KONGUNADU COLLEGE OF ENGINEERING AND TECHNOLOGY

NAMAKKAL-TRICHY MAIN ROAD, THOTTIAM, TRICHY -621 215

DEPARTMENT OF MECHANICAL ENGINEERING

REGULATIONS – 2017

YEAR/SEM: III/VI SUBJECT CODE & NAME: ME8651- DESIGN OF TRANSMISSION SYSTEMS

QUESTION BANK
UNIT-I DESIGN OF FLEXIBLE ELEMENTS

PART-A

1. What are the materials used for belt-drive?
2. Why slip is less in the case of V-belts when compared with flat belts?
3. Give an expression for ratio of tensions in a flat belt drive.
4. How is a V-belt specified?
5. Distinguish between open drive and cross drive of a belt drive. Which is better?
6. Give the advantages of chain drives over belt drives.
7. Specify the five parts of roller chain.
8. Give any three applications of chain drives. What are their limitations?
9. List out the various stresses induced in the wire ropes.
10. What is backsliding in chain drives?
11. What do you understand by simplex, duplex and triplex chain?
12. What are the materials used for V grooved pulleys?

PART-B

Problems on Flat Belt Drive:

1. Select a flat belt to drive a mill of 250 rpm from a 10 kW, 730 rpm motor. Center distance is to be around 2 m. The mill shaft pulley is of 1 m diameter. [AU, M/J 2011]

2. Design a flat belt drive for the following data: Power to be transmitted = 22.5 kW; driver speed = 740 rpm; speed ratio = 3; distance between the pulleys = 3 m; larger pulley diameter = 1.2 m. [AU, N/D 2011]

3. A flat belt drive is to design to drive a flour mill. The driving power requirement of the mill is 22.5 kW at 750 rpm with a speed reduction of 3.0. The distance between the shaft is 3 m. Diameter of the mill pulley is 1.2 m. Design and make a neat sketch of the drive. [AU, M/J 2012]

Problems on V-Belt Drive:

4. A motor of power 2 kW running at a speed of 1400 rpm transmits power to an air blower running at560 rpm. The motor pulley diameter is 200 mm. The center distance may be 1000 mm. Design a suitable V-belt drive. [AU, N/D 2012]

5. Design a V-belt drive to the following specifications: Power to be transmitted = 75 kW; Speed of driving wheel = 1440 rpm; Speed of driven wheel = 400 rpm; Diameter of driving wheel = 300 mm; Center distance = 2500 mm; Service = 16 hours/day. [AU, M/J 2013]

Problems on Rope Drive:

6. A workshop crane carries a load of 30 kN using wire ropes and a hook. The hook weighs 15 kN. Diameter of the rope drum is 30 times the diameter of the rope. The load is lifted with an acceleration of 1 m/s2. Find the diameter of the rope. Fs = 6; Er = 80 kN/mm^2, _U = 180 kN/mm2; cross section of the rope = 0.4 x (dia of rope) 2. [AU, N/D 2011]

Problems on Chain Drive:

7. Design a chain drive to actuate a compressor from a 10 kW electric motor at 960 rpm. The compressor speed is to be 350 rpm. Minimum center distance should be 0.5 m. Compressor is to work for 8 hours/day. [AU, M/J 2013]

8. Design a chain drive to actuate a compressor from a 10 kW electric motor. Speed of the motor shaft is 1050 rpm and the compressor speed is to be 350 rpm. Minimum center distance should be 600 mm. Compressor service required is 12 hours/day. [AU, N/D 2012]

9. Design a chain drive to drive a centrifugal compressor from an electric motor 15 kW at 1000 rpm. The speed reduction ratio required is 2.5. The compressor is to work for 16 hours a day. State solutions for common problems encountered in continuous operation of the drive. [AU, M/J 2012]

10. A truck equipped with a 9.5 kW engine uses a roller chain as the find drive to the rear axle. The driving sprocket runs at 900 rpm and the driven sprocket at 400 rpm with a center distance of approximately 600 mm. select the roller chain. [AU, M/J 2011]

UNIT-II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS

PART-A

1. Define module.
2. What are the main types of gear tooth failure?
3. State the law of gearing.
4. What are the generally used gear profiles?
5. Specify the significance of minimum no of teeth in pinions.
6. Mention the advantages of non-metallic gears..
7. How does failure by pitting happen in gears?
8. What is the effect of increasing the pressure angle in gears?
9. State advantages and disadvantages with helical gear.
10. Explain the term “Crowning of Pulley”.

