EX/PROD/T/326/2018

# B.PRODUCTION ENGINEERING EXAMINATION, 2018

(3rd Year, 2nd Semester)

## DESIGN OF ENGINEERING SYSTEM-II

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

**(Attempt any one (a) or(b) in Question-1)**

**(answer any five in (a)( 2X5)**

1. (a) (i) What is crown gear? Show with neat sketch.

(ii) **Differentiate** between involute and cyclodial gears.

(iii) Why tangential component of tooth gear forces is called ´useful´ Component and radial component is called ´separating´ component?

(iv) what are the advantages and disadvantages of V-belt drive over flat belt drive?

(v) what are ´$L_{10}$´ and ´$L_{10}h$´? Find the relation between them.

(vi) **Define** dynamic load capacity and equivalent dynamic load. Find their **relation.**

(vii) what are the applications of synchronous belts?

(viii) what are the types of failure in roller chain?

(ix) what are the **applications** of silent chain/Reynold/Morse chain?

(x) why are the ball and roller bearings are called ´Antifriction´ bearings?

(2X5)

(b) **Discuss** the design procedure of spur gear. (10)

[ Turn over

## (Attempt any one (a) or (b) in Question-2)

2. (a) (i) **Derive** the condition for maximum tension and transmission the maximum power In a flat belt drive. (10)

(ii) **Differentiate** between differential screw and compound screw. Give the sketches. (10)

OR

**Write the design procedure** of a power screw for lifting load(W) as shown in **FIGURE-1**, with various parts and standard dimensions. (20)

(b) (i) What is fluctuating stress? **Draw** a stress-time curve for fluctuating stress. (5)

(ii) A steel cantilever member is **200mm** long as shown in **FIGURE-2,** it is subjected to an axial load which varies from **150N**(compressive) to **450N**(tension) and a transverse load at its free end which varies from **80N**(↑)up to **120N**(↓) down. The cantilever is of circular cross-section. It is of diameter **'2d'** for the first **50mm** and of diameter **'d'** for the remaining length.
**Determine** its diameter.
Given: **F.O.S= 2,**
Strength of the properties of the material are :
Yield stress : **330N/mm$^2$**;
Endurance limit in reversed loading = **300N/mm$^2$**;

Stress concentration factors : **Ka= 1.64** and **Kb= 1.44**;
Notch sensitivity = **0.9;** Size factor= **0.85;** Surface finish factor = **0.85;**
Correction factors : **Ka'= 0.7** and **Kb'= 1.0** (15)

## (Attempt any one (a) or (b) in Question-3)

3. (a) A transmission shaft supporting a spur '**B**' and pulley '**D**' as shown in **FIGURE-3**. The Shaft is mounted on two bearings '**A**' and '**C**'. The diameter of the pulley and pitch circle diameter of gear are **ϕ450mm** and **ϕ300mm** respectively. The pulley transmits **20kW** power at **500 r.p.m.** to the gear. '$T_1$' and '$T_2$' are belt tensions in the tight and slack sides. '**Pt**' and '**Pr**' are tangential and radial components of gear tooth forces.
Given : $T_1 = 3T_2$ and $Pr = Pt(\tan\phi)$
The gear and pulley are keyed to the shaft. The material of the shaft is **50C4(σut= 700N/mm²,**
**σyt= 460N/mm²).** The factor **Km=Kt=1.5. Determine** the **size** of the shaft. (20)

(b) The dimension of a pair of bevel gears are shown in **FIGURE-4.** The gear 'G' delivers **5kW** Power at **500 r.p.m.** to the output shaft. The bearing '**A**' and '**B**' are mounted on the output Shaft in such a way that the bearing '**B**' can take radial as well as thrust load, while the bearing '**A**' can take only radial load. Pressure angle**(ϕ)=20°.**
**Determine:** (I) Components of tooth force on pinion;
(II) Components of tooth force on gear;
(III) Draw the space free-body-diagram;
(IV) Reactions at bearing '**A**' and '**B**'. (20)

