kinetic energy	D	Neither linear momentum nor kinetic energy
5.	Instantaneous center of a body rolling without sliding on a stationary curved surface lies			
	A	at the point of contact	B	on the common normal at the point of contact
	C	on the common tangent at the point of contact	D	at the center of curvature of the stationary surface
6.	A circular object of radius 'r' rolls without slipping on a horizontal level floor with the center having velocity 'V'. The velocity at the point of contact between the object and floor is			
	A	zero	B	'V' in the direction of motion
	C	'V' opposite to the direction of motion	D	'V' vertically upward from the floor
7.	A cylindrical elastic body subjected to pure tension about its axis develops			
	A	tensile stress in a direction 45° to the axis	B	no tensile or compressive stress
	C	maximum shear stress along the axis of the body	D	maximum shear stress at 45° to the axis
8.	A rod of length 'L' and diameter 'D' is subjected to a tensile load 'P'. Which of the following is sufficient to calculate the resulting change in diameter?			
	A	Young's modulus	B	Shear modulus
	C	Poisson's ratio	D	Both Young's modulus and Shear modulus
9.	An elastic body is subjected to a tensile stress 'X' in a particular direction and a compressive stress 'Y' in its perpendicular direction. 'X' and 'Y' are unequal in magnitude. On the plane of maximum shear stress in the body there will be			
	A	no normal stress	B	also the maximum normal stress

	C	the maximum normal stress	D	both normal stress and shear stress
10.	If the principal stresses in a plane stress problem are $\sigma_1 = 100$ MPa and $\sigma_2 = 40$ MPa, the magnitude of the maximum shear stress (in MPa) will be			
	A	60	B	50
	C	30	D	20
11.	The number of independent elastic constants required to define the stress-strain relationship for an isotropic elastic solid is			
	A	1	B	2
	C	3	D	4
12.	The Poisson's ratio for a perfectly incompressible linear elastic material is			
	A	1	B	0.5
	C	0	D	∞
13.	A two dimensional fluid element rotates like a rigid body. At a point within the element, the pressure is 1 unit. Radius of Mohr's circle, characterizing the state at that point is			
	A	0.5 unit	B	0 unit
	C	1 unit	D	2 unit
14.	A long thin walled cylindrical shell, closed at both the ends, is subjected to an internal pressure. The ratio of the hoop stress to longitudinal stress developed in the shell is			
	A	0.5	B	1
	C	2	D	4
15.	For a simply supported beam on two end supports the bending moment is maximum			
	A	usually on the supports	B	always at mid-span
	C	where there is no shear force	D	where the deflection is maximum
16.	An axial residual compressive stress due to a manufacturing process is present on the outer surface of a rotating shaft subjected to bending. Under a given bending load, the fatigue life of the shaft in the presence of the residual compressive stress is			
	A	decreased	B	increased or decreased, depending on the external bending load
	C	neither decreased nor increased	D	Increased
17.	A cantilever beam having square cross-section of side 'a' is subjected to an end load. If 'a' is increased by 19%, the tip deflection decreases approximately by			
	A	19%	B	29%
	C	41%	D	50%
18.	Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240 MPa. If the shaft diameter is doubled then the maximum shear stress developed corresponding to the same torque will be (in MPa)			
	A	120	B	60
	C	30	D	15
19.	Two solid circular shafts of radii R_1 and R_2 are subjected to same torque. The maximum shear stresses developed in the two shafts are τ_1 and τ_2 . If $R_1/R_2 = 2$, then τ_2/τ_1 is			
	A	8	B	4
	C	16	D	2
20.	The spring constant of a helical compression spring does not depend on			
	A	coil diameter	B	material strength
	C	number of active turn	D	wire diameter
21.	If the length of a column is doubled, the critical load becomes			
	A	1/2 of the original value	B	1/4 of the original value
	C	1/8 of the original value	D	1/16 of the original value

