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A

SET-Z

M.Phil./Ph.D./URS-EE-2019

SUBJECT : Mechanical Engineering

Sr. No.10005.....

Time : 1¼ Hours

Max. Marks : 100

Total Questions : 100

Roll No. (in figures) _____ (in words) _____

Name _____ Father's Name _____

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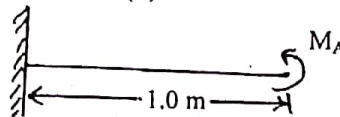
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MPH/PHD/URS-EE-2019/(Mech. Engg.)(SET-Z)/(A)

SEAL

1. A cylindrical tank with closed ends is filled with compressed air at a pressure of 500 kPa. The inner radius of the tank is 2 m. and it has wall thickness of 10 mm. The magnitude of maximum in-plane shear stress (in MPa) is :
 (1) 22 (2) 24 (3) 25 (4) 29
2. In a machining operation, if the generatrix and directrix both are straight lines, the surface obtained is :
 (1) Cylindrical (2) Helical (3) Plane (4) Surface of revolution
3. A single-degree-freedom spring-mass system is subjected to a sinusoidal force of 10 N amplitude and frequency w along the axis of the spring. The stiffness of the spring is 150 N/m, damping factor is 0.2 and the undamped natural frequency is $10w$. At steady state, the amplitude of vibration (in m) is approximately:
 (1) 0.05 (2) 0.07 (3) 0.70 (4) 0.90
4. A hollow shaft of 1 m length is designed to transmit a power of 30 kW at 700 rpm. The maximum permissible angle of twist in the shaft is 1° . The inner diameter of the shaft is 0.7 times the outer diameter. The modulus of rigidity is 80 GPa. The outside diameter (in mm) of the shaft is :
 (1) 44.5212 mm (2) 54.5212 mm (3) 64.5212 mm (4) 48.5212 mm
5. The atomic packing factor for a material with body centered cubic structure is :
 (1) 0.68 (2) 0.53 (3) 0.89 (4) 0.87
6. A horizontal cantilever beam of circular cross-section, length 10 m and flexural rigidity $EI = 200 \text{ N.m}^2$ is subjected to an applied moment $M_A = 1.0 \text{ N-m}$ at the free end as shown in the figure. The magnitude of the vertical deflection of the free end is (mm --- round off to one decimal place) :
 (1) 2.5 (2) 1.5 (3) 3.5 (4) 0.5



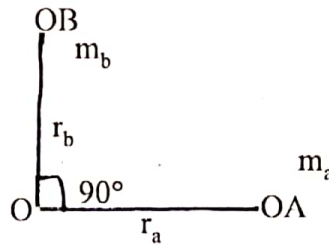
7. A wire of circular cross-section of diameter 1.0 mm is bent into a circular arc of radius 1.0 mm by application of pure bending moments at its ends. The Young's modulus of the material of the wire is 100 GPa. The maximum tensile stress developed in the wire is (MPa) :
 (1) 60 (2) 70 (3) 50 (4) 55
8. A small ball of mass 1 kg moving with a velocity of 12 m/s undergoes a direct central impact with a stationary ball of mass 2 kg. The impact is perfectly elastic. The speed (in m/s) of 2 kg mass ball after the impact will be :
 (1) 4 (2) 8 (3) 6 (4) 2
9. A gas is stored in a cylindrical tank of inner radius 7 in and wall thickness 50 mm. The gage pressure of the gas is 2 MPa. The maximum shear stress (in MPa) in the wall is:
 (1) 35 (2) 70 (3) 140 (4) 280

10. In a spring-mass system, the mass is m and the spring constant is k . The critical damping coefficient of the system is 0.1 kg/s . In another spring-mass system, the mass is $2m$ and the spring constant is $8k$. The critical damping coefficient (in kg/s) of this system is :

- (1) 0.6 (2) 0.3 (3) 0.4 (4) 0.8

11. Two masses A and B having mass m_a and m_b , respectively, lying in the plane of the figure shown, are rigidly attached to a shaft which revolves about an axis through O perpendicular to the figure. The radii of rotation of the masses m_a and m_b are r_a and r_b respectively. The angle between lines OA and OB is 90° . If $m_a = 10 \text{ kg}$, $m_b = 20 \text{ kg}$, $r_a = 200 \text{ mm}$ and $r_b = 400 \text{ mm}$, then the balance mass to be placed at a radius of 200 mm is (kg --- round off to two decimal places) :

- (1) 41.23 (2) 42.23 (3) 40.23 (4) 43.23



12. The thickness of a sheet is reduced by rolling (without any change in width) using 600 mm diameter rolls. Neglect elastic deflection of the rolls and assume that the coefficient of friction at the roll-work piece interface is 0.05 . The sheet enters the rotating rolls unaided. If the initial sheet thickness is 2 mm , the minimum possible final thickness that can be produced by this process in a single pass is (mm -- round off to two decimal places) :

- (1) 1.35 (2) 1.25 (3) 1.45 (4) 1.15

13. Consider a linear rectangular thin sheet of metal, subjected to uniform uniaxial tensile stress of 100 MPa along the length direction. Assume plane stress conditions in the plane normal to the thickness. The Young's modulus $E = 200 \text{ MPa}$ and Poisson's ratio $\nu = 0.3$ are given. The principal strains in the plane of the sheet are :

- (1) $(0.5, 0.0)$ (2) $(0.35, -0.15)$ (3) $(0.5, -0.5)$ (4) $(0.5, -0.15)$

14. Sphere 1 with a diameter of 0.1 m is completely enclosed by another sphere 2 of diameter 0.4 m . The view factor F_{12} is :

- (1) 0.25 (2) 0.0625 (3) 1.0 (4) 0.5

15. The state of stress at a point in a component is represented by a Mohr's circle of radius 100 MPa centered at 200 MPa on the normal stress axis. On a plane passing through the same point, the normal stress is 260 MPa . The magnitude of the shear stress on the same plane at the same point is (MPa) :

- (1) 80 (2) 90 (3) 60 (4) 70

16. Endurance limit of a beam subjected to pure bending decreases with :

- (1) Increase in the surface roughness and increase in the size of the beam
 (2) Decrease in the surface roughness and decrease in the size of the beam
 (3) Decrease in the surface roughness and increase in the size of the beam
 (4) Increase in the surface roughness and decrease in the size of the beam

17. Which of the following is the most conservative fatigue failure criterion ?
(1) Soderberg (2) Modified Goodman
(3) ASME Elliptic (4) Gerber
18. Pre-tensioning of a bolted joint is used to :
(1) Strain harden the bolt head (2) Decrease stiffness of the bolted joint
(3) Increase stiffness of the bolted joint (4) Prevent yielding of the thread root
19. For an Oldham coupling used between two shafts, which among the following statements are correct ?
I. Torsional load is transferred along shaft axis.
II. A velocity ratio of 1:2 between shafts is obtained without using gears
III. Bending load is transferred transverse to shaft axis.
IV. Rotation is transferred along shaft axis:
(1) I and II (2) I and IV (3) II and III (4) II and IV
20. A self-aligning ball bearing has a basic dynamic load rating (C_{10} , for 10^6 revolutions) of 35 kN. If the equivalent radial load on the bearing is 45 kN, the expected life (in 10^6 revolutions) is :
(1) Below 0.5 (2) 0.5 to 0.8 (3) 0.8 to 1.0 (4) Above 1.0
21. A point mass is shot vertically up from ground level with a velocity of 4 m/s at time, $t=0$. It loses 20% of its impact velocity after each collision with the ground. Assuming that the acceleration due to gravity is 10 m/s^2 and that air resistance is negligible, the mass stops bouncing and comes to complete rest on the ground after a total time (in seconds) of :
(1) 1 (2) 2 (3) 4 (4) 6
22. In a linearly hardening plastic material. The true stress beyond initial yielding :
(1) Increases linearly with the true strain
(2) Decreases linearly with the true strain
(3) First increases linearly and then decreases linearly with the true strain
(4) Remain constant
23. The spring constant of a helical compression spring DOES NOT depend on :
(1) Coil diameter (2) Material strength
(3) Number of active turns (4) Wire diameter
24. A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
(1) 150 (2) 200 (3) 100 (4) 125

25. 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 :
- (1) 19% (2) 29% (3) 41% (4) 50%
26. One side of a wall is maintained at 400 K and the other at 300 K. The rate of heat transfer through the wall is 1000 W and the surrounding temperature is 25°C. Assuming no generation of heat within the wall, the irreversibility (in W) due to heat transfer through the wall is :
- (1) 274 (2) 248 (3) 360 (4) 244
27. Air in a room is at 35°C and 60% relative humidity (RH). The pressure in the room is 0.1 MPa. The saturation pressure of water at 35°C is 5.63 kPa. The humidity ratio of the air (in grain/kg of dry air) is :
- (1) 21.74 (2) 22.20 (3) 25.17 (4) 20.37
28. Within a boundary layer for a steady incompressible flow, the Bernoulli equation :
- (1) Holds because the flow is steady
 (2) Holds because the flow is incompressible
 (3) Holds because the flow is transitional
 (4) Does not hold because the flow is frictional
29. Which of the following statements regarding a Rankine cycle with reheating are TRUE ?
- (i) increase in average temperature of heat addition
 (ii) reduction in thermal efficiency
 (iii) drier steam at the turbine exit
- (1) Only (i) and (ii) are correct (2) Only (ii) and (iii) are correct
 (3) Only (i) and (iii) are correct (4) (i), (ii) and (iii) are correct
30. A rope-brake dynamometer attached to the crank shaft of an I.C. engine measures a brake power of 10 kW when the speed of rotation of the shaft is 400 rad/s. The shaft torque (in N-m) sensed by the dynamometer is :
- (1) 25 (2) 52 (3) 35 (4) 45
31. An air standard Otto cycle has thermal efficiency of 0.5 and the mean effective pressure of the cycle is 1000 kPa. For air, assume specific heat ratio $\gamma = 1.4$ and specific gas constant $R = 0.287$ kJ/kg.K, If the pressure and temperature at the beginning of the compression stroke are 100 kPa and 300 K, respectively, then the specific net work output of the cycle is (kJ/kg --- round off to two decimal places) :
- (1) 608.6 (2) 908.6 (3) 708.8 (4) 1008.8
32. An idealized centrifugal pump (blade outer radius of 50 mm) consumes 2 kW power while running at 3000 rpm. The entry of the liquid into the pump is axial and exit from the pump is radial with respect to impeller. If the losses are neglected, then the mass flow rate of the liquid through the pump is (kg/s -- round off to two decimal places) :
- (1) 8.106 (2) 7.106 (3) 6.106 (4) 9.106

33. A through hole is drilled in an aluminum alloy plate of 15 mm thickness with a drill bit of diameter 10 mm, at a feed of 0.25 mm/rev and a spindle speed of 1200 rpm. If the specific energy required for cutting this material is 0.7 N.m/mm^3 , the power required for drilling is (W -- round off to two decimal places) :
- (1) 276.9 (2) 274.89 (3) 278.9 (4) 277.89
34. One-dimensional steady state heat conduction takes place through a solid whose cross-sectional area varies linearly in the direction of heat transfer. Assume there is no heat generation in the solid and the thermal conductivity of the material is constant and independent of temperature.
- The temperature distribution in the solid is :
- (1) Quadratic (2) Exponential (3) Logarithmic (4) Linear
35. Which one of the following modifications of the simple ideal Rankine cycle increases the thermal efficiency and reduces the moisture content of the steam at the turbine outlet :
- (1) Decreasing the condenser pressure. (2) Increasing the boiler pressure.
(3) Decreasing the boiler pressure. (4) Increasing the turbine inlet temperature.
36. Water enters a circular pipe of length $L = 5.0 \text{ m}$ and diameter $D = 0.20 \text{ m}$ with Reynolds number $R_{eD} = 500$. The velocity profile at the inlet of the pipe is uniform while it is parabolic at the exit. The Reynolds number at the exit of the pipe is :
- (1) 450 (2) 550 (3) 500 (4) 600
37. Ambient air is at a pressure of 100 kPa, dry bulb temperature of 30°C and 60% relative humidity. The saturation pressure of water at 30°C is 4.24 kPa. The specific humidity of air (in g/kg of dry air) is (correct to two decimal places) :
- (1) 16.24 (2) 17.24 (3) 18.24 (4) 15.24
38. The peak wavelength of radiation emitted by a black body at a temperature of 2000 K is 1.45 μm . If the peak wavelength of emitted radiation changes to 2.90 μm , then the temperature (in K) of the black body is :
- (1) 500 (2) 1000 (3) 4000 (4) 8000
39. Select the correct statement for 50% reaction stage in a steam turbine.
- (1) The rotor blade is symmetric.
(2) The stator blade is symmetric.
(3) The absolute inlet flow angle is equal to absolute exit flow angle.
(4) The absolute exit flow angle is equal to inlet angle of rotor blade.
40. Which one of the following statement is correct for a superheated vapour :
- (1) Its pressure is less than the saturation pressure at a given temperature.
(2) Its temperature is less than the saturation temperature at a given pressure.
(3) Its volume is less than the volume of the saturated vapour at a given temperature.
(4) Its enthalpy is less than enthalpy of the saturated vapour at a given pressure.

