·Serial No. | | C–FTF–M–NIB

MECHANICAL ENGINEERING
Paper—II

(Conventional)

| Time Allowed : Three Hours | Maximum Marks : 200 |

INSTRUCTIONS

*Candidates should attempt Question No. 1 in Section—A which is compulsory, **TWO** questions from Section—B and **TWO** questions from Section—C. Each question carries 40 marks.*

Question No. 1 is of short answer type.

The number of marks carried by each part of a question is indicated against each.

*Answers must be written only in **ENGLISH**.*

Assume suitable data, if necessary and indicate the same clearly.

Unless otherwise indicated, symbols and notations have their usual meanings.

Neat sketches to be drawn, wherever required.

① 1

Important note :—

All parts and sub-parts of a question being attempted are to be answered contiguously on the answer-book. That is, all the parts and sub-parts of one question must be completed before attempting the next question.

Pages left blank in the answer-book, if any, are to be struck out. Answers that follow blank pages may not be given credit.

SECTION—A

Answer all the 20 (twenty) parts of the question below. Each part carries 2 marks.

1. (a) Determine the maximum and minimum transmission angle of the mechanism shown which is driven by member O_1A.
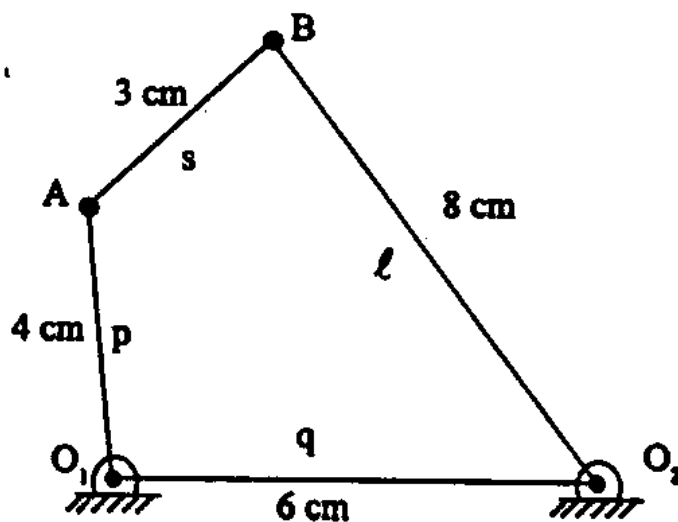
(b) For a cam whose acceleration is constant and is rotating with a constant speed, plot and show displacement diagram, velocity diagram, acceleration diagram and jerk diagram during rise.

(c) What is the effect of V belt over flat belt in transmission ? How to avoid slip in flat belt ?

(d) What are Lang lay and Regular lay wire ropes ? Explain.

(e) Fine pitch threads are more resistant to loosening due to vibrations than coarse pitch threads, why ?

(f) What is the difference between thick film lubrication and thin film lubrication ?

(g) Differentiate between basic static load rating and basic dynamic load rating of a ball bearing.

(h) Differentiate clearly between Yield stress and 0·2% Proof stress for a ductile metal.

(i) At a point in a stressed body, principal strains are e_1 and e_2. If E is the Young's modulus and v is the Poisson's ratio, write down expressions for principal stresses in terms of e_1, e_2, E and v.

(j) A close coiled helical spring is subjected to axial load. Shear stress is developed in spring wire. Why the resultant shear stress at inner coil radius is more than the resultant shear stress at outer coil radius ?

(k) Mark the plane with Miller Indices $(1\ \bar{1}\ 0)$ in a cubic structure.

(l) What is lead-tin eutectic alloy ? What are special characteristics of a eutectic alloy ? What is the composition of solder used in joining electrical connections ?

(m) What types of oxyacetylene flames you will use to weld (i) Copper base metals (ii) High carbon steel ?

Why are all fuel lines threaded left handed ?

(n) Write the advantages and disadvantages of climb milling. In connection with grinding define grinding ratio.

(o) In connection with surface texture define (a) waviness (b) flaws, and (c) lay. List three defects found on surfaces.

(p) Name and explain very briefly the steps in Value Analysis.

(q) Name and differentiate very briefly the principal classes of methods used in forecasting of demand.

(r) List the principal inputs and outputs of a Material Requirement Planning System.

(s) List the steps involved in numbering events and activities in a project so that CPM/PERT can be used for scheduling it.

(t) What are the Memory Management systems used in a computer ?

