



KINGS

COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING



QUESTION BANK

Sub Code/Name: ME 1352 – DESIGN OF TRANSMISSION SYSTEMS Year/Sem: III / VI

UNIT-I (Design of transmission systems for flexible elements)

PART-A (2 Marks)

1. Sketch and name the different type of compound wire ropes .
2. What is meant by chordal action in chain drives?
3. Why tight-side of the belt should be at the bottom side of the pulley?
4. Explain the term "Crowning of Pulley" .
5. In what way silent chain is better than ordinary driving chain?
6. What are the various losses in the power transmission by belts?
7. In what ways the timing belts are superior to ordinary V-belts?
8. What is done to accommodate initial sag in chain drive?
9. How is a wire rope specified?

UNIT-I (Design of transmission systems for flexible elements)

PART-B (16 Marks)

1. Designs a chain drive to actuate a compressor from a 12 kW electric motor at 900 rpm, the compressor begin 250 rpm. Minimum centre distance should be 500 mm, the chain tension may be adjusted by shifting the motor on rails. The compressor is to work 8 hour/day. (16)
2. Design a chain drive to actuate a compressor from 15kW electric motor running at 1,000 r.p.m, the compressor speed being 350 rpm. The minimum centre distance is 500 mm. the compressor operates 15 hours per day. The chain tension may be adjusted by shifting the motor. (16)
3. Design a V-belt drive and calculate the actual belt tension and average stress for the following data. Driven pulley diameter, $D= 500$ mm, driver pulley diameter, $d=150$ mm, center distance $c=925$ mm, speed $n_1 = 1000$ rpm, $n_2 = 300$ rpm and power, $P = 7.5$ kW. (16)
4. A crane is lifting a load of 18 KN through a wire rope and a hook. The weight of the hook etc., is 10kN. The load is to be lifted with an acceleration of 1m/sec^2 . Calculate the diameter of the wire rope. The rope diameter may be taken as 30 times the diameter of the rope. Take a factor of safety of 6 and Young's modulus for the wire rope 0.8×10^5 N/mm. The ultimate stress may be taken as 1800 N/mm. The cross-sectional area of the wire rope may be taken as 0.38 times the square of the wire rope diameter. (16)

5. A 15 kW squirrel cage motor, 1250 r.p.m. is driving a centrifugal pump at 550 r.p.m. The centrifugal pump is located at 700 mm from the motor. Design a chain drive. (16)

UNIT-II (Spur gears and parallel axis helical gears)

PART-A (2 Marks)

1. Specify the conditions based on which gear cutters are selected.
2. Why is dedendum value more than addendum value?
3. What is working depth of a gear-tooth ?
4. What factors influence backlash in gear drives?
5. Where do we use skew helical gears?
6. What is interference in Involute profile?
7. How number of teeth affects the design of gears ?
8. What are the advantages of the helical gear over spur gear ?
9. State the law of Gearing.
10. What is pressure angle? What is the effect of increase in pressure angle?

UNIT II (Spur gears and parallel axis helical gears)

PART-B (16 Marks)

1. Design a pair of helical gears to transmit 30kW power at a speed reduction ratio of 4:1. The input shaft rotates at 2000 rpm. Take helix and pressure angles equal to 25° and 20° respectively. The number of teeth on the pinion may be taken as 30. (16)
2. Design a straight spur gear drive to transmit 8 kW. The pinion speed is 720 rpm and the speed ratio is 2. Both the gears are made of the same surface hardened carbon steel with 55RC and core hardness less than 350 BHN. Ultimate strength is 720 N/mm^2 and yield strength is 360 N/mm^2 . (16)
3. A motor shaft rotating at 1500 rpm has to transmit 15kW to a low speed shaft with a speed reduction of 3:1. Assume starting torque to be 25% higher than the running torque. The teeth are 20° involutes with 25 teeth on the pinion. Both the pinion and gear are made of C45 steel. Design a spur gear drive to suit the above conditions and check for compressive and bending stresses and plastic deformations. Also sketch the spur gear drive. (16)
4. A helical gear with 30° helix angle has to transmit 35kW at 1500 rpm. With a speed reduction ratio 2.5. If the pinion has 24 teeth, determine the necessary module, pitch diameter and face width for 20° full depths the teeth. Assume 15Ni 2Cr 1 Mo 15 material for both pinion and wheel. (16)
5. A pair of helical gears subjected to moderate shock loading is to transmit 37.5kW at 1750 r.p.m. of the pinion. The speed reduction ratio is 4.25 and the helix angle is 15° . The service is continuous and the teeth are 20° FD in the normal plane. Design the gears, assuming a life of 10,000 hours. (16)
6. A compressor running at 300 rpm is driven by a 15 Kw, 1200 rpm motor through a $14\frac{1}{2}^\circ$ full depth spur gears. The centre distance is 375 mm. The motor pinion is to be of C30 forged steel hardened and tempered, and the driven gear is to be of cast iron. Assuming medium shock condition, design the

gear drive.

