ACFMCE

2018

MECHANICAL ENGINEERING

Duration : 3 Hours

Max. Marks : 300

General Instructions to the Applicants :

i) This Question Paper is descriptive type in Degree Standard.

ii) There is no reservation of marks for neatness of execution and correctness of spelling in respect of this paper.

MECHANICAL ENGINEERING

PART — A

Note :   i)   Answer **not exceeding 50 words** each.

         ii)   Each question carries **three marks**.

         iii)   Answer any **thirty** questions only out of **thirty five** Questions.

<div align="right">(30 × 3 = 90)</div>

1. The velocity-time relationship of a moving particle is given by the equation $\dot{x} = \frac{1}{2}Ct^2$, where $C = 2.4\,\text{m/sec}^2$. Determine the displacement velocity and acceleration at $t = 3\,s$, if there was no initial displacement.

2. State parallelogram law of forces.

3. State Hooke's law.

4. Define fit and state the types of fit.

5. Define Young's modulus.

6. What do you mean by resilience?

7. Define and write the expression for unit discharge as applied to turbines.

8. What is hydraulic jump in a fluid flow?

9. On a hot summer day, a student turns his fan on, when he leaves his room in the morning. When he returns back in the evening, will the room be warmer or cooler than the neighbouring rooms. Assume all doors and windows are closed, given explanation for your answer.

10. What is the difference between intensive and extensive properties? Give two examples for each.

<div align="right">**ACFMCE**
[Turn over</div>

11. A 4 kW resistance heater in a water heater runs for 3 hours to raise the temperature to the desired level. Determine the amount of electric energy used in kW-hr and kJ.

12. State Fourier law of heat conduction.

13. What are the essential factors that influence thermal conductivity?

14. Calculate the rate of heat transfer per unit area through a copper plate 45 mm thick, whose one face is maintained at 350°C and the other surface at 50°C. Take thermal conductivity of copper as 370 W/m°C.

15. Define Gibb's phase rule.

16. What is an Eutectic system? Write its equation.

17. What is a substitutional solid solution?

18. List the factors which brings in distortion defects in the weldments.

19. Distinguish between liquid shrinkage and solid shrinkage, with reference to casting. Explain how these are taken care off in the design of sand casting.

20. What is draft allowance? How is it provided in the pattern?

21. Write any three applications of clinometer.

22. State any three causes of out-of-roundness.

23. What do you understand by the term 'Cosine error'?

24. What are the synthetic entities for geometric modeling?

25. Narrate the significance of lofted surface in Geometric modeling.

26. How back-face test is conducted for visual realism?

27. What is the need of monotonic convergence in the FEA?

28. What do you understand by work study?

29. What is method study?

30. What do you understand by the term "work measurement"?

31. A local of 5 kN is to be raised with the help of a steel wire. Find the maximum diameter of the steel wire, if the stress is not to exceed 100 MPa.

32. Using Maxwell relations, determine a relation for $\left(\dfrac{\partial S}{\partial P}\right)_T$ for a gas, whose gas equation of state is $P(V - b) = RT$.

33. Write the effect of chromium and carbon in steel.

34. What are the two corrections applied in the measurement of effective diameter by method of wires?

35. Write the basic requirements for a work study man.

PART — B

Note :   i)   Answer **not exceeding 100 words** each.

  ii)   Each question carries **eight marks**.

  iii)   Answer any **fifteen** questions only out of **eighteen** Questions.

$(15 \times 8 = 120)$

36. In a crank and slotted lever quick return mechanism, the distance between the fixed centres is 240 mm and the length of the driving crank is 120 mm. Find the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to return stroke. If the length of slotted bar is 450 mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever.

37. State and prove the law of gearing. Show that involute profile satisfies the condition for correct gearing.

5

38. Two beams are simply supported over the same span and have the same flexural strength. Compare the weight of these two beams, if one of them is solid and the other is Hallow circular with internal diameter half of the external diameter.

39. An I section beam 350×200 mm has a web thickness of 12.5 mm and a flange thickness of 25 mm. It carries a shearing force of 200 kN at a section. Sketch the shear stress distribution across the section.

40. How is the metacentric height of a floating body determined experimentally?

41. State the assumptions made while deriving Euler's equation of motion for steady flow.

42. A fuel mixture of 60% methane (CH_4) and 40% ethanol (C_2H_6O) by mass is burnt. Completely with theoretical air. If the total flow rate of the fuel is 10 kg/s determine the required flow rate of air.

43. An 80 litre vessel contains 4 kg of refrigerant–134a at a pressure of 160 KPa. Determine the temperature, the quality, the enthalpy of the refrigerant if, the data at 160 KPa reads as follows.

