11/01/2026

EAM/DWR/I/25/11

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

Test Booklet No. :

01673

Series

A

TEST BOOKLET

MECHANICAL ENGINEERING

(Paper—I)

Time Allowed : 2 Hours **Full Marks : 100**

Read the following instructions carefully before you begin to answer the questions :

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Series are to be written legibly and correctly in the space provided on the Answer-Sheet with Black/Blue ballpoint pen.
2. **Answer-Sheet without marking Series as mentioned above in the space provided for in the Answer-Sheet shall not be evaluated.**
3. All questions carry equal marks.
   The Answer-Sheet should be submitted to the Invigilator.
   Directions for giving the answers : Directions for answering questions have already been issued to the respective candidates in the 'Instructions for marking in the OMR Answer-Sheet' along with the Admit Card and Specimen Copy of the OMR Answer-Sheet.
   Example :
   Suppose the following question is asked :
   The capital of Bangladesh is
   (A) Chennai
   (B) London
   (C) Dhaka
   (D) Dhubri
   You will have four alternatives in the Answer-Sheet for your response corresponding to each question of the Test Booklet as below :

   Ⓐ Ⓑ Ⓒ Ⓓ

   In the above illustration, if your chosen response is alternative (C), i.e., Dhaka, then the same should be marked on the Answer-Sheet by blackening the relevant circle with a Black/Blue ballpoint pen only as below :

   Ⓐ Ⓑ ● Ⓓ

   The example shown above is the only correct method of answering.
4. Use of eraser, blade, chemical whitener fluid to rectify any response is prohibited.
5. Please ensure that the Test Booklet has the required number of pages (16) and 100 questions immediately after opening the Booklet. In case of any discrepancy, please report the same to the Invigilator.
6. No candidate shall be admitted to the Examination Hall/Room 20 minutes after the commencement of the examination.
7. No candidate shall leave the Examination Hall/Room without prior permission of the Supervisor/Invigilator. No candidate shall be permitted to hand over his/her Answer-Sheet and leave the Examination Hall/Room before expiry of the full time allotted for each paper.
8. No Mobile Phone, Electronic Communication Device, etc., are allowed to be carried inside the Examination Hall/Room by the candidates. Any Mobile Phone, Electronic Communication Device, etc., found in possession of the candidate inside the Examination Hall/Room, even if on off mode, shall be liable for confiscation.
9. No candidate shall have in his/her possession inside the Examination Hall/Room any book, notebook or loose paper, except his/her Admission Certificate and other connected papers permitted by the Commission.
10. Complete silence must be observed in the Examination Hall/Room. No candidate shall copy from the paper of any other candidate, or permit his/her own paper to be copied, or give, or attempt to give, or obtain, or attempt to obtain irregular assistance of any kind.
11. This Test Booklet can be carried with you after answering the questions in the prescribed Answer-Sheet.
12. Noncompliance with any of the above instructions will render a candidate liable to penalty as may be deemed fit.
13. No rough work is to be done on the OMR Answer-Sheet. You can do the rough work on the space provided in the Test Booklet.

N.B. : There will be negative marking @ 0·25 per 1 (one) mark against each wrong answer.

SEAL

[No. of Questions : 100]

1. Three forces P, Q and R keep a body in equilibrium. The angle between the lines of action of forces Q and R is 150°, between P and R is 30° and that between P and Q is α. If $Q = 400$ N, then the value of P is