(16)

UNIT III (Bevel, worm and cross helical gears)
PART-A(2 Marks)

1. Name the different applications of worm gear.
2. When bevel gears are used?
3. What are commonly used materials for worm and wheel?
4. What is Herringbone gear? State its application.
5. State true or false and justify. "Mitre gears are used for connecting non-intersecting shafts".
6. State the advantages of Herringbone gear.
7. Why is multistart worm more efficient than the single start one?
8. Define the following terms: (a) Cone distance, (b) Face angle.
9. In which gear-drive, self-locking is available?
10. Where do we use skew gears?
11. What is the specific feature of a miter gear?
12. Why is the efficiency of worm gear drive comparatively low?
13. When the number start of a worm is increased in worm gear drive, how it affects the other parameters and action of the drive?

UNIT III (Bevel, worm and cross helical gears)
PART-B (16 Marks)

1. Design a pair of bevel gears for two shafts whose axes are at right angles. The power transmitted is 25kW. The speed of the pinion is 300 rpm and the gear is 120 rpm. (16)
2. A 2 kW power is applied to a worm shaft at 720 rpm. The worm is of quadruple start with 50mm as pitch circle diameter. The worm is of quadruple start type with 50mm as pitch circle diameter. The worm gear has 40 teeth with 5mm module. The pressure angle in the diametral plane is 20° . Determine (i) the lead angle of the worm, (ii) velocity ratio, and (ii) centre distance. Also, calculate efficiency of the worm gear drive, and power lost in friction. (16)
3. A pair of straight tooth bevel gears has a velocity ratio of 4/3. The pitch diameter of the pinion is 150 mm. The face width is 50mm. The pinion rotates at 240 rev/min. The teeth are 5mm module, $14\frac{1}{2}^{\circ}$ involutes. If 6 kW is transmitted, determine (i) the tangential force at the Mean radius (ii) the pinion thrust force (iii) the gear thrust force. Draw the free body diagrams indicating the forces. (16)
4. A 90 degree straight bevel gear set is needed to give a 3:1 reduction. Determine the pitch cone angle, pitch diameter, and gear forces if the, 25 degree pressure angle pinion has 15 teeth of pitch circle diameter, 4, and the transmitted power is 8 HP at 550 pinion rpm. (16)

5. Design a worm gear drive to transmit 22.5 kW at a worm speed of 1440 rpm. Velocity ratio is 24:1. An efficiency of at least 85% is desired. The temperature rise should be restricted to 40 °C. Determine the required cooling area. (16)
6. Design a bevel gear drive to transmit 3.5 kW with the following specifications: speed ratio = 4; driving shaft speed = 200 r.p.m.; drive is non-reversible; material for pinion is steel; material for wheel is cast iron; and life 25000 hours. (16)
7. Design a worm gear drive to transmit a power of 22.5 kW. The worm speed is 1440 r.p.m. and the speed of the wheel is 60 r.p.m. The drive should have a minimum efficiency of 80% and above. Select suitable materials for worm and wheel and decide upon the dimensions of the drive. (16)

UNIT IV (Design of gear boxes)
PART-A (2 Marks)

1. What is the function of spacers in a gear-box?
2. What are the methods of lubrication in speed reducers?
3. What is the function of spacers in a gear-box?
4. What is step ratio? Name the series in which speeds of multi-speed gear box are arranged.
5. Give some applications of constant mesh gear box.