   $v_f = 0.0007435 \, \text{kg/m}^3$, $v_g = 0.12355 \, \text{m}^3\text{/kg}$

   $h_f = 31.18 \, \text{kg/m}^3$, $h_g = 209.96 \, \text{kJ/kg}$.

44. Using the Maxwell relations and the ideal gas equation state, determine relationship for $\left(\dfrac{\partial S}{\partial V}\right)_T$ for gas and also prove that $\left(\dfrac{\partial P}{\partial T}\right)_T = \dfrac{\gamma}{\gamma-1}\left(\dfrac{\partial P}{\partial V}\right)_V$.

45. Explain analogy between momentum and heat transfer.

46. Air at 1 atm and 25°C, containing small quantities of iodine, flows with a velocity of 6.2 m/s inside a 35 mm diameter tube. Calculate mass transfer co-efficient for iodine. The properties are : $v = 15.5 \times 10^{-6} \, \text{m}^2\text{/s}$; $D = 0.82 \times 10^{-5} \, \text{m}^2\text{/s}$.

47. Derive the steady state diffusion through a cylindrical shell.

48. In a given arc-welding operation, the power source is at 20 V and current is at 300 A. If the electrode travels at a speed of 6 mm/s, calculate the cross-sectional area of the joint. The heat transfer efficiency is 80% and melting efficiency is 0.3. Heat required to melt the sheet is 10 J/mm³.

49. Calculate the punching load required to produce the component shown below.
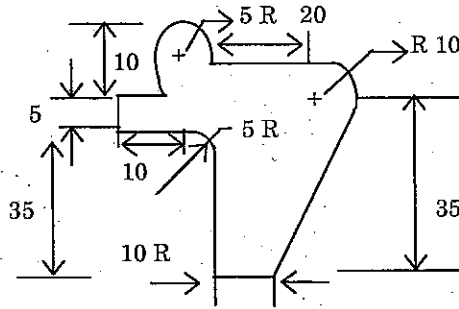
Material C 30 steel

Thickness 1.25 mm

$\tau = 350\,\text{MPa}$.

50. Explain with a suitable case study, the relevance of IGES in the Indian manufacturing scenario.

51. With diagrammatic layout explain the function of DDC (Direct Digital Control) for an oil refinery process.

52. Explain the good qualities of leadership.

53. The activities involved in a small project are given below along with relevant information. Construct the network and find the critical path. Find the floats for each activity.

Activity :	1-2	1-3	2-3	2-4	3-4	4-5
Duration :	20	25	10	12	6	10

PART — C

Note :   i)   Answer **not exceeding 200 words** each.

   ii)   Each question carries **fifteen marks**.

   iii)   Answer any **six** questions only out of **nine** questions.

$(6 \times 15 = 90)$

54. A coil of spring stiffness 4 N/mm supports vertically a mass of 20 kg at the free end. The motion is resisted by the oil dash pot. It is found that the amplitude of vibration at the beginning of the fourth cycle is 0.8 times the amplitude of previous vibration. Determine the damping force per unit velocity. Also find the ratio of the frequency of damped and undamped vibrations.

55. Explain the concept of balancing multi cylinder In-line engine.

ACFMCE

[Turn over

56. Design a belt drive to transmit 110 kW for a system consisting of two pulleys of diameters 0.9 m and 1.2 m, centre distance of 3.6 m, a belt speed 20 m/sec, coefficient of friction 0.3, a slip of 1.2% at each pulley and 5% friction loss at each shaft, 20% over load.

57. An inward flow reaction turbine, having an external diameter of 1.5 metre, runs at 400 rpm. The velocity of flow at inlet is 10 m/s. If the guide blade angle is 15°, find absolute velocity of water and velocity of whirl at inlet.

58. A 70 mm thick metal plate with a circular hole of 35 mm diameter along the thickness is maintained at a uniform temperature 250°C. Find the energy loss to the surroundings at 27°C, assuming the two ends of the holes to be as parallel discs and the metallic surfaces and surroundings have black body characteristics.

59. A 100 mm thick square plate, a right circular cylinder with a radius of 100 mm and a height of 50 mm each have the same volume. If each is to be cast using a cylindrical riser, which part require the same size riser to ensure proper feeding.

60. With suitable example discuss the Generative type process planning taking an Automotive part produced in the Industry.

61. A work study was conducted in a machine shop. The data has been recorded

Total number of observations = 2000

No. activity = 500

The ratio between manual to machine = 3 : 1

Average performance rating = 85%

Total number of pieces produced = 120

Duration of study = 60 hrs.

Calculate the standard time/piece assuming 15% relaxation allowances.

62. Annual requirement of an item is 2,400 units. Each item costs the company Rs. 6. The manufacturer offers a discount of 5% if 500 or more quantities are purchased. The ordering cost is Rs. 32/order and inventory cost is 16%. Whether it is advisable to accept the discount? Comment.