Name of Post:	Assistant Manager (Electrical, Mechanical & Civil) in Assam Electricity Grid Corporation Limited (AEGCL)
Advt. No.	13/2023 dated 28.04.2023
Date of Screening Test	18.11.2023

AM/AEGCL/ME/23

RE ASKED TO DO SO

Series

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00584

TEST BOOKLET

Paper—II

(MECHANICAL ENGINEERING)

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.

[No. of Questions : 100]

SEAL

1. In a kinematic chain, a quaternary joint is equivalent to

(A) one binary joint

(B) two binary joints

(C) three binary joints

(D) four binary joints

2. The number of instantaneous centres for a mechanism of n links is

(A) $\frac{n}{2}$

(B) n

(C) $\frac{n-1}{2}$

(D) $\frac{n(n-1)}{2}$

3. When a point at the end of a link moves with constant angular velocity, its acceleration will have

(A) radial component only

(B) tangential component only

(C) Coriolis component only

(D) radial and tangential components both

4. The gear by which two non-intersecting and non-parallel shafts can be connected is

(A) spur gear

(B) helical gear

(C) bevel gear

(D) spiral gear

5. A gear with 60 teeth has pitch circle diameter of 720 cm. The module of the teeth is

(A) $\frac{12}{\pi}$ cm

(B) 12 cm

(C) 12π cm

(D) 24 cm

6. For a cam, the maximum travel of the follower from its lowest position to the topmost position is called

(A) trace

(B) pitch

(C) lift

(D) cam profile

7. The tool used for closing down the edges of the plates and heads of the rivets to form metal-to-metal leak-proof joint is

(A) fullering tool

(B) caulking tool

(C) chipping hammer

(D) angle grinder

8. In underdamped vibrating system, if x_1 and x_2 are the successive values of the amplitude on the same side of the mean position, then the logarithmic decrement is equal to

(A) $\frac{x_1}{x_2}$

(B) $\log\left(\frac{x_1}{x_2}\right)$

(C) $\log_e\left(\frac{x_1}{x_2}\right)$

(D) $\log(x_1 x_2)$

9. For a vibratory body, the ratio of energy dissipation per cycle to the maximum kinetic energy is called

(A) specific damping capacity

(B) damping factor

(C) damping ratio

(D) damping coefficient

10. When a shaft is subjected to combined twisting moment T and bending moment M, then the equivalent bending moment is equal to

(A) $\frac{1}{2}\sqrt{M^2+T^2}$

(B) $\sqrt{M^2+T^2}$

(C) $\frac{1}{2}(M+\sqrt{M^2+T^2})$

(D) $M+\sqrt{M^2+T^2}$

11. An open-coiled helical compression spring A of mean diameter 5 cm is subjected to an axial load W. Another spring B of mean diameter 2·5 cm is similar to spring A in all respects. The deflection of spring B will be _____ as compared to spring A.

(A) one-eighth

(B) one-fourth

(C) one-half

(D) eight times

12. The backlash for the spur gear depends upon

(A) module

(B) pitch line velocity

(C) tooth profile

(D) Both (A) and (B)

13. In cyclic loading, stress concentration is more serious in

(A) brittle materials

(B) ductile materials

(C) brittle as well as ductile materials

(D) elastic materials

14. If the surface tension at the soap-air interface is 0·088 N/m, the internal pressure in a soap bubble of 3 cm diameter is

(A) 23·47 Pa

(B) 43·46 Pa

(C) 52·87 Pa

(D) 21·12 Pa

15. If the potential function is expressed as $\phi = 4(x^2 - y^2)$, the corresponding stream function is

(A) $4xy + c$

(B) $4x + y + c$

(C) $x + 4y + c$

(D) $8xy + c$

16. Pelton turbine is to operate under a net head of 500 m and at 420 r.p.m. A single jet with diameter 18 cm is used whose $C_v = 0{\cdot}98$, speed ratio = 0·45 and overall efficiency = 85%. The power developed in kW is