22.	The number of degrees of freedom in a planar mechanism having 'n' links and 'j' simple hinge joints is			
	A	$3(n - 3) - 2j$	B	$3(n - 1) - 2j$
	C	$3n - 2j$	D	$2j - 3n + 4$
23.	Mobility of a statically indeterminate structure is			
	A	≤ -1	B	0
	C	1	D	≥ 2
24.	For a four bar linkage in toggle position, the value of mechanical advantage is			
	A	0	B	0.5
	C	1	D	∞
25.	For an underdamped harmonic oscillator, resonance			
	A	occurs when excitation frequency is greater than undamped natural frequency	B	occurs when excitation frequency is less than undamped natural frequency
	C	occurs when excitation frequency is equal to undamped natural frequency	D	never occurs
26.	If two nodes are observed at a frequency of 1800 rpm during whirling of a simply supported long slender rotating shaft, the first critical speed of the shaft in rpm is			
	A	200	B	450
	C	600	D	900
27.	The maximum diameter of a metallic (density = ρ) spherical ball that can float in a constant temperature liquid (surface tension = σ) bath is proportional to			
	A	$\sqrt{\sigma\rho}$	B	$\sqrt{\frac{1}{\sigma\rho}}$
	C	$\sqrt{\frac{\sigma}{\rho}}$	D	$\sqrt{\frac{\rho}{\sigma}}$
28.	On the free surface of a body of liquid resting inside an open container, a constant shear force is applied. Which one of the following events is most unlikely to follow afterwards?			
	A	The liquid deforms continuously	B	A liquid flow pattern develops inside the container
	C	The liquid changes its shape	D	The liquid remains at rest
29.	For an ideal gas at pressure 'P' and temperature 'T', the coefficient of volume expansion is equal to			
	A	T	B	P
	C	1/T	D	1/P
30.	Which one of the following statements is NOT correct?			
	A	Liquids wetting a solid surface have acute contact angles.	B	Non-wetting liquids have obtuse contact angles.
	C	For hydrophilic surfaces, water has a large contact angle.	D	For hydrophobic surfaces, water has a large contact angle.
31.	A cylindrical tank is filled with water up to a height 'h'. An air bubble of diameter 'd' is present at the bottom of the tank. If 'd _n ' is be diameter of the bubble after it has traveled a distance of h/2 while rising to the surface, then			
	A	d _n > d	B	d _n = d/2
	C	d _n = d	D	d _n < d
32.	For a Newtonian fluid			

	A	Shear stress is proportional to shear strain	B	Rate of shear stress is proportional to shear strain
	C	Shear stress is proportional to rate of shear strain	D	Rate of shear stress is proportional to rate of shear strain
33.	A sphere having a uniform density throughout and submerged in a liquid			
	A	is always stable	B	is always unstable
	C	always neutrally stable	D	could be stable or unstable
34.	On the top surface of a given submerged horizontal plate in a given fluid, the distance between the centroid and the center of pressure can be			
	A	changed by changing the fluid surface pressure	B	increased by submerging the plate further deep
	C	never changed by changing the shape of the plate	D	changed by changing the acceleration due to gravity
35.	For the stability of a floating body, under the influence of gravity alone, which of the following is TRUE?			
	A	Metacenter should be below center of gravity	B	Metacenter should be above center of gravity
	C	Metacenter and center of gravity must lie on the same horizontal line	D	Metacenter and center of gravity must lie on the same vertical line
36.	An orifice meter having an orifice of diameter 'd' is present in a pipe of diameter 'D'. Generally, the coefficient of discharge of the orifice meter:			
	A	is independent of d/D and Reynolds number of flow	B	depends on d/D and Reynolds number of flow
	C	depends only on d/D	D	depends only on Reynolds number of flow
37.	A streamline and an equipotential line in a flow field			
	A	are parallel to each other	B	are perpendicular to each other
	C	intersect at an acute angle	D	are identical
38.	A Prandtl tube (Pitot-static tube with $C = 1$) is used to measure the velocity of water. The differential manometer reading is 10 mm of liquid column with a relative density of 10. Assuming $g = 9.8 \text{ m/s}^2$, the velocity of water (in m/s) is			
	A	2.81	B	2.33
	C	1.33	D	1.21
39.	The maximum velocity of a one-dimensional incompressible fully developed viscous flow, between two fixed parallel plates, is 6 m/s. The mean velocity (in m/s) of the flow is			
	A	2	B	3
	C	4	D	5
40.	In order to have maximum power from a Pelton turbine, the bucket speed must be			
	A	equal to the jet speed	B	equal to half of the jet speed
	C	equal to twice the jet speed	D	independent of the jet speed
41.	Biot number signifies the ratio of			
	A	convective resistance in the fluid to conductive resistance in the solid	B	conductive resistance in the solid to convective resistance in the fluid
	C	inertia force to viscous force in the fluid	D	buoyancy force to viscous force in the fluid
42.	As the temperature increases, the thermal conductivity of a gas			
	A	increases	B	decreases
	C	remains constant	D	increases up to certain temperature and then decreases