## (Attempt (a)and (b) or (c) from Question-4)

4. (a) A motor shaft rotating at **1500rpm** has to transmit **15kW** to a low speed shaft with speed reduction of **3:1.** The teeth are **ϕ=14.5°** involute with **25T** on the pinion . Both the pinion and gear are made of steel with a maximum safe stress of **200MN/m².** A safe stress **40MN/m²** may be taken for the shaft on which the gear is mounted and for the key.
Assume starting torque be **25%** higher than the running torque.
Given : Gear module**(m)** = **8mm;**
Service factor**(S)** = **1** for 8hrs. to 10hrs.;

Velocity ratio**(v) = 3/(3+v),** Upto 12.5m/s;

The tooth form factor **Y = 0.124 – 0.684/Tp;**
Pinion centre overhung on the shaft from bearing centre = **100mm;**

**Design** : (i) **Spur gears;**
(ii) **Pinion shaft;**
(iii) **Gear shaft**
(iv) **Dimensional sketch of this drive.** (20)

(b) Power of **60kW** at **750rpm** is to be transmitted from an electric motor to compressor shaft at **300rpm** by **V-belt**. The approximate larger pulley diameter is **ϕ1500mm.** The approximate centre distance is **1650mm** and over load factor is to be taken **1.5.**
Given : belt cross-sectional area = **350mm²;**
Density of belt material = **1000Kg/m³;**
Allowable tensile stress for belt = **2N/mm²;**
Co-efficient of friction(**μ**) between belt and the pulley = **0.28;**
The centre distance of driven pulley from nearest bearing centre = **300mm;**
Shaft having permissible shear stress = **40N/mm²;**
Standard inside length of '**D**' **type** V-belt = **6807mm;**
Pitch length of V-belt = **6886mm;**
Standard key size for shaft diameter ϕ80mm = **25X14mm²;**
**Give a complete design of** :
(i) The **V-belt drive;**
(ii) **Shaft;**
(iii) **V-grooved pulley;**
(iv) **Key.** (20)

(c) A Rocking-lever and its supporting bracket are as shown in **FIGURE-5.** The loads at the ends of the lever arms '**A**' and '**B**' are **2000Kgs**. Acting as indicated. The lever arms oscillates on the fixed fulcrum pin of diameter '**D**'.
(i) **Design** the fulcrum pin size '**D**';
(ii) **Calculate** the bearing pressure on the **75mm** long at the end of each boss;

(iii) **Determine** the dimensions of the bearing at the ends of the arms '**A**' and '**B**'. The fully floating pin there have a length to diameter ratio of **1.2** and can withstand a bearing pressure of **1.2Kg/mm²** of projected bearing area.

(iv) **Calculate** the bending stress in the pins at '**A**' and '**B**'(allowable stress of **10Kg/mm²**);

(v) **Calculate** the the **shear stress** at the section '**XX**' on the lever boss. **Check** the safety factor;

(vi) **Find** suitable dimension of the rectangular section '**CC**' of the lever arms for allowable stress of **5 Kg/mm².**

(vii) **Find** also the suitable size of two bolts securing the bracket to its foundation allowing a core stress of **5.6 Kg/mm²;**

(viii) **Find** a suitable thickness '**t**', for the base of the bracket. Allowable bending stress of **4.2 Kg/mm².** (5X8)=40

## (Attempt any one (a) or (b) in Question-5)

5. (a) (i) what is the function of lubrication in bearing? (3)

(ii) How will you classify lubrication? Give at least one example for each type. (4)

(iii) **State** any five desirable properties of a good lubricant. (3)

(b) A transmission shaft rotating at **720 rpm** and transmitting power from pulley '**P**' to Spur gear '**G**' as shown in **FIGURE-6.** The belt tensions and the gear toot forces are given below :

$T_1$ = **498N** , $T_2$ = **166N** and **Pt =497N**, $P_r$ = **181N**;