(A) 1200 N

(B) 800 N

(C) 400 N

(D) 200 N

2. The resultant force of 5 N and 10 N cannot be

(A) 12 N

(B) 8 N

(C) 5 N

(D) 4 N

3. Three forces F, $2F$ and $3F$ act along the sides of an equilateral triangle taken in order. The resultant force is

(A) 0 (B) $\sqrt{3}F$

(C) $2\sqrt{3}F$ (D) $6F$

4. The moment equilibrium for three-force member will only be satisfied if

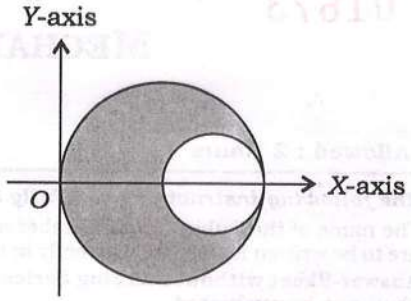
(A) the forces are concurrent

(B) the forces are perpendicular

(C) the forces are in different dimensions

(D) the forces are in the same direction

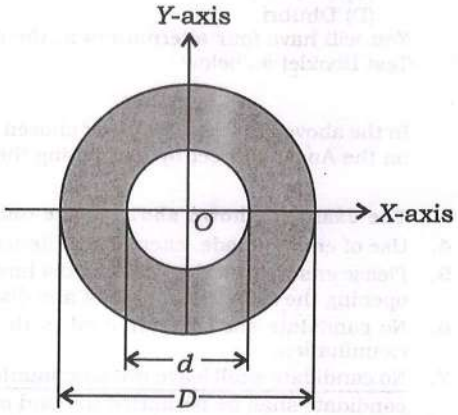
5. A circular hole of diameter r is cut out from a circular disc of diameter $2r$ as shown in the figure below. The centroid of the remaining circular portion with respect to point O will be



(A) $\frac{1}{6}r$ (B) $\frac{10}{11}r$

(C) $\frac{5}{6}r$ (D) $\frac{2}{3}r$

6. The moment of inertia of the hollow circular section as shown in the figure about X-axis is



(A) $\frac{\pi}{16}(D^2 - d^2)$

(B) $\frac{\pi}{16}(D^3 - d^3)$

(C) $\frac{\pi}{32}(D^4 - d^4)$

(D) $\frac{\pi}{64}(D^4 - d^4)$

7. According to parallel axis theorem, the moment of inertia of a section about an axis parallel to the axis through the centre of gravity I_P is given by

(A) $I_P = I_G + Ah^2$

(B) $I_P = I_G - Ah^2$

(C) $I_P = I_G / Ah^2$

(D) $I_P = Ah^2 / I_G$

where A = area of the section, I_G = moment of inertia of the section about an axis passing through its CG, and h = distance between CG and the parallel axis.

8. Moment of inertia of a triangular section of base b and height h about an axis passing through the base is

(A) $\frac{bh^3}{4}$ (B) $\frac{bh^3}{8}$

(C) $\frac{bh^3}{12}$ (D) $\frac{bh^3}{36}$

9. If the angle between force and displacement is 90°, then work done is

(A) zero

(B) minimum

(C) maximum

(D) infinite

10. Find the mechanical advantage of a pulley system if it has an efficiency of 60%. The load is lifted by 3 m when the rope is pulled by 12 m.

(A) 1·2 (B) 2·4

(C) 3·6 (D) 4·8

11. The mechanical advantage of an ideal first system of pulleys having N number of movable pulleys is

(A) 2^{N+1} (B) 2^{N-1}

(C) 2^N (D) $2^N - 1$

12. For a DC generator armature, the back pitch is 7 and the front pitch is 5. The pitch of the winding for lap winding is

(A) 1·4

(B) 2

(C) 3

(D) 12

13. Where does electrostatic shielding occur in a charged spherical shell?

(A) When electrical potential outside the spherical shell is zero

(B) When electrical potential inside the spherical shell is zero

(C) When electrical field is zero outside the spherical shell

(D) When electrical field is zero inside the spherical shell

14. Why is shell-type 3-phase transformer used in larger power transforming applications?

(A) Due to other reasons

(B) Can be made with less height

(C) Can be made with more height

(D) More height and less height flexibility

15. Which of the following parts of a transformer is visible from outside?

(A) Core

(B) Bushing

(C) Primary winding

(D) Secondary winding

16. Which of the following motors can be used to drive rotary compressor?

(A) DC shunt motor

(B) DC series motor

(C) Universal motor

(D) Synchronous motor

17. For which of the following applications a DC motor is preferred over an AC motor?

(A) Low speed operation

(B) High speed operation

(C) Variable speed operation

(D) Fixed speed operation

18. The armature voltage control of DC motor provides

(A) constant torque drive

(B) constant voltage drive

(C) constant current drive

(D) None of the above

19. Which of the following statements about the losses in a DC motor is incorrect?

(A) Brush losses form a part of mechanical losses.

(B) Stray load losses are produced due to the distortion of the air gap flux due to armature reaction.