SECTION—B

2. (a) The following particulars refer to a screw jack shown in Figure below :

Vertical load on the screw	$W = 20,000 \text{ N}$
Force applied at the lever end whose length	$\ell = 80 \text{ cm}$
Mean radius of the screw	$r = 2 \cdot 5 \text{ cm}$
Pitch of the screw	$p = 1 \text{ cm}$
Mean radius of contact surface between swivel & head	$r_m = 4 \text{ cm}$
Coefficient of friction between screw thread and bearing	$\mu' = 0 \cdot 15$
Coefficient of friction between the swivel head and bearing	$\mu = 0 \cdot 1$

(Contd.)

Determine :—

(i) the force on the lever end required while raising and lowering the load.

(ii) the efficiency of the screw jack in both cases.

12
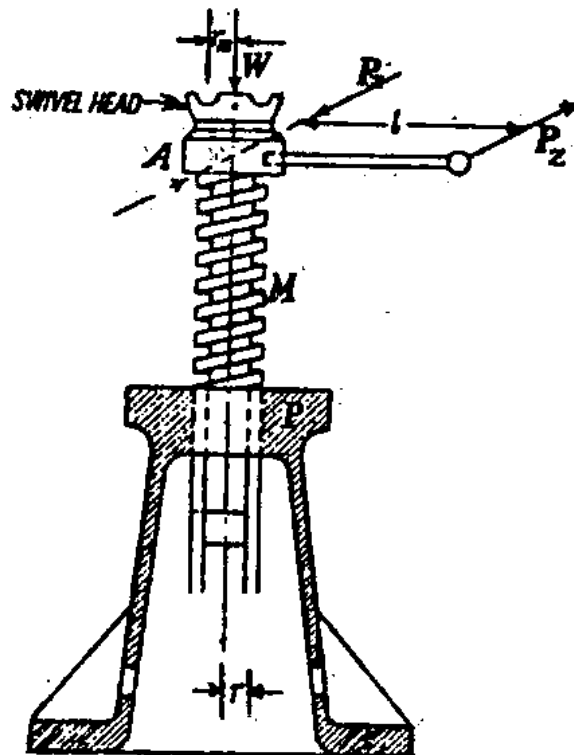
(b) A rotor of mass 10 kg is mounted midway on a 20 mm diameter horizontal shaft supported at the ends by two bearings. The bearing span is 0·8 m. Because of manufacturing defect the center of gravity of the disc is 0·1 mm away from the geometric

(Contd.)

center of the rotor. If the system rotates at 3000 rpm, determine the amplitude of the steady state vibration and the dynamic force transmitted to the bearing. Take $E = 2 \times 10^6$ bar.   10

(c) Write short notes on the following :— .

    (i) Epicyclic gear trains.

    (ii) Interference and undercutting in Involute gears.   8

(d) What are metal matrix composites ? What are special characteristics of these composites ? What are the reinforcing materials ? What are the applications of MMC ?   10

3. (a) An open belt system is transmitting 10 kW power. Driving pulley is of diameter 200 mm and driven pulley is of diameter 480 mm. Centre distance between the pulleys is 2 m. Maximum stress in belt is not to exceed 2·2 MPa. Thickness of the belt is 8 mm. Determine breadth and length of the belt.

Given density of belt material = 950 kg/m^3

Coefficient of friction between belt and pulley = 0·3.

Driving pulley is rotating at 1000 rpm. Neglect bending stress in belt.   20

(b) What are different types of threads used for power transmission ? Make a simple sketch of each. Give special features of each thread and their applications. 10

