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

TEST BOOKLET NO-25024

PAPER -II

Time Allowed: 3:00 hrs

Maximum Marks: 300

MECHANICAL ENGINEERING

INSTRUCTIONS TO CANDIDATES

Read the instructions carefully before answering the questions: -

1. This Test Booklet consists of 12(twelve) pages and has 75 (seventy five) **items (questions).**
2. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
3. **Please note that it is the candidate's responsibility to fill in the Roll Number and other required details carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet and the Separate Answer Booklet. Any omission/discrepancy will render the OMR Answer Sheet and the Separate Answer Booklet liable for rejection.**
4. Do not write anything else on the OMR Answer Sheet except the required information. Before you proceed to mark in the OMR Answer Sheet, please ensure that you have filled in the required particulars as per given instructions.
5. Use **only Black Ball Point Pen** to fill the OMR Answer Sheet.
6. This Test Booklet is divided into 4 (four) parts – **Part – I, Part - II , Part – III and Part IV**
7. All four parts are **Compulsory**.
8. **Part-I consists of Multiple Choice-based Questions.** The answers to these questions have to be marked in the **OMR Answer Sheet** provided to you.
9. **Part - II ,Part – III and Part IV consists of Conventional Questions.** The answers to these questions have to be written in the **Separate Answer Booklet** provided to you.
10. In Part-I, each item (question) comprises of 04 (four) responses (answers). You are required to select the response which you want to mark on the OMR Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
11. After you have completed filling in all your responses on the OMR Answer Sheet and the Answer Booklet(s) and the examination has concluded, you should hand over to the Invigilator ***only the OMR Answer Sheet and the Answer Booklet(s)***. You are permitted to take the Test Booklet with you.
12. **Penalty for wrong answers in Multiple Choice-based Questions:**
    THERE WIL BE **PENALTY** FOR WRONG ANSWERS MARKED BY A CANDIDATE.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to the question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to the question.
    (iii) If a question is left blank. i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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PART – I

MULTIPLE CHOICE BASED QUESTIONS

Instructions for Questions 1 to 50:

- Choose the correct answer for the following questions
- Each question carries 3 marks (50 x 3 = 150 marks)

1. If $\begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}$ is an orthogonal matrix, then the value of $2a^2 + b^2 + 3c^2$ will be

   A. $\frac{13}{7}$
   B. $\frac{13}{6}$
   C. $\frac{6}{13}$
   D. $\frac{2}{13}$

2. The atomic packing factor is the highest in which of the following cubic lattice systems.

   A. Simple Cubic
   B. Body Centered Cubic (BCC)
   C. Face Centered Cubic (FCC)
   D. Diamond Cubic

3. Which of the following is expected to have the highest thermal conductivity?

   A. Steam
   B. Solid ice
   C. Melting ice
   D. Water

4. The rate of heat transfer across any plane normal to the x- direction is proportional to the wall area and the temperature gradient in the x- direction. This statement is also referred to as _____.

   A. Second Law of Thermodynamics
   B. Kelvin's Law
   C. Third Law of Thermodynamics
   D. Fourier's Law

5. The material commonly used for aircraft gas turbines is.

   A. Stainless steel
   B. High alloy steel
   C. Duralumin
   D. Titanium

6. Falling drops of water become spheres due to the property of _.

   A. Adhesion
   B. Cohesion
   C. Surface tension
   D. Viscosity

7. What is the primary advantage of a worm gear drive?

   A. It can transmit motion between parallel shafts
   B. It provides a high reduction ratio in a compact design
   C. It has very high efficiency
   D. It is used for increasing speed only

8. A fluid whose shear stress is linearly proportional to the velocity gradient in the direction perpendicular to the plane of shear is called as

   A. Friction fluid
   B. Stress fluid
   C. Newtonian fluid
   D. Cartesian fluid

9. The distance between the centres of the rivets in adjacent rows of zigzag riveted joint is known as _.

   A. Pitch
   B. Back pitch
   C. Diagonal pitch
   D. Diametric pitch

10. A body is resting on a plane inclined at an angle of 30° to horizontal. What force would be required to slide it down if the coefficient of friction between body and plane is 0.3?