11. What is slack adjuster?
12. What are the standard interchangeable tooth profiles?
13. What are the advantages of toothed gears over the types of transmission system?

PART-B

Problems on Spur Gear:

1. Design a straight spur gear drive. Transmitted power 8 kW. Pinion speed 764 rpm. Speed ratio is 2. The gears are to be made of C45 Steel. Life is to be 10,000 hours. [AU, M/J 2013]

2. Design a pair of straight gears to transmit 12 kW at 1500 rpm. Speed reduction required is 4. Check for compressive and bending stresses. Also check for plastic deformation of teeth. Make a schematic diagram and show the results neatly. [AU, N/D 2012]

3. Design a spur gear drive for a heavy machine tool with moderate shocks. The pinion is transmitting 18 kW at 1200 rpm with a gear ratio of 3.5. Design the drive and check for elastic stresses and plastic deformation. Make a sketch and label important dimensions carried. [AU, M/J 2012]

4. In a spur gear drive for a stone crusher, the gears are made of C40 steel. The pinion is transmitting 20 kW at 1200 rpm. The gear ratio is 3. Gear is to work 8 hours per day, six hours a week and for 3 years. Design the drive. [AU, M/J 2011]

5. Design a spur gear drive required to transmit 15 KW at pinion speed of 1400 rpm to a low speed shaft rotating at 500 rpm. The teeth are 20 degree full depth in volute with 25 teeth on the pinion. Both the pinion and gear are made of CI with a maximum safe static stress of 56 N /mm^2

6. A motor shaft rotating at 1500 rpm has to transmit 15 kW to a low speed shaft with a speed reduction of 3:1. The teeth are 20° involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 N/mm2. A safe stress of 40 N/mm2 may be taken for the shaft on which the gear is mounted and also for the key. Design a spur gear drive to suit the above conditions. Assume starting torque to be 25% higher than the running torque. [AU, N/D 2011]

Problems on Helical Gear:

7. Design a pair of helical gears to transmit 10 kW at 1000 rpm of the pinion. Reduction ratio of 5 is required. Give details of the drive in a tabular form. [AU, M/J 2013]

8. Design a pair of full depth involute teeth helical gears to transmit 5 kW at 1440 rpm. Use C45 steel for the gears. Number of teeth on pinion may be 24 and that in on gear 56. Check the compressive and bending stresses. Make a simple sketch and label the important dimensions of the drive. [AU, N/D 2012]

9. Design a pair of helical gears to transmit 37.5 kW at 1750 rpm of the pinion. The drive is subjected to heavy shock loading. The speed reduction is 4 and the helix angle is 15°. Select suitable material and design the gear. Check for working stresses and sketch the drive [AU, M/J 2012]

10. Design a pair of helical gears to transmit 10 kW at 1000 rpm of the pinion. Reduction ratio of 5 is required. [AU, M/J 2011]

11. A general purpose enclosed gear train is based on parallel helical gears, specified life is 36,000 hours. Torque at driven shaft is 411 N-m. Driving shaft speed is 475 rpm. Velocity ratio is 4. It is desired to have standard centre distance. Design the gear drive. [AU, N/D 2011]

12. Design a helical gear to transmit 15KW at 1400rpm.to the following specifications: speed reduction is 3, pressure angle is 20°, helix angle is 15^{0}, and the material of both the gear is C45 steel. Allowable static stress 180 N/mm^2, Surface endurance limit is 800 N/mm^2, Young's modulus of material=$2x10^5$ N/mm^2.

UNIT-III BEVEL, WORM AND CROSS HELICAL GEARS

PART-A

1. What are the forces acting on bevel gear?
2. When is bevel gear preferred?
3. What is reference angle? How is it related to speed ratio of bevel gear ratio?
4. Under what situation, bevel gears are used?
5. Where do we use worm gears?
6. Give the speed ratio range of worm-wheel drive.
7. In worm gear drive, only the wheel is designed. Why?
8. Why is dynamic loading rarely considered in worm gear drives?
9. Calculate angle between the shafts of a crossed helical gears made of two left handed helical gears of 10° helix angle each.
10. What is helical angle of worm? May/June 2016
12. What is a zerol bevel gears? may 2015
13. Mention the advantages of worm gear drive. Nov 2014, April2008
14. What is virtual number of teeth in bevel gears? nov 2014, May2014
15. Why phosphor bronze is widely used for worm gear?Nov2013

PART-B

Problems on Bevel Gear:

1. Design a bevel gear drive to transmit 7 kW at 1600 rpm for the following data: Gear ratio = 3; Material for pinion and gear = C45 Steel; Life = 10,000 hours. [AU, M/J 2013]

