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APR-MAY2022

B. E. (Sixth Semester) Examination 2020

(New Scheme)

(Mech. Engg. Branch)

MACHINE DESIGN-II

FOUR

Time Allowed : ~~Three~~ hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Attempt all questions. Part (a) of each question is compulsory. PSG Design Data Book is permitted. Attempt total of 16 marks from each question.

Unit-I

1. (a)   What is Spring Index?   2

(b) A helical tension spring is used in the spring balance to measure the weights. One end of the spring is attached to the rigid support while the other end, which is free, carries the weights to be measured. The maximum weight attached to the spring balance is 1500 N and the length of the scale should be approx 100 mm. The spring index can be taken as 6. The spring is made of oil-hardened and tempered steel wire of SW grade ($G = 81370$ N/mm^2). The constants A and m can be taken as 1885 and 0·187 respectively. The permissible shear stress in the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate : 14

(i) Wire diameter

(ii) Mean coil diameter

(iii) No. of active coils

(iv) Required spring rate

(v) Actual spring rate.

(c) Derive load stress equation and load deflection equation for the design of helical springs. A semi

elliptical multi leaf spring is used for the suspension of the rear axle of a truck. It consists of two extra full-length leaves and ten graduated length leaves including the master leaf. The center to center distance between the spring eyes is 1·2 m. The leaves are made up of steel 55Si2 Mo 90 ($Syt = 1500$ N/mm^2 and $E = 207000$ N/mm^2) and FOS = 2·5. The spring is to be designed for a maximum force of 30 kN. The leaves are prestressed so as to equalize stresses to all leaves. Determine : 14

(i) The cross-section of leaves

(ii) The deflection at the end of spring.

Unit-II

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

(b) Design a spur gear drive to transmit 30 kW at 1440 rpm, speed reduction is 2·5 and life of the spur gear is 1000 hours. 14

(c) The train of gears transmitting power from 10 kW, 1440 rpm motor to a rope drum is shown in fig.

The no. of teeth on the various gears are as follows :

$Z_1 = 20$, $Z_2 = 100$, $Z_3 = 25$, $Z_4 = 150$, $Z_5 = 25$, $Z_6 = 150$

The module of gears 1 & 2 are 5 mm for that of other gears 6 mm. The pressure angle 20°. Calculate : 14

(i) Torque acting on shafts A, B, C & D.

(ii) Tangential and radical components of tooth forces between all gears.

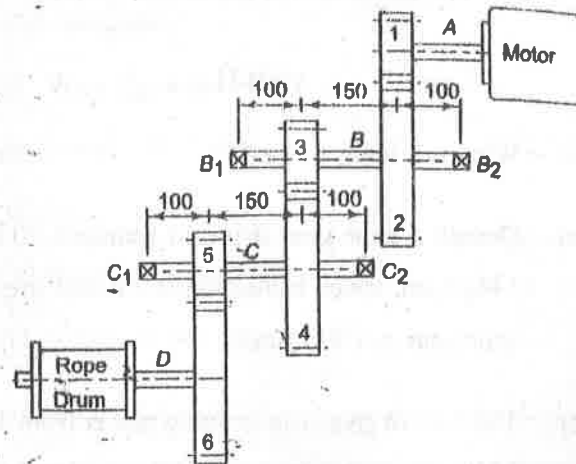(iii) Resultant reactions in bearings B_1 and B_2 and C_1 & C_2.

Fig.

Unit-III

3. (a) What is the difference between double and herringbone helical gears? 2

(b) The layout of a double reduction helical gear box is shown in fig. Pinion A is the driving gear and 10 kW power at 720 rpm is subjected to it through its shaft no. 1. The no. of tooth on different helical gears are as follows : $Z_A = 20$, $Z_B = 50$, $Z_C = 20$, $Z_D = 60$. The normal pressure angle for all gears is 20°. For the pair of helical gears A and B the helix angle is 30° & normal module is 3 mm for the pair C and D the helix angle is 25° and the normal module is 5 mm. Pinion A has right handed helical teeth while C has left handed helical teeth. The bearings B_1 and B_2 are mounted on shaft 2 in such a way the bearing B_1 can take only radial load while B_2 can take both radial as well as thrust load. Determine the magnitude and direction of bearing reactions in shaft 2. 14
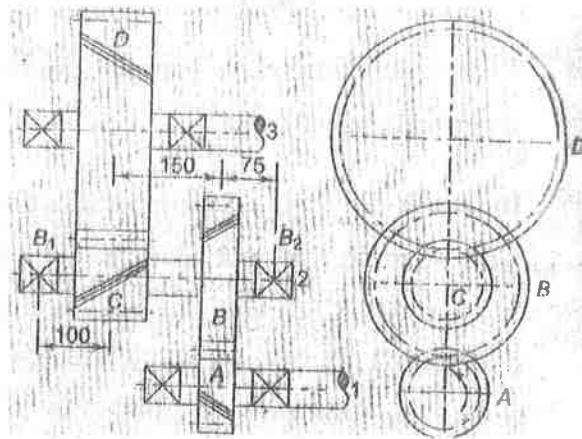
Fig.

(c) Design a Bevel gear drive to transmit 10 kW at 1440 rpm. Gear ratio is 3, material for pinion and gear is C45 steel and life of gear is 10,000 hrs. 14

Unit-IV

4. (a) Why hydrodynamic journal bearing is called self acting bearing? 2

(b) A single row deep groove ball bearing is used to support the lay shaft of a four speed automobile gearbox. It is subjected to loads in respective speed ratio as shown. The lay shaft is fixed to the engine shaft and rotates at 1750 rpm. The static

and dynamic load carrying capacities of the bearing are 11600 and 17600 N respectively. The bearing is expected to be in use for 4000 hr. of operation. Find out the reliability with which the life could be expected : 7

Gear	Axial Load (N)	Radial Load (N)	% time engaged
Ist Gear	3250	4000	1%
IInd Gear	500	2750	3%
IIIrd Gear	50	2750	21%
IVth Gear	NIL	NIL	75%

(c) Select a suitable ball bearing to carry a radial load of 10,000 N and an axial load of 4000 N. The shaft rotates at 1000 rpm. Average life is 5000 hrs. Inner race rotates. Take mild shocks. 7

(d) Write and derive Petroff's equation for journal bearing. Explain Mckee's investigation. 7

Unit-V

5. (a) What is the polygonal action in roller chain? 2

(b) A simple chain no. 08B is used to transmit power from a transmission shaft running at 200 rpm to another shaft running at 100 rpm. There are 19 teeth on the driving sprocket wheel and the operation is smooth without any shocks. Calculate :

   (i) The power transmitting capacity of the chain drive.

   (ii) The chain velocity

   (iii) The chain tension

   (iv) The factor of safety based on the preaking load. 7

(c) It is required to select a V-belt drive to connect a 15 kW, 2800 rpm normal torque AC motor to a centrifugal pump running at approximately 2400 rpm, for a service of 18 hr per day. The center distance should be approximately 400 mm. Assume that the pitch diameters of driving pulley is 125 mm. 7

(d) Design complete belt drive to drive a which from an electric motor of 11 kW power. Speed of motor shaft is 750 rpm. Speed ratio is 4. Belt position is horizontal and there is considerable variation of load. 7