43.	A 10 mm diameter electrical conductor is covered by an insulation of 2 mm thickness. The conductivity of the insulation is 0.08 W/m K and the convection coefficient at the insulation surface is 10 W/m ² K. Addition of further insulation of the same material will			
	A	increase heat loss continuously	B	decrease heat loss continuously
	C	increase heat loss to maximum and then decrease heat loss	D	decrease heat loss to maximum and then increase heat loss
44.	In descending order of magnitude, the thermal conductivity (a) pure iron (b) liquid water (c) saturated water vapor (d) pure aluminium can be arranged as			
	A	Abcd	B	bcad
	C	dabc	D	dcba
45.	In a composite slab, the temperature at the interface between two materials is equal to the average of the temperature at the two ends. Thickness of slab 1 is twice of that of slab 2. Assuming steady one dimensional heat conduction, which of the following statements is true about the respective thermal conductivities?			
	A	$2k_1 = k_2$	B	$k_1 = k_2$
	C	$2k_1 = 3k_2$	D	$k_1 = 2k_2$
46.	A long cylinder ($k = 1.05$ W/m K) having outer and inner diameters equals to 50 mm and 30 mm respectively carries hot fluid inside. The thermal resistance (K/W) per unit length of the cylinder is			
	A	0.031	B	0.077
	C	0.17	D	0.34
47.	Heat is generated uniformly in a long solid cylindrical rod of 10 mm diameter at the rate of 8×10^7 W/m ³ . The thermal conductivity of rod material is 50 W/m K. Under steady state condition, the temperature difference between the center and the surface of the rod is			
	A	10°C	B	15°C
	C	20°C	D	25°C
48.	For flow of viscous fluid over a flat plate, if the fluid temperature is same as the plate temperature, the thermal boundary layer is			
	A	thinner than the velocity boundary layer	B	thicker than the velocity boundary layer
	C	of the same thickness as the velocity boundary layer	D	not formed at all
49.	The Blasius equation related to boundary layer theory is a			
	A	third order linear partial differential equation	B	third order nonlinear partial differential equation
	C	second order nonlinear ordinary differential equation	D	third order nonlinear ordinary differential equation
50.	Water ($Pr = 6$) flows over a flat plate which is heated over the entire length. Which one of the following relationship between the hydrodynamic boundary layer thickness (δ) and thermal boundary layer thickness (δ_t) is true?			
	A	$\delta_t = \delta$	B	$\delta_t < \delta$
	C	$\delta_t > \delta$	D	cannot be predicted
51.	The emissive power of a black body is 'P'. If its absolute temperature is doubled, the emissive power will be			
	A	2P	B	4P
	C	8P	D	16P

52.	In a heat exchanger, it is observed that $\Delta T_1 = \Delta T_2$, where ΔT_1 is the temperature difference between the two single phase fluid streams at one end and ΔT_2 is the temperature difference at the other end. This heat exchanger is			
	A	a condenser	B	an evaporator
	C	a counter flow heat exchanger	D	a parallel flow heat exchanger
53.	Which of the following statements are TRUE with respect to heat and work? (i) They are boundary phenomena (ii) They are exact differentials (iii) They are path functions			
	A	both (i) and (ii)	B	both (i) and (iii)
	C	both (ii) and (iii)	D	only (iii)
54.	If a closed system is undergoing an irreversible process, the entropy of the system			
	A	must increase	B	always remain constant
	C	must decrease	D	can increase, decrease or remain constant
55.	The molar specific heat at constant volume of an ideal gas is equal to 2.5 times the universal gas constant (8.314 J/mol K). When temperature increases by 100K, the change in molar specific enthalpy (J/mol) is			
	A	2910	B	2950
	C	3010	D	3050
56.	A condenser of a refrigeration system rejects 150 kW of heat, while compressor consumes a power of 30 kW. The COP of the system would be			
	A	$\frac{1}{4}$	B	4
	C	$\frac{1}{5}$	D	5
57.	Increase in carbon content in plain carbon steels raise its			
	A	ductility and ultimate tensile strength	B	tensile strength and malleability
	C	tensile strength and hardness	D	ductility and melting temperature
58.	The main purpose of spheroidizing treatment is to improve			
	A	hardenability of low carbon steels	B	machinability of low carbon steels
	C	hardenability of high carbon steels	D	machinability of high carbon steels
59.	The crystal structure of austenite is			
	A	body centered cubic	B	face centered cubic
	C	hexagonal closed packed	D	body centered tetragonal
60.	Centrifugally casted products have			
	A	large grain structure with high porosity	B	Segregation of slug towards the outer skin of the casting
	C	fine grain structure with low density	D	fine grain structure with high density
61.	Light impurities in the molten metal are prevented from reaching the mould cavity by providing			
	A	strainer	B	bottom well
	C	skim bob	D	all of the above
62.	Which of the following materials requires the largest shrinkage allowance, while making a pattern for casting			
	A	Aluminium	B	Brass
	C	Cast iron	D	Plain carbon steel
63.	The true strain for a low carbon steel bar which is doubled in length by forging is			
	A	0.307	B	0.5
	C	0.693	D	1.0

