EX/PROD/T/326/2019

B.PRODUCTION ENGINEERING EXAMINATION, 2019

(3rd Year, 2nd Semester)

Time: 3 hrs. **DESIGN OF ENGINEERING SYSTEM-II** Full marks: 100.

(Attempt Question-1 which is compulsory and answer 80 marks from rest)

1.(a) What is **S-N curves? (2)**

(b) What is **notch sensitivity factor**?(2)

(c) What are the applications of **multi-leaf spring? (2)**

(d) What are the **objectives** of **series** and **parallel** connection of **springs? (2)**

(e) why it is necessary to **dissipate the heat** generated when **clutches operate**? **(2)**

(f) what are the **applications** of **recirculating ball screw**? **(2)**

(g)where do you use **differential** and **compound screws**? **(4)**

(h) where do you use needle roller bearing? **(2)**

(i) what do you mean by **Bearing No.6015** and **6315. (4)**

(j)What is miter gears?(2)

(k) what are the **applications** of **ribbed V-belts. (2)**

(l) what is **crown gear?** Show with **neat sketch. (4)**

(m) sketch neatly when **two bevel gears** in **mesh** and show the **various forces acting** on it. **(4)**

(n) what is **creep of belts. (2)**

(o) what are the **methods** of **reducing stress concentration**? Explain with **neat sketches.(4)**

(p) write **SODERBERG's** equation and states its **application** of **different** type of **loadings.(4)**

(q) what is the relationship between **actual** and **virtual number** of **teeth** and **pitch angle** in **bevel gears**? **(2)** **(20)**

2. A Steel cantilever is **180mm** long as shown in **FIGURE-1** .It is subjected to an axial load which varies from **110N**(compressive) to **450N**(tension) and also a transverse load at its free end which varies from **45N** up to **135N** down. The cantilever is of circular cross-section. It is of diameter **ϕ2d** for the first **55mm** and of diameter **ϕd** for the remaining length.**Determine its diameter** taking a **factor of safety of 2**.The strength properties are as follows:

Ultimate stress = **550 N/mm^2**;

Yield strength = **470 N/mm^2;**

Endurance limit = **275 N/mm^2;**

[Turn over

The stress concentration factors for bending and axial loads are **1.44** and **1.63** respectively, at the change of cross-section. Take size factor= **0.85** and surface finish factor = **0.90**; notch sensitivity= **0.90**. (20)

3. An overhung pulley transmit **46.67H.P**. at **240 r.p.m**. The belt drive is vertical and angle of wrap is **180°**. The distance of the pulley centre line from the nearest bearing is **350mm.** The co-efficient of friction between belt and pulley(**μ**)= **0.25**.
The section of the arm may be taken as elliptical, the major axis being twice the minor axis.

The following stress may be taken for design purposes:

Shaft Tension and compression : **80 N/mm²;**

Key shear : **50 N/mm²;**

Belt : Tension : **2.5 N/mm²;**

Pulley rim: Tension : **4.5 N/mm²;**

Pulley arms: Tension : **15 N/mm²;**

Belt thickness=**10mm;** density of pulley material= **7.2gms/cm³;**

Design the following: (i) diameter of the pulley; (ii) diameter of shaft; (iii) width of the belt; (iv) **size of arm;** (v) **dimension of the key;** (vi) **draw the diamensional sketch of belt and pulley.**

(3+3+3+ 2+ 4+5)

4. A pair of straight teeth spur gears, having **20°** involute full depth teeth is to transmit **20H.P**. at **300 r.p.m.** of the pinion. The following are given for design purpose:

(a)Velocity ratio = **3;**

(b) the allowable static stress for gearand pinion are **60N/mm²** and **105N/mm**

(c) No. of teeth for pinion= **16T;**

(d) face width =**14m**;

(e) velocity factor(**Cv**) = **4.5/(4.5+v),** where v m/s pitch line velocity;

(f) tooth form factor(**y**)=**0.154 – 0.912/T;**

(g) **σes= 600N/mm²;**

(h) Young's modulus of pinion and gear materials are **200kN/mm²** and **100kN/mm².**

Design the following for the gear drive : (i) the **modul** and **face width**; (8)
(ii) pitch diameter of **pinion** and **gear**; **(2)**
(iii) check the gears **for wear**; **(6)**
(iv) **draw** the **dimensional sketch** of this drive. **(4)**

5. A differential planetary gear train is shown in **FIGURE- 2.** The input shaft receive **13.33H.P**. power at **500r.p.m**. The pitch circle diameters of **bevel gears A,B, C** and **D** at the midpoint along the face width are **ϕ250mm, ϕ125mm, ϕ250mm** and **ϕ500mm** resoectively. The pitch circle diameters of **spur gears E and F** are **ϕ250mm** and **ϕ350mm**. respectively. The gears rotate at constant speed.