    A. Zero
    B. 1 kg
    C. 5 kg
    D. None of these

11. The tension in the cable supporting a lift is more when the lift is ____.

    A. moving downwards with uniform velocity
    B. moving upwards with uniform velocity
    C. stationary
    D. moving upwards with acceleration

12. The modulus of rigidity is defined as the ratio of _____.

A. longitudinal stress and longitudinal strain
B. volumetric stress and volumetric strain
C. lateral stress and lateral strain
D. shear stress and shear strain

13. What is the primary function of the clapper box in a shaper machine

A. To hold and rotate the cutting tool
B. To allow the tool to lift slightly during the return stroke
C. To increase the cutting speed during forward stroke
D. To control the feed movement of the tool post

14. At the principal planes ___.

A. The normal stress is maximum or minimum, and the shear stress is zero
B. The tensile and compressive stresses are zero
C. The tensile stress is zero and the shear stress is maximum
D. No stress acts

15. Carburising flame is used to weld metals like ___.

A. Steel
B. Copper and brass
C. Nickel and Monel
D. Carburised steel

16. The moment of inertia of a hollow circular section whose external diameter is 8 cm and internal diameter is 6 cm about centroidal axis is_____cm^4.

A. 437.5
B. 337.5
C. 237.5
D. 137.5

17. The maximum frictional force which comes into play when a body just begins to slide over the surface of another body is known as _.

A. sliding friction
B. rolling friction
C. limiting friction
D. None of these

18. The Chemical formula of refrigerant R11 is

A. CCl_3F
B. CClHF
C. CHF
D. $CClF_3$

19. The process of enlarging the hole to accurate size is called

A. Counter boring
B. Drilling
C. Reaming
D. Knurling

20. Which of the following is the hardest constituent of steel

A. Bainite
B. Martensite
C. Austenite
D. Ledeburite

21. What is the numbers of mole for 52 g of He

A. 14
B. 12
C. 13
D. 11

22. The process of making flat surface on lathe is called

A. Boring
B. Reaming
C. Facing
D. Drilling

23. In the typical grinding wheel specification, "51A60K5V05", what does the letter 'V' represent?

A. Grade
B. Bond type
C. Grit size
D. Abrasive type

24. Which one of the following is a ferromagnetic material

A. Tungsten
B. Aluminium
C. Nickel
D. Copper

25. Steel with 0.8% carbon and 100 % pearlite is called

A. Hypo eutectoid steel
B. Hyper eutectoid steel
C. Eutectoid steel
D. Pro eutectoid steel

26. The frequency of sound wave is 50 Hz and its wavelength is 4 m. What is the distance travelled by the sound wave in 3 seconds.

A. 200 m
B. 100 m
C. 300 m
D. 600 m

27. In reverse polarity welding, the electrode holder is

A. Connected to the positive and work to negative
B. Connected to the negative and work to positive
C. Earthed and work is negative
D. Earthed and work is positive

28. Which of the following is the correct relationship between the elastic constants: Young's modulus (E), shear modulus (G), and Poisson's ratio (ν)

A. $E=2G(1+\nu)$
B. $G=2E(1+\nu)$
C. $E=\frac{G}{2(1+\nu)}$
D. $G=\frac{E(1+\nu)}{2}$

29. The back rake of a turning tool is measured on its

A. Orthogonal plane
B. Machine transverse plane
C. Normal plane
D. Machine longitudinal plane

30. Corundum is composed of 85% of

A. Aluminium oxide
B. Steel
C. Silicon
D. Iron oxide

31. Which of the following is not related to spark ignition engine

A. Spark plug
B. Ignition coil
C. Fuel injector
D. Carburettor

32. Which one of the following is used to check the diameters of holes

A. Standard screw pitch gauge
B. Fillet gauge
C. Slip gauge
D. Plug gauge

33. The property by virtue of which metal can be beaten into thin sheets is called.

A. Lustre
B. Malleability
C. Sonority
D. Ductility

34. Which of the following property is desirable in parts subjected to shock and impact loads

A. Brittleness
B. Strength
C. Toughness
D. Stiffness

35. Which of the following is fitted on top of the cross slide and is used to support the tool post and the cutting tool.

A. Carriage
B. Compound rest
C. Saddle
D. Tail stock

36. A pipe of diameter 10 cm, carrying water at 5 m/s, reduces into a smaller diameter of 5 cm. What is the velocity in the smaller diameter section

A. 1.25 m/s
B. 20 m/s
C. 10 m/s
D. 2.5 m/s

37. Desert cooler operates primarily based on which of the following thermodynamic principles?

    A. Adiabatic expansion of air
    B. Sensible heat transfer by forced convection
    C. Latent heat of vaporization in evaporative cooling
    D. Radiative heat exchange with surroundings.