(A) 10300

(B) 13500

(C) 12300

(D) 15900

17. If there are no externally induced flow velocities, then the Nusselt number (Nu) ***does not*** depend upon

(A) Prandtl number (Pr)

(B) Reynolds number (Re)

(C) Grashof number (Gr)

(D) Richardson number (Ri)

18. The second law of thermodynamics defines

(A) heat

(B) work

(C) entropy

(D) enthalpy

19. Which property depends on the surface temperature?

(A) Absorptivity

(B) Reflectivity

(C) Emissivity

(D) Transmissivity

20. Piezometer is used to measure

(A) gauge pressure

(B) vacuum pressure

(C) humidity

(D) radiation

21. The friction factor f for hydrodynamically developed laminar flow inside a circular tube is

(A) $\frac{16}{Re}$

(B) $\frac{32}{Re}$

(C) $\frac{48}{Re}$

(D) $\frac{64}{Re}$

22. Which one of the following is an irrotational flow?

(A) Free vortex flow

(B) Forced vortex flow

(C) Couette flow

(D) Wake flow

23. The range for coefficient of discharge for a venturi meter is

(A) 0·6 to 0·7

(B) 0·7 to 0·8

(C) 0·8 to 0·9

(D) 0·95 to 0·99

24. The maximum efficiency of transmission through a pipe is

(A) 50%

(B) 56·7%

(C) 66·7%

(D) 76·6%

25. The optimum intermediate pressure in case of two-stage compression is given by

(A) $p_2 = \frac{(p_1 + p_3)}{2}$

(B) $p_2 = p_1 + \frac{p_1 - p_3}{2}$

(C) $p_2 = \sqrt{p_1 p_3}$

(D) $p_2 = p_1 + \sqrt{p_1^2 + p_3^2}$

26. Gas contained in a closed system consisting of piston cylinder arrangement is expanded. Work done by the gas during expansion is 50 kJ. Decrease in internal energy during expansion is 30 kJ. Heat transfer during the process is equal to

(A) –20 kJ

(B) +20 kJ

(C) –80 kJ

(D) +80 kJ

27. If the thermal efficiency of a Carnot heat engine is 40%, then the coefficient of performance of a refrigerator working within the same temperature limits would be

(A) 1·5

(B) 2·5

(C) 3·5

(D) 4·5

28. The absorption refrigeration cycle employs which of the following devices for raising pressure?

(A) Compressor

(B) Pump

(C) Generator

(D) Absorber

29. A heat pump working on reversed Carnot cycle between the temperature of 27 °C and –13 °C. The COP of the heat pump is

(A) 7·5

(B) 6·5

(C) 4·5

(D) 3·5

30. A room has room sensible heat load of 20 kW and room latent heat load of 30 kW. The room sensible heat factor will be

(A) 1·5

(B) 0·67

(C) 0·6

(D) 0·4

31. The COP of a refrigerator working on a reversed Carnot cycle is 4. The ratio of the highest absolute temperature to the lowest absolute temperature is

(A) 1·2

(B) 1·25

(C) 3·33

(D) 4

32. The subcooling is a process of cooling the refrigerant in vapour-compression refrigeration system

(A) before compression

(B) after compression

(C) before throttling

(D) after throttling

33. An impulse turbine is used for

(A) low head of water

(B) high head of water

(C) medium head of water

(D) high discharge

34. A turbine develops 5000 kW when running at 80 r.p.m. The head on the turbine is 10 m. If the head on the turbine is increased to 40 m, the speed will become

(A) 40 r.p.m.

(B) 80 r.p.m.

(C) 120 r.p.m.

(D) 160 r.p.m.