Calculate : (i) tangential component of tooth force between
gears **A and B, C and D** and **E and F**. **(10)**
(i) the **torque** on each of the two **output shaft**; **(10)**
(ii) **draw** a **free-body diagram** of Showing the **forces acting** on **various gears.** **(10)**

6. Design a toggle jack as shown in **FIGURE-3**, is to be designed for lifting a load of **5kN.** When the jack is in the top position, the distance between the centre lines of nuts is **50mm** and is the bottom position this distance is **220mm.** The eight links are symmetrical and **120mm** long. The link pins in the base are set **30mm** apart. The link, screw and pins are made from mild steel for which the permissible stresses are **90N/mm²** in tension and **50N/mm²** in shear. The bearing pressure on the pin is **20N/mm².** Assume the coefficient of friction between screw and nut**(μ) = 0.15** and pitch**(p)** of the pitch of the square threaded screw is **6mm**. **(30)**

7. In a spring loaded governor as shown in **FIGURE – 4**, the balls are attached to the vertical arms of the bell crank lever, the horizontal arms of which lift the sleeve against the pressure exerted by a spring. The mass of each ball is **2.97Kgs**. and the lengths of the vertical and horizontal arms of the of the bell crank lever are **150mm** and **112.5mm** respectively. The extreme radii of rotation of the balls are **100mm** and **150mm** and the governor sleeve begains to lift at **240 r.p.m**. and reaches the highest position with a **7.5 %** increase

of speed when effects of friction are neglected. Design a suitable close coiled round section spring for the governor.

Assume permissible stress in spring steel as **420N/mm²**, modulus of rigidity **84kN/mm²** and **spring index(C)= 8**. Allowance for stress concentration is **(4C-1) /(4C-4) +(0.615/C)** **(30)**

8. (a) **Describe** the **design procedure** of the **shoes** and **spring** for a **centrifugal clutch.** **(5)**

(b) A single dry plate clutch is to be designed to transmit **10H.P.** at **900 r.p.m.**

Calculate: **(i) diameter of the shaft;**

(ii) mean radius and face width of the friction lining assuming the Ratio of the mean radius to the face width **as 4;**

(iii) outer and inner radii of the clutch plate;

(iv) dimensions of the spring, assuming that the number of springs **= 6,** the allowable shear stress for the wire is **420N/mm², μ=0.25** Intensity of pressure**(p) = 0.07N/mm²**.

(3+3+3+6)

9. A shaft transmitting **66.67H.P.** at **125 r.p.m.** from gear G_1 to gear G_2 and mounted on two **single-row deep** groove ball bearings B_1 and B_2 is shown in **FIGURE – 5.**

The tooth forces are : P_{t_1}**=15915N,** P_{r1} **= 5793N,**

P_{t_2} **= 9549N,** P_{r2} **= 3476N.**

The diameter of the shaft at bearings B_1 and B_2 is **75mm**.The load factor is **1.4** and the expected life for **90%** of the bearings is **10000hrs. Select suitable ball bearings.** **(20)**

10. The **plane view** of a **two throw crankshaft** is shown in **FIGURE – 6.**

The pump **crankshaft** is made from a **single round steel bar**. The pumps are **single acting** and the **connecting rods** are assumed to be at **right angles(downwards)** to the **crank pins C and D**. For the **position shown, pump D is lifting** a total **downward load of 25kN**. The load at the same instant **at C is 5kN(downwards)**

due to **deadweights** of the moving parts only.

Determine:-

(iv) The **driving force** on **spur- pinion** and the **bearing reactions**;

(v) **Bending moment** and **twisting moment** on **bearing A and B** and **pins C and D** and their **respective diameters** required for an allowable shear stress of **42N/mm²;**

(vi) ***Maximum shear stress*** *at* ***section X-X*** *due to* ***combined bending*** *and* ***twisting moments***, *taking the* **diameter** of the **round bar** to its nearest **stock size 1.2d**, where '**d**' is the diameter of the largest journals. **(40)**

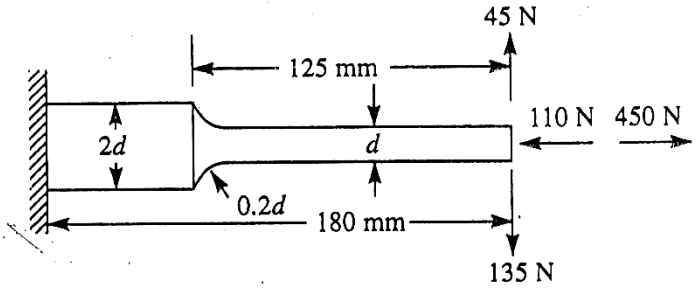


FIGURE- 1.

