

337651(37)BE (6th Semester)

Examination, April - May, 2017

[New Scheme]

Machine Design-II*Time Allowed* : 4 hours*Maximum Marks* : 80

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Minimum Pass Marks : 28

- Note :** (i) PSG data book is allowed. In Question Nos. 1, 2, 3, 4 all parts are compulsory. There are internal choices. In question 5 part (a) is compulsory and any two parts from (b), (c) and (d).
- (ii) The figures in the right-hand margin indicate marks.

1. (a) What is surge in spring? [2]
- (b) A helical compression spring of a cam mechanism is subjected to an initial preload by 50N. The maximum operating force during the load cycle is 150N. The wire diameter is 3 mm while the mean coil diameter is 18 mm.

The spring is made up of oil-hardened and tempered valve spring wire of Grade-VW ($S_{ut}=1430 \text{ N/mm}^2$). Determine the factor of safety used in the design on the basis of fluctuating stresses. Explain Wahl's factor. [14]

OR

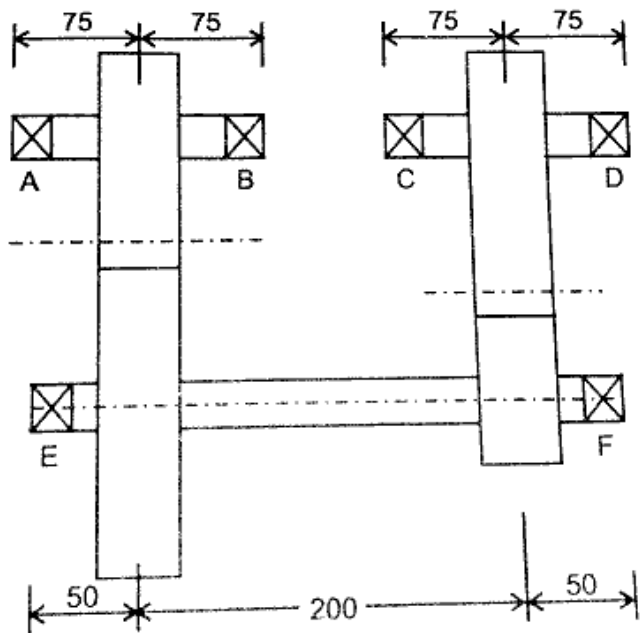
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- (c) A semi-elliptical leaf spring used for automobile suspension consists of three extra full-length leaves and 15 graduated length leaves, including a master leaf. The centre-to-centre distance of two eyes of spring is 1m. The max. force that can act on spring is 75 kN. For each leaf, the ratio of width to thickness is 9:1. The modulus of elasticity of the leaf material is 207000 N/mm^2 . The leaves are prestressed in such a manner that when the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm^2 . Determine—
- the width and thickness of the leaves;
 - the initial nip;
 - the initial pre-load required to close the gap C between extra full-length leaves and graduated length leaves.
- What do you understand by full length and graduated leaves of a leaf spring? [14]

2. (a) What is a hunting tooth? [2]

(b) The layout of a two-stage gear box is shown in fig. The no. of teeth on the gears are : $Z_1=20$, $Z_2=50$, $Z_3=20$, $Z_4=50$. Pinion 1 rotates at 1440 rpm in the anti-clockwise direction when observed from the left side and transmits 10 kW of power to the gear train. The pressure angle is 20° . Draw free body diagram of the gear tooth forces and determine the reactions on bearings E and F. [14]

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OR

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(c) Explain the different causes of tooth failure.

It is required to design a pair of spur gear with 20° full depth involute teeth consisting of 20 teeth pinion meshing with 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1450 rpm motor. The starting torque is 150% of the rated torque. The material for the pinion is plain carbon steel Fe 410 ($S_{ut} = 410 \text{ N/mm}^2$) while the gear is made up of grey cast iron FG 200 ($S_{ut} = 200 \text{ N/mm}^2$). The factor of safety is 1.5. Design the gears based on Lewis equation and using velocity factor to account for dynamic load. [14]

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3. (a) What is virtual or formative helical gears? [2]

(b) Derive an expression for cone distance of a bevel gear, i.e.

$$R \geq \psi_y \sqrt{i^2 + 1} \sqrt[3]{\left(\frac{0.72}{(\psi_y - 0.5)[\sigma_c]}\right)^2 \frac{E[M_t]}{i}} \quad [14]$$

OR

(c) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm.

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The normal pressure angle is 20° while the helix angle is 25° . The face width is 40 mm and the normal module is 4 mm. The pinion as well as the gear made of steel 40 C8 ($S_{ut} = 600 \text{ N/mm}^2$) and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load. Calculate the power transmitting capacity of gears. [14]

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4. (a) What is Sommerfeld number? [2]
- (b) A journal bearing of length 2.5 cm and a diametral clearance of 0.00508 cm supports a load of 200 kg while rotating at 1800 rpm. SAE 10 oil is used with an average temperature of 52°C . Determine—
- minimum oil film thickness;
 - coefficient of friction;
 - maximum film thickness;
 - angle between load direction and minimum film thickness ' ϕ '.

- total circumferential oil flow rate.
- side flow rate.

Would you recommend that a little smaller clearance or a little larger be used, why? [14]

OR

- (c) Derive an expression for Reynolds one direction flow for lubricant and write down the assumption made. CSVTUonline.com [14]

5. (a) What do you mean by ply or belt? [2]

Attempt any **two** parts :

- (b) Select suitable chain drive to transmit 30 kW from electric motor running at 1200 rpm to a line shaft running at 250 rpm and centre distance adjustable 600 mm, working 10 hrs per day and lubrication is done by drop lubrication method. The shaft diameter is 16 mm. CSVTUonline.com [7]

- (c) It is required to select a V-belt drive to connect a 15 kW, 2880 rpm normal torque AC motor to a centrifugal pump running at approximately 2400 rpm for a service of 18 hrs per day. The centre distance should be approximately 400 mm. Assume that the pitch diameter of the driving pulley is 125 mm. [7]
- (d) Design a V-belt drive to transmit 10HP running at 1200 rpm to a compressor at 300 rpm. [7]

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