35. An oil engine working on dual combustion cycle has a compression ratio 13. If the cut-off occurs at 5% of stroke, the cut-off ratio will be

(A) 1·2

(B) 1·4

(C) 1·6

(D) 1·8

36. For flow along a flat plate, the critical Reynolds number at which the transition from laminar to turbulent flow takes place is

(A) 2×10^3

(B) 5×10^3

(C) 2×10^5

(D) 5×10^5

37. The example of spring-controlled governor is

(A) Watt governor

(B) Porter governor

(C) Proell governor

(D) Hartung governor

38. When two links have surface contact while in motion, the pair so formed is known as

(A) power pair

(B) higher pair

(C) medium pair

(D) surface pair

39. For isochronous governor, the controlling force curve is a

(A) straight line passing through the origin

(B) parabola

(C) circle

(D) cube

40. A horizontal cross-compounded steam engine develops 400 hp at 90 r.p.m. If the speed is to be kept with 0·5% of the mean speed, the coefficient of fluctuation of speed will be

(A) 0·05

(B) 0·5

(C) 0·01

(D) 0·1

41. The coupling used to join two shafts which have lateral misalignment is called

(A) Oldham coupling

(B) universal coupling

(C) flexible coupling

(D) muff coupling

42. The atomic packing factor for body-centred cubic structure is

(A) 0·52

(B) 0·68

(C) 0·74

(D) 1

43. The interstitial solid solution of carbon in γ-iron is called

(A) ferric

(B) austenite

(C) cementite

(D) pearlite

44. The measure of the amount of energy, a material can absorb before fracture, is called

(A) fatigue

(B) toughness

(C) strength

(D) creep

45. The failure that happens due to cyclic loading is called

(A) static failure

(B) shear failure

(C) creep failure

(D) fatigue failure

46. The top part of moulding box used in casting is called

(A) cope

(B) cheek

(C) drag

(D) gagger

47. The process of heating a martensitic steel at a temperature below the eutectoid transformation temperature to make it softer and ductile is

(A) annealing

(B) normalizing

(C) hardening

(D) tempering

48. Spot welding is a type of

(A) gas welding

(B) arc welding

(C) resistance welding

(D) solid-state welding

49. Filler metal used in brazing has a melting point

(A) 227 °C

(B) 327 °C

(C) 427 °C

(D) above 427 °C

50. The 'GO' gauge represents

(A) minimum hole size

(B) maximum hole size

(C) minimum shaft size

(D) difference of hole and shaft size

51. To proceed with the modified distribution method algorithm for solving a transportation problem, the number of dummy allocations need to be added is

(A) n

(B) $n-1$

(C) $2n-1$

(D) $n-2$

52. The method used to solve linear programming problem without use of artificial variable is called

(A) big-M method

(B) simplex method

(C) dual simplex method

(D) graphical method

53. Break-even analysis chart is drawn between

(A) overhead cost and fixed cost

(B) volume of production and income

(C) material cost and labour cost

(D) supply and demand

54. The progressive plastic deformation at constant load over a long period is known as

(A) creep

(B) fatigue

(C) resilience

(D) plasticity

55. The process which improves the machinability of steels, but lowers the hardness and tensile strength is

(A) normalizing

(B) full annealing

(C) process annealing

(D) spheroidizing

56. The casting defect which occurs near the ingates as rough lumps on the surface of a casting is known as

(A) shift

(B) sand wash

(C) swell

(D) scab

57. The purpose of the riser is to

(A) deliver molten metal into the mould cavity

(B) act as a reservoir for the molten metal

(C) feed the molten metal to the casting in order to compensate the shrinkage

(D) deliver the molten metal from pouring basin to gate

58. During cold working process

(A) grain structure is distorted

(B) strength and hardness of the metal increase

(C) surface finish is improved

(D) All of the above

59. The temperature at which the new grains are formed in the metal is called

(A) lower critical temperature

(B) upper critical temperature

(C) eutectic temperature

(D) recrystallization temperature

60. In welding copper alloys with TIG arc welding

(A) direct current with straight polarity is used

(B) direct current with reversed polarity is used

(C) alternating current is used

(D) Any one of (A), (B) and (C)

61. Which one of the lathe parts mentioned below is ***not*** provided with a power feed?

(A) Carriage

(B) Compound rest

(C) Cross-slide

(D) Lead screw

62. The helical grooves which extend to the full length of the drill body are called

(A) lips

(B) cutting edges

(C) margins

(D) flutes

63. The high cutting speed and large rake angle of the tool will result in the formation of

(A) continuous chip

(B) discontinuous chip

(C) continuous chip with built-up edge

(D) Either (A) or (C)