2. Design a bevel gear drive to transmit 7.5 kW at 150 rpm. Gear ratio is 3.5. Material for pinion and gear is C45 Steel. Minimum no of teeth is to be 25. [AU, M/J 2012]

3. Design a bevel gear drive to transmit 7.5 kW; Speed ratio is 4. Driving shaft speed is 400 rpm. [AU, N/D 2012]

4. Design a bevel gear drive to transmit 7.36 kW at 1440 rpm for the following data: Gear ratio = 3; Material for pinion and gear = C45 surface hardened. [AU, M/J 2011]

5. Design a bevel gear drive to transmit 3.5 kW. Speed ratio = 4; Driving shaft speed = 200 rpm. The drive is non-reversible pinion is of steel and wheel of CI. Assume a life of 25,000 hours. [AU, N/D 2011]

6. Design a straight bevel gear drive between two shafts at right angles to each other. Speed of the pinion shaft is 360rpm and the speed of the gear wheel shaft is 120rpm. Pinion is of steel and wheel of cast iron. Each gear is expected to work 2hours/day for 10 years. The drive transmits 9.37kw.

7. Design a bevel gear drive to transmit a power of 9kW at 200 rpm of the pinion. Gear ratio is 3, material used is C20. Ultimate tensile strength (σu) is 500N/mm^2, Yield strength (σy) is 260 N/mm^2.

Problems on Worm Gear:

8. 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. [AU, N/D 2011] [AU, M/J 2013]

9. Design a worm gear drive to transmit 12kW at 1440 rpm with a speed ratio of 20. Use steel worm and cast iron wheel. [AU, N/D 2012]

10. Design a worm gear and determine the power loss by heat generation. The hardened steel worm rotates at 1500 rpm and transmits 10 kW to a phosphor bronze gear with gear ratio of 16. [AU, M/J 2012]

11. Design a worm drive or a speed reducer to transmit 15 kW at 1440 rpm of the worm shaft. The desired wheel speed is 60 rpm. Select a suitable worm and wheel materials. [AU, M/J 2011]

12.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.

13.A hardened steel worm rotates at 1440 rpm and transmits 12kW to a phosphor bronze gear. The speed of the worm wheel should be 60 ±3% rpm. Design the worm gear drive if an efficiency of atleast 82% is desired.

UNIT – IV GEAR BOXES

PART –A

1. What are preferred numbers? [M/J'13] [A/M'11]
2. What are the possible arrangements to achieve 12 speeds from a gear box? [M/J'13]
3. Calculate standard step ratio for six speed gear box with speed ranging between 100 and 560 rpm [N/D'12]
4. Select 3 pairs of gears with total teeth for each pair 60 and speed ratio 1, 1.41 and 2 [N/D'12]
5. What is step ratio in gear box? [M/J'12]
6. What is meant by ray diagram? [M/J'12]
7. Distinguish between structural diagram and speed diagram. [N/D'11]
8. What are the methods of lubrication in speed reducers? [N/D'11]
9. What are the possible arrangements to achieve 12 speeds from a gear box? [A/M'11]
10. What are the points to be considered while designing a sliding-mesh type of multi speed gear box?
11. List the ways by which the number of intermediate steps may be arranged in a gear box.
12. Which type of gear is used in constant mesh gear box? Justify.
13. Compare sliding mesh and synchronous gear box.
14. Where is multi speed gear boxes employed?
15. Name the series in which speeds are arranged in multi-speed gear boxes.
16. Sketch the kinematic layout of gears for 3 speeds between two shafts.
17. List six standard speeds starting from 18 rpm with a step ratio 1:4.
18. List out the basic rules to be followed for optimum gear box design
19. What is step ratio? Name the series in which speeds of multi- speed box are arranged.
20. Give some applications of constant mesh gear box.