41. Which one of the following is NOT a rotating machine ?
(1) Centrifugal pump (2) Gear pump (3) Jet pump (4) Vane pump
42. Saturated steam at 100°C condenses on the outside of a tube. Cold fluid enters the tube at 20°C and exits at 50°C . The value of the Log Mean Temperature Difference (LMTD) is ($^{\circ}\text{C}$).
(1) 55.76 (2) 58.46 (3) 63.82 (4) 69.33
43. For an inline slider-crank mechanism, the lengths of the crank and connecting rod are 3m and 4m, respectively. At the instant when the connecting rod is perpendicular to the crank, if the velocity of the slider is 1m/s, the magnitude of angular velocity (upto 3 decimal points accuracy) of the crank is (radian/s).
(1) 0.222 (2) 0.267 (3) 0.298 (4) 0.316
44. A 10 mm deep cylindrical cup with diameter of 15mm is drawn from circular blank. Neglecting the variation in the sheet thickness, the diameter (upto 2 decimal points accuracy) of the blank is (mm) :
(1) 27.12 (2) 28.72 (3) 29.49 (4) 33.41
45. Air contains 79% N_2 and 21% O_2 on a molar basis. Methane (CH_4) is burned with 50% excess air than required stoichiometrically. Assuming complete combustion of methane, the molar percentage of N_2 in the products is :
(1) 70 (2) 73.8 (3) 75 (4) 79.8
46. Heat and Work are :
(1) Intensive properties (2) Extensive properties
(3) Point functions (4) Path functions
47. The internal energy of an ideal gas is a function of :
(1) Temperature and pressure (2) Volume and pressure
(3) Entropy and pressure (4) Temperature only
48. The Rateau turbine belong to the category of :
(1) Pressure compounded turbine (2) Reaction turbine
(3) Velocity compounded turbine (4) Radial flow turbine
49. A two dimensional fluid element rotates like a rigid body. At a point within the element, the pressure is 1 unit. Radius of the Mohr's circle, characteristics the state of stress at the point is :
(1) 0.5 unit (2) 0 unit (3) 01 unit (4) 2 units
50. For a Newtonian fluid :
(1) Shear stress is proportional to shear strain
(2) Rate of Shear stress is proportional to shear strain
(3) Shear stress is proportional to rate of shear strain
(4) Rate of shear stress is proportional to rate of shear strain

51. Using the Taylors tool life equation with exponent $n = 0.5$,if the cutting speed is reduced by 50% the ratio of new tool life to original tool life is :
- (1) 4 (2) 2 (3) 1 (4) 0.5
52. Interpolator in a CNC machine :
- (1) Controls spindle speed (2) Coordinates axes movements
(3) Operates tool changer (4) Commands canned cycle
53. The non-traditional machining process that essentially requires vacuum is :
- (1) Electron beam machining (2) Electro chemical machining
(3) Electro chemical discharge machining (4) Electro discharge machining
54. A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
- (1) 150 (2) 200 (3) 100 (4) 125
55. Which two of the following joining processes are autogeneous is ?
- (i) Diffusion welding (ii) Electroslog welding
(iii) Tungsten inert gas welding (iv) Friction welding
- (1) (i) and (iv) (2) (ii) and (iii) (3) (ii) and (iv) (4) (i) and (iii)
56. In fill mould (cavity-less) casting process, the pattern is made of :
- (1) Expanded polystyrene (2) Wax
(3) Epoxy (4) Plaster of Paris
57. A single point cutting tool with 0° rake angle is used in an orthogonal machining process. At a cutting speed of 180 m/min. the thrust force is 490 N. If the coefficient of friction between the tool and the chip is 0.7, then the power consumption (in kW) for the machining operation is :
- (1) 3.5 (2) 2.1 (3) 5.6 (4) 7.1
58. A cube and a sphere made or cast iron (each of volume 1000 cm^3) were cast under identical conditions. The time taken for solidifying the cube was 4 s. The solidification time (in s) for the sphere is :
- (1) 6.57355 sec. (2) 7.23455 sec. (3) 5.23455 sec. (4) 2.52355 sec.
59. During a TIG welding process, the arc current and arc voltage were 50 A and 60 V. respectively, when the welding speed was 150 mm/min. In another process, the TIG welding is carried out at a welding speed of 120 mm/min at the same arc voltage and heat input to the material so that weld quality remains the same the welding current (in A) for this process is :
- (1) 40.00 (2) 44.72 (3) 55.90 (4) 62.25

60. The fluidity of molten metal of cast alloys (without any addition of fluxes) increases with increase in :
- (1) Freezing range (2) Surface tension
(3) Degree of superheat (4) Viscosity
61. The most common limit gage used for inspecting the hole diameter is :
- (1) Ring gage (2) Snap gage
(3) Plug gage (4) Master gage
62. A gas tungsten arc welding operation is performed using a current of 250 A and an arc voltage of 20 V at a welding speed of 5 mm/s. Assuming that the arc efficiency is 70%, the net heat input per unit length of the weld will be (kJ/mm - round off to one decimal place).
- (1) 0.7 (2) 0.9 (3) 0.4 (4) 0.3
63. Hardenability of steel is a measure of :
- (1) The ability to harden when it is cold worked
(2) The maximum hardness that can be obtained when it is austenitized and then quenched
(3) The ability to retain its hardness when it is heated to elevated temperatures
(4) The depth to which required hardening is obtained when it is austenitized and then quenched
64. The cold forming process in which a hardened tool is pressed against a work piece (when there is relative motion between the tool and the work piece) to produce a roughened surface with a regular pattern is :
- (1) Strip rolling (2) Knurling (3) Roll forming (4) Chamfering
65. The preferred option for holding an odd-shaped workpiece in a centre lathe is :
- (1) Live and dead centres (2) Three jaw chuck
(3) Lathe dog (4) Four jaw chuck
66. A welding operation is being performed with voltage = 30 V and current = 100 A. The cross-sectional area of the weld bead is 20 mm^2 . The work-piece and filler are of titanium for which the specific energy of melting is 14 J/mm^3 . Assuming a thermal efficiency of the welding process 70%, the welding speed is (in mm/s -- correct to two decimal places) :
- (1) 7.5 (2) 8.5 (3) 9.5 (4) 5.5
67. Feed rate in slab milling operation is equal to :
- (1) Rotation per minute (rpm)
(2) Product of rpm and number of teeth in the cutter
(3) Product of rpm, feed per tooth and number of teeth in the cutter
(4) Product of rpm, feed per tooth and number of teeth in contact

68. During solidification of a pure molten metal, the grains in the casting near the mould wall are :
- (1) Coarse and randomly oriented (2) Fine and randomly oriented
(3) Fine and ordered (4) Coarse and ordered
69. Metal removal in electric discharge machining takes place through :
- (1) Ion displacement (2) Melting and vaporization
(3) Corrosive reaction (4) Plastic shear
70. In a wire-cut EDM process the necessary conditions that have to be met for making a successful cut are that :
- (1) Wire and sample are electrically non-conducting
(2) Wire and sample are electrically conducting
(3) Wire is electrically conducting and sample is electrically non-conducting
(4) Sample is electrically conducting and wire is electrically non-conducting
71. Internal gears are manufactured by :
- (1) Hobbing (2) Shaping with pinion cutter
(3) Shaping with rack cutter (4) Milling
72. For an orthogonal cutting operation, tool material is HSS, rake angle is 22° chip thickness is 0.8 mm, speed is 48 m/min and feed is 0.4 mm/rev. The shear angle (in degrees) is :
- (1) 19.24 (2) 29.70 (3) 56.00 (4) 68.75
73. Chaplets are placed between mould and core surfaces in order :
- (1) Reduce directional solidification (2) Help local alloying of molten metal
(3) Help easy removal of core from casting (4) Prevent core movement due to buoyancy
74. An expandable pattern is used in :
- (1) Slush casting (2) Squeeze casting
(3) Centrifugal casting (4) Investment casting
75. In the manufacture of the twist drills, the shank is joined to the body of the drill using :
- (1) Spot Welding (2) TIG Welding
(3) Projection Welding (4) Friction Welding
76. The annual requirement of rivets at a ship manufacturing company is 2000 kg. The rivets are supplied in units of 1 kg costing Rs. 25 each. If it costs Rs. 100 to place an order and the annual cost of carrying one unit is 9% of its purchase cost, the cycle length of the order (in days) will be :
- (1) 73 (2) 77 (3) 80 (4) 85

77. A manufacturer has the following data regarding a product :
Fixed cost per month = Rs. 50000
Variable cost per unit = Rs. 200
Selling price Per unit = Rs. 300
Production capacity = 1500 units per month
If the production is carried out at 80% of the rated capacity, then the monthly profit (in Rs.) is :
(1) 60,000 (2) 70,000 (3) 57,000 (4) 72,000
78. During the development of a product, an entirely new process plan is made based on design logic, examination of geometry and tolerance information. This type of process planning is known as :
(1) Retrieval (2) Generative
(3) Variant (4) Group technology based
79. Annual demand of a product is 50000 units and the ordering cost is Rs. 7000 per order. Considering the basic economic order quantity model, the economic order quantity is 10000 units. When the annual inventory cost is minimized, the annual inventory holding cost (in Rs.) is :
(1) 35,000 (2) 43,330 (3) 45,000 (4) 65,000
80. The chance of a student passing an exam is 20%. The chance of a student passing the exam and getting above 90% marks in it is 5%. GIVEN that a student passes the examination, the probability that the student gets above 90% marks is :
(1) $1/18$ (2) $1/4$ (3) $2/9$ (4) $5/18$
81. The annual demand of valves per year in a company is 10,000 units. The current order quantity is 400 valves per order. The holding cost is Rs. 24 per valve per year and the ordering cost is Rs. 400 per order. If the current order quantity is changed to Economic Order Quantity, then the saving in the total cost of inventory per year will be (Rs. round off value to two decimal places).
(1) 943.59 (2) 948.59 (3) 940.59 (4) 941.59
82. The probability that a part manufactured by a company will be defective is 0.05. If 15 such parts are selected randomly and inspected, then the probability that at least two parts will be defective is (round off to two decimal places) :
(1) 0.19 (2) 0.17 (3) 0.14 (4) 0.13
83. If x is the mean of data 3, x , 2 and 4, then the mode is :
(1) 4 (2) 2 (3) 3 (4) 0
84. A local tyre distributor expects to sell approximately 9600 steel belted radial tyres next year. Annual carrying cost is Rs. 16 per tyre and ordering cost is Rs. 75. The economic order quantity of the tyres is :
(1) 64 (2) 212 (3) 300 (4) 1200

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85. The time series forecasting method that gives equal weightage to each of the M most recent observation is :
- (1) Moving average method
 - (2) Exponential smoothing with linear trend
 - (3) Triple Exponential smoothing
 - (4) Kalman Filter
86. Four red balls, four green balls and four blue balls are put in a box. Three balls are pulled out of the box at random one after another without replacement. The probability that all the three balls are red is :
- (1) $1/72$
 - (2) $1/55$
 - (3) $1/36$
 - (4) $1/27$
87. At a work station, 05 jobs arrive every minute. The mean time spent on each job in the work station is $1/8$ minute. The mean steady state number of jobs in the system is :
- (1) 1.666
 - (2) 1.888
 - (3) 1.777
 - (4) 1.999
88. The jobs arrive at a facility for a service, in a random manner. The probability distribution of number of arrivals of jobs in a fixed time interval is :
- (1) Normal
 - (2) Poisson
 - (3) Erlang
 - (4) Beta
89. Little's law is a relationship between :
- (1) Stock level and lead time in an inventory system
 - (2) Waiting time and length of queue in a queuing system
 - (3) Number of machines and job due dates in a scheduling problem
 - (4) Uncertainty in the activity time and project completion time
90. For a single server with poisson arrival and exponential service time, the arrival rate is 12 per hour. Which one of the following service rates will provide a steady state finite queue length ?
- (1) 06 per hour
 - (2) 10 per hour
 - (3) 12 per hour
 - (4) 24 per hour
91. In a single channel queuing model, the customer arrival rate is 12 per hour and the serving rate is 24 hour per. The expected time that a customer is in queue is (min) :
- (1) 2.5
 - (2) 3.5
 - (3) 1.5
 - (4) 4.5
92. The word Kanban is most appropriately associated with :
- (1) Economic order quantity
 - (2) Just in time production
 - (3) Capacity planning
 - (4) Product Design
93. A company uses 2555 units of an item annually. Delivery lead time is 08 days. The recorder point (in number of units) to achieve optimum inventory is :
- (1) 07
 - (2) 08
 - (3) 56
 - (4) 60

94. The supply at three sources is 50, 40 & 60 units respectively while the demand at four destination is 20, 30, 10 & 50 units. In solving this transportation problem :
- (1) A dummy source of capacity 40 units is needed
 - (2) A dummy destination of capacity 40 units is needed
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95. Which one of the following is NOT a decision taken during the aggregate production planning stage ?
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 - (4) Exponential smoothing method
98. The time series forecasting method that gives equal weightage to each of the m most recent observations is :
- (1) Moving average method
 - (2) Exponential smoothing with linear trend
 - (3) Triple Exponential smoothing
 - (4) Kalman Filter
99. Two models, P and Q, of a product earn profits of Rs. 100 and Rs. 80 per piece, respectively. Production times for P and Q are 5 hours and 3 hours, respectively, while the total production time available is 150 hours. For a total batch size of 40, to maximize profit, the number of units of P to be produced is :
- (1) 12
 - (2) 15
 - (3) 18
 - (4) 20
100. In a company with 100 employees, 45 earn Rs. 20,000 per month, 25 earn Rs. 30,000, 20 earn Rs. 40,000, 8 earn Rs. 60,000, and 2 earn Rs. 150,000. The median of the salaries is :
- (1) Rs. 20,000
 - (2) Rs.30,000
 - (3) Rs. 32,300
 - (4) Rs. 40,000

Total No. of Printed Pages : 13

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B

SET-Z

M.Phil./Ph.D./URS-EE-2019

SUBJECT : Mechanical Engineering

Sr. No. 10026

Time : 1¼ Hours

Max. Marks : 100

Total Questions : 100

Roll No. (in figures) _____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

(Signature of the Candidate)

(Signature of the Invigilator)

