

GUJARAT TECHNOLOGICAL UNIVERSITY**BE SEM-VIII Examination May 2012****Subject code: 181902****Subject Name: Machine Design - II****Date: 12/05/2012****Time: 10.30 am – 01.00 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.
5. Use of any data book is restricted.

- 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 **10**
running 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)** Design a single rope drum to transmit a torque of 8 kN.m with a 32 mm rope. **07**
Assume the height of the load to be raised as 2.7 meter and the ratio of the pulley system as 2. The mean diameter of the drum is 576 mm. Assume the drum to be made of Grey cast iron, grade 20 having allowable shear strength of 33 MPa. Make a neat sketch of the arrangement.

- (b) A single point hook is made from a 50 mm M.S. bar with 84 mm bed diameter. Calculate the safe load that can be taken by this hook, if the design permissible stress is limited to 160 MPa. If the hook section is changed to trapezoidal section from triangular section for the same bar what will be the change in load carrying capacity? 07

For trapezoidal section,

$$R_n = \frac{\left(\frac{b_i + b_o}{2}\right) \cdot H}{\left(\frac{b_i \cdot R_o - b_o \cdot R_i}{H}\right) \log_e \left(\frac{R_o}{R_i}\right) - (b_i - b_o)}$$

$$R = R_i + \frac{H(b_i + 2b_o)}{3(b_i + b_o)}$$

For triangular section,

put $b_o = 0$ in above relations.

OR

- (b) Explain the procedure of designing multi speed gear box. 07
- Q.3** (a) What are the advantages of helical gears over spur gears? 04
- (b) Design a pair of helical gears to transmit 50 kW at a speed of 1440 rpm to a shaft required to run at 480 rpm. The helix angle is approximately 25° and 20° full depth teeth are used. Both the gear and pinion are made of steel with permissible stress 80 N/mm² and 100 N/mm² respectively. Take minimum number of teeth on pinion 16. Check your design for dynamic load and determine minimum hardness of teeth required. 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/mm² 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 data: 10

Cylinder bore = 100 mm, stroke = 125 mm, $p_{\max} = 5.8$ N/mm², $p_{\text{mean}} = 0.8$ N/mm²,

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

H.C.V. = 40×10^3 kJ/kg, Constant C = 0.05, K = 46.6 W/m⁰K,

σ_t (C.I.) = 30 N/mm²

For piston : $\mu = 0.1$, $p_b = 0.45$ N/mm²

For piston rings: $p_w = 0.030$ N/mm², $\sigma_t = 80$ N/mm²

For piston pin: $p_b = 20$ N/mm², $\sigma_b = 120$ N/mm², $\tau = 60$ N/mm².

OR

- Q.4** (a) Why 'I' section is chosen for the connecting rod in the design of I.C.Engine? 04

- (b) Design a connecting rod for a 4 – stroke petrol engine from the following data: **10**
- | | |
|--|------------|
| Cylinder bore | = 100 mm |
| Stroke length | = 140 mm |
| Engine speed | = 1500 rpm |
| Possible over speed of engine | = 2500 rpm |
| Maximum explosion pressure | = 2.5 MPa |
| Weight of reciprocating parts | = 18.5 N |
| Length of connecting rod | = 315 mm |
| Yield strength of connecting rod material | = 320 MPa |
| Factor of safety | = 5 |
| Permissible bearing pressure for big end | = 12.5 MPa |
| Permissible bearing pressure for small end | = 15 MPa |

Q.5 (a) Explain Wire ropes with its designation. What are the advantages of wire ropes. **07**
Explain selection of wire ropes.

(b) Why trapezoidal section is used for hook? Draw a neat sketch of single hook and show the critical section on it. **07**

OR

Q.5 (a) Explain design procedure designing belt conveyors. **07**

(b) Classify the conveyors. Explain construction and working of any one conveyor. **07**
