EX/PROD/T/326/2017

B. PRODUCTION ENGG. EXAMINATION, 2017

(3rd Year, 2nd Semester)

DESIGN OF ENGINEERING SYSTEM –II

Time : 3 hrs **Full marks : 100**

(Attempt 100 marks)

1. (a) What is miter gear? (b) What is wahl factor? (c) What is **S-N curve**?
(d) What are the objectives of series and parallel connections of springs ?
(e) What is notch sensitivity factor? (f) What are the applications of ribbed V-belts/ synchronous belts ? (g) Distinguish clearly between spindle, axle and shaft. (h) what is size factor? (i) Define dynamic load carrying capacity of rolling contact bearing? (j) why tangential component of gear tooth force is called 'useful' component? **(2 X 5)**

2 (a) Explain the terms with neat sketches
(i) base circle (ii) pressure angle **(4)**
(b) what conditions must be satisfied in order that a pair of spur gears may have a constant velocity ratio? **(6)**

3. (a) Define formative or virtual number of teeth on a helical gear. Establish the relation $T = T_e.Cos^3\alpha$, where T = **actual number of teeth on helical gear,** T_e **=equivalent number of teeth on helical gear,** α **= helix angle.** **(6)**
(b) what is the difference between double and heringbon helical gears? state two advantages of these gears. **(4)**

4. A cantilever beam made of cold drawn carbon steel of circular cross-section as shown in **FIGURE -1,** is subjected to a load which **varies from -F to 3F.** Determine the maximum load that this member can withstand for an indefinite

life using **factor of safety as 2**. The **theoretical stress concentration factor** is **1.42** and the **notch sensitivity is 0.9**. assuming the following values:

Ultimate stress : 550 N/mm², yield stress : 470 N/mm²
Endurance limit : 275 N/mm², size factor : 0.85
Surface finish factor : 0.89. **(15)**

5. A pair of straight teeth spur gears is to transmit **20kW** when the pinion rotates **at 300rpm**. The velocity ratio **is 3 : 1.** The allowable static stresses of the pinion and gear materials are **120N/mm²** and **100N/mm²**. Respectively.

The pinion has **15T** and its face width is **14 times the module**. Determine : (i)module (ii) face width (iii) pitch circle diameters of both the pinion and the gear from the standpoint of strength only, taking into consideration the effect of dynamic loading.

The tooth form **factor y = 0.154 - 0.912/T** , where **T= No.** of teeth and velocity Factor C_v **= 3/ 3+v,** where **v** is expressed in **m/ second, service factor(Cs)=1.**
(20)

6. Design a Compression spring for a service load ranging from **2250N to 2750N.** The axial deflection of the spring for the load range is 6mm. Spring index of 5. The permissible shear stress intensity **is 420N/mm²** and **modulus of rigidity = 8.4 X 10^4 kN/mm².** Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring showing details of the finish of the end coils. **(15)**

7. A Shaft transmitting **50kW at 125 rpm** from gear **G_1 to gear G_2** and mounted on two single row deep groove ball **bearings B_1 and B_2** are shown in **FIGURE-2.** The gear tooth forces are : **P_{t_1} =15915 N , P_{r1} = 5793 N , P_{t_2} = 9549 N and P_{r2} = 3476 N.** The diameter of the shaft at bearings **B_1 and B_2** is **ϕ75mm**. The load factor is **1.4** and the expected life **$L_{10}h$** of the bearings is **10,000 hrs.** Select suitable bearings. Given **ϕ75mm bore diameter of bearings** :

Dynamic loads (C) in N	:	**28600**	**39700**	**66300**	**112000**	**153000**
Bearing No	:	**10615**	**6015**	**6215**	**6315**	**6415**

(20)

8. A stepped shaft, with a ratio of large diameter to small diameter **of D/d =1.2** Having a fillet radius of **10%** of the smaller diameter is subjected to twisting Moment if that fluctuates between **+500 N-m to -800 N-m**. The material of the

Shaft has **a notch sensitivity factor is 0.925, yield shear stress** of **160N/mm²** and **Endurance shear stress of 120N/mm².** Given factor of **safety =2** and **size factor is 0.85** and refer to **FIGURE -3 ,** for stress concentration factor. Determine the diameter of the shaft at the minimum cross-section. **(10)**

9. A screw Jack is lift a load **of 80kN** through a height of **400mm. The** elastic strength of screw material in tension and compression **is 200 N/mm²** and shear stress **120 N/mm²**. The material for Nut is bronze for which elastic limit may be taken as **100 N/mm²** in tension, **90 N/mm²** in compression and **80 N/mm²** in shear. The bearing pressure between the nut and the screw is not to exceed **18 N/mm²** and pitch of the thread is **8mm**. Design and draw the screw Jack. The design should include the design of :
   (i) **Screw** (ii) **nut** (iii) **handle and cup** (iv) **body**
   The **co-efficient of friction** between **screw and nut** is **0.14**. **(30)**

10. A solid shaft is supported on two bearings **P and Q, 1.8metres** apart and rotates at **250 r.p.m. A 20°** involute **gear D**, p.c.d **ϕ300mm** is keyed to the shaft at a distance of **150mm** to the left on the right hand bearing. Two pulleys **B and C** are located on the shaft at distances of **600mm** and **1350mm** respect--ively to the right of the left hand bearing. The diameters of the **pulleys B and C** are **ϕ750mm** and **ϕ600mm** respectively. **30kW** is supplied to the gear, out of Which **18.75kW** is taken off at the **pulley C** and **11.25kW** from **pulley B**. The Drive from **B** is vertically downward while from **C** the drive is downward at an angle **of 60°** to the horizontal. In both cases the belt **tension ratio is 2** and angle of lap is **180°**. Given **K_t = 1.5** and **K_η =2.0**. The shaft is made of plain carbon steel **40C8** and Yield strength of the shaft material **380 N/mm²** and factor of **Safety is 4.5**. Draw : (i) **space diagrams** (ii) **load diagrams** **(30)**
   (iii)bending moment diagrams (iv) design a suitable SHAFT

