GB/M–06–30A

2006

MECHANICAL ENGINEERING

FIRST PAPER

Full Marks : 200

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Answer *any* **five** questions

1. (a) Draw the shear force and bending moment diagrams for a cantilever of length l, carrying uniformly distributed load of w per meter length over its entire length. 10+10

   (b) Draw the shear force and bending moment diagrams for a simply supported beam of length l, carrying a point load W at its mid-point. 10+10

2. (a) A porter governor having each arm pivoted on axis of rotation has the following particulars :

   Length of each arm = 250 mm
   Mass of each ball = 2 kg
   Central mass = 20 kg
   Minimum ball radius = 100 mm
   Lift of sleeve = 62.5 mm

   Calculate the range of speed of the governor. 20

(*Turn Over*)

(b) Derive an expression for the speed ratio of a compound gear train using one intermediate shaft. 20

3. (a) Four masses A, B, C and D having masses 40, 50, 60 and M kg respectively are rigidly connected to a shaft at 30, 24, 28 and 24 cm respectively from the axis of the shaft. The shaft revolves about its axis and the planes of revolution of the masses are at equal intervals apart. Determine the magnitude of M and the angular positions of masses B, C and D in relation to that of A in order that the masses may completely balance one another. 20

(b) (i) When is crossed belt used instead of open belt?

(ii) On what factor does the centrifugal tension in a belt of a belt drive depend?

(iii) What are the factors on which the ratio of limiting tensions in a belt depend?

(iv) What is the condition for power transmitted by a belt to be maximum? 5×4=20

4. (a) State the principle of electric arc welding and explain what factors affect the depth of penetration in arc welding. 20

(b) Distinguish clearly among the processes of welding, brazing and soldering. 20

5. (a) A spring-mass system having mass m_1 and stiffness k_1 has a natural frequency f_1. Calculate the value of stiffness k_2 of another spring which when connected to k_1 in parallel increases the frequency by 30%. 20

(b) Calculate the modulus of rigidity and bulk modulus of the material of a cylindrical bar of diameter 30 mm and length 1·5 m, if the longitudinal strain in the bar during a tensile test is four times the lateral strain. Find the change in volume when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. Take, $E = 1 \times 10^5$ N/m^2. 20

6. (a) State the advantages of quality control and clearly explain how it can reduce cost of production. 20

(b) Illustrating the progress of an operation with the help of a Gantt chart, explain the utility of the chart as a tool of production. 20

7. Discuss the factors which influence the location of industries. In this context, examine the location of Numaligarh Refinery in Assam. 20+20

8. (a) Discuss the importance of work study in machine shop.   20

   (b) A machine shop produces 5000 articles with average rating factor 1·16 in a work study of 100 hours. The total number of observations recorded was 2500 and no working activity could be noticed for 400 observations. The ratio between the manual and the machine elements was 2 : 1. Estimate the standard time considering allowance to be 12% of the normal time.   20

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