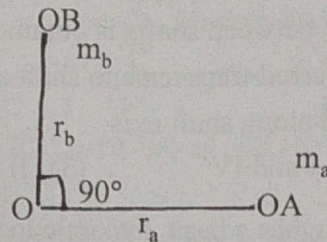
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- The candidate **must not** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers **must not** be ticked in the question booklet.
- There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
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MPH/PHD/URS-EE-2019/(Mech. Engg.)(SET-Z)/(B)

SEAL

1. Two masses A and B having mass m_a and m_b , respectively, lying in the plane of the figure shown, are rigidly attached to a shaft which revolves about an axis through O perpendicular to the figure. The radii of rotation of the masses m_a and m_b are r_a and r_b respectively. The angle between lines OA and OB is 90° . If $m_a = 10$ kg, $m_b = 20$ kg, $r_a = 200$ mm and $r_b = 400$ mm, then the balance mass to be placed at a radius of 200 mm is (kg --- round off to two decimal places) :
- (1) 41.23 (2) 42.23 (3) 40.23 (4) 43.23



2. The thickness of a sheet is reduced by rolling (without any change in width) using 600 mm diameter rolls. Neglect elastic deflection of the rolls and assume that the coefficient of friction at the roll-work piece interface is 0.05. The sheet enters the rotating rolls unaided. If the initial sheet thickness is 2 mm, the minimum possible final thickness that can be produced by this process in a single pass is (mm -- round off to two decimal places) :
- (1) 1.35 (2) 1.25 (3) 1.45 (4) 1.15
3. Consider a linear rectangular thin sheet of metal, subjected to uniform uniaxial tensile stress of 100 MPa along the length direction. Assume plane stress conditions in the plane normal to the thickness. The Young's modulus $E = 200$ MPa and Poisson's ratio $\nu = 0.3$ are given. The principal strains in the plane of the sheet are :
- (1) (0.5, 0.0) (2) (0.35, -0.15) (3) (0.5, -0.5) (4) (0.5, -0.15)
4. Sphere 1 with a diameter of 0.1 m is completely enclosed by another sphere 2 of diameter 0.4 m. The view factor F_{12} is :
- (1) 0.25 (2) 0.0625 (3) 1.0 (4) 0.5
5. The state of stress at a point in a component is represented by a Mohr's circle of radius 100 MPa centered at 200 MPa on the normal stress axis. On a plane passing through the same point, the normal stress is 260 MPa. The magnitude of the shear stress on the same plane at the same point is (MPa) :
- (1) 80 (2) 90 (3) 60 (4) 70
6. Endurance limit of a beam subjected to pure bending decreases with :
- (1) Increase in the surface roughness and increase in the size of the beam
 (2) Decrease in the surface roughness and decrease in the size of the beam
 (3) Decrease in the surface roughness and increase in the size of the beam
 (4) Increase in the surface roughness and decrease in the size of the beam
7. Which of the following is the most conservative fatigue failure criterion ?
- (1) Soderberg (2) Modified Goodman
 (3) ASME Elliptic (4) Gerber

8. Pre-tensioning of a bolted joint is used to :
- (1) Strain harden the bolt head (2) Decrease stiffness of the bolted joint
 (3) Increase stiffness of the bolted joint (4) Prevent yielding of the thread root
9. For an Oldham coupling used between two shafts, which among the following statements are correct ?
- I. Torsional load is transferred along shaft axis.
 II. A velocity ratio of 1:2 between shafts is obtained without using gears
 III. Bending load is transferred transverse to shaft axis.
 IV. Rotation is transferred along shaft axis:
- (1) I and II (2) I and IV (3) II and III (4) II and IV
10. A self-aligning ball bearing has a basic dynamic load rating (C_{10} , for 10^6 revolutions) of 35 kN. If the equivalent radial load on the bearing is 45 kN, the expected life (in 10^6 revolutions) is :
- (1) Below 0.5 (2) 0.5 to 0.8 (3) 0.8 to 1.0 (4) Above 1.0
11. In a single channel queuing model, the customer arrival rate is 12 per hour and the serving rate is 24 hour per. The expected time that a customer is in queue is (min) :
- (1) 2.5 (2) 3.5 (3) 1.5 (4) 4.5
12. The word Kanban is most appropriately associated with :
- (1) Economic order quantity (2) Just in time production
 (3) Capacity planning (4) Product Design
13. A company uses 2555 units of an item annually. Delivery lead time is 08 days. The reorder point (in number of units) to achieve optimum inventory is :
- (1) 07 (2) 08 (3) 56 (4) 60
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B

16. Production flow analysis (PFA) is a method of identifying part families that uses data from :
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- (1) 12 (2) 15 (3) 18 (4) 20
20. In a company with 100 employees, 45 earn Rs. 20,000 per month, 25 earn Rs. 30,000, 20 earn Rs. 40,000, 8 earn Rs. 60,000, and 2 earn Rs. 150,000. The median of the salaries is :
- (1) Rs. 20,000 (2) Rs. 30,000 (3) Rs. 32,300 (4) Rs. 40,000
21. Internal gears are manufactured by :
- (1) Hobbing (2) Shaping with pinion cutter
(3) Shaping with rack cutter (4) Milling
22. For an orthogonal cutting operation, tool material is HSS, rake angle is 22° chip thickness is 0.8 mm, speed is 48 m/min and feed is 0.4 mm/rev. The shear angle (in degrees) is :
- (1) 19.24 (2) 29.70 (3) 56.00 (4) 68.75
23. Chaplets are placed between mould and core surfaces in order :
- (1) Reduce directional solidification (2) Help local alloying of molten metal
(3) Help easy removal of core from casting (4) Prevent core movement due to buoyancy
24. An expandable pattern is used in :
- (1) Slush casting (2) Squeeze casting
(3) Centrifugal casting (4) Investment casting

25. In the manufacture of the twist drills, the shank is joined to the body of the drill using :
- (1) Spot Welding (2) TIG Welding
(3) Projection Welding (4) Friction Welding
26. The annual requirement of rivets at a ship manufacturing company is 2000 kg. The rivets are supplied in units of 1 kg costing Rs. 25 each. If it costs Rs. 100 to place an order and the annual cost of carrying one unit is 9% of its purchase cost, the cycle length of the order (in days) will be :
- (1) 73 (2) 77 (3) 80 (4) 85
27. A manufacturer has the following data regarding a product :
- Fixed cost per month = Rs. 50000
Variable cost per unit = Rs. 200
Selling price Per unit = Rs. 300
Production capacity = 1500 units per month
If the production is carried out at 80% of the rated capacity, then the monthly profit (in Rs.) is :
- (1) 60,000 (2) 70,000 (3) 57,000 (4) 72,000
28. During the development of a product, an entirely new process plan is made based on design logic, examination of geometry and tolerance information. This type of process planning is known as :
- (1) Retrieval (2) Generative
(3) Variant (4) Group technology based
29. Annual demand of a product is 50000 units and the ordering cost is Rs. 7000 per order. Considering the basic economic order quantity model, the economic order quantity is 10000 units. When the annual inventory cost is minimized, the annual inventory holding cost (in Rs.) is :
- (1) 35,000 (2) 43,330 (3) 45,000 (4) 65,000
30. The chance of a student passing an exam is 20%. The chance of a student passing the exam and getting above 90% marks in it is 5%. GIVEN that a student passes the examination, the probability that the student gets above 90% marks is :
- (1) 1/18 (2) 1/4 (3) 2/9 (4) 5/18
31. Using the Taylors tool life equation with exponent $n = 0.5$, if the cutting speed is reduced by 50% the ratio of new tool life to original tool life is :
- (1) 4 (2) 2 (3) 1 (4) 0.5
32. Interpolator in a CNC machine :
- (1) Controls spindle speed (2) Coordinates axes movements
(3) Operates tool changer (4) Commands canned cycle

33. The non-traditional machining process that essentially requires vacuum is :
- (1) Electron beam machining (2) Electro chemical machining
(3) Electro chemical discharge machining (4) Electro discharge machining
34. A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
- (1) 150 (2) 200 (3) 100 (4) 125
35. Which two of the following joining processes are autogeneous is ?
- (i) Diffusion welding (ii) Electroslag welding
(iii) Tungsten inert gas welding (iv) Friction welding
- (1) (i) and (iv) (2) (ii) and (iii) (3) (ii) and (iv) (4) (i) and (iii)
36. In fill mould (cavity-less) casting process, the pattern is made of :
- (1) Expanded polystyrene (2) Wax
(3) Epoxy (4) Plaster of Paris
37. A single point cutting tool with 0° rake angle is used in an orthogonal machining process. At a cutting speed of 180 m/min. the thrust force is 490 N. If the coefficient of friction between the tool and the chip is 0.7, then the power consumption (in kW) for the machining operation is :
- (1) 3.5 (2) 2.1 (3) 5.6 (4) 7.1
38. A cube and a sphere made or cast iron (each of volume 1000 cm^3) were cast under identical conditions. The time taken for solidifying the cube was 4 s. The solidification time (in s) for the sphere is :
- (1) 6.57355 sec. (2) 7.23455 sec. (3) 5.23455 sec. (4) 2.52355 sec.
39. During a TIG welding process, the arc current and arc voltage were 50 A and 60 V. respectively, when the welding speed was 150 mm/min. In another process, the TIG welding is carried out at a welding speed of 120 mm/min at the same arc voltage and heat input to the material so that weld quality remains the same the welding current (in A) for this process is :
- (1) 40.00 (2) 44.72 (3) 55.90 (4) 62.25
40. The fluidity of molten metal of cast alloys (without any addition of fluxes) increases with increase in :
- (1) Freezing range (2) Surface tension
(3) Degree of superheat (4) Viscosity

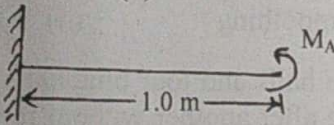
41. An air standard Otto cycle has thermal efficiency of 0.5 and the mean effective pressure of the cycle is 1000 kPa. For air, assume specific heat ratio $\gamma = 1.4$ and specific gas constant $R = 0.287$ kJ/kg.K. If the pressure and temperature at the beginning of the compression stroke are 100 kPa and 300 K, respectively, then the specific net work output of the cycle is (kJ/kg --- round off to two decimal places) :
- (1) 608.6 (2) 908.6 (3) 708.8 (4) 1008.8
42. An idealized centrifugal pump (blade outer radius of 50 mm) consumes 2 kW power while running at 3000 rpm. The entry of the liquid into the pump is axial and exit from the pump is radial with respect to impeller. If the losses are neglected, then the mass flow rate of the liquid through the pump is (kg/s -- round off to two decimal places) :
- (1) 8.106 (2) 7.106 (3) 6.106 (4) 9.106
43. A through hole is drilled in an aluminum alloy plate of 15 mm thickness with a drill bit of diameter 10 mm, at a feed of 0.25 mm/rev and a spindle speed of 1200 rpm. If the specific energy required for cutting this material is 0.7 N.m/mm^3 , the power required for drilling is (W -- round off to two decimal places) :
- (1) 276.9 (2) 274.89 (3) 278.9 (4) 277.89
44. One-dimensional steady state heat conduction takes place through a solid whose cross-sectional area varies linearly in the direction of heat transfer. Assume there is no heat generation in the solid and the thermal conductivity of the material is constant and independent of temperature.
- The temperature distribution in the solid is :
- (1) Quadratic (2) Exponential (3) Logarithmic (4) Linear
45. Which one of the following modifications of the simple ideal Rankine cycle increases the thermal efficiency and reduces the moisture content of the steam at the turbine outlet :
- (1) Decreasing the condenser pressure. (2) Increasing the boiler pressure.
 (3) Decreasing the boiler pressure. (4) Increasing the turbine inlet temperature.
46. Water enters a circular pipe of length $L = 5.0$ m and diameter $D = 0.20$ m with Reynolds number $Re_D = 500$. The velocity profile at the inlet of the pipe is uniform while it is parabolic at the exit. The Reynolds number at the exit of the pipe is :
- (1) 450 (2) 550 (3) 500 (4) 600
47. Ambient air is at a pressure of 100 kPa, dry bulb temperature of 30°C and 60% relative humidity. The saturation pressure of water at 30°C is 4.24 kPa. The specific humidity of air (in g/kg of dry air) is (correct to two decimal places) :
- (1) 16.24 (2) 17.24 (3) 18.24 (4) 15.24

48. The peak wavelength of radiation emitted by a black body at a temperature of 2000 K is 1.45 μm . If the peak wavelength of emitted radiation changes to 2.90 μm , then the temperature (in K) of the black body is :
- (1) 500 (2) 1000 (3) 4000 (4) 8000
49. Select the correct statement for 50% reaction stage in a steam turbine.
- (1) The rotor blade is symmetric.
(2) The stator blade is symmetric.
(3) The absolute inlet flow angle is equal to absolute exit flow angle.
(4) The absolute exit flow angle is equal to inlet angle of rotor blade.
50. Which one of the following statement is correct for a superheated vapour :
- (1) Its pressure is less than the saturation pressure at a given temperature.
(2) Its temperature is less than the saturation temperature at a given pressure.
(3) Its volume is less than the volume of the saturated vapour at a given temperature.
(4) Its enthalpy is less than enthalpy of the saturated vapour at a given pressure.
51. A point mass is shot vertically up from ground level with a velocity of 4 m/s at time, $t=0$. It loses 20% of its impact velocity after each collision with the ground. Assuming that the acceleration due to gravity is 10 m/s^2 and that air resistance is negligible, the mass stops bouncing and comes to complete rest on the ground after a total time (in seconds) of :
- (1) 1 (2) 2 (3) 4 (4) 6
52. In a linearly hardening plastic material. The true stress beyond initial yielding :
- (1) Increases linearly with the true strain
(2) Decreases linearly with the true strain
(3) First increases linearly and then decreases linearly with the true strain
(4) Remain constant
53. The spring constant of a helical compression spring DOES NOT depend on :
- (1) Coil diameter (2) Material strength
(3) Number of active turns (4) Wire diameter
54. A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
- (1) 150 (2) 200 (3) 100 (4) 125
55. 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 :
- (1) 19% (2) 29% (3) 41% (4) 50%

