CCE(P) - 2015
MECHANICAL ENGINEERING

KTM-21-XV

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Subject Code : | 2 | 1 |

Test Booklet No. : 00985

TEST BOOKLET

MECHANICAL ENGINEERING

Time Allowed : 2 (Two) Hours **Full Marks : 200**

INSTRUCTIONS

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Subject Code shall be written legibly and correctly in the space provided on the Answer Sheet with black ball pen.
2. **Space provided for Series in the Answer Sheet is not applicable for Optional Subject. So the space shall be left blank.**
3. All questions carry equal marks. Your total marks will depend only on the number of correct responses marked by you in the Answer Sheet.
4. No candidate shall be admitted to the Examination Hall/Room 20 minutes after commencement of distribution of the paper. The Supervisor of the Examination Hall/Room will be the time-keeper and his/her decision in this regard is final.
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7. 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 paper permitted by the Commission.
8. 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.
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[No. of Questions : 100]

SEAL

CCE (P) - 2015

MECHANICAL ENGINEERING

1. The resultant of two equal forces is equal to either of them. The angle between the forces is

(A) 0°

(B) 60°

(C) 90°

(D) 120°

2. If the resultant of two forces P and Q acting at an angle θ, makes an angle α with the force P, then

(A) $\tan\alpha = P\sin\theta / (P + Q\cos\theta)$

(B) $\tan\alpha = P\cos\theta / (P + Q\cos\theta)$

(C) $\tan\alpha = Q\sin\theta / (P + Q\cos\theta)$

(D) $\tan\alpha = Q\cos\theta / (P + Q\cos\theta)$

3. Which of the following physical quantities is not a vector?

(A) Mass

(B) Momentum

(C) Impulse

(D) Acceleration

4. The acceleration of a particle, moving with simple harmonic motion, at any instant is given by

(A) $\omega \cdot y$

(B) $\omega^2 \cdot y$

(C) ω^2 / y

(D) ω^3 / y

5. When a body moves with simple harmonic motion, the product of its periodic time and frequency is equal to

(A) zero

(B) 1

(C) $\pi / 2$

(D) π

6. The dimensional formula ML^2T^{-3} represents

(A) work

(B) power

(C) force

(D) momentum

7. For perfectly elastic bodies, the value of coefficient of restitution is

(A) 1

(B) 0·5 to 1

(C) 0 to 0·5

(D) zero

8. In simple harmonic motion, the acceleration is proportional to

(A) displacement

(B) linear velocity

(C) angular velocity

(D) rate of change of angular velocity

9. A force which combines two or more forces to produce equilibrium is called

(A) resultant

(B) equilibrant

(C) couple

(D) moment

10. An attempt to turn a key into a lock manifests in the application of

(A) coplanar force

(B) moment

(C) couple

(D) torque

11. An automobile steering gear is an example of

(A) sliding pair

(B) rolling pair

(C) lower pair

(D) higher pair

12. Inversion of a mechanism means

(A) turning it upside down

(B) fixing different links in a kinematic chain

(C) changing a higher pair to lower pair

(D) changing the input and output links

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

(A) N

(B) $N-1$

(C) $N+1$

(D) $N+2$

14. The relation between number of pairs (p) forming a kinematic chain and number of links (l) is

(A) $l = 2p - 2$

(B) $l = 2p - 3$

(C) $l = 2p - 4$

(D) $l = 2p - 5$

15. The linear velocity of a point B on a link rotating at an angular velocity ω relative to another point A on the same link is

(A) $\omega^2 \cdot AB$

(B) $\omega \cdot AB$

(C) $\omega \cdot (AB)^2$

(D) ω / AB

16. The total number of instantaneous centres of a mechanism having n links is

(A) $n(n-1)/2$

(B) $(n-1)/2$

(C) $n(n+1)/2$

(D) $(n+1)/2$

17. If the mean radius of a rim-type flywheel is halved, its stored energy is _____ of/as the original flywheel at the same speed.

(A) two times

(B) half

(C) same

(D) one-fourth

18. A Hartnell governor is a governor of the

(A) deadweight type

(B) pendulum type

(C) inertia type

(D) centrifugal type

19. The speed range of a Watt governor is

(A) 20 r.p.m. to 50 r.p.m.

(B) 60 r.p.m. to 80 r.p.m.

(C) 80 r.p.m. to 120 r.p.m.

(D) 120 r.p.m. to 200 r.p.m.

