

Subject Code: PROD/PC/B/T/324/2025

B.PRODUCTION ENGINEERING EXAMINATION, 2025

(3RD Year, 2nd Semester)

DESIGN OF ENGINEERING SYSTEM – II

Time: 3 hours

Full marks : 100

(Answer questions not exceeding 100 marks)

1. The efficiency of a square threaded screw is given by $\eta = \tan \alpha / \tan (\Phi + \alpha)$. α = helix angle, $\tan \Phi = \mu$ (coefficient of friction). Show that the efficiency of selflocking square threaded power screw is less than $\frac{1}{2}$ or 50 %. (10)
2. A single-start square threaded screw is used in a screw press to exert a force of 50 KN. The screw is made of plain carbon steel 10C4 ($S_{ut} = 340 \text{ N/mm}^2$) and the factor of safety is 4. The permissible compressive stress is equal to permissible tensile stress and permissible shear stress is 50% of permissible tensile stress. The nut is made of grey cast iron FG200 and the permissible bearing pressure between contacting surfaces of screw and nut is 17 Mpa. A low friction thrust ball bearing is used in the mechanism and collar friction can be neglected. The coefficient of friction at the thread surface between the screw and cast iron nut can be taken as 0.15. Determine the size of screw and the length of nut. The axial length of threads in the nut should be between 1 to 1.5 times of the nominal diameter of the screw. Assume for $d = 36 \text{ mm}$ pitch $p = 6 \text{ mm}$ and for $d = 40 \text{ mm}$ $p = 7 \text{ mm}$. (30)

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3. Design a helical compression spring for a valve mechanism. The axial force acting on the spring is 300N when the valve is open and 150N when the valve is closed. The length of the spring is 30 mm when the valve is open and 35 mm when the valve is closed. The spring is made of oil-hardened and tempered valve spring wire of VW grade. The constants A and m can be taken as 1855 and 0.187 respectively. The permissible shear stress of the spring wire should be taken as 30% of the ultimate tensile strength. The modulus of rigidity is 81370 N/mm².

The spring is to be fitted over a valve rod and the minimum inside diameter of the spring should be 20 mm.

Calculate:

- i) Wire diameter
- ii) Mean coil diameter
- iii) No. of active coils
- iv) Total no. of coils
- v) Free length of the spring

Assume that the clearance between the adjacent coils is 15% of the deflection under maximum load.

(40)

4. A single plate clutch consists of only one pair of contacting surfaces. It is used for an engine which develops a maximum torque of 120 N-m. Assume a factor of safety of 1.5 to account for slippage at full engine torque. The permissible intensity of pressure is 350 kPa and the coefficient of friction is 0.35. Assuming uniform pressure theory calculate the inner and outer diameter of the friction lining. Assume condition for maximum torque transmission $d/D = 0.577$.

(20)

5. A V-belt drive has the following data :
- Diameter of driving pulley = 200 mm
 - Diameter of driven pulley = 600 mm
 - Belt angle = 40°
 - Mass of belt = 0.5 kg/m
 - Maximum permissible tension in belt = 500N
 - Coefficient of friction = 0.2
 - Contact angle for smaller pulley = 157°
 - Speed of smaller pulley = 1440 rpm
 - Power to be transmitted = 10 kW

Assuming each belt takes its proportional part of the load, determine how many V-belts are to be used.

(30)

6. A transmission shaft rotating at 720 rpm and transmitting power from pulley P to spur gear G as shown in Fig 1. The belt tensions and gear tooth forces are as follows:
- $P_1 = 498 \text{ N}$, $P_2 = 166 \text{ N}$, $P_t = 497 \text{ N}$, $P_r = 181 \text{ N}$
- The weight of the pulley is 100 N. The diameter of the shafts at bearings B_1 and B_2 is 10 mm and 20 mm respectively. The load factor is 2.5 and the expected life for 90% of the bearings is 8000 hrs. Determine the dynamic load capacity of the bearings at B_1 and B_2 .

(30)

7. A two stage reduction unit has spur gears with 20° full depth Involute teeth. The input shaft rotates at 1440 rpm and receives 10 kW power through a flexible coupling. The speed of the output shaft should be approximately 180 rpm. The gears are made of plain carbon steel 45C8 ($S_{ut} = 700 \text{ N/mm}^2$) and heat treated to a surface hardness of 340 BHN. Service factor can be taken as 1.5. Assume pitch line velocity as 5 m/s and factor of safety 1.5. Estimate value of the module. Assume minimum no. of teeth 18 for which Lewis form factor is 0.308. Give list of gear dimensions.

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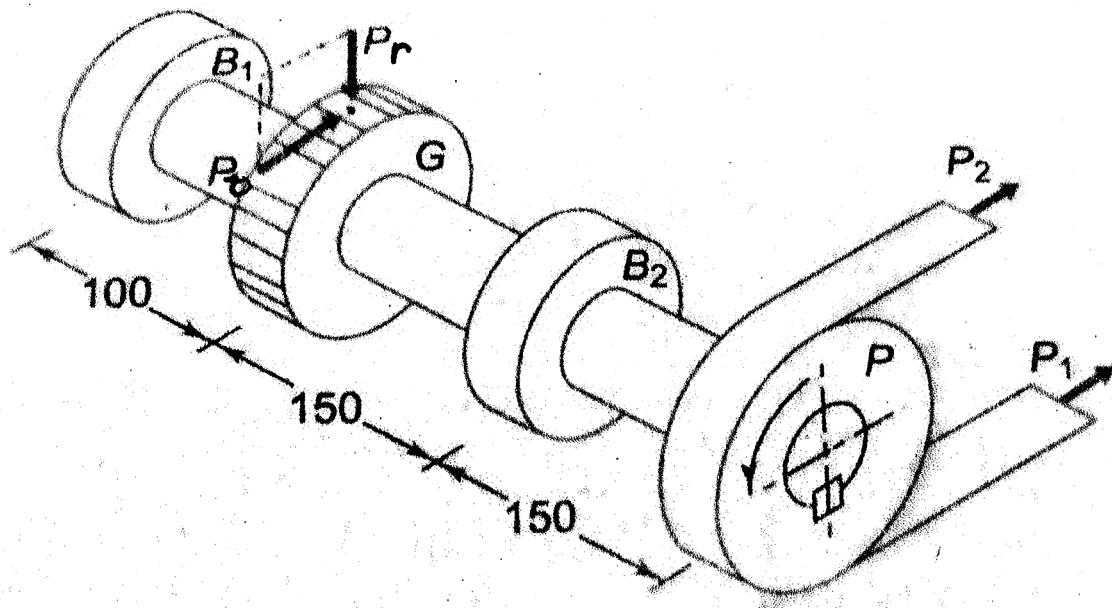


Fig. 1