56. One side of a wall is maintained at 400 K and the other at 300 K. The rate of heat transfer through the wall is 1000 W and the surrounding temperature is 25°C. Assuming no generation of heat within the wall, the irreversibility (in W) due to heat transfer through the wall is :
- (1) 274 (2) 248 (3) 360 (4) 244
57. Air in a room is at 35°C and 60% relative humidity (RH) The pressure in the room is 0.1 MPa The saturation pressure of water at 35°C is 5.63 kPa. The humidity ratio of the air (in grain/kg of dry air) is :
- (1) 21.74 (2) 22.20 (3) 25.17 (4) 20.37
58. Within a boundary layer for a steady incompressible flow, the Bernoulli equation :
- (1) Holds because the flow is steady
 (2) Holds because the flow is incompressible
 (3) Holds because the flow is transitional
 (4) Does not hold because the flow is frictional
59. Which of the following statements regarding a Rankine cycle with reheating are TRUE ?
- (i) increase in average temperature of heat addition
 (ii) reduction in thermal efficiency
 (iii) drier steam at the turbine exit
- (1) Only (i) and (ii) are correct (2) Only (ii) and (iii) are correct
 (3) Only (i) and (iii) are correct (4) (i), (ii) and (iii) are correct
60. A rope-brake dynamometer attached to the crank shaft of an I.C. engine measures a brake power of 10 kW when the speed of rotation of the shaft is 400 rad/s. The shaft torque (in N-m) sensed by the dynamometer is :
- (1) 25 (2) 52 (3) 35 (4) 45
61. Which one of the following is NOT a rotating machine ?
- (1) Centrifugal pump (2) Gear pump (3) Jet pump (4) Vane pump
62. Saturated steam at 100°C condenses on the outside of a tube. Cold fluid enters the tube at 20°C and exists at 50°C. The value of the Log Mean Temperature Difference (LMTD) is (°C).
- (1) 55.76 (2) 58.46 (3) 63.82 (4) 69.33
63. For an inline slider-crank mechanism, the lengths of the crank and connecting rod are 3m and 4m, respectively. At the instant when the connecting rod is perpendicular to the crank, if the velocity of the slider is 1m/s, the magnitude of angular velocity (upto 3 decimal points accuracy) of the crank is (radian/s).
- (1) 0.222 (2) 0.267 (3) 0.298 (4) 0.316
64. A 10 mm deep cylindrical cup with diameter of 15mm is drawn from circular blank. Neglecting the variation in the sheet thickness, the diameter (upto 2 decimal points accuracy) of the blank is (mm) :
- (1) 27.12 (2) 28.72 (3) 29.49 (4) 33.41

65. Air contains 79% N_2 and 21% O_2 on a molar basis. Methane (CH_4) is burned with 50% excess air than required stoichiometrically. Assuming complete combustion of methane, the molar percentage of N_2 in the products is :
- (1) 70 (2) 73.8 (3) 75 (4) 79.8
66. Heat and Work are :
- (1) Intensive properties (2) Extensive properties
(3) Point functions (4) Path functions
67. The internal energy of an ideal gas is a function of :
- (1) Temperature and pressure (2) Volume and pressure
(3) Entropy and pressure (4) Temperature only
68. The Rateau turbine belong to the category of :
- (1) Pressure compounded turbine (2) Reaction turbine
(3) Velocity compounded turbine (4) Radial flow turbine
69. A two dimensional fluid element rotates like a rigid body. At a point with in the element, the pressure is 1 unit. Radius of the Mohr's circle, characteristics the state of stress at the point is :
- (1) 0.5 unit (2) 0 unit (3) 01 unit (4) 2 units
70. For a Newtonian fluid :
- (1) Shear stress is proportional to shear strain
(2) Rate of Shear stress is proportional to shear strain
(3) Shear stress is proportional to rate of shear strain
(4) Rate of shear stress is proportional to rate of shear strain
71. The most common limit gage used for inspecting the hole diameter is :
- (1) Ring gage (2) Snap gage
(3) Plug gage (4) Master gage
72. A gas tungsten arc welding operation is performed using a current of 250 A and an arc voltage of 20 V at a welding speed of 5 mm/s. Assuming that the arc efficiency is 70%, the net heat input per unit length of the weld will be (kJ/mm -round off to one decimal place).
- (1) 0.7 (2) 0.9 (3) 0.4 (4) 0:3
73. Hardenability of steel is a measure of :
- (1) The ability to harden when it is cold worked
(2) The maximum hardness that can be obtained when it is austenitized and then quenched
(3) The ability to retain its hardness when it is heated to elevated temperatures
(4) The depth to which required hardening is obtained when it is austenitized and then quenched

74. The cold forming process in which a hardened tool is pressed against a work piece (when there is relative motion between the tool and the work piece) to produce a roughened surface with a regular pattern is :
 (1) Strip rolling (2) Knurling (3) Roll forming (4) Chamfering
75. The preferred option for holding an odd-shaped workpiece in a centre lathe is :
 (1) Live and dead centres (2) Three jaw chuck
 (3) Lathe dog (4) Four jaw chuck
76. A welding operation is being performed with voltage = 30 V and current = 100 A. The cross-sectional area of the weld bead is 20 mm^2 . The work-piece and filler are of titanium for which the specific energy of melting is 14 J/mm^3 . Assuming a thermal efficiency of the welding process 70%, the welding speed is (in mm/s -- correct to two decimal places) :
 (1) 7.5 (2) 8.5 (3) 9.5 (4) 5.5
77. Feed rate in slab milling operation is equal to :
 (1) Rotation per minute (rpm)
 (2) Product of rpm and number of teeth in the cutter
 (3) Product of rpm, feed per tooth and number of teeth in the cutter
 (4) Product of rpm, feed per tooth and number of teeth in contact
78. During solidification of a pure molten metal, the grains in the casting near the mould wall are :
 (1) Coarse and randomly oriented (2) Fine and randomly oriented
 (3) Fine and ordered (4) Coarse and ordered
79. Metal removal in electric discharge machining takes place through :
 (1) Ion displacement (2) Melting and vaporization
 (3) Corrosive reaction (4) Plastic shear
80. In a wire-cut EDM process the necessary conditions that have to be met for making a successful cut are that :
 (1) Wire and sample are electrically non-conducting
 (2) Wire and sample are electrically conducting
 (3) Wire is electrically conducting and sample is electrically non-conducting
 (4) Sample is electrically conducting and wire is electrically non-conducting
81. A cylindrical tank with closed ends is filled with compressed air at a pressure of 500 kPa. The inner radius of the tank is 2 m. and it has wall thickness of 10 mm. The magnitude of maximum in-plane shear stress (in MPa) is :
 (1) 22 (2) 24 (3) 25 (4) 29
82. In a machining operation, if the generatrix and directrix both are straight lines, the surface obtained is :
 (1) Cylindrical (2) Helical (3) Plane (4) Surface of revolution

83. A single-degree-freedom spring-mass system is subjected to a sinusoidal force of 10 N amplitude and frequency ω along the axis of the spring. The stiffness of the spring is 150 N/m, damping factor is 0.2 and the undamped natural frequency is 10ω . At steady state, the amplitude of vibration (in m) is approximately:
- (1) 0.05 (2) 0.07 (3) 0.70 (4) 0.90
84. A hollow shaft of 1 m length is designed to transmit a power of 30 kW at 700 rpm. The maximum permissible angle of twist in the shaft is 1° . The inner diameter of the shaft is 0.7 times the outer diameter. The modulus of rigidity is 80 GPa. The outside diameter (in mm) of the shaft is :
- (1) 44.5212 mm (2) 54.5212 mm (3) 64.5212 mm (4) 48.5212 mm
85. The atomic packing factor for a material with body centered cubic structure is :
- (1) 0.68 (2) 0.53 (3) 0.89 (4) 0.87
86. A horizontal cantilever beam of circular cross-section, length 10 m and flexural rigidity $EI = 200 \text{ N.m}^2$ is subjected to an applied moment $M_A = 1.0 \text{ N-m}$ at the free end as shown in the figure. The magnitude of the vertical deflection of the free end is (mm --- round off to one decimal place) :
- (1) 2.5 (2) 1.5 (3) 3.5 (4) 0.5
- 
87. A wire of circular cross-section of diameter 1.0 mm is bent into a circular arc of radius 1.0 mm by application of pure bending moments at its ends. The Young's modulus of the material of the wire is 100 GPa. The maximum tensile stress developed in the wire is (MPa) :
- (1) 60 (2) 70 (3) 50 (4) 55
88. A small ball of mass 1 kg moving with a velocity of 12 m/s undergoes a direct central impact with a stationary ball of mass 2 kg. The impact is perfectly elastic. The speed (in m/s) of 2 kg mass ball after the impact will be :
- (1) 4 (2) 8 (3) 6 (4) 2
89. A gas is stored in a cylindrical tank of inner radius 7 in and wall thickness 50 mm. The gage pressure of the gas is 2 MPa. The maximum shear stress (in MPa) in the wall is:
- (1) 35 (2) 70 (3) 140 (4) 280
90. In a spring-mass system, the mass is m and the spring constant is k . The critical damping coefficient of the system is 0.1 kg/s. In another spring-mass system, the mass is $2m$ and the spring constant is $8k$. The critical damping coefficient (in kg/s) of this system is :
- (1) 0.6 (2) 0.3 (3) 0.4 (4) 0.8

91. The annual demand of valves per year in a company is 10,000 units. The current order quantity is 400 valves per order. The holding cost is Rs. 24 per valve per year and the ordering cost is Rs. 400 per order. If the current order quantity is changed to Economic Order Quantity, then the saving in the total cost of inventory per year will be (Rs. round off value to two decimal places).
- (1) 943.59 (2) 948.59 (3) 940.59 (4) 941.59
92. The probability that a part manufactured by a company will be defective is 0.05. If 15 such parts are selected randomly and inspected, then the probability that at least two parts will be defective is (round off to two decimal places) :
- (1) 0.19 (2) 0.17 (3) 0.14 (4) 0.13
93. If x is the mean of data 3, x , 2 and 4, then the mode is :
- (1) 4 (2) 2 (3) 3 (4) 0
94. A local tyre distributor expects to sell approximately 9600 steel belted radial tyres next year. Annual carrying cost in Rs. 16 per tyre and ordering cost is Rs. 75. The economic order quantity of the tyres is :
- (1) 64 (2) 212 (3) 300 (4) 1200
95. The time series forecasting method that gives equal weightage to each of the M most recent observation is :
- (1) Moving average method (2) Exponential smoothing with linear trend
(3) Triple Exponential smoothing (4) Kalman Filter
96. Four red balls, four green balls and four blue balls are put in a box. Three balls are pulled out of the box at random one after another without replacement. The probability that all the three balls are red is :
- (1) $1/72$ (2) $1/55$ (3) $1/36$ (4) $1/27$
97. At a work station, 05 jobs arrive every minute. The mean time spent on each job in the work station is $1/8$ minute. The mean steady state number of jobs in the system is :
- (1) 1.666 (2) 1.888 (3) 1.777 (4) 1.999
98. The jobs arrive at a facility for a service, in a random manner. The probability distribution of number of arrivals of jobs in a fixed time interval is :
- (1) Normal (2) Poisson (3) Erlang (4) Beta
99. Little's law is a relationship between :
- (1) Stock level and lead time in an inventory system
(2) Waiting time and length of queue in a queuing system
(3) Number of machines and job due dates in a scheduling problem
(4) Uncertainty in the activity time and project completion time
100. For a single server with poisson arrival and exponential service time, the arrival rate is 12 per hour. Which one of the following service rates will provide a steady state finite queue length ?
- (1) 06 per hour (2) 10 per hour (3) 12 per hour (4) 24 per hour

Total No. of Printed Pages : 13

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C

SET-Z

M.Phil./Ph.D./URS-EE-2019

SUBJECT : Mechanical Engineering

Sr. No. 10027

Time : 1¼ Hours

Max. Marks : 100

Total Questions : 100

Roll No. (in figures) _____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

(Signature of the Candidate)

(Signature of the Invigilator)

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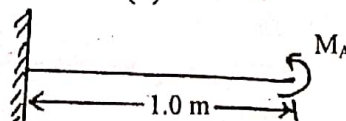
MPH/PHD/URS-EE-2019/(Mech. Engg.)(SET-Z)/(C)