64. A grinding wheel gets glazed due to

(A) wear of abrasive grains

(B) wear of bond

(C) breaking of abrasives

(D) cracks in wheel

65. Which process is used for producing fine surface finish?

(A) Shot peening

(B) Sintering

(C) Tumbling

(D) Swaging

66. For machining a casting on a lathe, it should be held in

(A) collet chuck

(B) magnetic chuck

(C) three-jaw chuck

(D) four-jaw chuck

67. Sine bar is a tool used to measure

(A) length

(B) thickness

(C) inner diameter

(D) angle

68. The smallest measurement that can be recorded accurately with an instrument is called

(A) least count

(B) zero error

(C) precision

(D) accuracy

69. The degree of repetitiveness is known as

(A) least count

(B) zero error

(C) precision

(D) accuracy

70. When the dimension is expressed as $20^{+0\cdot035}_{-0\cdot025}$, then the tolerance is

(A) 0·035 mm

(B) 0·025 mm

(C) 0·01 mm

(D) 0·06 mm

71. The algebraic difference between the minimum limit and the basic size is called

(A) actual deviation

(B) upper deviation

(C) lower deviation

(D) fundamental deviation

72. CNC drilling machine is considered to be a

(A) point-to-point controlled machine

(B) straight line controlled machine

(C) continuous path controlled machine

(D) servo-controlled machine

73. The demand for the four months of the last year are 3, 4, 5 and 6 tons of ingots. The demand for the period of two months from now is

(A) 3·3 tons

(B) 4·3 tons

(C) 9·3 tons

(D) 7·3 tons

74. The demand for the four months of the last year are 3, 4, 5 and 6 tons of ingots. The general equation of demand is

(A) $2+0\cdot5t$

(B) $2\cdot5+0\cdot4t$

(C) $2\cdot5+0\cdot8t$

(D) $3+0\cdot8t$

75. If A is the total items consumed per year, P is the procurement cost per order, and C is the annual inventory carrying cost per item, then the most economic ordering quantity is given by

(A) $\frac{AP}{C}$

(B) $\frac{2AP}{C}$

(C) $\sqrt{\frac{2AP}{C}}$

(D) $\left(\frac{AP}{C}\right)^2$

76. CPM is the

(A) time-oriented technique

(B) activity-oriented technique

(C) event-oriented technique

(D) work-oriented technique

77. Graphical method, simplex method and transportation method are concerned with

(A) value analysis

(B) linear programming

(C) break-even analysis

(D) queuing theory

78. In an LPP, there are n variables and m constraints. The condition of degeneracy occurs when the number of allocated cells is

(A) equal to $(m+n-1)$

(B) more than $(m+n-1)$

(C) less than $(m+n-1)$

(D) None of the above

79. Dielectric is used in

(A) electro-chemical machining

(B) ultrasonic machining

(C) electro-discharge machining

(D) laser machining

80. In a counterflow heat exchanger, oil enters at 100 °C, while water enters at 20 °C and leaves at 60 °C. The overall heat transfer coefficient is 400 W/(m^2C). The effectiveness of the heat exchanger is

(A) 0·5

(B) 0·6

(C) 0·7

(D) 0·8

81. The process in which work is provided with the cutting motion, whereas feed is given to the tool is known as

(A) shaping

(B) planning

(C) turning

(D) milling

82. The face of the tool in contact with the chip is called

(A) flank face

(B) rake face

(C) clearance face

(D) shear face

83. Taylor's tool life equation is

(A) $VT^n = C$

(B) $VT^{n-1} = C$

(C) $V^nT = C$

(D) $V^{n-1}T = C$

where V = cutting speed in m/min, T = tool life in min, n and C are constants.