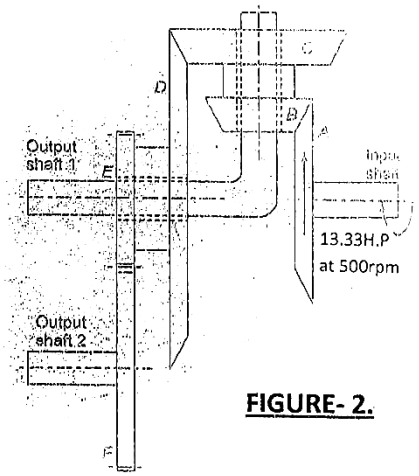
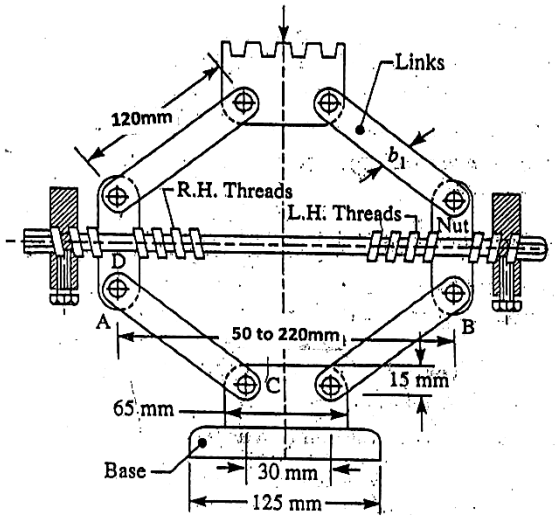


FIGURE- 2.



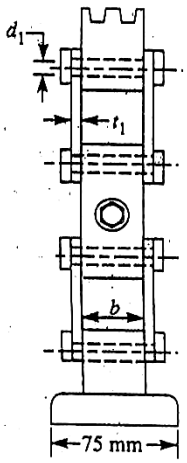


FIGURE- 3.

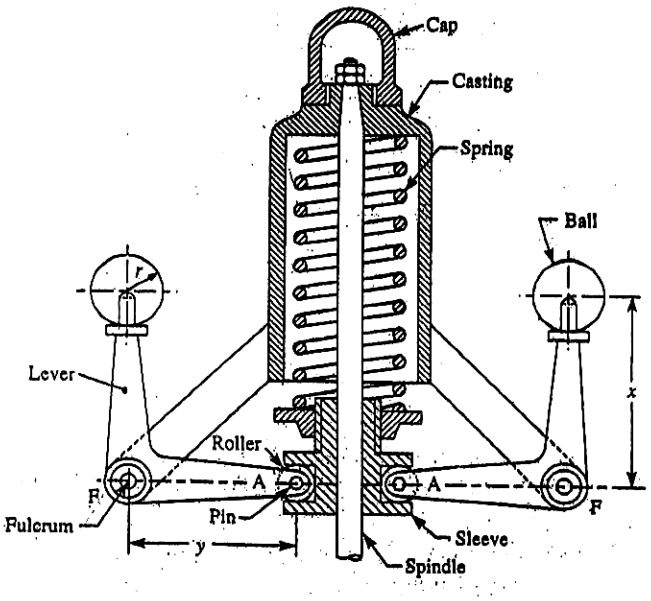


FIGURE- 4.

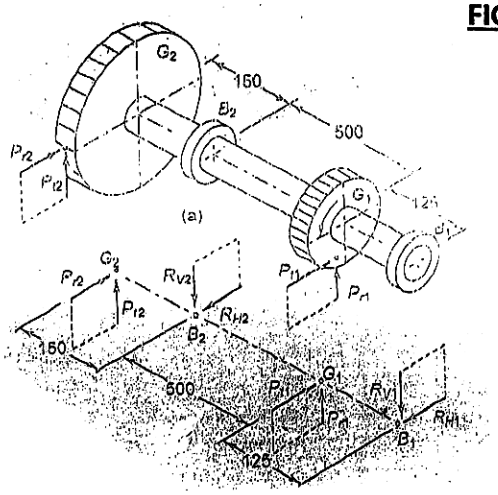


FIGURE- 5.

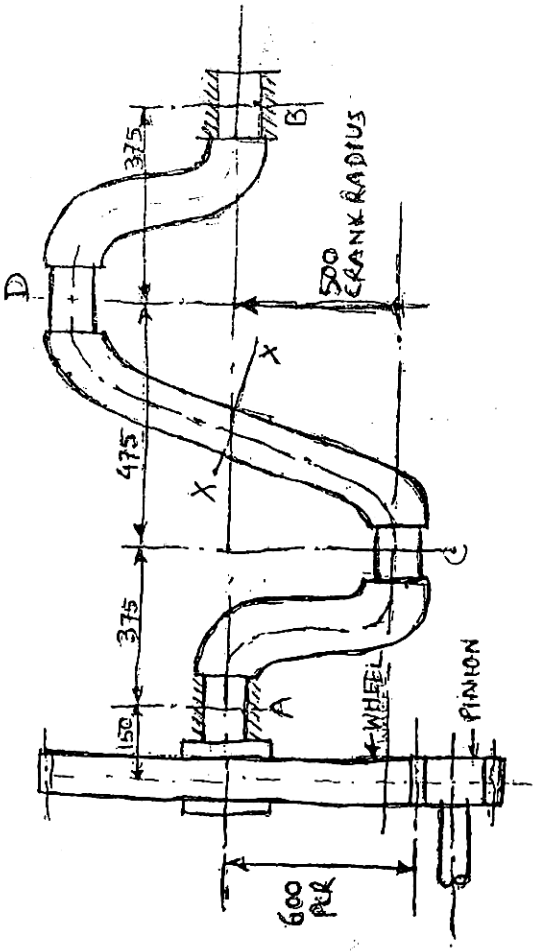


FIGURE- 6.