20. A Porter governor has maximum and minimum equilibrium speeds of 200 r.p.m. and 150 r.p.m. respectively. If the effective load on the sleeve is 300 N, the governor effort would be

(A) 16·7 N

(B) 58·3 N

(C) 75 N

(D) 100 N

21. A rack is a gear of infinite

(A) pitch

(B) module

(C) diameter

(D) number of teeth

22. An external gear with 60 teeth meshes with a pinion of 20 teeth, module being 6 mm. What is the centre distance in mm?

(A) 120

(B) 180

(C) 240

(D) 300

23. The motion transmitted between the teeth of two spur gears is generally

(A) sliding

(B) rolling

(C) rotary

(D) partly sliding and partly rolling

24. In one revolution of the crank, the maximum value of primary force occurs

(A) twice

(B) three times

(C) four times

(D) six times

25. The size of a gear is usually specified by

(A) pressure angle

(B) pitch circle diameter

(C) circular pitch

(D) diametral pitch

26. What is the condition for dynamic balancing of a shaft-rotor system?

(A) $\Sigma M = 0$ and $\Sigma F = 0$

(B) $\Sigma M = 0$

(C) $\Sigma F = 0$

(D) $\Sigma F + \Sigma M = 0$

where ΣF is the total force and ΣM is the total torque.

27. The balancing of a rigid rotor can be achieved by appropriately placing balancing masses in

(A) a single plane

(B) two planes

(C) three planes

(D) four planes

28. A _____-cylinder in-line engine working on a four-stroke cycle is completely balanced inherently.

(A) two

(B) three

(C) four

(D) six

29. If the damping factor for a vibrating system is unity, then the system will be

(A) over-damped

(B) under-damped

(C) critically damped

(D) without vibrations

30. In a forced vibration with viscous damping, maximum amplitude occurs when forced frequency is

(A) equal to natural frequency

(B) slightly less than natural frequency

(C) slightly greater than natural frequency

(D) zero

31. Hooke's law holds good up to

(A) yield point

(B) elastic limit

(C) plastic limit

(D) breaking point

32. The Young's modulus of a material is 125 GPa and Poisson's ratio is 0·25. The modulus of rigidity of the material is

(A) 30 GPa

(B) 50 GPa

(C) 80 GPa

(D) 100 GPa

33. The value of modulus of elasticity for steel is

(A) 70 GPa

(B) 100 GPa

(C) 125 GPa

(D) 200 GPa

34. Bulk modulus is measured in terms of

(A) N/m

(B) N/m^2

(C) N-m/s

(D) $N\text{-}s/m^2$

35. When a wire is stretched to double its length, the longitudinal strain produced in it is

(A) 0·5

(B) 1·0

(C) 1·5

(D) 2·0

36. When the shear force diagram is a parabolic curve between two points, it indicates that there is

(A) a point load at two points

(B) no loading between the two points

(C) a uniformly distributed load between the two points

(D) a uniformly varying load between the two points

37. The bending moment for a certain portion of a beam is constant. For that section, shear force would be

(A) zero

(B) increasing

(C) decreasing

(D) constant

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

(A) $Wl/4$

(B) $Wl/2$

(C) Wl

(D) $Wl^2/4$

39. The strain energy stored in a body, when the load is gradually applied, is

(A) $\sigma E/V$

(B) $\sigma V/E$

(C) $\sigma^2 E/2V$

(D) $\sigma^2 V/2E$

where σ = stress in the material of the body, V = volume of the body and E = modulus of elasticity of the material.