64.	A solid cylinder of diameter 100 mm and height 50 mm is forged between two frictionless flat dies to a height of 25 mm. The percentage change in diameter is		
	A	0	B 2.07
	C	20.7	D 41.4
65.	The maximum possible draft in cold rolling of sheet increases with the		
	A	increase in coefficient of friction	B decrease in coefficient of friction
	C	decrease in roll radius	D increase in roll velocity
66.	Wall thickness of drawn cup is controlled by		
	A	Deep drawing	B Reverse drawing
	C	Redrawing	D Ironing
67.	In a bending operation, If the modulus of elasticity 'E' is increased keeping all other parameters unchanged, the spring back will		
	A	increase	B Decrease
	C	remain unchanged	D be independent of 'E'
68.	Internal gears are manufactured by		
	A	hobbing	B shaping with pinion cutter
	C	shaping with rack cutter	D milling
69.	High alloy steel components are preheated before welding for reducing		
	A	heat affected zone	B total energy consumption
	C	total time of weld	D welding stresses
70.	Which of the following powders should be fed for effective oxy-fuel cutting of stainless steel?		
	A	Steel	B Aluminium
	C	Copper	D Ceramic
71.	High speed electron beam welding is focused on the weld spot using		
	A	vacuum lens	B inert gas lens
	C	optical lens	D magnetic lens
72.	Cutting tools are provided with large positive rake angle mainly for		
	A	Increasing the strength of the cutting edge	B Avoiding rubbing action with the finished surfaces
	C	Reducing the magnitude of the cutting force	D Better heat dissipation
73.	Cutting speed in grinding is set to a high value to		
	A	reduce the cutting time	B increase the bond strength
	C	improve cooling of job and wheel	D reduce the wheel wear
74.	Most of the metal cutting heat goes into the		
	A	moving chip	B cutting tool
	C	work material	D machine tool
75.	Appropriate instrument to check the flatness of slip gauge is		
	A	dial indicator	B pneumatic comparator
	C	optical interferometer	D tool maker microscope with projection facility
76.	Which one of the following instruments is a comparator?		
	A	Tool maker microscope	B GO/NOGO gauge
	C	optical interferometer	D Dial gauge
77.	The interpolator in a CNC machine controls		
	A	Spindle speed	B Coolant flow
	C	Feed rate	D Tool change

78.	Which of the following forecasting methods takes a fraction of forecast error into account for the next period forecast?			
	A	Simple average method	B	Moving average method
	C	Weighted moving average method	D	Exponential smoothening method
79.	Setup costs do not include			
	A	labour cost of setting up machine	B	ordering cost of raw material
	C	maintenance cost of the machine	D	cost of processing the work piece
80.	In PERT analysis a critical activity has			
	A	maximum float	B	zero float
	C	maximum cost	D	minimum cost
81.	The inverse of a matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & -2 \end{bmatrix}$ is _____			
	A	$\begin{bmatrix} -2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 1 \end{bmatrix}$	B	$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1/3 & 0 \\ 0 & 0 & -1/2 \end{bmatrix}$
	C	$\begin{bmatrix} -0.5 & 0 & 0 \\ 0 & 0.3 & 0 \\ 0 & 0 & 1 \end{bmatrix}$	D	None of the above
82.	Which of the following is an eigen value of A^2 where $A = \begin{bmatrix} 1 & 0 \\ 3 & 4 \end{bmatrix}$			
	A	1	B	2
	C	3	D	4
83.	If every minor of order ' r ' of a matrix A is zero, then the rank of A is _____			
	A	Greater than r	B	Equal to r
	C	Less than r	D	Less than or equal to r
84.	$\lim_{x \rightarrow 0} x \log x =$ _____			
	A	-1	B	0
	C	1	D	None of these
85.	Find out the minima of the function $x^4 + y^4 - 2x^2 + 4xy - 2y^2$.			
	A	(0,0)	B	$(\sqrt{2}, -\sqrt{2})$
	C	$(\sqrt{2}, \sqrt{2})$	D	No minima exists