The weight of the pulley is **100N**. The diameter of the shaft at bearings '$B_1$' and '$B_2$' are **ϕ10mm** and **ϕ20mm**. The **load factor= 2.5** and the expected life for **90%** of the bearings

is **8000hrs**. **select** the single-row deep groove ball bearing at '$B_1$' and '$B_2$'.
**Given:** Four different bearings are available for shaft diameter **ϕ10mm** are **61800, 6000, 6200** and **6300** for dynamic load capacity: **1480N, 4620N, 5070N** and **8060N.**
Six different bearing are available for shaft diameter **ϕ20mm** are **61804, 16404, 6004, 6204, 6304** and **6404** for dynamic load capacity: **2700N, 7020N, 12700N, 15900N** and **30700N.** (10)

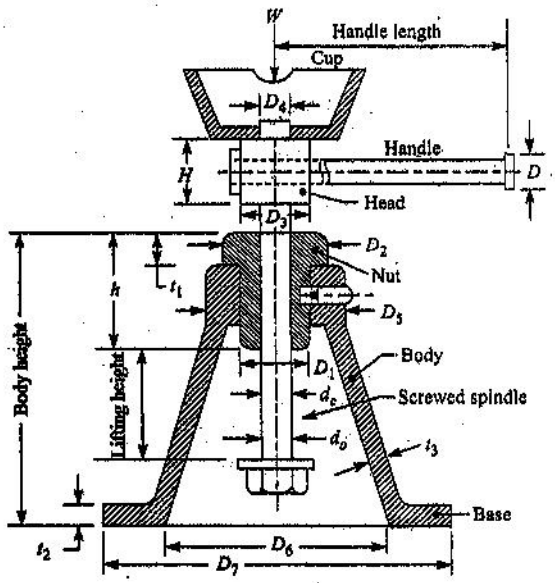
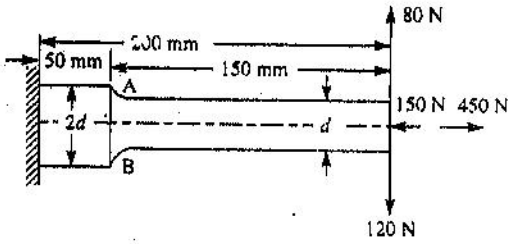