40. When a shaft is subjected to twisting moment, every cross-section of the shaft will be under

(A) tensile stress

(B) compressive stress

(C) shear stress

(D) bending stress

41. In a centrifugal casting method

(A) no core is used

(B) core is made of sand

(C) core is made of ferrous metal

(D) core is made of any metal

42. The property of a material necessary for forgings, in stamping image on coins and in ornamental work is

(A) elasticity

(B) plasticity

(C) ductility

(D) malleability

43. Cold working of metal increases

(A) tensile strength

(B) yield strength

(C) hardness

(D) All of the above

44. The process of decreasing the cross-section of a bar and increasing its length is called

(A) drawing-down

(B) upsetting

(C) spinning

(D) peening

45. Which one of the following processes produces a casting when pressure forces the molten metal into the mould?

(A) Shell moulding

(B) Investment casting

(C) Die casting

(D) Continuous casting

46. A casting defect which occurs due to improper venting of sand is known as

(A) cold shut

(B) blowhole

(C) shift

(D) swell

47. The process of cutting a flat sheet to the desired shape is known as

(A) blanking

(B) trimming

(C) stamping

(D) piercing

48. Neutral flame is used to weld

(A) steel

(B) cast iron

(C) copper

(D) All of the above

49. A hacksaw blade cuts on the

(A) forward stroke

(B) return stroke

(C) both forward and return strokes

(D) None of the above

50. Which one of the following is a single-point cutting tool?

(A) Hacksaw blade

(B) Milling cutter

(C) Grinding wheel

(D) Parting tool

51. The number of zones of heat generation in spot welding is

(A) two

(B) three

(C) five

(D) seven

52. Filler metal is used in

(A) seam welding

(B) spot welding

(C) projection welding

(D) gas welding

53. Flank wear occurs on

(A) relief face of the tool

(B) rake face

(C) nose of the tool

(D) cutting edge

54. A moving mandrel is used in

(A) wire drawing

(B) tube drawing

(C) metal cutting

(D) forging

55. Dies for wire drawing are made of

(A) cast iron

(B) wrought iron

(C) mild steel

(D) carbides

56. Which of the following is the extensive property of a thermodynamic system?

(A) Volume

(B) Temperature

(C) Pressure

(D) Specific volume

57. As differentials, heat and work would be described mathematically as

(A) exact

(B) inexact

(C) point function

(D) discontinuity

58. The change in internal energy in a reversible process occurring in a closed system is equal to the heat transferred if the process occurs at constant

(A) temperature

(B) pressure

(C) volume

(D) enthalpy

59. Which of the following parameters remains constant in a throttling process?

(A) Entropy

(B) Enthalpy

(C) Pressure

(D) Temperature

60. The second law of thermodynamics defines

(A) enthalpy

(B) internal energy

(C) entropy

(D) specific heat

61. A Carnot cycle is having an efficiency of 0·75. If the temperature of high-temperature reservoir is 727 °C, what is the temperature of low-temperature reservoir?

(A) 23 °C

(B) –23 °C

(C) 0 °C

(D) 250 °C

62. A condenser of a refrigeration system rejects 120 kW heat while the power supplied is 30 kW. The COP of the system is

(A) 2

(B) 3

(C) 4

(D) 5

63. A Carnot engine operates between a source and sink. If 40% of heat is rejected at 27 °C, what will be the source temperature?

(A) 67 °C

(B) 227 °C

(C) 477 °C

(D) 757 °C

64. A mixture of gas expands from $0{\cdot}03\ m^3$ to $0{\cdot}06\ m^3$ at constant pressure of 1 MPa and absorbs 84 kJ of heat during process. The change in internal energy of the mixture is

(A) 30 kJ

(B) 54 kJ

(C) 84 kJ

(D) 114 kJ

65. An electric current of 1 amp flows through a resistor of 300 ohm, which is in contact with a reservoir at 300 K. At steady state, the rate of entropy generation of the universe is

(A) 1 W/K

(B) 2 W/K

(C) 2 J/K

(D) 1 J/K

66. A pure substance cannot remain in liquid phase if it is below the

(A) critical state

(B) triple point

(C) saturated liquid line

(D) saturated vapour line

67. Which of the following expands in volume upon freezing?

(A) Mercury

(B) Alcohol

(C) Water

(D) Chloroform

68. The gas constant (R) is equal to the

(A) ratio of two specific heats

(B) product of two specific heats

(C) sum of two specific heats

(D) difference of two specific heats

69. The general law of expansion or compression is $pv^n = c$. The process is said to be hyperbolic if n is equal to

(A) zero

(B) 1

(C) γ

(D) ∞

70. The increase in entropy of a system represents

(A) increase in availability of energy

(B) increase in temperature

(C) decrease in pressure

(D) degradation of energy

71. A composite slab has two layers of different materials with thermal conductivity k_1 and k_2. If each layer has the same thickness, then the equivalent thermal conductivity of the slab will be

(A) $k_1 k_2$

(B) $k_1 + k_2$

(C) $(k_1 + k_2) / k_1 k_2$

(D) $2k_1 k_2 / (k_1 + k_2)$

72. The process of heat transfer from one particle of the fluid to another by the actual movement of fluid particles due to difference of density caused by temperature of the particles is known as