(C) The no-load rotational loss is made up of iron loss and mechanical loss.

(D) In series motors, the field ohmic loss forms a part of the armature circuit loss.

20. The thickness of lamination in a transformer is usually between

(A) 0·1 mm to 0·2 mm

(B) 0·35 mm to 0·5 mm

(C) 0·1 mm to 0·35 mm

(D) 0·5 mm to 1·2 mm

21. If a transformer has leading power factor load, then voltage regulation will be

(A) zero

(B) negative

(C) positive

(D) All of the above

22. When a transformer is operating on no-load condition, the primary voltage is approximately balanced by

(A) primary induced e.m.f.

(B) secondary induced e.m.f.

(C) terminal voltage across the secondary

(D) voltage drop across the resistance and reactance

23. According to kinetic theory of heat

(A) at absolute zero, there is no vibration of molecules

(B) temperature should rise during the heat transfer

(C) at low temperature, all bodies are in a liquid state

(D) temperature should fall during freezing

24. In a Carnot engine, when the working substance gives heat to the sink

(A) the temperature of the sink increases

(B) the temperature of the sink remains the same

(C) the temperature of the source decreases

(D) the temperatures of both the sink and the source decrease

25. The more effective way of increasing efficiency of Carnot engine is to

(A) increase higher temperature

(B) decrease higher temperature

(C) increase lower temperature

(D) decrease lower temperature

26. Efficiency of Rankine cycle can be increased by

(A) increasing exhaust pressure

(B) decreasing exhaust pressure

(C) increasing the expansion ratio

(D) decreasing initial steam pressure and temperature

27. The efficiency of a Carnot engine working between 600 K and 300 K is

(A) 30% (B) 40%

(C) 50% (D) 60%

28. The property of a working substance which increases or decreases as the heat is supplied or removed in a reversible manner is known as

(A) enthalpy

(B) internal energy

(C) entropy

(D) external energy

29. Rankine efficiency of a steam power plant

(A) improves in summer as compared to that in winter

(B) improves in winter as compared to that in summer

(C) is unaffected by climatic conditions

(D) None of the above

30. In Rankine cycle, the work output from the turbine is given by the

(A) change of internal energy between inlet and outlet

(B) change of enthalpy between inlet and outlet

(C) change of entropy between inlet and outlet

(D) change of temperature between inlet and outlet

31. Which of the following is used to increase the efficiency of a boiler?

(A) Superheater

(B) Economizer

(C) Air preheater

(D) All of the above

32. Which of the following is used for periodical cleaning by discharging the water and sediments from the bottom of boiler?

(A) Feed check valve

(B) Fusible plug

(C) Blow-off cock

(D) Safety valve

33. The mechanical draught _____ the amount of smoke.

(A) increases with

(B) decreases with

(C) does not affect

(D) None of the above

34. In a locomotive boiler, the draught is produced by

(A) chimney

(B) an induced draught fan

(C) steam jet

(D) centrifugal fan

35. The Stirling cycle consists of

(A) two isothermal and two adiabatic processes

(B) two isothermal and two constant volume processes

(C) two isothermal and two constant pressure processes

(D) two isothermal and two isenthalpic processes

36. Which of the following cycles is used for gas turbines?

(A) Joule cycle

(B) Diesel cycle

(C) Dual cycle

(D) Carnot cycle

37. An IC engine works with a compression ratio of 16. If cut-off happens at 8% of the stroke, then the cut-off ratio of the engine is

(A) 1·2

(B) 2·2

(C) 3·2

(D) 4·2

38. The internal energy of an ideal gas is a function of

(A) temperature and pressure

(B) volume and pressure

(C) entropy and pressure

(D) temperature only

39. A polytropic process with $n = -1$, initiates with $P = V = 0$ and ends with $P = 600$ kPa and $V = 0{\cdot}01$ m^3. The work done is