PART-B

1. Design a 9 speed gear box to give output speeds between 280 and 1800 rpm. The input power is 5.5 KW at 1400 rpm. Draw the kinematic layout diagram and the speed diagram. Determine the number of teeth on all gears. [M/J'13]

2. Design the layout of a 12 speed gear box for a lathe. The minimum and maximum speeds are 100 and 1200 rpm. Power is 5 KW from 1440 rpm. Draw the speed and kinematic diagram. Also calculate the number of teeth on all gears. [M/J'13]

3. For a load lifting arrangement transmitting 10 KW with electric motor running at 1400 rpm, constant mesh type speed reducer is required with reduction ratio 12. Design a suitable arrangement and make a neat sketch. [N/D'12]

4. Select speeds for a 12 speed gear box for a minimum speed of 16 rpm and maximum speed of 900 rpm. Drive speed is 900 rpm. Draw speed diagram and draw kinematic arrangement of the gear box showing the number of teeth in all the gears. [N/D'12]

5. Design a sliding mesh nine speed gear box for a machine tool with speed ranging from 36 rpm to 550 rpm. Draw the speed diagram and kinematic arrangement showing number of teeth in all gears. [M/J'12]

6. An all geared headstock of a lathe requires a 12 speed gear box with minimum and maximum of 110 rpm and 1440 respectively. Draw speed diagram and show the details of number of teeth in all the gears in a kinematic layout. [M/J'12]

7. A gear box is to be designed with the following specifications: [N/D'11] Power=14.72 KW, number of speeds =18 Minimum speed = 16 rpm, step ratio =1.25 Motor speed = 1400 rpm. The 18 speeds are obtained as 2*3*3

1. Sketch the layout of the gear box.
2. Draw the speed diagram.

8. The minimum and maximum speed of a six speed gear box is to be 160 and 500 rpm. Construct the kinematic arrangement and the ray diagram of the gear box. Also find the number of teeth of all gears. [M/J'11]

9. Design a 12 speed gear box for an all geared headstock of a lathe. Maximum and minimum speeds are 600 rpm and 25 rpm respectively. The drive is from an electric motor giving 2.25 KW at 1440 rpm. [M/J'11]

10. Draw the kinematic arrangement and speed diagram of the head stock gear box of a turret lathe having arrangement for 9spindle speeds, ranging from 31.5 rpm and 1050 rpm. Calculate the number of teeth on each gear. Minimum number of teeth on a gear is 25. Also calculate the percentage deviation of the obtainable speeds from the calculated ones.

11. Sketch the arrangements of a six speed gear box. The minimum and maximum speeds required are around 460 and 1440 rpm. Drive speed as 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.

PART- A

Clutch:

1. What is the axial force required at the engagement and disengagement of cone clutch? [M/J'13]
2. Name different types of clutch? [N/D'12]
3. Why is it necessary to dissipate the heat generated during a clutch operation? [M/J'12]

4. What are the factors upon which the torque capacity of a clutch depends? [N/D'11]
5. When do we use multiple disc clutches?
6. Under what condition of a clutch, uniform rate of wear assumption is more valid?
7. How the "uniform rate of wear" assumption is valid for clutches?
8. What are the effects of temperature rise in clutches?
9. What is the use of a clutch in power transmission system?
10. Name the different friction materials used in friction clutches?
11. Sketch a cone clutch.
12. 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?
13. What are the desirable properties of friction materials to be used for clutches? Brakes:

1. What is self locking brake? [M/J'13] [N/D'11] [M/J'11]
2. How does the function of a brake differ from that of a clutch? [N/D'12]
3. Name few commonly used friction materials. [A/M'11]
4. What is the disadvantage of block brake with one short shoe? What is the remedy?
5. Differentiate between self- energizing and self-locking brakes.
6. Give reason for left and right shoe of internal expansion brakes having different actuating forces.
7. Why in automobiles, braking action when travelling in reverse is not as effective as when move forward?
8. What is meant by self energizing brake?

1. State the profile of cam that gives no jerk and mention how jerk is eliminated. [M/J'12]
2. Name four profiles normally used in cams.
3. State the advantages of cam mechanisms.
4. What is the significance of pressure angle in cam design?

PART –B

Problems based on clutch:

1. An automobile single plate clutch consists of two pairs of contacting surfaces. The inner and outer radii of friction plate are 120 mm and 250 mm respectively. The co efficient of friction is 0.25 and the total axial force is 15 Kn. Calculate the power transmitting capacity of the clutch plate at 500 rpm using

a. Uniform wear theory. b. Uniform pressure theory. [M/J'13]

2. A single plate clutch, effective on both sides, required to transmit 22.5 KW at 2400 rpm. Determine the outer and inner diameter of frictional surfaces if the co efficient of friction is 0.2,

ratio of diameter is 1.2 and the maximum pressure is not to exceed 0.1 N/ mm^2. Determine 1. The face width required and 2. The axial spring force necessary to engage the clutch. [N/D'12]

3. A dry single plate clutch is to be designed to transmit 112 KW at 2000 rpm. The outer radius of the friction plate is 1.25 times the inner radius. The intensity of pressure between the plates is not to exceed 0.07 N/ mm^2 . The co efficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are 8. If each spring has stiffness equal to 40 N/mm. determine the dimensions of the friction plate and initial compression in the springs. [M/J'12]

4. A single plate clutch, both sides being effective, is required to connect a machine shaft to a driver shaft which runs at 500 rpm. The moment of inertia of the rotating parts of the machine is 1 Kg m^2 . The inner and outer radii of the friction discs are 50 mm and 100 mm respectively. Assuming uniform pressure of 0.1 N/ mm^2 and co efficient of friction 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 dissipating during clutch slip and the energy supplied to the machine during engagement.

