

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination-Nov/Dec-2011

Subject code: 160201

Date: 21/11/2011

Subject Name: Automobile Component Design

Time: 10.30 am -1.00 pm

Total marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Illustrate your answer with neat sketches wherever required.

- Q.1 (a)** Explain different modes of gear teeth failures, stating their reasons and remedies. **04**
- (b)** Design a spur gear pair to transmit 15 kW power from an electric motor shaft running **10**
at 1500 rpm to a machine shaft from the following specifications.

Tooth system = 20° pressure angle full depth involute

Number of teeth on pinion = 25

Speed reduction ratio = 3:1

Service factor = 1.25

Material of pinion and gear = FG 200

Design bending stress of material = 60 MPa

Surface hardness of pinion and gear = 200 BHN

Endurance strength of the material = 84 MPa

Dynamic load factor = 178 N/mm

Modulus of elasticity = 1.1 x 10⁵ MPa

Assume pitch line velocity as 7.5 m/sec for module calculation.

$$\text{Velocity factor, } C_v = \frac{3}{3+v}$$

$$\text{Lewis form factor, } y = \left(0.154 - \frac{0.912}{Z} \right) \text{ for } 20^\circ \text{ pressure angle full depth involute tooth system}$$

$$\text{Dynamic load equation, } F_d = F_t + \frac{21.v(f.C + F_t)}{21.v + \sqrt{f.C + F_t}}$$

$$\text{Wear load, } F_w = d_p \cdot f \cdot KW \cdot Q$$

- Q.2 (a)** A 306 radial ball bearing with inner ring rotation has 10 seconds work cycle as **07**
follows:

| | For 2 seconds | For 8 seconds |
|-------------|---------------|---------------|
| Radial load | 4 kN | 3 kN |
| Axial load | 2 kN | 0 |
| Speed | 900 rpm | 1200 rpm |
| | Light shock | Steady load |

If the basic dynamic capacity of the bearing is 24.25 kN, determine the expected average life of this bearing. Take X = 0.56, Y = 1.43 and Service factor, S = 1.5

- (b)** Draw the sketch of rolling contact bearing. Give nomenclature. Give functions of **07**
each component.

OR

[P.T.O.]

- (b) Explain the procedure of designing multi speed automobile gear box. **07**
- Q.3 (a)** What are the advantages of helical gears over spur gears? **04**
- (b) Design a pair of helical gear drive to transmit 20 kW power. The pinion has 20 teeth and rotates at 1000 rpm. The speed reduction is 5:1. The pressure angle is 20° and helix angle is 30° . Both gears are made of hardened steel having ultimate tensile stress 720 N/mm^2 . Take service factor 1.3 and factor of safety 4. Suggest surface hardness of pinion for wear design. Draw sketch of gear showing necessary information for detail drawing. **10**

OR

- Q.3 (a)** Explain the importance of thermal considerations in worm and worm gear design. **04**
- (b) Two shafts at right to each other are connected by a bevel pair having full depth involute teeth. The pinion having 20 teeth transmits 40 kW at 750 rpm to gear shaft running at 375 rpm. Take allowable static stress for pinion and gear materials 100 and 70 N/mm^2 respectively. Determine module, pitch diameters and face width from strength considerations. **10**

- Q.4 (a)** Explain the piston materials. **04**
- (b) Design a cast iron piston for a single acting four stroke diesel engine for following **10**
data:

Cylinder bore = 100 mm, stroke = 125 mm, $p_{\max} = 5.8 \text{ N/mm}^2$, $p_{\text{mean}} = 0.8 \text{ N/mm}^2$,

$\eta_m = 85 \%$, speed = 1500 rpm, Fuel consumption = 0.16 kg/BP/hr,

H.C.V. = $40 \times 10^3 \text{ kJ/kg}$, Constant C = 0.05, $K = 46.6 \text{ W/m}^0\text{K}$,

$\sigma_t \text{ (C.I.)} = 30 \text{ N/mm}^2$

For piston : $\mu = 0.1$, $p_b = 0.45 \text{ N/mm}^2$

For piston rings: $p_w = 0.030 \text{ N/mm}^2$, $\sigma_t = 80 \text{ N/mm}^2$

For piston pin: $p_b = 20 \text{ N/mm}^2$, $\sigma_b = 120 \text{ N/mm}^2$, $\tau = 60 \text{ N/mm}^2$.

OR

- Q.4 (a)** Why 'I' section is chosen for the connecting rod in the design of I.C.Engine? **04**
- (b) Write step by step design procedure for the design of connecting rod for an I.C. **10**
engine with design equations. Draw the sketch of connecting rod including small and big end bearings and bolts.

- Q.5 (a)** Explain design considerations for casting. **07**
- (b) Explain the importance of assembly considerations in machine design. **07**

OR

- Q.5 (a)** State and explain design considerations for machining. **07**
- (b) What is creep? How will you design the parts subjected to creep? Give the practical **07**
applications of the components designed for creep.