(c) Fatigue life of a 6×37 wire rope of nominal diameter of 12 mm is to be achieved to.be 0.2 million bends. Tensile stress designation of wire rope is 1960 MPa. How much load can be lifted through a sheave of diameter 400 mm, through the arrangement shown in figure. Take ratio of bearing pressure between rope and sheave to ultimate strength of rope = 0.0024. 10
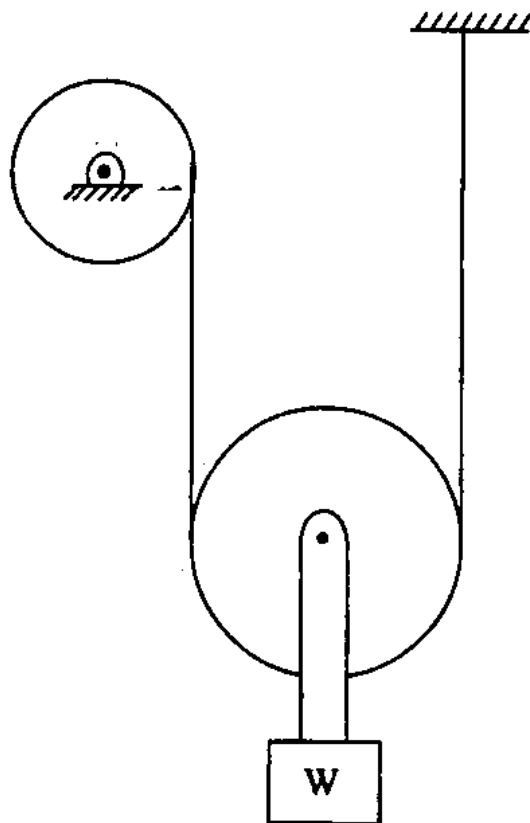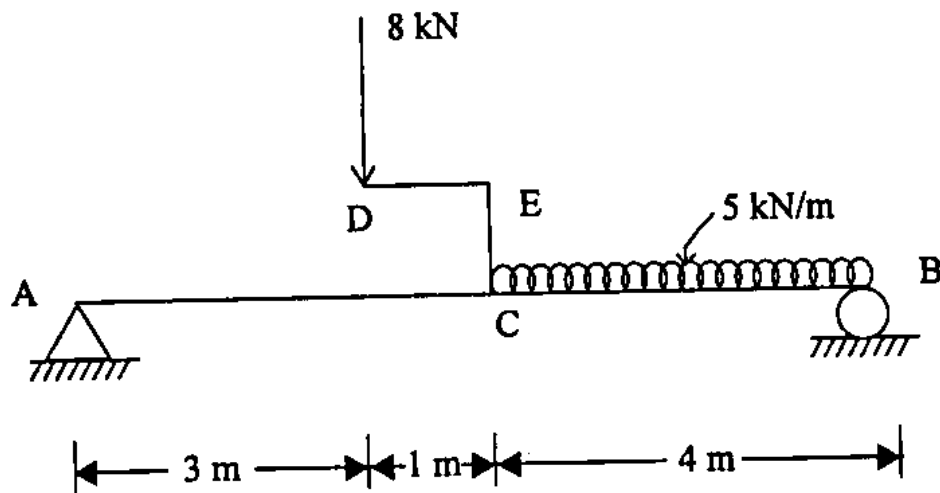
(Contd.)

4. (a) A beam AB, 8 m long hinged at end A and roller supported at end B carries a point load of 8 kN at crank ED = 1 m, and a uniformly distributed load of 5 kN/m over CB = 4 m.

Determine :

(i) reactions at ends.

(ii) bending moment at section where SF is zero.
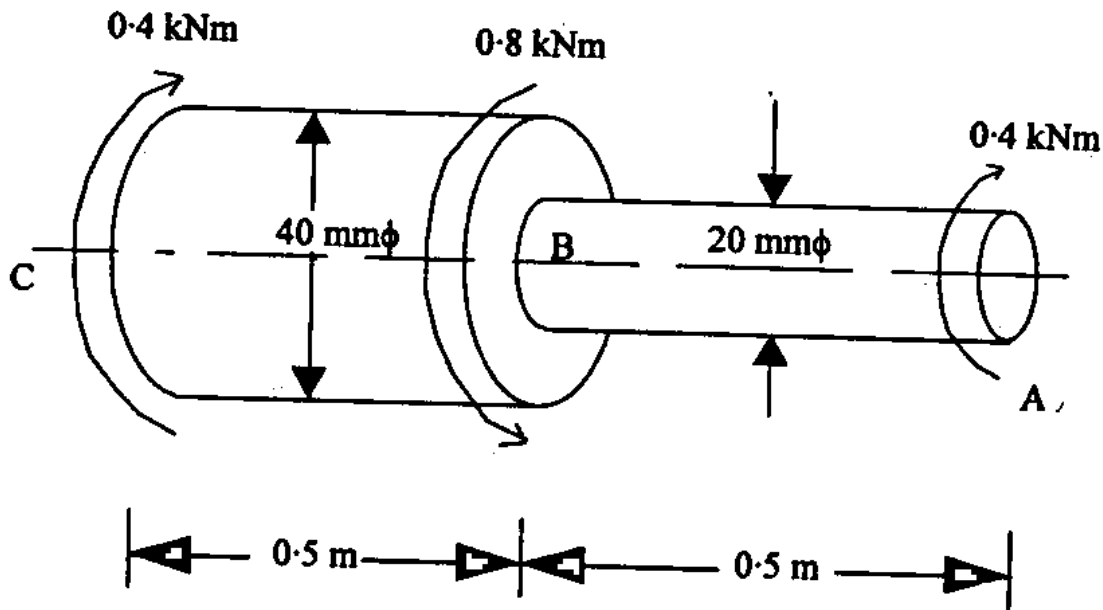
(iii) Draw BM diagram only.   20