(A) 2 kJ (B) 3 kJ

(C) 4 kJ (D) 5 kJ

40. Bomb calorimeter is used to find the

(A) calorific value of a gaseous fuel

(B) calorific values of solid and gaseous fuels

(C) calorimetric composition of any solid bomb material

(D) calorific value of solid or liquid fuel

41. The two elements of a pair said to form a higher pair, when they

(A) have a surface contact when in motion

(B) have a line or point contact when in motion

(C) are kept in contact by the action of external forces, when in motion

(D) permit relative motion

42. If the number of links in a mechanism is equal to l, then the number of possible inversions is equal to

(A) $l-1$ (B) l

(C) $l+1$ (D) $l+2$

43. The number of degrees of freedom in a planar mechanism having n links and j simple hinge joints is

(A) $3(n-3)-2j$ (B) $3(n-1)-2j$

(C) $3n-2j$ (D) $2j-3n+4$

44. Which of the following are used to correct a rotational motion to translation motion?

(A) Bevel gears

(B) Double helical gears

(C) Worm gears

(D) Rack and pinion gears

45. Maximum fluctuation of energy in a flywheel is equal to

(A) $I\omega(\omega_1 - \omega_2)$

(B) $I\omega^2 C_s$

(C) $2EC_s$

(D) All of the above

46. Do V-belts result in smooth and quiet operation even at high speeds?

(A) Yes

(B) No, they are very noisy

(C) They are not endless and hence do not provide smooth motion

(D) None of the above

47. The centrifugal tension (T_C) in a belt is given by

(A) $T_C = m \times v^2$

(B) $T_C = 2m \times v^2$

(C) $T_C = m / v^2$

(D) $T_C = 2m / v^2$

where m = mass of the belt per unit length, v = velocity of the belt in m/s.

48. The train value of a gear train is

(A) equal to velocity ratio of a gear train

(B) reciprocal of velocity ratio of a gear train

(C) always greater than unity

(D) always less than unity

49. The gear train usually employed in clocks is a

(A) reverted gear train

(B) simple gear train

(C) sun and planet gear

(D) differential gear

50. The force of friction depends upon

(A) nature of surface of contact

(B) material of objects in contact

(C) Both (A) and (B)

(D) None of the above

51. A scooter weighs 120 kg-f. Brakes are applied so that wheels stop rolling and start skidding. Find the force of friction if the coefficient of friction is 0·4.

(A) 60 kg-f (B) 48 kg-f

(C) 25 kg-f (D) 32 kg-f

52. A Hartnell governor is a/an

(A) pendulum type governor

(B) spring loaded governor

(C) dead weight governor

(D) inertia governor

53. For two governors A and B, the lift of sleeve of governor A is more than that of governor B, for a given fractional change in speed. It indicates that

(A) governor A is more sensitive than governor B

(B) governor B is more sensitive than governor A

(C) both governors A and B are equally sensitive

(D) None of the above

54. A governor is said to be hunting, if the speed of the engine

(A) remains constant at the mean speed

(B) is above the mean speed

(C) is below the mean speed

(D) fluctuates continuously above and below the mean speed

55. The dimension of the coefficient of viscosity having the dimensions of mass, length and time as M, L and T respectively is

(A) $M^{-1}L^{-1}T^{-1}$ (B) $M^{-1}L^{1}T^{-1}$

(C) $M^{1}L^{-1}T^{-1}$ (D) $M^{1}L^{-1}T^{-2}$

56. In free vortex flow, the tangential velocity is

(A) directly proportional to radius of fluid particle

(B) inversely proportional to radius of fluid particle

(C) directly proportional to square of radius of fluid particle

(D) inversely proportional to square of radius of fluid particle

57. When the Bernoulli's equation is applied between any two points in a flow field

(A) flow is steady, compressible and irrotational

(B) flow is steady, incompressible and irrotational

(C) flow is unsteady, compressible and rotational

(D) flow is unsteady, incompressible and irrotational

58. Velocity potential exists for

(A) all three-dimensional flow situations

(B) flow of perfect fluid

(C) all irrotational flows

(D) steady irrotational flow

59. The flow of water through the hole in the bottom of a wash basin is an example of

(A) steady flow

(B) uniform flow

(C) free vortex flow

(D) forced vortex flow

60. Which of the following factors affects the discharge of fluid through an orifice?

(A) Density of the fluid

(B) Viscosity of the fluid

(C) Temperature of the fluid

(D) All of the above

61. The depth of flow of water at which the specific energy is minimum is known as

(A) critical depth

(B) pressure depth

(C) energy depth

(D) velocity depth

62. In order that flow takes place between two points in a pipeline, the differential pressure between these points must be more than

