Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII(NEW) • EXAMINATION – WINTER 2016

Subject Code:2171909 Date:29/11/2016

Subject Name: Machine Design

Time:10.30 AM to 1.30 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Design data book is permitted.**

Q.1 **(a)** What is structure diagram? Explain the method of drawing structure diagram of gear box. **07**

(b) A pair of straight teeth spur gears, having 20° involute full depth teeth is to transmit 12 kW at 300 r.p.m. of the pinion. The speed ratio is 3:1. The allowable static stresses for gear of cast iron and pinion of steel are 60 MPa and 105 MPa respectively. Assume the following: Number of teeth of pinion = 16; Face width = 14 times module; Velocity factor (C_v) = 4.5/(4.5 + v), v being the pitch line velocity in m / s; and tooth form factor Y = [0.912 – (0.154/No. of teeth)]. Determine the module, face width and pitch diameter of gears. Check the gears for wear; given σ_{es} = 600 MPa; E_P = 200 kN/mm^2 and E_G = 100 kN/mm^2. **07**

Q.2 **(a)** Explain the following terms used in helical gears : (a) Helix angle; (b) Normal pitch; (c) Axial pitch; (d) Normal Pressure angle **04**

(b) A 90º bevel gearing arrangement is to be employed to transmit 4 kW at 600 r.p.m. from the driving shaft to another shaft at 200 r.p.m. The pinion has 30 teeth. The pinion is made of cast steel having a static stress of 80 MPa and the gear is made of cast iron with a static stress of 55 MPa. The tooth profiles of the gears are of 14.5º composite form. The tooth form factor may be taken as y' = [0.124 – (0.684 / T_E)], where T_E is the formative number of teeth and velocity factor, C_v = 3/(3 + v) , where v is the pitch line speed in m/s. The face width may be taken as 1/3 rd of the slant height of the pitch cone. Determine the module, face width and pitch diameters for the pinion and gears, from the standpoint of strength and check the design from the standpoint of wear. Take surface endurance limit as 630 MPa and modulus of elasticity for the material of gears is E_P = 200 kN/mm^2 and E_G = 80 kN/mm^2. **10**

OR

(b) The speed reducer unit is to be designed for an input of 2 KW at 1600 rpm. The velocity ratio is 25. The worm is to be made of hardened steel and the gear of phosphor bronze having a static stress of 70 MPa. The approximate distance between two shafts is 120 mm. Taking a velocity factor C_v = 6/(6+v), Tooth form factor, Y= [0.912 – (0.154/No. of teeth)] and a wear factor of a 0.7. Find Standard module of gear, Face Width of the gear & length of worm and Check the design for wear load. Take tooth system 20^0 full depth involute. **10**

Q.3 **(a)** Explain the performance of a hydrodynamic bearing with neat curve of coefficient of friction versus bearing characteristic number. **07**

(b) It is required to select a ball bearing suitable for a 50 mm diameter shaft rotating at 1500 rpm. The radial and thrust loads at the bearing are 4500 N and 1600 N respectively. The value of X and Y factors are 0.56 and 1.4 respectively. Select a proper ball bearing from the following table for the rating life of 22500 hr. the inner ring rotates and the service factor is 1. **07**

Bearing No.	6010	6210	6310	6410
C(N)	21600	35100	61800	87100

OR

Q.3 **(a)** Explain the static load capacity, dynamic load capacity and equivalent dynamic load capacity of bearing. **05**

(b) Design a journal bearing from the following data: **09**

Radial load = 20 kN,
Diameter of journal =100 mm
Speed of journal =900 r.p.m.
Oil SAE 10 with viscosity at 55^0C = 0.017 kg/m-sec
Ambient temperature =15.5^0C
Maximum bearing pressure = 1.5 MPa
Permissible rise in oil temperature = 10^0C
Heat dissipation coefficient = 1232 W/m2/^{0}C
L/D ratio = 1.6
Design parameter ZN/p = 28
Clearance ratio = 0.0013
Specific heat of oil = 1900 J/kg/^{0}C

Q.4 **(a)** Why an I-section is usually preferred to round section in case of connecting rods? **04**

(b) The following data is given for a single cylinder four stroke diesel engine having CI Piston: **10**

Cylinder bore = 0.30 m — Stroke length = 0.375 m
Speed = 500 rpm — Break Mean effective pressure=1.15 MPa
Maximum gas pressure = 8 MPa — Allowable tensile stress = 37.5 N/ mm^2
Break specific fuel consumption = 0.22 kg/ kW –h

Temperature difference between centre and edge of piston head is 220^0C
Assume 5% of the total heat is developed in cylinder is transmitted by piston.
Design (1) Piston Head (2) Piston pin.

OR

Q.4 **(a)** Explain the design procedure of cylinder of an I.C. engine **04**

(b) Determine the dimensions of an I-section connecting rod for a petrol engine from the following data: **10**

Diameter of the piston = 110 mm; Mass of the reciprocating parts = 2 kg; Length of the connecting rod from centre to centre = 325 mm; Stroke length = 150 mm; R.P.M. = 1500 with possible over speed of 2500; Compression ratio = 4 : 1; Maximum explosion pressure = 2.5 N/mm^2.

Q.5 **(a)** Explain the thermal consideration in journal bearing design. **04**

(b) Design a crane hook for lifting capacity of 50 KN. It is made from forged steel and has triangular section. Take permissible tensile stress 80 N/mm2. Select the most suitable cross section for the hook. **10**

OR

Q.5 **(a)** Explain design procedure of wire rope drum. **07**

(b) What do you understand by 6 x 37 ropes? Explain with neat sketch the different rope section. **07**

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