**FIGURE- 1.**




**FIFGURE -2.**

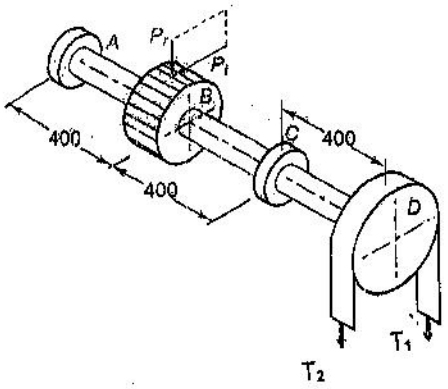



**FIGURE -3.**

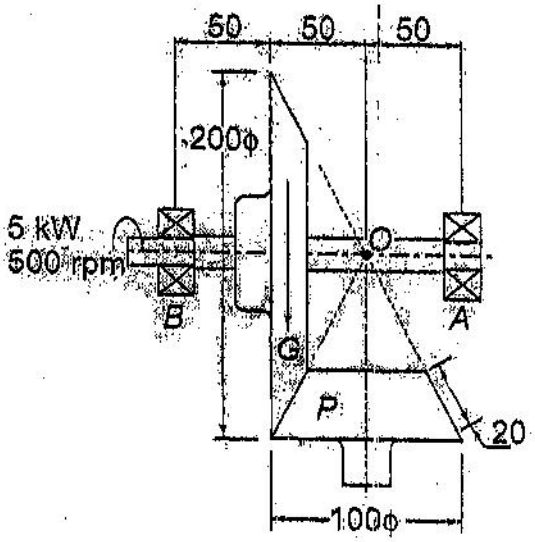



**FIGURE – 4.**

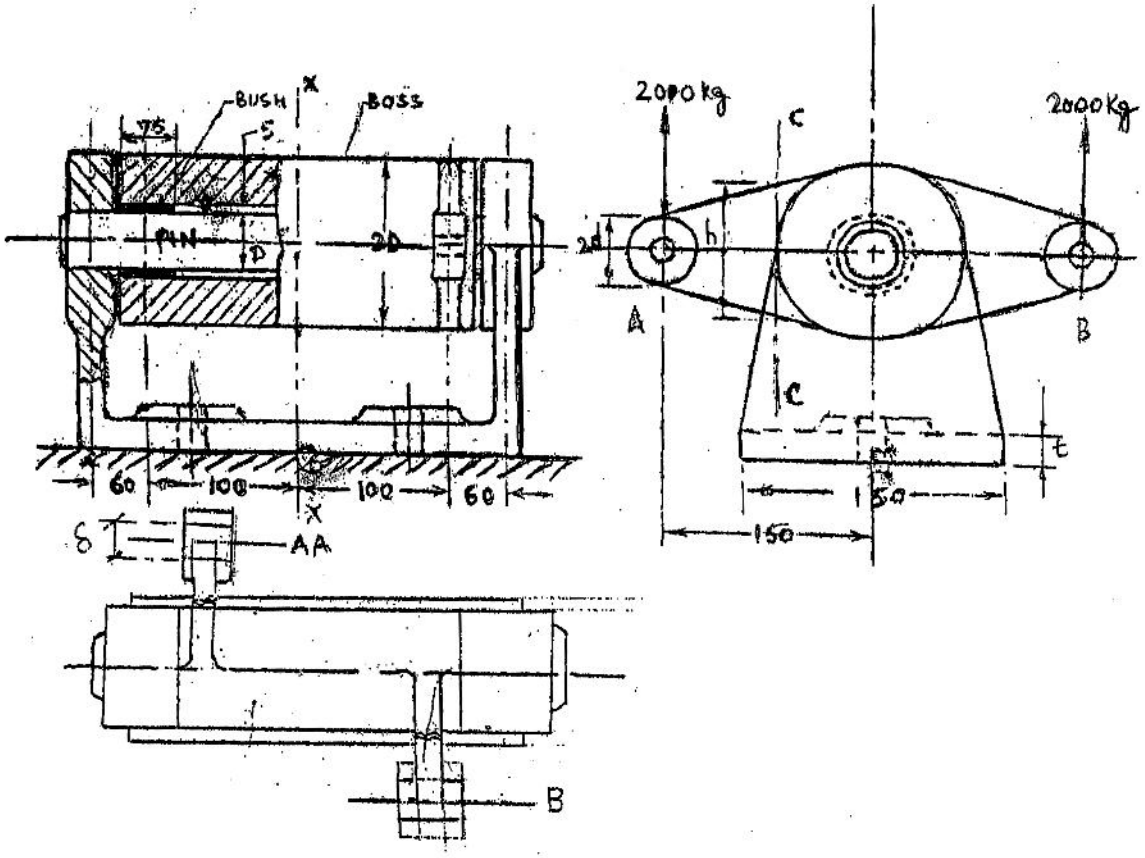



**FIGURE – 5.**

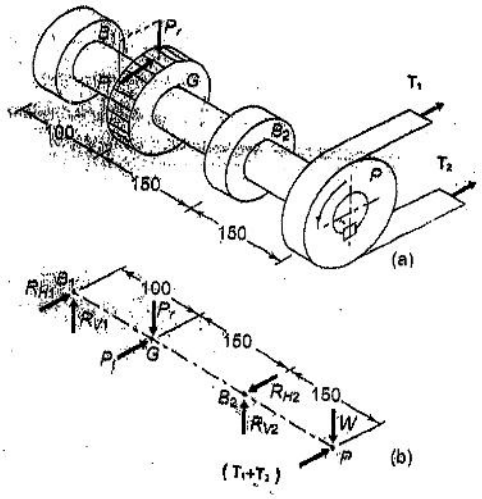



**FIGURE -6.**