84. The operation of cutting internal thread of small diameter is called

(A) drilling

(B) reaming

(C) boring

(D) tapping

85. ABC inventory control focuses on those

(A) items not really available

(B) items which consume less money

(C) items which have more demand

(D) items which consume more money

86. Which of the following is ***not*** an input in the material requirement planning process?

(A) The item master file

(B) The product structure file

(C) The master production schedule

(D) The planned order report

87. Two unequal forces acting at a point at an angle of 150° have a resultant, which is perpendicular to the smaller force. The larger force is 24 kN. The approximate smaller force is

(A) 12 kN

(B) 18 kN

(C) 6 kN

(D) 21 kN

88. A column of length L has one end fixed and other end pin-jointed. The equivalent length of the column will be

(A) L

(B) $2L$

(C) $\frac{L}{\sqrt{2}}$

(D) $\frac{L}{2}$

89. At the point of impending motion

(A) the body is on the verge of moving

(B) the frictional force reaches the maximum value

(C) the frictional force is equal to the tangential applied force

(D) All of the above

90. The rectilinear motion of a particle is governed by

$$a = -\frac{16}{x^3}$$

where a is in m/s^2 and x is in m. Given that at time $t = 1$ s, $x = 2$ m and $v = 2$ m/s. The position at $t = 4$ s is

(A) 2·59 m

(B) 4·32 m

(C) 5·29 m

(D) 0·48 m

91. A block of 150 N weight is resting on a rough horizontal table. The coefficient of kinetic friction between the contact surface is 0·2. The horizontal force required to move the block with acceleration of 1·5 m/s^2 is determined to be

(A) 23·78 N

(B) 43·89 N

(C) 52·94 N

(D) 3·21 N

92. For an overdamped system, the value of damping ratio is

(A) 0

(B) 1

(C) <1

(D) >1

93. A vibrating system having mass 2 kg is suspended by a spring of stiffness 800 N/m and it is put to harmonic excitation of 10 N. If the damping is viscous, then the resonant frequency of the system will be

(A) 10 rad/s

(B) 20 rad/s

(C) 30 rad/s

(D) 40 rad/s

94. A varying force $\vec{F} = t^2\vec{i} + 2t\vec{j}$ is applied on a particle from time $t = 0$ to 3 s. The impulse of the force in 3 seconds is

(A) 23·6 N

(B) 9 N

(C) 34·5 N

(D) 12·73 N

95. A train of 400 tons mass is pulled by a locomotive of 20 tons along level rails at a constant speed of 80 kmph. If the force of friction is 100 N/ton, the driving power of the locomotive is

(A) 67 kW

(B) 934 kW

(C) 420 kW

(D) 234 kW

96. The maximum mechanical advantage of a lifting machine is

(A) $(1 + m)$

(B) $(1 - m)$

(C) $\frac{1}{m}$

(D) m

where m = coefficient of friction.

97. Polar modulus of the section of a shaft is a measure of

(A) strength of the shaft in torsion

(B) strength of the shaft in bending

(C) strength of the shaft in lateral loading

(D) torsional rigidity of the shaft

98. A simply supported beam has distributed load of linearly varying intensity with zero at one end to W per unit run at the other. The maximum bending moment is

(A) $\frac{Wl^2}{\sqrt{3}}$

(B) $\frac{Wl^2}{2\sqrt{3}}$

(C) $\frac{Wl^2}{3\sqrt{3}}$

(D) $\frac{Wl^2}{9\sqrt{3}}$

99. The cross-sectional area of a solid shaft of 160 mm diameter is the same as of a hollow shaft of the same material and 120 mm inside diameter. The ratio of angles of twist for the equal lengths when stressed to same intensity is

(A) 3·1

(B) 3·6

(C) 2·4

(D) 1·7

100. A 10 m long simply supported beam carries two point loads of 10 kN and 6 kN at 2 m and 9 m respectively from the left end. It also has a uniformly distributed load of 4 kN/m run for the length between 4 m and 7 m from the left end. The maximum shear force is determined to be

(A) 22 kN

(B) 14 kN

(C) 8 kN

(D) 28 kN

SPACE FOR ROUGH WORK

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