

WBCS MADE EASY

MWC(O)-ME-I/23

2023

MECHANICAL ENGINEERING

PAPER-I

Time Allowed — 3 Hours

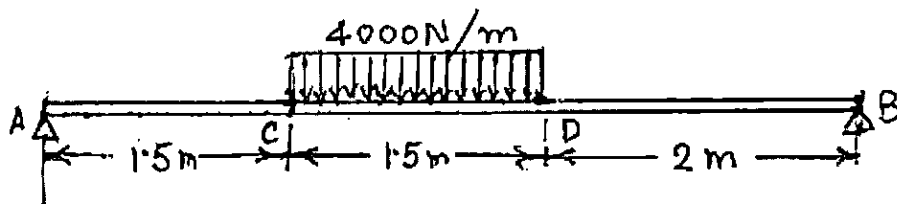
Full Marks — 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in English or in Bengali but all answers must be in one and same language.

Answer any five questions.

1. (a) An open belt drive is required to transmit 9.5 kW of power from a motor running at 580 rpm. Diameter of the driving pulley is 250mm. The speed of the driven pulley is 200 rpm. The belt is 12mm thick and has a mass density of 0.001 g/mm^3 . Safe stress in the belt is not to exceed 2.5 N/mm^2 . The two shafts are 1.25m apart. The coefficient of friction is 0.25. Determine the width of the belt.
(b) In a porter governor, each of the four arms is 380mm long. The upper arms are pivoted on the axis of the sleeve whereas the lower arms are attached to the sleeve at a distance of 40mm from the axis of rotation. Each ball has a mass of 7kg and the load on the sleeve is 55kg. What will be the equilibrium speeds for the two extreme radii of 250mm and 300mm of rotation of the governor balls. 20+20
2. (a) In an unconventional Machining process what is EDM? Explain its principle and working with the help of suitable diagram mentioning its important characteristics.
(b) Write down its merits, demerits and applications. (5+15)+20
3. (a) Describe, with a neat sketch, the working principle of Laser Beam Machining (LBM) mentioning its characteristics.
(b) State its advantages, disadvantages and applications. 20+20
4. (a) Draw the shear force and bending moment diagrams for the beam shown below. Find also the position and magnitude of the maximum bending moment.



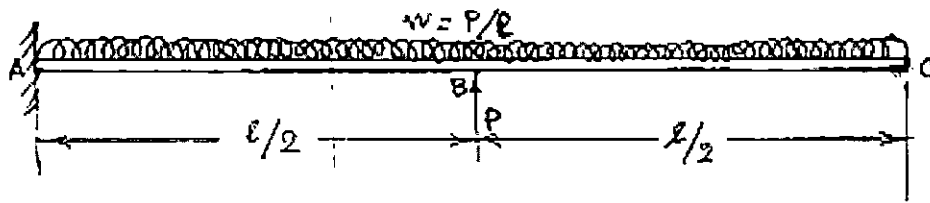
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(2)

- (b) Determine the slope and deflection at the end C of the cantilever ABC as shown below.

20+20



5. (a) What is 'Inventory Control'? What are its objectives?
- (b) Explain briefly 'ABC analysis'.
- (c) What is 'Economic Ordering Quantity'?
- (d) The manager of a factory is purchasing forgings of outer-ring ₹ 10,000 annually. Records reveal that cost of an order is ₹ 15, cost of inventory carrying is 9% of the average inventory value and unit price is ₹ 65.

Obtain the following:

- (i) Economic Ordering Quantity (Q_{opt}), and
- (ii) Optimum Number of Orders per year

15+8+5+12

6. (a) The angle between the axes of two shafts joined by Hooke's joint is 25° . The driving shaft rotates at a uniform speed of 180rpm. The driven shaft carries a steady load of 7.5 kW. Calculate the mass of the flywheel of the driven shaft if its radius of gyration is 150mm and the output torque of the driven shaft does not vary by more than 15% of the input shaft.

- (b) The following data relate to a shaft held in long bearings.

Length of the shaft	= 1.2 m
Diameter of shaft	= 14 mm
Mass of a rotor at midpoint	= 16 kg
Eccentricity of centre of mass of rotor from centre of rotor	= 0.4 mm
Modulus of elasticity of shaft material	= 200 GN/m ²
Permissible stress in shaft material	= 70×10^6 N/m ²

Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Assume the shaft to be massless.

20+20

7. (a) Write short note on "sub zero treatment of steel".
- (b) What is retained austemite? Why is it not desirable? How can it be eliminated.
- (c) Distinguish between full annealing and process annealing.
- (d) State composition, properties and uses of carbon steels.

8+15+8+9

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