C

1. Which one of the following is NOT a rotating machine ?
 (1) Centrifugal pump (2) Gear pump (3) Jet pump (4) Vane pump
2. Saturated steam at 100°C condenses on the outside of a tube. Cold fluid enters the tube at 20°C and exists at 50°C . The value of the Log Mean Temperature Difference (LMTD) is ($^{\circ}\text{C}$).
 (1) 55.76 (2) 58.46 (3) 63.82 (4) 69.33
3. For an inline slider-crank mechanism, the lengths of the crank and connecting rod are 3m and 4m, respectively. At the instant when the connecting rod is perpendicular to the crank, if the velocity of the slider is 1m/s, the magnitude of angular velocity (upto 3 decimal points accuracy) of the crank is (radian/s).
 (1) 0.222 (2) 0.267 (3) 0.298 (4) 0.316
4. A 10 mm deep cylindrical cup with diameter of 15mm is drawn from circular blank. Neglecting the variation in the sheet thickness, the diameter (upto 2 decimal points accuracy) of the blank is (mm) :
 (1) 27.12 (2) 28.72 (3) 29.49 (4) 33.41
5. Air contains 79% N_2 and 21% O_2 on a molar basis. Methane (CH_4) is burned with 50% excess air than required stoichiometrically. Assuming complete combustion of methane, the molar percentage of N_2 in the products is :
 (1) 70 (2) 73.8 (3) 75 (4) 79.8
6. Heat and Work are :
 (1) Intensive properties (2) Extensive properties
 (3) Point functions (4) Path functions
7. The internal energy of an ideal gas is a function of :
 (1) Temperature and pressure (2) Volume and pressure
 (3) Entropy and pressure (4) Temperature only
8. The Rateau turbine belong to the category of :
 (1) Pressure compounded turbine (2) Reaction turbine
 (3) Velocity compounded turbine (4) Radial flow turbine
9. A two dimensional fluid element rotates like a rigid body. At a point within the element, the pressure is 1 unit. Radius of the Mohr's circle, characteristics the state of stress at the point is :
 (1) 0.5 unit (2) 0 unit (3) 01 unit (4) 2 units
10. For a Newtonian fluid :
 (1) Shear stress is proportional to shear strain
 (2) Rate of Shear stress is proportional to shear strain
 (3) Shear stress is proportional to rate of shear strain
 (4) Rate of shear stress is proportional to rate of shear strain

11. A point mass is shot vertically up from ground level with a velocity of 4 m/s at time, $t=0$. It loses 20% of its impact velocity after each collision with the ground. Assuming that the acceleration due to gravity is 10 m/s^2 and that air resistance is negligible, the mass stops bouncing and comes to complete rest on the ground after a total time (in seconds) of :
- (1) 1 (2) 2 (3) 4 (4) 6
12. In a linearly hardening plastic material. The true stress beyond initial yielding :
- (1) Increases linearly with the true strain
(2) Decreases linearly with the true strain
(3) First increases linearly and then decreases linearly with the true strain
(4) Remain constant
13. The spring constant of a helical compression spring DOES NOT depend on :
- (1) Coil diameter (2) Material strength
(3) Number of active turns (4) Wire diameter
14. A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
- (1) 150 (2) 200 (3) 100 (4) 125
15. 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 :
- (1) 19% (2) 29% (3) 41% (4) 50%
16. One side of a wall is maintained at 400 K and the other at 300 K. The rate of heat transfer through the wall is 1000 W and the surrounding temperature is 25°C . Assuming no generation of heat within the wall, the irreversibility (in W) due to heat transfer through the wall is :
- (1) 274 (2) 248 (3) 360 (4) 244
17. Air in a room is at 35°C and 60% relative humidity (RH) The pressure in the room is 0.1 MPa The saturation pressure of water at 35°C is 5.63 kPa. The humidity ratio of the air (in grain/kg of dry air) is :
- (1) 21.74 (2) 22.20 (3) 25.17 (4) 20.37
18. Within a boundary layer for a steady incompressible flow, the Bernoulli equation :
- (1) Holds because the flow is steady
(2) Holds because the flow is incompressible
(3) Holds because the flow is transitional
(4) Does not hold because the flow is frictional

19. Which of the following statements regarding a Rankine cycle with reheating are TRUE ?
 (i) increase in average temperature of heat addition
 (ii) reduction in thermal efficiency
 (iii) drier steam at the turbine exit
 (1) Only (i) and (ii) are correct (2) Only (ii) and (iii) are correct
 (3) Only (i) and (iii) are correct (4) (i), (ii) and (iii) are correct
20. A rope-brake dynamometer attached to the crank shaft of an I.C. engine measures a brake power of 10 kW when the speed of rotation of the shaft is 400 rad/s. The shaft torque (in N-m) sensed by the dynamometer is :
 (1) 25 (2) 52 (3) 35 (4) 45
21. A cylindrical tank with closed ends is filled with compressed air at a pressure of 500 kPa. The inner radius of the tank is 2 m, and it has wall thickness of 10 mm. The magnitude of maximum in-plane shear stress (in MPa) is :
 (1) 22 (2) 24 (3) 25 (4) 29
22. In a machining operation, if the generatrix and directrix both are straight lines, the surface obtained is :
 (1) Cylindrical (2) Helical (3) Plane (4) Surface of revolution
23. A single-degree-of-freedom spring-mass system is subjected to a sinusoidal force of 10 N amplitude and frequency w along the axis of the spring. The stiffness of the spring is 150 N/m, damping factor is 0.2 and the undamped natural frequency is $10w$. At steady state, the amplitude of vibration (in m) is approximately:
 (1) 0.05 (2) 0.07 (3) 0.70 (4) 0.90
24. A hollow shaft of 1 m length is designed to transmit a power of 30 kW at 700 rpm. The maximum permissible angle of twist in the shaft is 1° . The inner diameter of the shaft is 0.7 times the outer diameter. The modulus of rigidity is 80 GPa. The outside diameter (in mm) of the shaft is :
 (1) 44.5212 mm (2) 54.5212 mm (3) 64.5212 mm (4) 48.5212 mm
25. The atomic packing factor for a material with body centered cubic structure is :
 (1) 0.68 (2) 0.53 (3) 0.89 (4) 0.87
26. A horizontal cantilever beam of circular cross-section, length 10 m and flexural rigidity $EI = 200 \text{ N.m}^2$ is subjected to an applied moment $M_A = 1.0 \text{ N-m}$ at the free end as shown in the figure. The magnitude of the vertical deflection of the free end is (mm --- round off to one decimal place) :
 (1) 2.5 (2) 1.5 (3) 3.5 (4) 0.5



27. A wire of circular cross-section of diameter 1.0 mm is bent into a circular arc of radius 1.0 mm by application of pure bending moments at its ends. The Young's modulus of the material of the wire is 100 GPa. The maximum tensile stress developed in the wire is (MPa) :
- (1) 60 (2) 70 (3) 50 (4) 55
28. A small ball of mass 1 kg moving with a velocity of 12 m/s undergoes a direct central impact with a stationary ball of mass 2 kg. The impact is perfectly elastic. The speed (in m/s) of 2 kg mass ball after the impact will be :
- (1) 4 (2) 8 (3) 6 (4) 2
29. A gas is stored in a cylindrical tank of inner radius 7 in and wall thickness 50 mm. The gage pressure of the gas is 2 MPa. The maximum shear stress (in MPa) in the wall is:
- (1) 35 (2) 70 (3) 140 (4) 280
30. In a spring-mass system, the mass is m and the spring constant is k . The critical damping coefficient of the system is 0.1 kg/s. In another spring-mass system, the mass is $2m$ and the spring constant is $8k$. The critical damping coefficient (in kg/s) of this system is :
- (1) 0.6 (2) 0.3 (3) 0.4 (4) 0.8
31. In a single channel queuing model, the customer arrival rate is 12 per hour and the serving rate is 24 per hour. The expected time that a customer is in queue is (min) :
- (1) 2.5 (2) 3.5 (3) 1.5 (4) 4.5
32. The word Kanban is most appropriately associated with :
- (1) Economic order quantity (2) Just in time production
(3) Capacity planning (4) Product Design
33. A company uses 2555 units of an item annually. Delivery lead time is 08 days. The reorder point (in number of units) to achieve optimum inventory is :
- (1) 07 (2) 08 (3) 56 (4) 60
34. The supply at three sources is 50, 40 & 60 units respectively while the demand at four destination is 20, 30, 10 & 50 units. In solving this transportation problem :
- (1) A dummy source of capacity 40 units is needed
(2) A dummy destination of capacity 40 units is needed
(3) No solution exists as the problem is infeasible
(4) No solution exists as the problem is degenerate
35. Which one of the following is NOT a decision taken during the aggregate production planning stage ?
- (1) Scheduling of Machines
(2) Amount of labour to be committed
(3) Rate at which production should happen
(4) Inventory to be carried forward

36. Production flow analysis (PFA) is a method of identifying part families that uses data from :
- (1) Engineering Drawing
 - (2) Production schedule
 - (3) Bill of Materials
 - (4) Route Sheet
37. Which of the following forecasting methods takes a fraction of forecast error into account for the next period forecast ?
- (1) Simple average Method
 - (2) Moving average method
 - (3) Weighted Moving average method
 - (4) Exponential smoothing method
38. The time series forecasting method that gives equal weightage to each of the m most recent observations is :
- (1) Moving average method
 - (2) Exponential smoothing with linear trend
 - (3) Triple Exponential smoothing
 - (4) Kalman Filter
39. Two models, P and Q, of a product earn profits of Rs. 100 and Rs. 80 per piece, respectively. Production times for P and Q are 5 hours and 3 hours, respectively, while the total production time available is 150 hours. For a total batch size of 40, to maximize profit, the number of units of P to be produced is :
- (1) 12
 - (2) 15
 - (3) 18
 - (4) 20
40. In a company with 100 employees, 45 earn Rs. 20,000 per month, 25 earn Rs. 30,000, 20 earn Rs. 40,000, 8 earn Rs. 60,000, and 2 earn Rs. 150,000. The median of the salaries is :
- (1) Rs. 20,000
 - (2) Rs. 30,000
 - (3) Rs. 32,300
 - (4) Rs. 40,000
41. The most common limit gage used for inspecting the hole diameter is :
- (1) Ring gage
 - (2) Snap gage
 - (3) Plug gage
 - (4) Master gage
42. A gas tungsten arc welding operation is performed using a current of 250 A and an arc voltage of 20 V at a welding speed of 5 mm/s. Assuming that the arc efficiency is 70%, the net heat input per unit length of the weld will be (kJ/mm - round off to one decimal place).
- (1) 0.7
 - (2) 0.9
 - (3) 0.4
 - (4) 0.3
43. Hardenability of steel is a measure of :
- (1) The ability to harden when it is cold worked
 - (2) The maximum hardness that can be obtained when it is austenitized and then quenched
 - (3) The ability to retain its hardness when it is heated to elevated temperatures
 - (4) The depth to which required hardening is obtained when it is austenitized and then quenched

44. The cold forming process in which a hardened tool is pressed against a work piece (when there is relative motion between the tool and the work piece) to produce a roughened surface with a regular pattern is :
- (1) Strip rolling (2) Knurling (3) Roll forming (4) Chamfering
45. The preferred option for holding an odd-shaped workpiece in a centre lathe is :
- (1) Live and dead centres (2) Three jaw chuck
(3) Lathe dog (4) Four jaw chuck
46. A welding operation is being performed with voltage = 30 V and current = 100 A. The cross-sectional area of the weld bead is 20 mm^2 . The work-piece and filler are of titanium for which the specific energy of melting is 14 J/mm^3 . Assuming a thermal efficiency of the welding process 70%, the welding speed is (in mm/s -- correct to two decimal places) :
- (1) 7.5 (2) 8.5 (3) 9.5 (4) 5.5
47. Feed rate in slab milling operation is equal to :
- (1) Rotation per minute (rpm)
(2) Product of rpm and number of teeth in the cutter
(3) Product of rpm, feed per tooth and number of teeth in the cutter
(4) Product of rpm, feed per tooth and number of teeth in contact
48. During solidification of a pure molten metal, the grains in the casting near the mould wall are :
- (1) Coarse and randomly oriented (2) Fine and randomly oriented
(3) Fine and ordered (4) Coarse and ordered
49. Metal removal in electric discharge machining takes place through :
- (1) Ion displacement (2) Melting and vaporization
(3) Corrosive reaction (4) Plastic shear
50. In a wire-cut EDM process the necessary conditions that have to be met for making a successful cut are that :
- (1) Wire and sample are electrically non-conducting
(2) Wire and sample are electrically conducting
(3) Wire is electrically conducting and sample is electrically non-conducting
(4) Sample is electrically conducting and wire is electrically non-conducting
51. An air standard Otto cycle has thermal efficiency of 0.5 and the mean effective pressure of the cycle is 1000 kPa. For air, assume specific heat ratio $\gamma = 1.4$ and specific gas constant $R = 0.287 \text{ kJ/kg.K}$, If the pressure and temperature at the beginning of the compression stroke are 100 kPa and 300 K, respectively, then the specific net work output of the cycle is (kJ/kg --- round off to two decimal places) :
- (1) 608.6 (2) 908.6 (3) 708.8 (4) 1008.8

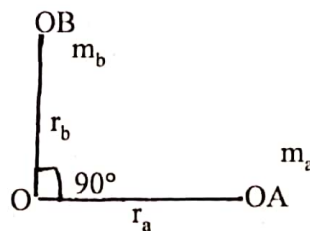
52. An idealized centrifugal pump (blade outer radius of 50 mm) consumes 2 kW power while running at 3000 rpm. The entry of the liquid into the pump is axial and exit from the pump is radial with respect to impeller. If the losses are neglected, then the mass flow rate of the liquid through the pump is (kg/s -- round off to two decimal places) :
- (1) 8.106 (2) 7.106 (3) 6.106 (4) 9.106
53. A through hole is drilled in an aluminum alloy plate of 15 mm thickness with a drill bit of diameter 10 mm, at a feed of 0.25 mm/rev and a spindle speed of 1200 rpm. If the specific energy required for cutting this material is 0.7 N.m/mm^3 , the power required for drilling is (W -- round off to two decimal places) :
- (1) 276.9 (2) 274.89 (3) 278.9 (4) 277.89
54. One-dimensional steady state heat conduction takes place through a solid whose cross-sectional area varies linearly in the direction of heat transfer. Assume there is no heat generation in the solid and the thermal conductivity of the material is constant and independent of temperature.
- The temperature distribution in the solid is :
- (1) Quadratic (2) Exponential (3) Logarithmic (4) Linear
55. Which one of the following modifications of the simple ideal Rankine cycle increases the thermal efficiency and reduces the moisture content of the steam at the turbine outlet :
- (1) Decreasing the condenser pressure. (2) Increasing the boiler pressure.
 (3) Decreasing the boiler pressure. (4) Increasing the turbine inlet temperature.
56. Water enters a circular pipe of length $L = 5.0 \text{ m}$ and diameter $D = 0.20 \text{ m}$ with Reynolds number $R_{eD} = 500$. The velocity profile at the inlet of the pipe is uniform while it is parabolic at the exit. The Reynolds number at the exit of the pipe is :
- (1) 450 (2) 550 (3) 500 (4) 600
57. Ambient air is at a pressure of 100 kPa, dry bulb temperature of 30°C and 60% relative humidity. The saturation pressure of water at 30°C is 4.24 kPa. The specific humidity of air (in g/kg of dry air) is (correct to two decimal places) :
- (1) 16.24 (2) 17.24 (3) 18.24 (4) 15.24
58. The peak wavelength of radiation emitted by a black body at a temperature of 2000 K is 1.45 μm . If the peak wavelength of emitted radiation changes to 2.90 μm , then the temperature (in K) of the black body is :
- (1) 500 (2) 1000 (2) 4000 (4) 8000
59. Select the correct statement for 50% reaction stage in a steam turbine.
- (1) The rotor blade is symmetric.
 (2) The stator blade is symmetric.
 (3) The absolute inlet flow angle is equal to absolute exit flow angle.
 (4) The absolute exit flow angle is equal to inlet angle of rotor blade.