(A) frictional force

(B) viscosity force

(C) surface friction

(D) All of the above

63. A static fluid can have

(A) non-zero normal and shear stress

(B) negative normal stress and zero shear stress

(C) positive normal stress and zero shear stress

(D) zero normal stress and zero shear stress

64. For interface boundary condition

(A) velocity is continuous across the interface, but its slope is not

(B) both velocity and its slope are continuous across the interface

(C) temperature is continuous across the interface, but its slope is not

(D) Both (A) and (C)

65. What is creep?

(A) Gradual increase of plastic strain with time at varying load

(B) Gradual increase of elastic strain with time at varying load

(C) Gradual increase of plastic strain with time at constant load

(D) Gradual increase of elastic strain with time at constant load

66. What is the primary failure mode for ductile material?

(A) Brittle fracture

(B) Yielding

(C) Shear failure

(D) Fatigue

67. The Young's modulus E, the shear modulus G and the Poisson's ratio μ for material are related by the expression

(A) $E = 2G(1+\mu)$

(B) $E = 3G(1-\mu)$

(C) $E = 3G(1-2\mu)$

(D) $E = 3G(1+2\mu)$

68. When a body is subjected to direct tensile stresses P_1 and P_2 in two mutually perpendicular directions, accompanied by a simple shear stress q, then in Mohr's circle method, the radius is taken as

(A) $\frac{P_1 - P_2}{2} + q$

(B) $\frac{P_1 + P_2}{2} + q$

(C) $\sqrt{\left(\frac{P_1 - P_2}{2}\right)^2 + q^2}$

(D) $\sqrt{\left(\frac{P_1 + P_2}{2}\right)^2 + q^2}$

69. The maximum bending moment in a cantilever beam subjected to uniformly distributed load w over the entire span l is

(A) wl (B) wl^3

(C) $\frac{wl^2}{2}$ (D) w

70. The shear force of a cantilever beam of length l carrying a uniformly distributed load of w per unit length is _____ at the free end.

(A) zero (B) $\frac{wl}{4}$

(C) $\frac{wl}{2}$ (D) wl

71. The maximum bending moment of a simply supported beam of span l and carrying a point load W at the centre of beam is

(A) $\frac{Wl}{4}$ (B) $\frac{Wl}{2}$

(C) $\frac{Wl^2}{4}$ (D) $\frac{Wl^2}{2}$

72. Shear force at a point in a beam, where maximum bending moment occurs is

(A) maximum

(B) minimum

(C) zero

(D) None of the above

73. Two closely coiled helical springs A and B are equal in all respects but the diameter of the spring A is doubled that of spring B. The stiffness of spring B will be _____ that of spring A.

(A) $\frac{1}{16}$ (B) $\frac{1}{8}$

(C) $\frac{1}{4}$ (D) $\frac{1}{2}$

74. Two closely-coiled helical springs A and B of the same material, same number of turns and made from same wire are subjected to an axial load W. The mean diameter of spring A is double the mean diameter of spring B. The ratio of deflections in spring B to spring A will be

(A) 4 (B) 2

(C) $\frac{1}{4}$ (D) $\frac{1}{8}$

75. Which of the following is an example of steady-state heat transfer?

(A) Electric bulb cools down by the surrounding atmosphere

(B) Chilling effect of cold wind on a warm body

(C) Boilers and turbines

(D) Cooling of IC engine

76. Which of the following processes is reversible?

(A) Transfer of heat by conduction

(B) Transfer of heat by radiation

(C) Isothermal compression

(D) Electrical heating of a nichrome wire

77. A person prefers to sit by a fire during the cold winter months. Which of the following heat transfer types gives him the most heat?

(A) Convection and radiation together

(B) Radiation will provide quick warmth

(C) If it is near the fire, convection sounds good

(D) Conduction from the fire

78. To achieve faster thermal equilibrium with the test piece or test domain, the geometry of bulb of the thermometer should be

(A) spherical (B) cylindrical

(C) ellipsoidal (D) cubic

79. The insulating ability of an insulator with the presence of moisture

(A) would increase

(B) would decrease

(C) remains unaffected

(D) may increase/decrease depending on temperature and thickness of insulation

80. The appropriate rate equation for convective heat transfer between a surface and adjacent fluid is prescribed by which law?