(A) conduction

(B) free convection

(C) forced convection

(D) radiation

73. The ratio of energy transferred by convection to that by conduction is called

(A) Stanton number

(B) Nusselt number

(C) Biot number

(D) Peclet number

74. The emissivity of a black body is

(A) zero

(B) 0·5

(C) 0·75

(D) 1

75. The hydrodynamic and thermal boundary layers are identical if Prandtl number is equal to

(A) 0·5

(B) 1

(C) 10

(D) 50

76. Fins are made as thin as possible to

(A) reduce the total weight

(B) accommodate more number of fins

(C) increase the width for the same profile area

(D) improve flow of coolant around the fins

77. In a heat exchanger, the hot liquid enters with a temperature of 180 °C and leaves at 160 °C. The cold fluid enters at 30 °C and leaves at 110 °C. The capacity ratio of the heat exchanger is

(A) 0·25

(B) 1·5

(C) 0·33

(D) 0·2

78. The steam condenser is a heat exchanger of which of the following types?

(A) Direct contact

(B) Regenerator

(C) Recuperator

(D) None of the above

79. A refrigerator working on reversed Carnot cycle has a COP of 4. If it works as a heat pump and consumes 1 kW, the heating effect will be

(A) 1 kW

(B) 4 kW

(C) 5 kW

(D) 6 kW

80. The throttling operation in a refrigeration cycle is carried out in

(A) evaporator

(B) discharge valve

(C) capillary tube

(D) compressor

81. Which of the following parameters remains constant during sensible cooling or heating process?

(A) Dry-bulb temperature

(B) Wet-bulb temperature

(C) Humidity ratio

(D) Relative humidity

82. The capacity of a refrigerating machine is expressed as

(A) inside volume of cabinet

(B) lowest temperature attained

(C) gross weight of the machine in tons

(D) rate of extraction of heat from space being cooled

83. The expansion of steam, as it flows over the blades in reaction turbine, represents

(A) isothermal process

(B) isentropic process

(C) throttling process

(D) free-expansion process

84. An air preheater is installed

(A) before the economizer

(B) before the superheater

(C) between the economizer and chimney

(D) None of the above

85. If clearance volume of IC engines is increased, the compression ratio will

(A) increase

(B) decrease

(C) remain same

(D) be doubled

86. What is often called the fuel of future?

(A) Hydrogen

(B) Methane

(C) Ethanol

(D) Natural gas

87. The dimensions of surface tension are

(A) ML^{-1}

(B) L^2T^{-1}

(C) $ML^{-1}T^{-1}$

(D) MT^{-2}

88. The depth of centre of pressure in a rectangular lamina immersed vertically in water up to height h is given by

(A) $h/4$

(B) $2h/3$

(C) $3h/4$

(D) $h/2$

89. One poise is equal to

(A) 0·1 N-s/m^2

(B) 1 N-s/m^2

(C) 10 N-s/m^2

(D) 100 N-s/m^2

90. A fluid having no viscosity is known as

(A) real fluid

(B) ideal fluid

(C) Newtonian fluid

(D) non-Newtonian fluid

91. A floating body has the centre of buoyancy at B, centre of gravity at G and metacentre at M. For stable equilibrium of the body

(A) $MG = 0$

(B) M is below G

(C) $BG = 0$

(D) M is above G

92. The equations of motion for a viscous fluid are known as

(A) Euler's equation

(B) Reynolds equation

(C) Navier-Stokes equation

(D) Hagen-Poiseuille equation

93. In the boundary layer, the flow is

(A) viscous and rotational

(B) inviscid and irrotational

(C) inviscid and rotational

(D) viscous and irrotational

94. At the point of boundary layer seperation

(A) shear stress is maximum

(B) shear stress is zero

(C) velocity is negative

(D) density variation is maximum

95. The kinematic viscosity is the

(A) ratio of absolute viscosity to the density of the liquid

(B) ratio of density of the liquid to absolute viscosity

(C) product of absolute viscosity and density of the liquid

(D) product of absolute viscosity and mass of the liquid

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

(A) value analysis

(B) network analysis

(C) linear programming

(D) queuing theory

97. Percent idle time for men and machines is found by

(A) time study

(B) analytical sampling

(C) analytical estimating

(D) PERT

98. Gantt charts are associated with

(A) material handling

(B) inventory control

(C) production schedule

(D) sales forecast

99. ABC analysis is used in

(A) job analysis

(B) production schedule

(C) inventory control

(D) CPM

100. In production, planning and control, the document which authorizes the start of an operation on the shop floor is

(A) despatch order

(B) route plan

(C) loading chart

(D) schedule