38. A horizontal pipe carries water flowing at a velocity of 10 m/s. The static pressure gauge reading at its inlet and outlet were 3 and 2.6 kgf/cm^2. The approximate head loss in the pipe is

    A. 0.4 m of water
    B. 4 m of water
    C. 9 m of water
    D. 7.7 m of water

39. Which one of the following elements is used to hold and support the shaft during power transmission

    A. Belt
    B. Pulley
    C. Bearing
    D. Gear

40. Addition of sulphur to the stainless steel increases which of the following

    A. Corrosion resistance
    B. Hardness
    C. Machinability
    D. Wear resistance

41. The maximum shear stress in a shaft of diameter 'd' subjected to torsion 'T' is given by

    A. $32\ T/\pi\ d^3$
    B. $8\ T/\pi\ d^3$
    C. $64\ T/\pi\ d^3$
    D. $16\ T/\pi\ d^3$

42. The modern method of making primary steel from liquid iron and scrap uses

    A. The crucible process
    B. The Bessemer process
    C. Ladle furnace
    D. The basic oxygen steel-making process

43. Function of a governor is to

A. Reduce fluctuation of speed
B. Minimize the vibration of cycle
C. Regulate the speed during one cycle
D. Maintain the speed of engine within specified limit

44. The law that permits the measurement of temperature with a calibrated instrument is called

A. Zeroth law of thermodynamics
B. Second law of thermodynamics
C. First law of thermodynamics
D. Third law of thermodynamics

45. What is the coefficient of performance (COP) of a vapour compression refrigeration system if the enthalpies at the start of compression, at the end of compression and at the end of condensation are 195 kJ/kg, 220 kJ/kg and 95 kJ/kg, respectively?

A. 0.25
B. 4
C. 1
D. 2

46. High carbon steels have carbon percentage in the range of

A. 6–8%
B. 8–10%
C. 11–15%
D. 0.6–2%

47. The component of vector $A = 2\hat{\imath} + 5\hat{\jmath} + 7\hat{k}$ in the direction of a vector $B = 3\hat{\imath} - \hat{\jmath} + 5\hat{k}$ is

A. $\frac{36}{\sqrt{78}}$
B. $\frac{35}{6}$
C. $\sqrt{\frac{78}{35}}$
D. None of the above

48. If both the front view and top view of a 25 mm long line measure 25 mm, what will be its side view?

A. A line of 25 mm
B. A line shorter than 25 mm
C. A line longer than 25 mm
D. A dot

49. Which of the following is not a secondary storage device?

A. Hard Disk Drive (HDD)
B. Random Access Memory (RAM)
C. Solid State Drive (SSD)
D. Compact Disc (CD)

50. Which of the following is the correct extension of an Excel file by default?

A. .docx
B. .pptx
C. .xlsx
D. .txt

PART – II

SHORT ANSWER TYPE QUESTIONS

(Answer any 10 out of 13 questions) 10x 5 marks each = 50 marks

51. List and explain the essential properties of moulding sand required for producing defect-free metal castings.
52. What do you mean by chills and chaplets in context of casting process.
53. State and explain Bernoulli's equation. Using Bernoulli's principle, derive the expression for the theoretical discharge through a sharp-edged orifice of area A under a constant head h.
54. Briefly explain convection and its type.
55. Discuss any five mechanical properties of engineering materials and their practical applications.
56. Define a self-lubricating bearing. Explain its working.
57. Describe Isostatic pressing.
58. What is a broach? State its working and applications.
59. Define FMS.
60. Discuss octane number and cetane number.
61. Derive the expression for thermal stress in a material subjected to temperature change under constrained conditions.
62. Define calorific value of a fuel.
63. Explain the difference between particulate matter PM2.5 and PM10.

PART- III

LONG ANSWER TYPE QUESTIONS

(Answer any 5 out of 8 questions) 5 x 10 marks each = 50 marks

64. What are crystal defects? Describe the types of crystal defects.
65. Discuss in detail induction hardening and flame hardening.
66. Differentiate between thermoplastic and thermosetting plastics. Briefly describe one common processing method used for each type.
67. Define with example point and path function in context of thermodynamic properties. Also prove that work is a path function.
68. Define Non-Destructive Testing (NDT). Briefly explain any one NDT method.
69. Define the Second Law of Thermodynamics. Explain the Kelvin–Planck and Clausius statements of the second law with suitable examples.
70. Define welding. Describe the different types of welding processes in detail.
71. What do you mean by Kaizen? Briefly explain its significance in manufacturing

PART- IV

ESSAY TYPE QUESTIONS

(Answer any 2 out of 4 questions) 2 x 25 marks each = 50 marks

72. Explain the powder metallurgy process in detail with the help of neat diagrams, highlighting each stage involved.
73. Discuss the various types of fuels used in power plants. Explain their characteristics, applications, advantages, and limitations with suitable examples.
74. Explain and differentiate between NC, CNC, and DNC systems in manufacturing. Discuss their working principles, features, and advantages.
75. Describe the classification of internal combustion (IC) engines based on different criteria.

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