A-GTD-O-NDBB

MECHANICAL ENGINEERING

Paper II

(Conventional)

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

INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

Candidate should attempt FIVE questions in all.

Question No. 1 in Section A is compulsory.

Out of the remaining, attempt TWO from Section B and TWO from Section C.

All questions carry equal marks.

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

Answers must be written in ENGLISH only.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Neat sketches may be drawn, wherever required.

All parts and sub-parts of a question are to be attempted together in the answer book.

Attempts of questions shall be counted in chronological order.

Unless struck off, attempt of a question shall be counted even if attempted partly.

Any page or portion of the page left blank in the answer book must be clearly struck off.

Section – A

1. (a) Explain Grashof's linkage. Explain the inversions of this linkage.   4

   (b) A single plate clutch is designed to transmit 10 kW power at 2000 rpm. The equivalent mass and radius of gyration of the input shaft are 20 kg and 75 mm respectively. The equivalent mass and radius of gyration of the output shaft are 35 kg and 125 mm respectively.

   Calculate :

   The time required to bring the output shaft to the rated speed from rest.   4

   (c) A 5 cm dia. solid shaft is welded to a flat plate by 1 cm fillet weld. What will be the max. torque that the welded joint can sustain if the permissible shear stress in the weld material is not to exceed 8 kN/cm^2 ? Deduce the expression for the shear stress at the throat from the basic theory.   4

   (d) Illustrate International System of Units.   4

   (e) Derive equations for compressive and tensile thermal stresses.   4

(f) Draw the schematic of radiographic technique and explain. 4

(g) What are the conditions that would allow a continuous chip to be formed in metal cutting ? 4

(h) What are the different types of fits possible with reference to mechanical systems ? 4

(i) Find the optimal order quantity for a product of which the price breaks are as follows :

Qty	Unit Cost
$0 \le q_1 \le 50$	Rs. 10
$50 \le q_2 \le 100$	Rs. 9
$100 \le q_3$	Rs. 8

The monthly demand for the product is 200 units, the cost of storage is 25% of the unit cost and ordering cost is Rs. 20 per order. 4

(j) Define Value Engineering. What are the conditions conductive to take up Value Analysis/ Value Engineering. 4

Section – B

2. (a)
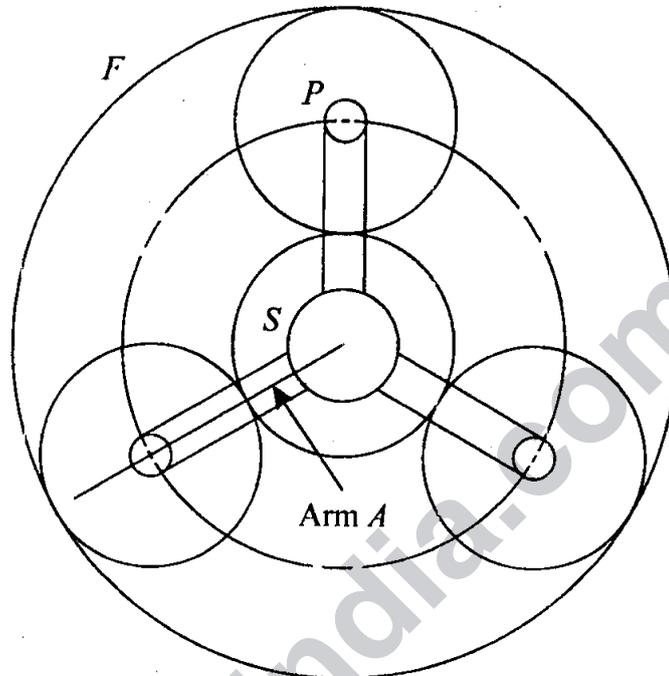
In the geartrain shown in the figure, the sun gear *S* rotates at 500 rpm and the planet carrier *A* rotates at 100 rpm in the same direction. Determine the number of teeth on each gear and the speed of planet gear *P* if the diametral pitch of all the gears is 3 teeth/cm and the diameter of the fixed gear *F* is to be as close to 25 cm as possible.   14

