

**Ganpat University**  
**B.Tech SEM VII Mechanical Engineering**  
**CBCS Regular Examination Nov / Dec 2013**  
**2ME702 Design of Mechanical System**

Duration: 3hr

Marks: 70

**Instructions:**

1. Assume suitable data if necessary.
2. Write your answer to the point and precisely.
3. Draw neat and clean sketch.

**SECTION - 1****Q.1 Attempt following questions**

- (a) A 35 kW motor running at 1200 r.p.m. drives a compressor at 780 r.p.m [12]  
 through a  $90^\circ$  bevel gearing arrangement. The pinion has 30 teeth. The pressure angle of teeth is  $14.5^\circ$ . The wheels are capable of withstanding a dynamic stress,  $\sigma_w = 140 \left( \frac{280}{280+v} \right) MPa$ , Where  $v$  is the pitch line speed in m/min. The form factor for teeth may be taken as  $0.124 - \frac{0.686}{T_E}$ , Where  $T_E$  is the number of teeth equivalent of a spur gear. The face width may be taken as  $\frac{1}{4}$  of the slant height of pitch cone. Determine for the pinion, the module pitch, face width, addendum, dedendum, outside diameter and slant height.

**OR****Q.1 Attempt following questions**

- (a) A pair of bevel gears with  $20^\circ$  pressure angle consists of a 20 teeth pinion [09]  
 meshing with a 30 teeth gear. The module is 4 mm while the face width is 20 mm. The material for pinion and gear is steel 50C4 ( $S_{ut} = 600 \text{ N/mm}^2$ ). The gears are machined to meet the specifications of grade 8 and the surface hardness is 350 BHN. The pinion rotates at 600 rpm and receives power from the electric motor. The starting torque of the motor is 150% of the rated torque. Assuming a minimum factor of safety as 2, determine the rated power that the gear can transmit. For Grade 8,  $e = 16 + 1.25\Phi$

Z	Y	Z	Y	z	Y	z	Y	Z	Y	Z	Y
16	0.295	20	0.320	24	0.337	28	0.352	33	0.367	40	0.389
17	0.302	21	0.326	25	0.340	29	0.355	35	0.373	45	0.399
18	0.308	22	0.330	26	0.344	30	0.358	37	0.380	50	0.408
19	0.314	23	0.333	27	0.438	32	0.364	39	0.386		

Table – 1 Value of Lewis Form Factor

- (b) Explain Application of worm Gear. Also explain Advantage and [03]  
 Disadvantage of worm gear.

**Q.2 Attempt following questions**

- (a) It is required to design a pair of spur gear with  $20^\circ$  full depth involute teeth [07]  
 based on Lewis equation. The velocity factor is to be used account for dynamic load. The pinion shaft is connected to a 10 kW, 1440 rpm motor.

The starting torque of the motor is 150% of the rated torque. The speed reduction is 4:1. The pinion as well as the gear are made of plain carbon steel 40C8 ( $S_{ut} = 600 \text{ N/mm}^2$ ). The factor of safety can be taken as 1.5. Design the gears, specify their dimensions and suggest suitable surface hardness for the gears.

- (b) Explain Gear Tooth failure. [04]

OR

Q.2 Attempt following questions

- (a) It is required to design a pair of spur gear with  $20^\circ$  full depth involute teeth consisting of a 20 teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1440 rpm electric motor. The starting torque of the motor can be taken as 150% of the rated torque. The material of the pinion is plain carbon steel Fe410 ( $S_{ut} = 410 \text{ N/mm}^2$ ), while the gear is made of grey cast iron FG200 ( $S_{ut} = 200 \text{ N/mm}^2$ ). The factor of safety is 1.5. Design the gear based on Lewis equation and using velocity factor to account for the dynamic load. [09]
- (b) Explain Advantage of gear drive compare with other drive [02]

Q.3 Attempt following questions

- (a) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 50 teeth gear. The pinion rotates at 1000 rpm. The normal pressure angle is  $20^\circ$ , while the helix angle is  $25^\circ$ . The face width is 40 mm and the normal module is 4 mm. The pinion as well as gear the gear are made of steel 40C8 ( $S_{ut} = 660 \text{ N/mm}^2$ ) and heat treated to a surface hardness of 350 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears. [10]
- (b) Evaluate Parallel and Crossed helical gear. [02]

SECTION – II

Q.4 Attempt following questions

- (a) Design as cast iron piston for a single acting two stroke engine for the following data: [11]
- Cylinder Bore = 100 mm
  - Stroke = 150 mm
  - Maximum gas pressure = 4  $\text{N/mm}^2$
  - Indicated Mean effective pressure = 0.75  $\text{N/mm}^2$
  - Mechanical Efficiency = 80%
  - Fuel Consumption = 0.10 kg per brake power per hour
  - Higher Calorific Value of fuel = 42000 kJ/Kg
  - Speed = 2000 rpm

OR

**Q.4 Attempt following questions**

- (a) A two stroke diesel engine has the following specifications: [11]  
Brake Power = 10 kw  
Speed = 1440 rpm  
Indicated Mean effective pressure = 0.35 N/mm<sup>2</sup>  
Mechanical Efficiency = 80%  
Determine the bore and length of cylinder, thickness of cylinder head and size of stud for the cylinder head.

- Q.5 (a) A rope drive is to transmit 250 kW from a pulley of 1.2 m diameter, running at a speed of 300 rpm. The angle of lap may be taken as  $\pi$  radians. The groove half angle is 22.5°. The ropes to be used are 50 mm in diameter. The mass of the rope is 1.3 kg per metre length and each rope has a maximum pull of 2.2 kN, the coefficient of friction between rope and pulley is 0.3. Determine the number of ropes required. If the overhung of the pulley is 0.5 m, suggest suitable size for the pulley shaft if it is made of steel with a shear stress of 40 MPa. [09]
- (b) Explain Sheave for fibre ropes. [02]

OR

- Q.5 (a) Design a tensile bar of length L = 200 mm to carry a tensile load of 6 kN for minimum cost, out of following materials:- [07]

Material	Mass Density (kg/m <sup>3</sup> )	Material Cost (Rs / N Weight)	Yield Strength (MPa)
Steel	7850	28	130
Al alloy	3000	32	50
Titanium Alloy	4800	480	90
Magnesium Alloy	2100	32	20

- (b) Differentiate Hydrodynamic and Hydrostatic Lubrication. [04]

**Q.6 Attempt following questions**

- (a) A single row deep groove ball bearing has a dynamic load capacity of 45000 N and operates on the following work cycle [06]  
1) Radial load of 5500 N at 700 rpm for 25% of the time  
2) Radial load of 11000 N at 900 rpm for 50% of the time and  
3) Radial load of 8000 N at 600 rpm for the remaining 25% of the time  
Calculate the life of the bearing in hour.
- (b) Explain Lubrication of Rolling contact Bearing. [03]
- (c) Explain difference types of mounting arrangement of Bearings. [03]

END OF PAPER