(A) Newton's law of cooling

(B) Kirchhoff's law

(C) Newton's first law

(D) Wien's displacement law

81. A wire of radius 3 mm and 1·25 m length is to be maintained at 60 degree celsius by insulating it by a material of thermal conductivity 0·175 W/m K. The temperature of surrounding is 20 degree celsius with heat transfer coefficient 8·5 $W/m^2 K$. Find the percentage increase in heat loss due to insulation.

(A) 124·23% (B) 100·00%

(C) 12·55% (D) 134·46%

82. Which of the following statements is incorrect according to heat transfer?

(A) Heat flow doesnot depend on temperature

(B) Material medium is not necessary for heat transmission

(C) The process of heat transfer is an irreversible process

(D) For heat exchange, a temperature gradient must exist

83. When the _____ number is unity, one can expect the momentum and mass transfer by diffusion to be the same.

(A) Grashof (B) Reynolds

(C) Lewis (D) Schmidt

84. What is the purpose of Time and Motion Study in Industrial Engineering?

(A) Analyzing financial statements

(B) Assessing employee satisfaction

(C) Monitoring market trends

(D) Evaluating work processes for efficiency

85. Which of the following statements is wrong with regards to reducing the product cost?

(A) A product should be designed with expensive material.

(B) A product should be designed with parts as fewer as possible.

(C) Make or buy decisions should be made correctly.

(D) A product should be designed out of as many standard parts as possible.

86. Which of the following is the preliminary stage of production planning?

(A) Capacity planning

(B) Material requirements planning

(C) Scheduling

(D) Product development and design

87. Which of the following is not a phase in the bath-tub curve?

(A) Early failure

(B) Constant failure

(C) Wear-out failure

(D) High failure

88. Which chart is used in production scheduling?

(A) Gantt chart

(B) Control chart

(C) Flow chart

(D) Pie chart

89. The mathematical technique for finding the best use of limited resources of a company in the maximum manner is known as

(A) value analysis

(B) network analysis

(C) linear programming

(D) queuing theory

90. Critical path method requires

(A) single time estimate

(B) double time estimate

(C) triple time estimate

(D) None of the above

91. The factor does not affect plant layout is

(A) product quality

(B) production volume

(C) space

(D) staff salary

92. Value analysis is a _____ process.

(A) remedial

(B) preventive

(C) continuous

(D) None of the above

93. What happens to the EOQ if the ordering cost increases?

(A) EOQ increases

(B) EOQ decreases

(C) EOQ remains the same

(D) EOQ becomes zero

94. Which of the following is limitation of break-even analysis?

(A) Static concept

(B) Capital employed is taken into account

(C) Limitation of non-linear behaviour of costs

(D) Limitation of presence of perfect competition

95. How is the cascade system achieved?

(A) VCR system in a parallel combination

(B) VCR system in a series combination

(C) VAR system in a series combination

(D) VAR system in a parallel combination

96. Which of the following represents sensible cooling on the psychrometric chart?

(A) Inclined line

(B) Curve

(C) Horizontal line

(D) Vertical line

97. In case of sensible cooling of air, the coil efficiency is given by ____, where BPF is by-pass factor.

(A) BPF – 1

(B) 1 – BPF

(C) $\frac{1}{\text{BPF}}$

(D) 1 + BPF

98. It is desired to condition the outside air from 70% relative humidity and 45 °C dry-bulb temperature to 50% relative humidity and 25 °C dry-bulb temperature (room condition). The practical arrangement will be

(A) dehumidification

(B) cooling and humidification

(C) cooling and dehumidification

(D) dehumidification and pure sensible cooling

99. Which of the following is denoted by $LH = (h_1 - h_2) = h_{fg}(W_1 - W_2)$?

(A) Sensible cooling

(B) Sensible heating

(C) Humidification

(D) Dehumidification

100. During humidification process, the dry-bulb temperature

(A) increases

(B) decreases

(C) tends to zero

(D) remains the same

SPACE FOR ROUGH WORK

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SEAL

★★★