Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – WINTER • 2014

Subject Code: 181902 Date: 29-11-2014

Subject Name: Machine Design-II

Time: 02:30 pm - 05:00 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 PSG Design Data Book is permitted in exam.**

Q.1 (a) Discuss causes & remedies of gear tooth failure. 04

(b) A spur gear pair made of plain carbon steel 55C8 (σ_{ut} = 720 N/mm^2 and E = 210 GPa) is required to transmit 7.5 kw power from an electric motor running at 1440 rpm to a machine running at 370 rpm. The tooth system is 20^o full depth involute and no. of teeth on pinion are as minimum as possible. The service factor and load concentration factor are 1.25 and 1.2 respectively. The factor of safety required is 1.25 to 1.5. The face width is twelve times the module. The gears are to be machined to meet the specifications of grade 7. Design the gear pair by using the velocity factor K_v = 3/ (3+v) and buckingham's equation for dynamic load. Suggest the case hardness for gear pair. Use the following relations. 10

$$y = 0.484 - \frac{0.287}{z},\ F_a = \frac{21v(bc + F_{\max})}{21v + \sqrt{bc + F_{\max}}}\ \text{N},\ c = 0.111e\left[\frac{E_p.E_g}{E_p + E_g}\right]\ \text{N/mm}$$

$$K = 0.16\left[\frac{BHN}{100}\right]^2\ \text{N/mm}^2,\ \text{For grade 7}\ e = 11 + 0.9\left(m + 0.25\sqrt{d}\right)\ \mu\text{m}$$

Q.2 (a) Explain the gear material and heat treatment. 04

(b) A helical gear speed reducer is to be designed. The rated power of the speed reducer is 75 kw at a pinion speed of 1200 rpm. The speed ratio is 3:1 for medium shock condition and 24 hr operation. Determine module, face width, no. of teeth in each gear. Specify material & heat treatment. The teeth are 20^o full depth in the normal plane. 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 $K_v = \frac{6}{6+v}$ and tooth form factor $y = 0.154 - \frac{0.912}{z_g}$ and a wear factor of 0.7 find 10

i. Standard module of gear
ii. Face Width of the gear & length of worm
iii. Check the design for wear load

Q.3 (a) Explain what is structural diagram and method of drawing structural diagram of gear box. 04

(b) Design a suitable speed gear box for a head stock of a lathe that has a variation of speed from 105 rpm to 690 rpm in 09 steps. The power is supplied by an electric motor of 10 kw capacity running at 1000 rpm and driving the input shaft through a V belt drive having a speed reduction of 2:1. Draw the structural diagram, speed chart and determine the number of teeth on each gears. 10

OR

Q.3 (a) Why it is necessary to provide multispeed drive for a machine tool? Give step by step procedure for the design of 8 speed drive for a lathe giving governing design equations. 04

(b) A radial drill machine using a gear box is required to give 8 stepped speeds. The motor power is 4 kw at 1440 rpm. The power from motor to the input shaft of gear box is transmitted by a V belt drive giving a speed reduction of 1:6. The minimum and maximum speeds are 70 rpm and 1800 rpm respectively. Make layout diagram of gear box. Draw ray diagram and speed chart. 10

Q.4 (a) Find the thickness of a piston crown based on thermal considerations for 4 stroke engine with following specifications: 06

i. Engine speed = 1500 rpm
ii. Piston diameter = 87 mm
iii. Length of stroke = 96 mm
iv. Brake mean effective pressure = 0.7 N/mm^2
v. BSFC = 0.26 kg/kw-h
vi. l/r ratio = 04
vii. Heat conducted through crown = 10% of heat generated during combustion
viii. Calorific value of fuel = 42 MJ/kg
ix. Assume that the piston is made of aluminum alloy with thermal conductivity of 175 w/m^oc and allowable temperature difference of 111^oc.

(b) Design a connecting rod for 4 stroke petrol engine with the following data: 08

i. Piston diameter = 0.10 m
ii. Stroke length = 0.15 m
iii. Length of connecting rod (centre to centre) = 0.30 m
iv. Weight of reciprocating parts = 20 N
v. Speed = 1500 rpm
vi. Possible over speed = 2500 rpm
vii. Compression ratio = 4:1
viii. Maximum explosion pressure = 2.5 MPa

Assume suitable additional data if required.

OR

Q.4 (a) Design an overhung Crank shaft with two main bearings for an I. C. engine with the following data: 08

i. Cylinder bore = 250 mm ii. Stroke length = 300 mm
iii. Flywheel weight = 27 kN iv. Maximum pressure = 2.5 N/mm^2
v. Maximum torque at crank rotation = 1.7 N/mm^2 30^o the pressure at that instant.

(b) Design a tubular type pushrod for operating an exhaust valve of 4 stroke I. C. engine using the following data: 06

i. Maximum force required to open the exhaust valve = 900 N
ii. Ratio of l_p/l_w for rocker arm = 1.2
iii. Length of push rod = 110 mm
iv. Ratio of inner diameter to outer diameter for tubular push rod = 0.75
v. Required factor of safety = 04
vi. Compressive yield strength for mild steel push rod = 350 N/mm^2
vii. Modulus of elasticity for mild steel = 210×10^3 N/mm^2

Q.5 (a) Explain the complete designation of steel wire ropes and various types of stresses induced in a wire rope. 06

(b) Design a wire rope for a lift using following details: 08

i. Number of ropes = 02
ii. Maximum load on the ropes including the cabin weight = 8 kN
iii. Tensile strength of 6×19 wire rope = 43.5 d^2 kN where d = Rope diameter in cm.
iv. Factor of safety = 12 and assume necessary data.

OR

Q.5 (a) Find the main dimensions of a cast iron rope drum from the following data for winding rope (two sides): 08

i. Maximum load to be lifted = 40 kN
ii. Diameter of wire rope = 14 mm
iii. Lifting height = 10 m iv. Number of falls = 04
v. Drum diameter is 30 times rope diameter
vi. Allowable stress for cast iron = 25 MPa
vii. Use two movable sheaves.

(b) Explain classification and working of different types of conveyors. 06

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