5. A multi-disc clutch has three discs on the driving shaft and two on the drive shaft is to be designed for a machine tool, driven by an electric motor of 22 KW running at 1440 rpm. The inside diameter of the contact surface is 130 mm. the maximum pressure between the surfaces is limited to 0.1 N/ mm^2 . Design the clutch. Take μ=0.3, n_1 =3, n_2 = 2. [N/D'11]

6. A multiplate disc clutch transmits 55 kW of power at 1800 rpm. Coefficient of friction for the friction surfaces is 0.1. Axial intensity at pressure is not to exceed 160 KN/m^2. The internal radius is 80mm and is 0.7 times the external radius. Find the number of plates needed to transmit the required torque.

Problems based on CAMs

7. A radial cam rotating at 200 rpm is driving a 10 mm diameter translating roller follower to produce the following motions, rise of 20 mm with SHM in 1500 of cam rotation, dwell for 600 and fall of 20 mm with SHM in 1200 of cam rotation and dwell for remaining 300 . Draw the profile of the cam. Check whether under cutting will occur. [N/D'12]

8. Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve, each of which corresponding to 600 of cam rotation. The valve should remain in the fully open position for 200 of cam rotation. The lift of the valve is 32 mm and the least radius of the cam is 50 mm, the follower is provided with a roller of 30mm diameter and its line of stroke passes through the axis of the cam. [M/J'12]

9. The displacement function of a cam -follower mechanism is given by y(theta) =100(1 cos (theta)) mm; 0 ≤theta≤ 2Π, where y is the follower displacement and theta is the cam rotation. The cam speed is 1000 rpm. The spring constant is 20 N/ mm^2 andthe spring has an initial compression of 10 mm,

when the follower is in its lowest position. The weight of the mass to be moved including the follower is 10 N, length of the follower outside the guide A= 40 mm. length of the guide B= 100 mm, Rb = 50 mm, Rr = 10 mm and the co efficient of friction between the guidance and the follower is 0.05. Compute normal force and the cam shaft torque when the cam has rotated 60 degrees. [N/D'11]

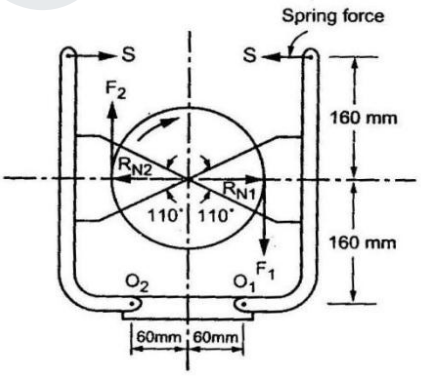
Problems based on brakes:

10. Describe with the help of a neat sketch the design procedure of an internal expanding shoe brake. Also deduce the expression for the braking torque. [M/J'13]

11. Determine the capacity and the main dimensions of a double brake for the following data: The brake shoe is mounted on the drum shaft. The hoist with its load weights 45 KN and moves downwards with a velocity of 1.5 m/s. the pitch diameter with in a distance of 3025m. The kinetic energy of the drum may be neglected. [M/J'11]

12. Design a differential band brake for a winch lifting a load of 20kN through a steel wire rope wound around a barrel of 600 mm diameter. The brake drum, keyed to the barrel shaft, is 800 mm diameter and the angle of lap of the band over the drum is about 240^0. Operating arms of the brake are 50 mm and 250 mm. The length of operating lever is 1.6m.

13. The layout of a double block brake is shown in fig. The brake is rated at 250N.m at 650 r.p.m. The drum diameter is 250mm assume coefficient of friction to be 0.3and for conditions of service a pv value of 1000(kpa) m/s may be assumed. Determine (a)Spring force S required to set the brake and (b)Width of shoes (c)Which shoe will have greater rate of wear and what will be the ratio of rates of wear of the two shoes?



14Describe with the help of a neat sketch the principles of an internal expanding shoe. Also deduce the expression for the braking torque.