UNIT IV (Design of gear boxes)
PART-B (16 Marks)

1. Sketch the arrangements of a six speed gear box. The minimum and maximum speeds required are around 460 and 1400 rpm. Drive speed is 1440 rpm. Construct speed diagram of the gear box and obtain various reduction ratios. Use standard output speeds and standard step ratio. Calculate number of teeth in each gear and verify whether the actual output speeds are within + 2% of standard speeds. (16)
2. Design the layout of a 12 speed gear box for a milling machine having an output of speeds ranging from 180 to 2000 rpm. Power is applied to the gear box from a 6 kW induction motor at 1440 rpm. Choose standard step ratio and construct the speed diagram. Decide upon the various reduction ratios and number of teeth on each gear wheel sketch the arrangement of the gear box. (16)
3. In a milling machine, 18 different speeds in the range of 35 rpm and 650 rpm are required. Design a three stage gear box with a standard step ratio. Sketch the layout of the gear box, indicating the number of teeth in each gear. The gear box receives 3.6 kW from an electric motor running at 1,440 rpm. Sketch also the speed diagram. (16)
4. Design a nine – speed gear box for a machine to provide speeds ranging from 100 to 1500 rpm. The input is from a motor of 5 kW at 1440 rpm. Assume any alloy steel for the gear. (16)
5. A machine tool gear box is to have 9 speeds. The gear box is driven by an electric motor whose shaft rotational speed is 1400 r.p.m. The gear box is connected to the motor by a belt drive. The maximum and minimum speeds required at the gear box output are 1000 r.p.m. and 200 r.p.m. respectively. Suitable speed reduction can also be provided in the belt drive. What is the step ratio and what are the values of 9 speeds? Sketch the arrangement. Obtain the number of teeth on each gear and also the actual output speeds. (16)

6 .A six speed gear box is required to provide output speeds in the range of 125 to 400 r.p.m. with a step ratio of 1.25 and transmit a power of 5 kW at 710 r.p.m. Draw the speed diagram and kinematics diagram. Determine the number of teeth module and face width of all gears, assuming suitable materials for the gears. Determine the length of the gear box along the axis of the gear shaft. (16)

UNIT V (Design of cam, clutches and brakes)

PART-A (2 Marks)

1. Name the profile of cam that gives no jerk.
2. Give the reason for left and right shoes of the internal expansion brakes having, different actuating forces.
3. If a multidisc clutch has 8 discs in driving shaft and 9 discs in driven shaft, then how many number of contact surfaces it will have?
4. What is meant by self-energising brake? .
5. Why should the temperature rise be kept within the permissible range in brakes?
6. Name four materials used for lining of friction surface in clutches.
7. Classify clutches based on the coupling methods:
8. What is fade?
9. Explain the desirable properties of friction material used for the lining of brake shoes.
10. Why in automobiles, braking action when travelling in reverse is not as effective as when moving forward?
10. What is the difference between a coupling and a clutch?

UNIT V (Design of cam, clutches and brakes)

PART-B (16 Marks)

1. A multi – disk clutch consists of five steel plates and four bronze plates. The inner and outer diameters of friction disks are 75mm and 150mm respectively. The coefficient of friction is 0.1 and the intensity of pressure is limited to 0.3 N/mm^2 . Assuming the uniform wear theory, calculate (i) the required operating force, and (ii) power transmitting capacity at 750 rpm. (16)
2. An automotive type internal – expanding double – shoe brake is shown in figure 15b. The face width of the friction lining is 40 mm and the intensity of normal pressure is limited to 1 N/mm^2 . The coefficient of friction is 0.32. The angle ϕ_1 can be assumed to be zero. Calculate (i) the actuating force P, and (ii) the torque – absorbing capacity of the brake. (16)
3. A leather faced conical clutch has cone angle of 30° . The pressure between the contact surfaces is limited to 0.35 N/mm^2 and the breadth of the conical surface is not to exceed $1/3$ of the mean radius. Find the dimensions of the contact surface to transmit 22Kw at 2000 rpm .Also calculate the force required to engage the clutch. .Take $\mu =0.1$ (16)

4. A single plate clutch, both side being effective is required to connect a machine shaft to a driver shaft which runs at 500rpm .The moment of inertia of the rotating parts of the machine is 1Kgm^2 .The inner and the outer radii of the friction discs are 50mm&100mm respectively .Assuming uniform pressure of 0.1N/mm^2 and $\mu =0.25$, determine the time taken for the machine to reach full speed when the clutch is suddenly engaged . Also determine the power transmitted by the clutch, the energy dissipated during the clutch slip and the energy supplied to the machine during engagement. (16)

6. A radial cam rotates at 1200 rpm with the follower rising 20mm with SHM in150of the cam rotation .The roller is 32mm in diameter and the prime circle is 80mm in diameter. Check whether undercutting will occur. (16)