60. Which one of the following statement is correct for a superheated vapour :
- (1) Its pressure is less than the saturation pressure at a given temperature.
 - (2) Its temperature is less than the saturation temperature at a given pressure.
 - (3) Its volume is less than the volume of the saturated vapour at a given temperature.
 - (4) Its enthalpy is less than enthalpy of the saturated vapour at a given pressure.
61. Internal gears are manufactured by :
- (1) Hobbing
 - (2) Shaping with pinion cutter
 - (3) Shaping with rack cutter
 - (4) Milling
62. For an orthogonal cutting operation, tool material is HSS, rake angle is 22° chip thickness is 0.8 mm, speed is 48 m/min and feed is 0.4 mm/rev. The shear angle (in degrees) is :
- (1) 19.24
 - (2) 29.70
 - (3) 56.00
 - (4) 68.75
63. Chaplets are placed between mould and core surfaces in order :
- (1) Reduce directional solidification
 - (2) Help local alloying of molten metal
 - (3) Help easy removal of core from casting
 - (4) Prevent core movement due to buoyancy
64. An expandable pattern is used in :
- (1) Slush casting
 - (2) Squeeze casting
 - (3) Centrifugal casting
 - (4) Investment casting
65. In the manufacture of the twist drills, the shank is joined to the body of the drill using :
- (1) Spot Welding
 - (2) TIG Welding
 - (3) Projection Welding
 - (4) Friction Welding
66. The annual requirement of rivets at a ship manufacturing company is 2000 kg. The rivets are supplied in units of 1 kg costing Rs. 25 each. If it costs Rs. 100 to place an order and the annual cost of carrying one unit is 9% of its purchase cost, the cycle length of the order (in days) will be :
- (1) 73
 - (2) 77
 - (3) 80
 - (4) 85
67. A manufacturer has the following data regarding a product :
- Fixed cost per month = Rs. 50000
- Variable cost per unit = Rs. 200
- Selling price Per unit = Rs. 300
- Production capacity = 1500 units per month
- If the production is carried out at 80% of the rated capacity, then the monthly profit (in Rs.) is :
- (1) 60,000
 - (2) 70,000
 - (3) 57,000
 - (4) 72,000

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68. During the development of a product, an entirely new process plan is made based on design logic, examination of geometry and tolerance information. This type of process planning is known as :
- (1) Retrieval (2) Generative
(3) Variant (4) Group technology based
69. Annual demand of a product is 50000 units and the ordering cost is Rs. 7000 per order. Considering the basic economic order quantity model, the economic order quantity is 10000 units. When the annual inventory cost is minimized, the annual inventory holding cost (in Rs.) is :
- (1) 35,000 (2) 43,330 (3) 45,000 (4) 65,000
70. The chance of a student passing an exam is 20%. The chance of a student passing the exam and getting above 90% marks in it is 5%. GIVEN that a student passes the examination, the probability that the student gets above 90% marks is :
- (1) $1/18$ (2) $1/4$ (3) $2/9$ (4) $5/18$
71. The annual demand of valves per year in a company is 10,000 units. The current order quantity is 400 valves per order. The holding cost is Rs. 24 per valve per year and the ordering cost is Rs. 400 per order. If the current order quantity is changed to Economic Order Quantity, then the saving in the total cost of inventory per year will be (Rs. round off value to two decimal places).
- (1) 943.59 (2) 948.59 (3) 940.59 (4) 941.59
72. The probability that a part manufactured by a company will be defective is 0.05. If 15 such parts are selected randomly and inspected, then the probability that at least two parts will be defective is (round off to two decimal places) :
- (1) 0.19 (2) 0.17 (3) 0.14 (4) 0.13
73. If x is the mean of data 3, x , 2 and 4, then the mode is :
- (1) 4 (2) 2 (3) 3 (4) 0
74. A local tyre distributor expects to sell approximately 9600 steel belted radial tyres next year. Annual carrying cost in Rs. 16 per tyre and ordering cost is Rs. 75. The economic order quantity of the tyres is :
- (1) 64 (2) 212 (3) 300 (4) 1200
75. The time series forecasting method that gives equal weightage to each of the M most recent observation is :
- (1) Moving average method
(2) Exponential smoothing with linear trend
(3) Triple Exponential smoothing
(4) Kalman Filter

76. Four red balls, four green balls and four blue balls are put in a box. Three balls are pulled out of the box at random one after another without replacement. The probability that all the three balls are red is :
- (1) $1/72$ (2) $1/55$ (3) $1/36$ (4) $1/27$
77. At a work station, 05 jobs arrive every minute. The mean time spent on each job in the work station is $1/8$ minute. The mean steady state number of jobs in the system is :
- (1) 1.666 (2) 1.888 (3) 1.777 (4) 1.999
78. The jobs arrive at a facility for a service, in a random manner. The probability distribution of number of arrivals of jobs in a fixed time interval is :
- (1) Normal (2) Poisson (3) Erlang (4) Beta
79. Little's law is a relationship between :
- (1) Stock level and lead time in an inventory system
 (2) Waiting time and length of queue in a queuing system
 (3) Number of machines and job due dates in a scheduling problem
 (4) Uncertainty in the activity time and project completion time
80. For a single server with poisson arrival and exponential service time, the arrival rate is 12 per hour. Which one of the following service rates will provide a steady state finite queue length ?
- (1) 06 per hour (2) 10 per hour (3) 12 per hour (4) 24 per hour
81. Two masses A and B having mass m_a and m_b , respectively, lying in the plane of the figure shown, are rigidly attached to a shaft which revolves about an axis through O perpendicular to the figure. The radii of rotation of the masses m_a and m_b are r_a and r_b respectively. The angle between lines OA and OB is 90° . If $m_a = 10$ kg, $m_b = 20$ kg, $r_a = 200$ mm and $r_b = 400$ mm, then the balance mass to be placed at a radius of 200 mm is (kg --- round off to two decimal places) :
- (1) 41.23 (2) 42.23 (3) 40.23 (4) 43.23



82. The thickness of a sheet is reduced by rolling (without any change in width) using 600 mm diameter rolls. Neglect elastic deflection of the rolls and assume that the coefficient of friction at the roll-work piece interface is 0.05. The sheet enters the rotating rolls unaided. If the initial sheet thickness is 2 mm, the minimum possible final thickness that can be produced by this process in a single pass is (mm -- round off to two decimal places) :
- (1) 1.35 (2) 1.25 (3) 1.45 (4) 1.15

83. Consider a linear rectangular thin sheet of metal, subjected to uniform uniaxial tensile stress of 100 MPa along the length direction. Assume plane stress conditions in the plane normal to the thickness. The Young's modulus $E = 200$ MPa and Poisson's ratio $\nu = 0.3$ are given. The principal strains in the plane of the sheet are :
- (1) (0.5, 0.0) (2) (0.35, -0.15) (3) (0.5, -0.5) (4) (0.5, -0.15)
84. Sphere 1 with a diameter of 0.1 m is completely enclosed by another sphere 2 of diameter 0.4 m. The view factor F_{12} is :
- (1) 0.25 (2) 0.0625 (3) 1.0 (4) 0.5
85. The state of stress at a point in a component is represented by a Mohr's circle of radius 100 MPa centered at 200 MPa on the normal stress axis. On a plane passing through the same point, the normal stress is 260 MPa. The magnitude of the shear stress on the same plane at the same point is (MPa) :
- (1) 80 (2) 90 (3) 60 (4) 70
86. Endurance limit of a beam subjected to pure bending decreases with :
- (1) Increase in the surface roughness and increase in the size of the beam
 (2) Decrease in the surface roughness and decrease in the size of the beam
 (3) Decrease in the surface roughness and increase in the size of the beam
 (4) Increase in the surface roughness and decrease in the size of the beam
87. Which of the following is the most conservative fatigue failure criterion ?
- (1) Soderberg (2) Modified Goodman
 (3) ASME Elliptic (4) Gerber
88. Pre-tensioning of a bolted joint is used to :
- (1) Strain harden the bolt head (2) Decrease stiffness of the bolted joint
 (3) Increase stiffness of the bolted joint (4) Prevent yielding of the thread root
89. For an Oldham coupling used between two shafts, which among the following statements are correct ?
- I. Torsional load is transferred along shaft axis.
 II. A velocity ratio of 1:2 between shafts is obtained without using gears
 III. Bending load is transferred transverse to shaft axis.
 IV. Rotation is transferred along shaft axis:
- (1) I and II (2) I and IV (3) II and III (4) II and IV
90. A self-aligning ball bearing has a basic dynamic load rating (c_{10} , for 10^6 revolutions) of 35 kN. If the equivalent radial load on the bearing is 45 kN, the expected life (in 10^6 revolutions) is :
- (1) Below 0.5 (2) 0.5 to 0.8 (3) 0.8 to 1.0 (4) Above 1.0
91. Using the Taylors tool life equation with exponent $n = 0.5$, if the cutting speed is reduced by 50% the ratio of new tool life to original tool life is :
- (1) 4 (2) 2 (3) 1 (4) 0.5

- 92.** Interpolator in a CNC machine :
- (1) Controls spindle speed (2) Coordinates axes movements
(3) Operates tool changer (4) Commands canned cycle
- 93.** The non-traditional machining process that essentially requires vacuum is :
- (1) Electron beam machining (2) Electro chemical machining
(3) Electro chemical discharge machining (4) Electro discharge machining
- 94.** A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
- (1) 150 (2) 200 (3) 100 (4) 125
- 95.** Which two of the following joining processes are autogeneous is ?
- (i) Diffusion welding (ii) Electroslag welding
(iii) Tungsten inert gas welding (iv) Friction welding
- (1) (i) and (iv) (2) (ii) and (iii) (3) (ii) and (iv) (4) (i) and (iii)
- 96.** In fill mould (cavity-less) casting process, the pattern is made of :
- (1) Expanded polystyrene (2) Wax
(3) Epoxy (4) Plaster of Paris
- 97.** A single point cutting tool with 0° rake angle is used in an orthogonal machining process. At a cutting speed of 180 m/min. the thrust force is 490 N. If the coefficient of friction between the tool and the chip is 0.7, then the power consumption (in kW) for the machining operation is :
- (1) 3.5 (2) 2.1 (3) 5.6 (4) 7.1
- 98.** A cube and a sphere made or cast iron (each of volume 1000 cm^3) were cast under identical conditions. The time taken for solidifying the cube was 4 s. The solidification tune (in s) for the sphere is :
- (1) 6.57355 sec. (2) 7.23455 sec. (3) 5.23455 sec. (4) 2.52355 sec.
- 99.** During a TIG welding process, the arc current and arc voltage were 50 A and 60 V. respectively, when the welding speed was 150 mm/min. In another process, the TIG welding is carried out at a welding speed of 120 mm/min at the same arc voltage and heat input to the material so that weld quality remains the same the welding current (in A) for this process is :
- (1) 40.00 (2) 44.72 (3) 55.90 (4) 62.25
- 100.** The fluidity of molten metal of cast alloys (without any addition of fluxes) increases with increase in :
- (1) Freezing range (2) Surface tension
(3) Degree of superheat (4) Viscosity

Total No. of Printed Pages : 13

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D

SET-Z

M.Phil./Ph.D./URS-EE-2019

SUBJECT : Mechanical Engineering

10004

Sr. No.