86.	The directional derivative of $f = xy^2 + yz^2$ at the point $(2, -1, 1)$ in the direction of the vector $i + 2j + 2k$ is _____			
	A	3	B	-1/3
	C	1/3	D	-3
87.	Which of the following is obtained for scalar point function?			
	A	Curl	B	Divergence
	C	Gradient	D	None of these
88.	The general solution of the differential equation $(D-1)^3 y = 0$ is _____			
	A	$y = c_1 e^x + c_2 e^{-x} + c_3$	B	$y = c_1 e^x + c_2 e^{-x} + c_3 x e^{-x}$
	C	$y = c_1 e^{-x} + c_2 x e^{-x} + c_3 x^2 e^{-x}$	D	$y = c_1 e^x + c_2 x e^x + c_3 x^2 e^x$
89.	Laplace transform of $e^{2t} \sin 3t$ is _____			
	A	$\frac{2}{s^2 + 9}$	B	$\frac{3}{s^2 + 9}$
	C	$\frac{s-2}{(s-2)^2 + 9}$	D	$\frac{3}{(s-2)^2 + 9}$
90.	In usual notations $L^{-1}\{e^{-as}F(s)\} = ______$			
	A	$f(t-a)u(t-a)$	B	$f(t+a)u(t+a)$
	C	$f(t-a)u(t+a)$	D	None of these
91.	In 30 balls, a batsman hit the boundary 6 times. What is the probability that he did not hit the boundaries?			
	A	1/5	B	4/5
	C	2/5	D	3/5
92.	Which of the following method is used to evaluate the value of integration numerically?			
	A	Newton Raphson method	B	Gauss elimination method
	C	Trapezoidal rule	D	Picard's rule
93.	Which of the following is true for $f(z) = \frac{z+iz}{z^2}$?			
	A	Continuous and differentiable	B	Continuous but not differentiable
	C	Differentiable but not continuous	D	Neither differentiable nor continuous
94.	Select an appropriate formula to apply False position method to find solution of algebraic equation. (a and b are the initial approximations)			

	A	$\frac{(a+b)}{2}$	B	$\frac{af(b)-bf(a)}{f(b)-f(a)}$
	C	$\frac{af(b)-bf(a)}{f(a)-f(b)}$	D	None of these
95.	In a box containing 100 bulbs, it is found that 10 are defective. What is the probability that in a random sample of 5 none of is found to be defective?			
	A	$\frac{9}{10}$	B	$\left(\frac{9}{10}\right)^5$
	C	$\left(\frac{1}{2}\right)^5$	D	None of these
96.	Evaluate $\oint_C \frac{e^{-z}}{z+1} dz$ where C is the circle $ z = \frac{1}{2}$.			
	A	0	B	1
	C	2π	D	$2\pi i$
97.	For the function $\frac{e^z}{1+z^2}$ which of the following is true?			
	A	$z=i$ is simple pole	B	$z=i$ is the pole of order 2
	C	$z=i$ is zero of order 3	D	$z=0$ is the pole of order 3
98.	If $E(X)=3$ and $E(X^2)=12$ then what is the value of the variance of X ?			
	A	0	B	1
	C	3	D	9
99.	The auxiliary quantity k_1 obtained by Runge-Kutta fourth order for the differential equation $\frac{dy}{dx} = x^2 + y^2$ with $y(0)=0$, when $h=0.1$ is ____			
	A	0.1	B	0
	C	1	D	None of these
100.	Solution of the differential equation $ye^x dx + (2y + e^x) dy = 0$ is _____			
	A	$e^x + y^2 = c$	B	$ye^x + y^2 = c$
	C	$y + y^2 = c$	D	None of these