(b)
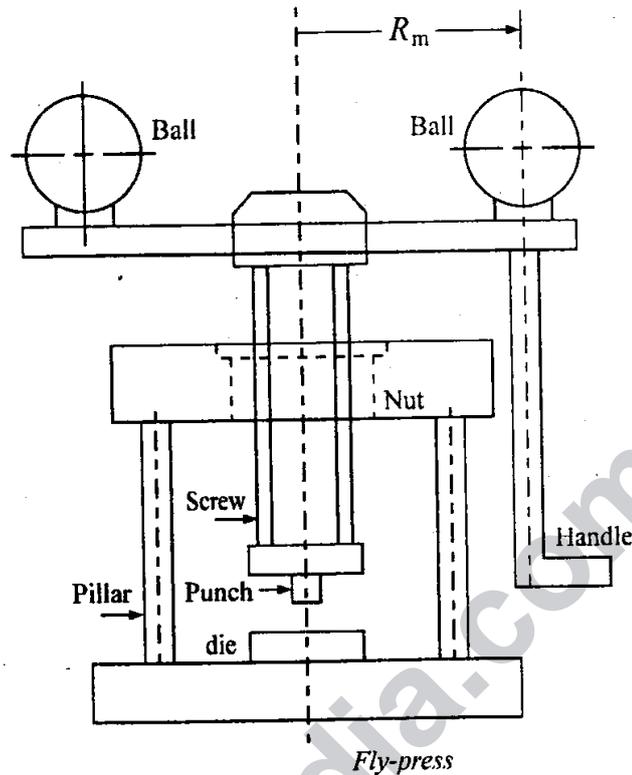
Fly-press

It is required to design a flypress, as shown in the figure, that is capable of punching 50 mm diameter circles from a 1·5 mm thick mild steel sheet. The ultimate shear strength of the sheet metal is 375 N/mm² and it can be assumed that shearing will be complete when the punch penetrates through half the thickness of the sheet. The screw, with square threads, is made of bronze. The factor of safety is 3. The total working stroke consists of a one quarter revolution, 45° in front of the press and 45°

behind the press. During the return stroke, the punch is raised by 5 mm to provide clearance to insert the sheet. The forward or working stroke is completed in 1 sec. The balls are made of cast iron, with a mass density of 7280 kg/m^3 and the radius R_m is 500 mm. Neglecting collar friction, calculate :

   (i) The dimensions of the screw,

   (ii) The length of the nut and

   (iii) The size of the balls.   20

(c) A cylindrical pressure vessel 200 cm in diameter and 350 cm in length is made of 1·30 cm thick plates. It is subjected to an internal pressure of 10 kg/cm^2. Calculate the longitudinal and circumferential stresses developed in the vessel.   6

3. (a) The mass of a trailer is 350 kg when empty and 1000 kg when fully loaded. The stiffness of suspension spring is 350 kN/m. The damping factor is 0·5 when fully loaded. The trailer moves at 50 kmph on a road having sinusoidal irregularity of wavelength 4 m. Determine transmissibility when trailer is fully loaded and when empty.   15

(b)
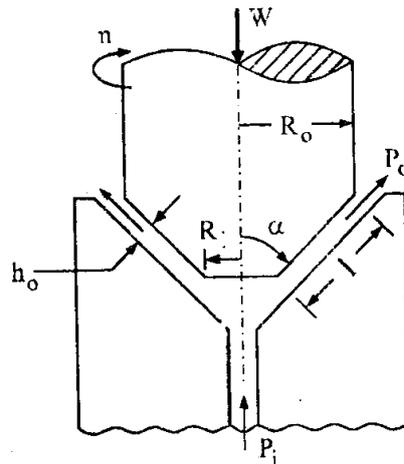
A hydrostatic conical thrust bearing is shown in the figure. Show that the load carrying capacity of the bearing is given by

$$W = \frac{\pi P_i}{2}\left[\frac{R_o^2 - R_i^2}{\log_e\left(\dfrac{R_o}{R_i}\right)}\right]$$

and the flow requirement is given by,

$$Q = \frac{\pi P_i h_o^3 \sin\alpha}{6\mu\, \log_e\left(\dfrac{R_o}{R_i}\right)}$$