Time : 1¼ Hours

Max. Marks : 100

Total Questions : 100

Roll No. (in figures) _____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

(Signature of the Candidate)

(Signature of the Invigilator)

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- Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
- Question Booklet along with answer key of all the A, B, C & D code will be got uploaded on the University website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E.Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.
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- There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
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MPH/PHD/URS-EE-2019/(Mech. Engg.)(SET-Z)/(D)

SEAL

1. Internal gears are manufactured by :

(1) Hobbing	(2) Shaping with pinion cutter
(3) Shaping with rack cutter	(4) Milling
2. For an orthogonal cutting operation, tool material is HSS, rake angle is 22° chip thickness is 0.8 mm, speed is 48 m/min and feed is 0.4 mm/rev. The shear angle (in degrees) is :

(1) 19.24	(2) 29.70	(3) 56.00	(4) 68.75
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3. Chaplets are placed between mould and core surfaces in order :

(1) Reduce directional solidification	(2) Help local alloying of molten metal
(3) Help easy removal of core from casting	(4) Prevent core movement due to buoyancy
4. An expandable pattern is used in :

(1) Slush casting	(2) Squeeze casting
(3) Centrifugal casting	(4) Investment casting
5. In the manufacture of the twist drills, the shank is joined to the body of the drill using :

(1) Spot Welding	(2) TIG Welding
(3) Projection Welding	(4) Friction Welding
6. The annual requirement of rivets at a ship manufacturing company is 2000 kg. The rivets are supplied in units of 1 kg costing Rs. 25 each. If it costs Rs. 100 to place an order and the annual cost of carrying one unit is 9% of its purchase cost, the cycle length of the order (in days) will be :

(1) 73	(2) 77	(3) 80	(4) 85
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7. A manufacturer has the following data regarding a product :

Fixed cost per month = Rs. 50000
 Variable cost per unit = Rs. 200
 Selling price Per unit = Rs. 300
 Production capacity = 1500 units per month

If the production is carried out at 80% of the rated capacity, then the monthly profit (in Rs.) is :

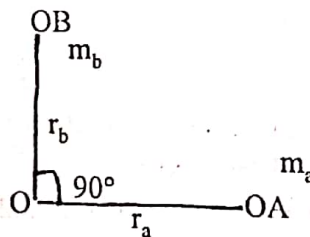
(1) 60,000	(2) 70,000	(3) 57,000	(4) 72,000
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8. During the development of a product, an entirely new process plan is made based on design logic, examination of geometry and tolerance information. This type of process planning is known as :

(1) Retrieval	(2) Generative
(3) Variant	(4) Group technology based

9. Annual demand of a product is 50000 units and the ordering cost is Rs. 7000 per order. Considering the basic economic order quantity model, the economic order quantity is 10000 units. When the annual inventory cost is minimized, the annual inventory holding cost (in Rs.) is :
- (1) 35,000 (2) 43,330 (3) 45,000 (4) 65,000
10. The chance of a student passing an exam is 20%. The chance of a student passing the exam and getting above 90% marks in it is 5%. GIVEN that a student passes the examination, the probability that the student gets above 90% marks is :
- (1) 1/18 (2) 1/4 (3) 2/9 (4) 5/18
11. Using the Taylors tool life equation with exponent $n = 0.5$, if the cutting speed is reduced by 50% the ratio of new tool life to original tool life is :
- (1) 4 (2) 2 (3) 1 (4) 0.5
12. Interpolator in a CNC machine :
- (1) Controls spindle speed (2) Coordinates axes movements
(3) Operates tool changer (4) Commands canned cycle
13. The non-traditional machining process that essentially requires vacuum is :
- (1) Electron beam machining (2) Electro chemical machining
(3) Electro chemical discharge machining (4) Electro discharge machining
14. A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
- (1) 150 (2) 200 (3) 100 (4) 125
15. Which two of the following joining processes are autogeneous is ?
- (i) Diffusion welding (ii) Electroslag welding
(iii) Tungsten inert gas welding (iv) Friction welding
- (1) (i) and (iv) (2) (ii) and (iii) (3) (ii) and (iv) (4) (i) and (iii)
16. In fill mould (cavity-less) casting process, the pattern is made of :
- (1) Expanded polystyrene (2) Wax
(3) Epoxy (4) Plaster of Paris
17. A single point cutting tool with 0° rake angle is used in an orthogonal machining process. At a cutting speed of 180 m/min. the thrust force is 490 N. If the coefficient of friction between the tool and the chip is 0.7, then the power consumption (in kW) for the machining operation is :
- (1) 3.5 (2) 2.1 (3) 5.6 (4) 7.1

18. A cube and a sphere made of cast iron (each of volume 1000 cm^3) were cast under identical conditions. The time taken for solidifying the cube was 4 s. The solidification time (in s) for the sphere is :
- (1) 6.57355 sec. (2) 7.23455 sec. (3) 5.23455 sec. (4) 2.52355 sec.
19. During a TIG welding process, the arc current and arc voltage were 50 A and 60 V, respectively, when the welding speed was 150 mm/min. In another process, the TIG welding is carried out at a welding speed of 120 mm/min at the same arc voltage and heat input to the material so that weld quality remains the same the welding current (in A) for this process is :
- (1) 40.00 (2) 44.72 (3) 55.90 (4) 62.25
20. The fluidity of molten metal of cast alloys (without any addition of fluxes) increases with increase in :
- (1) Freezing range (2) Surface tension
(3) Degree of superheat (4) Viscosity
21. An air standard Otto cycle has thermal efficiency of 0.5 and the mean effective pressure of the cycle is 1000 kPa. For air, assume specific heat ratio $\gamma = 1.4$ and specific gas constant $R = 0.287 \text{ kJ/kg.K}$. If the pressure and temperature at the beginning of the compression stroke are 100 kPa and 300 K, respectively, then the specific net work output of the cycle is (kJ/kg --- round off to two decimal places) :
- (1) 608.6 (2) 908.6 (3) 708.8 (4) 1008.8
22. An idealized centrifugal pump (blade outer radius of 50 mm) consumes 2 kW power while running at 3000 rpm. The entry of the liquid into the pump is axial and exit from the pump is radial with respect to impeller. If the losses are neglected, then the mass flow rate of the liquid through the pump is (kg/s -- round off to two decimal places) :
- (1) 8.106 (2) 7.106 (3) 6.106 (4) 9.106
23. A through hole is drilled in an aluminum alloy plate of 15 mm thickness with a drill bit of diameter 10 mm, at a feed of 0.25 mm/rev and a spindle speed of 1200 rpm. If the specific energy required for cutting this material is 0.7 N.m/mm^3 , the power required for drilling is (W -- round off to two decimal places) :
- (1) 276.9 (2) 274.89 (3) 278.9 (4) 277.89
24. One-dimensional steady state heat conduction takes place through a solid whose cross-sectional area varies linearly in the direction of heat transfer. Assume there is no heat generation in the solid and the thermal conductivity of the material is constant and independent of temperature.
- The temperature distribution in the solid is :
- (1) Quadratic (2) Exponential (3) Logarithmic (4) Linear

25. Which one of the following modifications of the simple ideal Rankine cycle increases the thermal efficiency and reduces the moisture content of the steam at the turbine outlet :
- (1) Decreasing the condenser pressure. (2) Increasing the boiler pressure.
 (3) Decreasing the boiler pressure. (4) Increasing the turbine inlet temperature.
26. Water enters a circular pipe of length $L = 5.0$ m and diameter $D = 0.20$ m with Reynolds number $R_{eD} = 500$. The velocity profile at the inlet of the pipe is uniform while it is parabolic at the exit. The Reynolds number at the exit of the pipe is :
- (1) 450 (2) 550 (3) 500 (4) 600
27. Ambient air is at a pressure of 100 kPa, dry bulb temperature of 30°C and 60% relative humidity. The saturation pressure of water at 30°C is 4.24 kPa. The specific humidity of air (in g/kg of dry air) is (correct to two decimal places) :
- (1) 16.24 (2) 17.24 (3) 18.24 (4) 15.24
28. The peak wavelength of radiation emitted by a black body at a temperature of 2000 K is 1.45 μm . If the peak wavelength of emitted radiation changes to 2.90 μm , then the temperature (in K) of the black body is :
- (1) 500 (2) 1000 (3) 4000 (4) 8000
29. Select the correct statement for 50% reaction stage in a steam turbine.
- (1) The rotor blade is symmetric.
 (2) The stator blade is symmetric.
 (3) The absolute inlet flow angle is equal to absolute exit flow angle.
 (4) The absolute exit flow angle is equal to inlet angle of rotor blade.
30. Which one of the following statement is correct for a superheated vapour :
- (1) Its pressure is less than the saturation pressure at a given temperature.
 (2) Its temperature is less than the saturation temperature at a given pressure.
 (3) Its volume is less than the volume of the saturated vapour at a given temperature.
 (4) Its enthalpy is less than enthalpy of the saturated vapour at a given pressure.
31. Two masses A and B having mass m_a and m_b , respectively, lying in the plane of the figure shown, are rigidly attached to a shaft which revolves about an axis through O perpendicular to the figure. The radii of rotation of the masses m_a and m_b are r_a and r_b respectively. The angle between lines OA and OB is 90° . If $m_a = 10$ kg, $m_b = 20$ kg, $r_a = 200$ mm and $r_b = 400$ mm, then the balance mass to be placed at a radius of 200 mm is (kg --- round off to two decimal places) :
- (1) 41.23 (2) 42.23 (3) 40.23 (4) 43.23



32. The thickness of a sheet is reduced by rolling (without any change in width) using 600 mm diameter rolls. Neglect elastic deflection of the rolls and assume that the coefficient of friction at the roll-work piece interface is 0.05. The sheet enters the rotating rolls unaided. If the initial sheet thickness is 2 mm, the minimum possible final thickness that can be produced by this process in a single pass is (mm -- round off to two decimal places) :
- (1) 1.35 (2) 1.25 (3) 1.45 (4) 1.15
33. Consider a linear rectangular thin sheet of metal, subjected to uniform uniaxial tensile stress of 100 MPa along the length direction. Assume plane stress conditions in the plane normal to the thickness. The Young's modulus $E = 200$ MPa and Poisson's ratio $\nu = 0.3$ are given. The principal strains in the plane of the sheet are :
- (1) (0.5, 0.0) (2) (0.35, -0.15) (3) (0.5, -0.5) (4) (0.5, -0.15)
34. Sphere 1 with a diameter of 0.1 m is completely enclosed by another sphere 2 of diameter 0.4 m. The view factor F_{12} is :
- (1) 0.25 (2) 0.0625 (3) 1.0 (4) 0.5
35. The state of stress at a point in a component is represented by a Mohr's circle of radius 100 MPa centered at 200 MPa on the normal stress axis. On a plane passing through the same point, the normal stress is 260 MPa. The magnitude of the shear stress on the same plane at the same point is (MPa) :
- (1) 80 (2) 90 (3) 60 (4) 70
36. Endurance limit of a beam subjected to pure bending decreases with :
- (1) Increase in the surface roughness and increase in the size of the beam
 (2) Decrease in the surface roughness and decrease in the size of the beam
 (3) Decrease in the surface roughness and increase in the size of the beam
 (4) Increase in the surface roughness and decrease in the size of the beam
37. Which of the following is the most conservative fatigue failure criterion ?
- (1) Soderberg (2) Modified Goodman
 (3) ASME Elliptic (4) Gerber
38. Pre-tensioning of a bolted joint is used to :
- (1) Strain harden the bolt head (2) Decrease stiffness of the bolted joint
 (3) Increase stiffness of the bolted joint (4) Prevent yielding of the thread root
39. For an Oldham coupling used between two shafts, which among the following statements are correct ?
- I. Torsional load is transferred along shaft axis.
 II. A velocity ratio of 1:2 between shafts is obtained without using gears
 III. Bending load is transferred transverse to shaft axis.
 IV. Rotation is transferred along shaft axis:
- (1) I and II (2) I and IV (3) II and III (4) II and IV

40. A self-aligning ball bearing has a basic dynamic load rating (C_{10} , for 10^6 revolutions) of 35 kN. If the equivalent radial load on the bearing is 45 kN, the expected life (in 10^6 revolutions) is :
(1) Below 0.5 (2) 0.5 to 0.8 (3) 0.8 to 1.0 (4) Above 1.0
41. In a single channel queuing model, the customer arrival rate is 12 per hour and the serving rate is 24 hour per. The expected time that a customer is in queue is (min) :
(1) 2.5 (2) 3.5 (3) 1.5 (4) 4.5
42. The word Kanban is most appropriately associated with :
(1) Economic order quantity (2) Just in time production
(3) Capacity planning (4) Product Design
43. A company uses 2555 units of an item annually. Delivery lead time is 08 days. The reorder point (in number of units) to achieve optimum inventory is :
(1) 07 (2) 08 (3) 56 (4) 60
44. The supply at three sources is 50, 40 & 60 units respectively while the demand at four destination is 20, 30, 10 & 50 units. In solving this transportation problem :
(1) A dummy source of capacity 40 units is needed
(2) A dummy destination of capacity 40 units is needed
(3) No solution exists as the problem is infeasible
(4) No solution exists as the problem is degenerate
45. Which one of the following is NOT a decision taken during the aggregate production planning stage ?
(1) Scheduling of Machines
(2) Amount of labour to be committed
(3) Rate at which production should happen
(4) Inventory to be carried forward
46. Production flow analysis (PFA) is a method of identifying part families that uses data from :
(1) Engineering Drawing (2) Production schedule
(3) Bill of Materials (4) Route Sheet
47. Which of the following forecasting methods takes a fraction of forecast error into account for the next period forecast ?
(1) Simple average Method (2) Moving average method
(3) Weighted Moving average method (4) Exponential smoothing method
48. The time series forecasting method that gives equal weightage to each of the m most recent observations is :
(1) Moving average method (2) Exponential smoothing with linear trend
(3) Triple Exponential smoothing (4) Kalman Filter