(b) A stepped shaft ABC, 1 m long made of steel is of diameter 20 mm from A to B = 0·5 m, 40 mm from B to C = 0·5 m. It is subjected to twisting

(Contd.)

moments 0·4 kNm (cw) at A, 0·8 kNm (ccw) at B and 0·4 kNm (cw) at C.

If $G = 84$ kN/mm^2 determine angular twist between A to C.

10

0·4 kNm   0·8 kNm   0·4 kNm

40 mmφ   B   20 mmφ

C

A

|← 0·5 m →|← 0·5 m →|

(c) What do you understand by tempering ? What are martempering and austempering processes ? What are their special features ? 10

(Contd.)

SECTION—C

5. (a) Write two causes of cold cracks in welded joints. Write the carbon equivalent formula and describe its importance in welding. Why preheat is required in welding ? A machine rated at 100 A at 60% duty cycle is accelerated to 160 A. Find the percentage reduction of the output cycle. 10

(b) Name the various tests to be performed for moulding sand. Draw a top gate and write its advantages. What is a misrun and how is it caused ? Write some advantages of cupola. 10

(c) Define mistcooling and its effectiveness. Draw a fig. showing relative severity of the following machining operations qualitatively :

Broaching (internal), milling, gear shaping and drilling, boring.

What happens to drilling if the lip relief angle is too small ? Too large ? In grinding, explain the meaning of the terms, loading and truing. 10

(d) Write a FORTRAN program to find average height of boys in a class. 10

(Contd.)

6. (a) Briefly describe some of the similarities between a robot and an NC machine. What are the five different types of robot systems ? Discuss some important aspects of pendant programming in robotics.' 10

(b) Explain the difference between tolerance and allowance. Write in short about optical flat. Two fringe patterns are supplied for two completely different surfaces using optical flat, name the types of surfaces, and draw if required. Discuss with fig., principle of working of a pneumatic gauge. 10

Fig. Q. 6 (b)

Fringe patterns for two completely different types of surfaces.

(Contd.)

(c) Write the process variables in wire drawing. In forging define the terms (i) Edging (ii) Fullering and (iii) Flash. How are the seamless tubes produced ? 10

(d) Explain with fig. a drill-jig mentioning various provisions. What is the difference between FMS and FMC ? Write some disadvantages of FMS. 10

7. (a) A unit manufactures 50,000 bottles of tomato Ketchup in a year. The factory cost per bottle is Rs. 6, the set-up cost per production run is estimated to be Rs. 90 and the carrying cost on finished goods inventory are 20% of the cost per annum. Production rate is 600 bottles per day and sales are expected at 150 bottles/day.

(i) Derive an expression for lot size that will give minimum cost. 10

(ii) What is the optimum lot size ? 5

(iii) What is the number of runs required per year ? 5

(iv) What will be the total cost per year if the number of runs has to be an integer ? 5

(Contd.)

(b) Ghosh and Company making pipes is considering investment in an aggressive advertising campaign for the next year's sales. The data for the last year 2009-10 is :

Variable Expenses

Direct Material	Rs. 3·25 per piece
Direct Labour	Rs. 8·00 per piece
Variable overhead	Rs. 2·50 per piece
	Rs. 13·75 per piece

Fixed Expenses :

Manufacturing	Rs. 25,000
Selling	Rs. 40,000
Administrative	Rs. 70,000
Total Fixed	1,35,000
Selling price per pipe	Rs. 25

Sales 2009-10

(20,000 units)   Rs. 5,00,000

The sales target for 2010-11 is Rs. 5,50,000 :

(i) What is the profit and break even point for the year 2009-10 ?   7

(ii) How will the BEP change if the company spends Rs. 11,250 on advertising in 2010-11 ?   4

(iii) What will be the profit if the company is able to sell 21,000 pipes only in 2010-11 ?   4