11. A **V-Belt pulley** and gear wheel bracket shown **in FIGURE- 4**, transmits **9.5HP at 300 r.p.m**. The belt tensions are **P_1 and P_2.** The direction of the total belt pull **($P_1 + P_2$)** is as indicated. Take the **tangential force 'E'** on the gear wheel as acting at right angles to the total belt pull and neglect the other actions. The co-efficient of friction between belt and pulley material is **0.20**, the V-groove has an inclined **angle of 40°, the wrapping angle is 155°.**

(i) Determine the **diameter D_1 of** the shaft and find the maximum bending Stress in D_1, for a torsion stress **of 2.8 Kg/mm².**

(ii) Find **the bearing pressure** on the bearings **at A and B.**

(iii) Determine **the bending and shear stress** in the shaft at the gear wheel which has diameter **(D_1 + 6) mm** and find the shear stress in the **KEY,** breath of **Key = 6mm.**

(iv) Calculate **the bending stress** at the bracket section 'CC' which **is ϕ80mm** in **Outer diameter** and **ϕ60mm in inner diameter.**

(v) Find the size of **the 6 STUDs** holding the flange. Allow a core stress of **1.4 Kg/ mm².** **(40)**

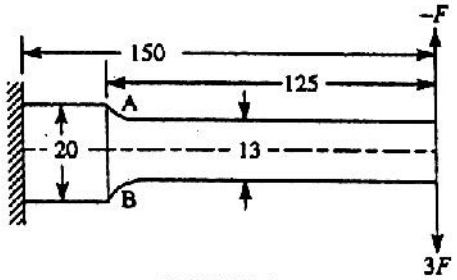

FIGURE-1.

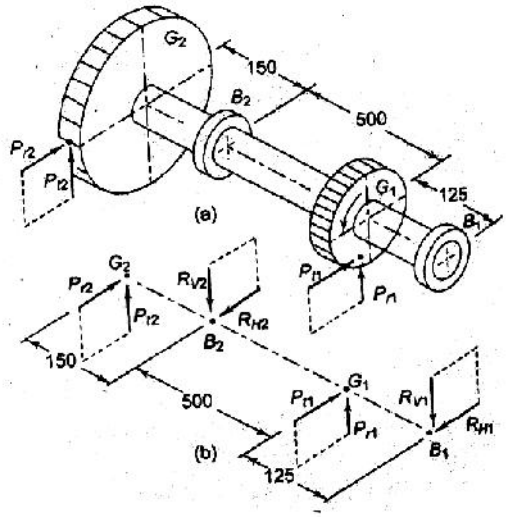

FIGURE -2.

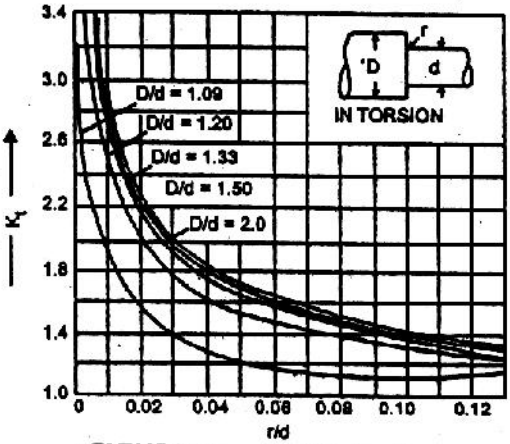

FIGURE -3. *Shaft in Torsion*

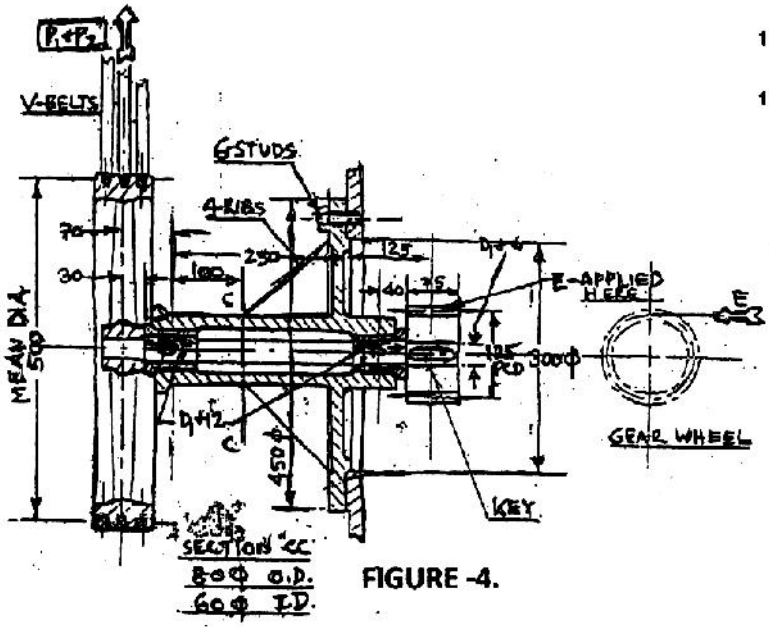

FIGURE -4.