

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-VIII • EXAMINATION – SUMMER • 2014**

Subject Code: 181902

Date: 31-05-2014

Subject Name: Machine Design-II

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. Design data book is permitted.

- Q1(a)** Explain Pitting and Scoring for gear tooth failure. 4
- (b)** A spur gear having 22 teeth to be made of plain carbon steel 40C8 ( $S_{ut}=580\text{N/mm}^2$ ) is to be mesh with a gear having 88 teeth to be made of grey cast iron FG260 ( $S_{ut}=260\text{N/mm}^2$ ). The pinion shaft is connected to 12KW, 1440 rpm electric motor. The starting torque of the motor is approximately twice the rated torque. The tooth system is  $20^\circ$  full depth involute. The face width is 10 times module for which the load distribution factor is 1.4. The gear are to be machined to met the specifications of grade 7 for which deformation factor is 240 N/mm. 10
- (I) If factor of safety require against bending failure 1.0 , design the gear pair by using velocity factor Velocity factor =  $\frac{6}{6+v}$  and Buckingham's equation for dynamic load.
- (ii) if the factor of safety required against pitting failure is 1.5 , specify surface hardness.  
 $Y = 0.484 - 2.87/Z$
- Buckingham's equation  $F_d = F_t + \frac{(21v(bC + Ft_{max}))}{(21v + \sqrt{(bC + Ft_{max})})}$
- $K = 0.18(\text{BHN}/100)^2$  for steel pinion and cast iron  
 Standard module are 4,5,6,8,10,12,16 , Service factor =2, Load concentration factor=1.4
- Q2(a)** A elevator is designed to carry workers and materials to height of 40 meter. It is estimated that at least 10 workers with material load of 12 KN should be hoisted at a speed of 0.5m/sec which should be attained in the first 0.4s. The recommended steel wire rope is 6x19 with wire diameter 2.5mm. Determine factor of safety. Assume  $E = 84\text{GPa}$ , for 6x19 rope wire diameter  $d_w = 0.063d$ , cross sectional area  $= 0.38d^2$ , ultimate tensile strength for the wire rope is  $435d^2$  7
- (b)** Design a crane hook for lifting capacity of 5 tones. Take permissible tensile stress  $80\text{N/mm}^2$  for forged steel. Assume a triangular section for hook design 7

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

$$R = R_i + H(b_i + 2b_o)/3(b_i + b_o)$$

**OR**

(b) Explain design procedure for 6 speed reduction gear box. 7

**Q3(a)** What is formative number of teeth in helical gear? Derive the expression for formative number of teeth in helical gears. 4

(b) Design a gear pair of helical gear 10

	Gear	Pinion
Material	50C <sub>4</sub>	60C <sub>4</sub>
Ultimate strength MPa	660	750
BHN	241	255
Pressure Angle in degree	20°	20°
Number of teeth	70	35
Normal module in mm	5	5
Face width in normal plane, mm	50	50
Modulus of elasticity GPa	205	200

Assume service factor 1.5 and factor of safety 3. Check wear and dynamic strength of gear. Helix angle is 25°, speed of pinion is 720 rpm.

Material	Error 0.02	Error 0.04
Steel steel 20degree involute	228	456

$$\text{Velocity factor} = \frac{6}{6+v}, \quad F_w = D_p b Q K / \cos^2 \psi$$

$$K = ((\sigma_{es})^2 \sin(\phi_n) / 1.4) (1/E_p + 1/E_g), \quad \sigma_{es} = 2.75(\text{BHN}) - 70$$

$$F_d = F_t + \frac{(21v(b C \cos \psi \cos \psi + F_{tmax}) \cos \psi)}{(21v + \sqrt{(b C \cos \psi \cos \psi + F_{tmax})})}$$

**OR**

**Q3(a)** Explain thermal consideration while designing worm and worm wheel drive. 4

(b) A pair of high grade cast iron bevel gears having shaft at right angle are to have an angular velocity ratio of driver to driven of 2 to 3. The driver is to rotate at 175 rev/min and is to transmit 10 KW. It is 0.4 meter in pitch diameter. Take the width of face as about one third of the length of pitch element and determine the pitch of the gear. Assume 24 hr/day operation. 10

$$\text{Velocity factor} = \frac{3}{3+v}, \quad \text{Levis factor} = \pi(0.154 - (0.921/\text{no. of teeth}))$$

$$\text{Beam strength} = f_{ef} m Y(1-F/L)$$

$$\text{High grade cast iron } f_{ef} = 84 \text{ MPa, } f_{es} \text{ for cast iron} = 630 \text{ MPa, } E_p = E_g = 105 \text{ MPa}$$

**Q4(a)** Discuss about various section of connecting rod. 4

(b) Design a cast iron piston for single acting four stroke engine for following specification 10  
 Cylinder Bore = 110 mm, Stroke = 130 mm, Maximum gas pressure = 5 N/mm<sup>2</sup>  
 Brake mean effective pressure = 0.5 N/mm<sup>2</sup>, Fuel consumption = 0.2 kg/kw/hr,  
 speed = 2000 rev/min. Assume suitable data for C.I permissible tensile stress is 40 N/mm<sup>2</sup>,  
 HCV = 41870 KJ/kg, K for C.I. = 46.6  
 Permissible tensile stress or piston ring is 100 N/mm<sup>2</sup>, permissible tensile stress for pin is 150 N/mm<sup>2</sup>

**OR**

**Q4(a)** Explain about material for piston. 4

- (b) Design a connecting rod for four stroke petrol engine for following data. 10  
Piston diameter =0.1 m  
Stroke=0.14 m,  
Length of C.R. =0.315 m  
Weight of reciprocating part =18.2 N  
Speed = 1500 rpm with over speed 2500  
Compression ratio 4:1  
Maximum explosion pressure = 2.45 MPa.  
F.O.S. =5 , For connecting rod  $\sigma_{\text{yield}} 380 \text{ N/mm}^2$  ,  $\sigma_{\text{ultimate}}= 580 \text{ N/mm}^2$

- Q5(a) Explain the design procedure of screw conveyer 7  
(b) Explain design of flat belt conveyer. 7

**OR**

- Q5(a) Explain design procedure of wire rope drum. 7  
(b) What do you understand by 6 x 37 ropes? Explain with neat sketch the different rope section. 7

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