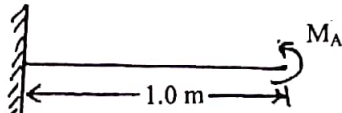
49. Two models, P and Q, of a product earn profits of Rs. 100 and Rs. 80 per piece, respectively. Production times for P and Q are 5 hours and 3 hours, respectively, while the total production time available is 150 hours. For a total batch size of 40, to maximize profit, the number of units of P to be produced is :
- (1) 12 (2) 15 (3) 18 (4) 20
50. In a company with 100 employees, 45 earn Rs. 20,000 per month, 25 earn Rs. 30,000, 20 earn Rs. 40,000, 8 earn Rs. 60,000, and 2 earn Rs. 150,000. The median of the salaries is :
- (1) Rs. 20,000 (2) Rs.30,000 (3) Rs. 32,300 (4) Rs. 40,000
51. The most common limit gage used for inspecting the hole diameter is :
- (1) Ring gage (2) Snap gage
(3) Plug gage (4) Master gage
52. A gas tungsten arc welding operation is performed using a current of 250 A and an arc voltage of 20 V at a welding speed of 5 mm/s. Assuming that the arc efficiency is 70%, the net heat input per unit length of the weld will be (kJ/mm -round off to one decimal place).
- (1) 0.7 (2) 0.9 (3) 0.4 (4) 0:3
53. Hardenability of steel is a measure of :
- (1) The ability to harden when it is cold worked
(2) The maximum hardness that can be obtained when it is austenitized and then quenched
(3) The ability to retain its hardness when it is heated to elevated temperatures
(4) The depth to which required hardening is obtained when it is austenitized and then quenched
54. The cold forming process in which a hardened tool is pressed against a work piece (when there is relative motion between the tool and the work piece) to produce a roughened surface with a regular pattern is :
- (1) Strip rolling (2) Knurling (3) Roll forming (4) Chamfering
55. The preferred option for holding an odd-shaped workpiece in a centre lathe is :
- (1) Live and dead centres (2) Three jaw chuck
(3) Lathe dog (4) Four jaw chuck
56. A welding operation is being performed with voltage = 30 V and current = 100 A. The cross-sectional area of the weld bead is 20 mm^2 . The work-piece and filler are of titanium for which the specific energy of melting is 14 J/mm^3 . Assuming a thermal efficiency of the welding process 70%, the welding speed is (in mm/s -- correct to two decimal places) :
- (1) 7.5 (2) 8.5 (3) 9.5 (4) 5.5

57. Feed rate in slab milling operation is equal to :
- (1) Rotation per minute (rpm)
 - (2) Product of rpm and number of teeth in the cutter
 - (3) Product of rpm, feed per tooth and number of teeth in the cutter
 - (4) Product of rpm, feed per tooth and number of teeth in contact
58. During solidification of a pure molten metal, the grains in the casting near the mould wall are :
- (1) Coarse and randomly oriented
 - (2) Fine and randomly oriented
 - (3) Fine and ordered
 - (4) Coarse and ordered
59. Metal removal in electric discharge machining takes place through :
- (1) Ion displacement
 - (2) Melting and vaporization
 - (3) Corrosive reaction
 - (4) Plastic shear
60. In a wire-cut EDM process the necessary conditions that have to be met for making a successful cut are that :
- (1) Wire and sample are electrically non-conducting
 - (2) Wire and sample are electrically conducting
 - (3) Wire is electrically conducting and sample is electrically non-conducting
 - (4) Sample is electrically conducting and wire is electrically non-conducting
61. The annual demand of valves per year in a company is 10,000 units. The current order quantity is 400 valves per order. The holding cost is Rs. 24 per valve per year and the ordering cost is Rs. 400 per order. If the current order quantity is changed to Economic Order Quantity, then the saving in the total cost of inventory per year will be (Rs. round off value to two decimal places).
- (1) 943.59
 - (2) 948.59
 - (3) 940.59
 - (4) 941.59
62. The probability that a part manufactured by a company will be defective is 0.05. If 15 such parts are selected randomly and inspected, then the probability that at least two parts will be defective is (round off to two decimal places) :
- (1) 0.19
 - (2) 0.17
 - (3) 0.14
 - (4) 0.13
63. If x is the mean of data 3, x , 2 and 4, then the mode is :
- (1) 4
 - (2) 2
 - (3) 3
 - (4) 0
64. A local tyre distributor expects to sell approximately 9600 steel belted radial tyres next year. Annual carrying cost in Rs. 16 per tyre and ordering cost is Rs. 75. The economic order quantity of the tyres is :
- (1) 64
 - (2) 212
 - (3) 300
 - (4) 1200

65. The time series forecasting method that gives equal weightage to each of the M most recent observation is :
- (1) Moving average method
 - (2) Exponential smoothing with linear trend
 - (3) Triple Exponential smoothing
 - (4) Kalman Filter
66. Four red balls, four green balls and four blue balls are put in a box. Three balls are pulled out of the box at random one after another without replacement. The probability that all the three balls are red is :
- (1) $1/72$ (2) $1/55$ (3) $1/36$ (4) $1/27$
67. At a work station, 05 jobs arrive every minute. The mean time spent on each job in the work station is $1/8$ minute. The mean steady state number of jobs in the system is :
- (1) 1.666 (2) 1.888 (3) 1.777 (4) 1.999
68. The jobs arrive at a facility for a service, in a random manner. The probability distribution of number of arrivals of jobs in a fixed time interval is :
- (1) Normal (2) Poisson (3) Erlang (4) Beta
69. Little's law is a relationship between :
- (1) Stock level and lead time in an inventory system
 - (2) Waiting time and length of queue in a queuing system
 - (3) Number of machines and job due dates in a scheduling problem
 - (4) Uncertainty in the activity time and project completion time
70. For a single server with poisson arrival and exponential service time, the arrival rate is 12 per hour. Which one of the following service rates will provide a steady state finite queue length ?
- (1) 06 per hour (2) 10 per hour (3) 12 per hour (4) 24 per hour
71. Which one of the following is NOT a rotating machine ?
- (1) Centrifugal pump (2) Gear pump (3) Jet pump (4) Vane pump
72. Saturated steam at 100°C condenses on the outside of a tube. Cold fluid enters the tube at 20°C and exists at 50°C . The value of the Log Mean Temperature Difference (LMTD) is ($^{\circ}\text{C}$).
- (1) 55.76 (2) 58.46 (3) 63.82 (4) 69.33
73. For an inline slider-crank mechanism, the lengths of the crank and connecting rod are 3m and 4m, respectively. At the instant when the connecting rod is perpendicular to the crank, if the velocity of the slider is 1m/s , the magnitude of angular velocity (upto 3 decimal points accuracy) of the crank is (radian/s).
- (1) 0.222 (2) 0.267 (3) 0.298 (4) 0.316

74. A 10 mm deep cylindrical cup with diameter of 15mm is drawn from circular blank. Neglecting the variation in the sheet thickness, the diameter (upto 2 decimal points accuracy) of the blank is (mm) :
- (1) 27.12 (2) 28.72 (3) 29.49 (4) 33.41
75. Air contains 79% N₂ and 21% O₂ on a molar basis. Methane (CH₄) is burned with 50% excess air than required stoichiometrically. Assuming complete combustion of methane, the molar percentage of N₂ in the products is :
- (1) 70 (2) 73.8 (3) 75 (4) 79.8
76. Heat and Work are :
- (1) Intensive properties (2) Extensive properties
(3) Point functions (4) Path functions
77. The internal energy of an ideal gas is a function of :
- (1) Temperature and pressure (2) Volume and pressure
(3) Entropy and pressure (4) Temperature only
78. The Rateau turbine belong to the category of :
- (1) Pressure compounded turbine (2) Reaction turbine
(3) Velocity compounded turbine (4) Radial flow turbine
79. A two dimensional fluid element rotates like a rigid body. At a point with in the element, the pressure is 1 unit. Radius of the Mohr's circle, characteristics the state of stress at the point is :
- (1) 0.5 unit (2) 0 unit (3) 01 unit (4) 2 units
80. For a Newtonian fluid :
- (1) Shear stress is proportional to shear strain
(2) Rate of Shear stress is proportional to shear strain
(3) Shear stress is proportional to rate of shear strain
(4) Rate of shear stress is proportional to rate of shear strain
81. A point mass is shot vertically up from ground level with a velocity of 4 m/s at time, $t=0$. It loses 20% of its impact velocity after each collision with the ground. Assuming that the acceleration due to gravity is 10 m/s² and that air resistance is negligible, the mass stops bouncing and comes to complete rest on the ground after a total time (in seconds) of :
- (1) 1 (2) 2 (3) 4 (4) 6
82. In a linearly hardening plastic material. The true stress beyond initial yielding :
- (1) Increases linearly with the true strain
(2) Decreases linearly with the true strain
(3) First increases linearly and then decreases linearly with the true strain
(4) Remain constant

83. The spring constant of a helical compression spring DOES NOT depend on :
- (1) Coil diameter (2) Material strength
(3) Number of active turns (4) Wire diameter
84. A cylindrical job with diameter of 200 mm and height of 100 mm is to be cast using modulus method of riser design. Assume that the bottom surface of cylindrical riser does not contribute as cooling surface. If the diameter of the riser is equal to its height, then the height of the riser [in mm] is :
- (1) 150 (2) 200 (3) 100 (4) 125
85. 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 :
- (1) 19% (2) 29% (3) 41% (4) 50%
86. One side of a wall is maintained at 400 K and the other at 300 K. The rate of heat transfer through the wall is 1000 W and the surrounding temperature is 25°C. Assuming no generation of heat within the wall, the irreversibility (in W) due to heat transfer through the wall is :
- (1) 274 (2) 248 (3) 360 (4) 244
87. Air in a room is at 35°C and 60% relative humidity (RH). The pressure in the room is 0.1 MPa. The saturation pressure of water at 35°C is 5.63 kPa. The humidity ratio of the air (in grain/kg of dry air) is :
- (1) 21.74 (2) 22.20 (3) 25.17 (4) 20.37
88. Within a boundary layer for a steady incompressible flow, the Bernoulli equation :
- (1) Holds because the flow is steady
(2) Holds because the flow is incompressible
(3) Holds because the flow is transitional
(4) Does not hold because the flow is frictional
89. Which of the following statements regarding a Rankine cycle with reheating are TRUE ?
- (i) increase in average temperature of heat addition
(ii) reduction in thermal efficiency
(iii) drier steam at the turbine exit
- (1) Only (i) and (ii) are correct (2) Only (ii) and (iii) are correct
(3) Only (i) and (iii) are correct (4) (i), (ii) and (iii) are correct
90. A rope-brake dynamometer attached to the crank shaft of an I.C. engine measures a brake power of 10 kW when the speed of rotation of the shaft is 400 rad/s. The shaft torque (in N-m) sensed by the dynamometer is :
- (1) 25 (2) 52 (3) 35 (4) 45
91. A cylindrical tank with closed ends is filled with compressed air at a pressure of 500 kPa. The inner radius of the tank is 2 m, and it has wall thickness of 10 mm. The magnitude of maximum in-plane shear stress (in MPa) is :
- (1) 22 (2) 24 (3) 25 (4) 29

92. In a machining operation, if the generatrix and directrix both are straight lines, the surface obtained is :
 (1) Cylindrical (2) Helical (3) Plane (4) Surface of revolution
93. A single-degree-freedom spring-mass system is subjected to a sinusoidal force of 10 N amplitude and frequency w along the axis of the spring. The stiffness of the spring is 150 N/m, damping factor is 0.2 and the undamped natural frequency is $10w$. At steady state, the amplitude of vibration (in m) is approximately:
 (1) 0.05 (2) 0.07 (3) 0.70 (4) 0.90
94. A hollow shaft of 1 m length is designed to transmit a power of 30 kW at 700 rpm. The maximum permissible angle of twist in the shaft is 1° . The inner diameter of the shaft is 0.7 times the outer diameter. The modulus of rigidity is 80 GPa. The outside diameter (in mm) of the shaft is :
 (1) 44.5212 mm (2) 54.5212 mm (3) 64.5212 mm (4) 48.5212 mm
95. The atomic packing factor for a material with body centered cubic structure is :
 (1) 0.68 (2) 0.53 (3) 0.89 (4) 0.87
96. A horizontal cantilever beam of circular cross-section, length 10 m and flexural rigidity $EI = 200 \text{ N.m}^2$ is subjected to an applied moment $M_A = 1.0 \text{ N-m}$ at the free end as shown in the figure. The magnitude of the vertical deflection of the free end is (mm --- round off to one decimal place) :
 (1) 2.5 (2) 1.5 (3) 3.5 (4) 0.5
- 
97. A wire of circular cross-section of diameter 1.0 mm is bent into a circular arc of radius 1.0 mm by application of pure bending moments at its ends. The Young's modulus of the material of the wire is 100 GPa. The maximum tensile stress developed in the wire is (MPa) :
 (1) 60 (2) 70 (3) 50 (4) 55
98. A small ball of mass 1 kg moving with a velocity of 12 m/s undergoes a direct central impact with a stationary ball of mass 2 kg. The impact is perfectly elastic. The speed (in m/s) of 2 kg mass ball after the impact will be :
 (1) 4 (2) 8 (3) 6 (4) 2
99. A gas is stored in a cylindrical tank of inner radius 7 in and wall thickness 50 mm. The gage pressure of the gas is 2 MPa. The maximum shear stress (in MPa) in the wall is:
 (1) 35 (2) 70 (3) 140 (4) 280
100. In a spring-mass system, the mass is m and the spring constant is k . The critical damping coefficient of the system is 0.1 kg/s. In another spring-mass system, the mass is $2m$ and the spring constant is $8k$. The critical damping coefficient (in kg/s) of this system is :
 (1) 0.6 (2) 0.3 (3) 0.4 (4) 0.8

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Question_				
No.	CODE-A	CODE-B	CODE-C	CODE-D
1	3	1	3	2
2	3	2	3	2
3	2	4	2	4
4	1	3	2	4
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47	4	1	3	4
48	1	2	2	1
49	2	4	2	2
50	3	1	2	2
51	1	3	3	3

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Answer Key of Entrance Exam -M.Phil/Ph.D/URS-EE-2019				
Question_				
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87	1	3	1	1
88	2	2	3	4
89	2	3	2	3
90	4	3	1	1
91	1	1	1	3
92	2	2	2	3
93	3	3	1	2
94	2	3	1	1
95	2	1	1	1
96	3	2	1	1
97	4	1	2	3
98	1	2	1	2
99	2	2	1	3
100	2	4	3	3

Paul
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