15

(c) Explain the concept of real and apparent areas of contact. Write the formula for each. 10

4. (a) A shaft consisting four masses *A*, *B*, *C* and *D* is in complete balance. The masses *A*, *C* and *D* are 20 kg, 12 kg and 10 kg respectively. The radii of rotations of masses *A*, *B*, *C* and *D* are 12 cm, 15 cm, 17 cm and 20 cm respectively. The planes of rotation of *A* and *B* are 20 cm apart whereas those of *B* and *C* are 25 cm apart. The angle between the radii of *A* and *C* is 90°. Determine mass at plane *B* and distance between the planes of *C* and *D*. 20

(b) A thin cylinder is turning about its axis. Find the safe number of revolutions for a rotor of 3 metres in diameter if the hoop stress is not to exceed 1300 kg/cm^2. Take density as 6500 kg/cm^3. 10

(c) Explain why corrosion occurs in materials. 10

Section – C

5. (a) Explain expendable pattern casting process with schematic illustration and applications. 10

(b) Differentiate between the working principles of Friction stir welding and Friction welding. 10

(c) Explain salient design principles of milling fixtures with a typical milling fixture diagram.   10

(d) Determine the fundamental deviation and tolerances and the limits of size for hole and shaft pair in the fit : 25 mm H_8-d_9. The diameter steps are 18 mm and 30 mm. The Fundamental deviation for d shaft is given as $-16\,D^{0.44}$. The tolerance unit is, $i = 0.45 * \sqrt[3]{D} + 0.001\,D$. The tolerance grade for number 8 quality is 25 i and for number 9 quality is 40 i.   10

6. (a) Classify the products that are commonly produced by powder metallurgy. Give examples of each.   10

(b) What is the principle of plasma arc welding ?   10

(c) A materials manager adopts the policy to place an order for a minimum quantity of 500 of a particular item in order to avail a discount of 10%. It was found from the company records that for last year 8 orders were placed each of size 200 Nos. Ordering cost is Rs. 500 per order. Inventory carrying charges at 40% cost per unit = Rs. 400. Is the purchase manager justified in his decision ? What is the effect of this decision on the company ?   10

(d) There are four machines *W*, *X*, *Y* and *Z*. Three jobs *A*, *B* and *C* are to be assigned to the 3 machines out of total 4 machines. The cost of assignment is given below. Find out the optimal assignment.

	W	*X*	*Y*	*Z*
A	18	24	28	32
B	8	13	17	18
C	10	15	19	22

10

7. (a) Explain the principle of Electro Chemical Machining Process with the help of a diagram.

10

(b) The *ABC* company wishes to plan its advertising strategy. There are two medias under consideration, call them Magazine I and Magazine II respectively. Magazine I has a reach of 2500 potential customers. The cost per page of advertising is Rs. 400 and Rs. 600 in Magazine I and II respectively. The firm has a monthly budget of Rs. 6000. There is an important requirement that the total reach for income group under Rs. 20000 per annum should not exceed 4000 potential customers The reach in Magazine I and II for this income group is 400 and 200 potential customers How many pages should be brought in the two Magazines to maximize the total reach ? 15

(c) *XYZ* Ltd carries out *ABC* analysis and has decided to concentrate on *A* item, which total up to the maximum cost of materials. For *A* class items the following data is available :

Annual requirement   =   5000 units

Ordering cost   =   Rs. 500

Carrying cost   =   Rs. 20%

Cost per unit   =   Rs. 80

The company has the following options for purchasing the items.

  (i)   Place 10 orders of equal size every year.

 (ii)   Place an order of 1000 units at any time and avail bulk purchase discount of 8%.

(iii)   Use *EOQ*

Which options, you think *XYZ* should follow and why ?   15

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