W 2538

M.E. DEGREE EXAMINATION, JANUARY 2007.

First Semester

Computer Aided Design

CD 1603 — INTEGRATED MECHANICAL DESIGN

(Common to M.E. CAD/CAM)

(Regulation 2005)

Time : Three hours Maximum : 100 marks

(Use of approved data book is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Hole basis system is preferred over shaft basis system in tolerancing. Justify.

2. Differentiate between functional datum and manufacturing datum.

3. Under what circumstances hollow shafts are preferred over solid shafts?

4. Name the type of rolling contact bearing used under the following conditions of loading :

   (a) Light radial load with high rotational speed.

   (b) Heavy axial and radial loads with shock.

5. State the different modes in which a gear tooth can fail.

6. Find the efficiency of a worm gear drive for the following specifications :

   Number of start on worm = 1; Number of teeth on gear = 40; Lead angle = 15°; Coefficient of friction = 0.2.

7. Clutches are usually designed on the basis of uniform wear. Why?

8. When will you prefer a positive engagement clutch?

9. What is meant by a self-energising brake?

10. Draw the type of brake used in electric cranes.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Discuss the six identified stages of the design process. How are these related to CAD? (8)

(ii) Specify the attainable tolerance grades for the following manufacturing processes together with their surface finish : (4)

(1) CNC machining centre

(2) Grinding

(3) Drilling

(4) Turning.

(iii) Differentiate between fixed fastener assembly and floating fastener assembly with neat sketches. (4)

Or

(b) (i) Experimentally how to calculate torsional stiffness of a given shaft. (6)

(ii) Differentiate design of a shaft based on shear strength and based on rigidity. Which one is more conservative? (5)

(iii) How to design the shaft against vibration? (5)

12. (a) A medium duty light commercial vehicle weighs 5 tonnes gross. The vehicle can have a maximum speed of 60 kmph while taking a turn of minimum radius 12 m. Select a suitable bearing for the axle shaft if the life of the bearing required is 5000 hours at a speed of 450 rpm.

Or

(b) A hoisting drum 0.5 m in diameter is keyed to a shaft which is supported in two bearings and driven through a 12 : 1 reduction ratio by an electric motor. Determine the power of the driving motor if the maximum load of 8 kN is hoisted at a speed of 50 m/min and the efficiency of the drive is 80%. Also determine the torque on the drum shaft and the speed of the motor in rpm. Determine also the diameter of the shaft made of machinery steel, the working stresses of which are 115 MPa in tension and 50 MPa in shear. The drive gear whose diameter is 450 mm is mounted at the end of the shaft such that it overhangs the nearest bearing by 150 mm. The combined shock and fatigue factors for bending and torsion may be taken as 2 and 1.5 respectively.

pair of straight bevel gears is required to transmit 40 hp at 710 rpm d a speed ratio of 3.55. Assume the number of teeth on pinion as 20, lect suitable materials for the gears and determine the gear tooth sizes. lso check for the stresses induced.

Or

A 12 speed gear box is required to run the head stock spindle of a lathe to give output speeds in the range 100 rpm and 1440 rpm from an input of 5 kW electric motor running at 1440 rpm.

(i) Find the progression ratio and individual speeds.

(ii) Sketch the layout of the gear box.

(iii) Draw the appropriate ray diagram.

(iv) Calculate the number of teeth on all the gears.

) A friction clutch is required to transmit 45 hp at 2000 rpm. It is to be of single plate disc type with both sides effective. The pressure is exerted by means of springs and limited to 0.7 kg/cm^2. If the maximum possible outer diameter of the clutch is 30 cm, find the required inner diameter of the clutch plate and the total force exerted by the springs. Assume the wear to be uniform and coefficient of friction is 0.3. Design the coil springs and release levers.

Or

(b) Design a roller type unidirectional clutch to transmit a torque of 400 Nm.

(a) A simple band brake operates at a drum 600 mm in diameter that is running at 200 rpm. The coefficient of friction is 0.25. The brake band has a contact of 270°; one end is fastened to a fixed pin and the other end to the brake arm 125 mm from the fixed pin. The straight brake arm is 750 mm long and placed perpendicular to the diameter that bisects the angle of contact.

(i) What is the pull necessary on the end of the brake arm to stop the wheel if 35 kW is being absorbed? What is the direction for this minimum pull?

(ii) What width of steel band of 2.5 mm thickness is required for this brake if the maximum tensile stress is not to exceed 50 N/mm^2?

Or

(b) A motor car weighing 1250 kg has 2.4 m wheel base and the centre of gravity is 60 cm above the ground level and 1.5 m behind the front axle. The car is moving down a gradient of 1 in 20 against a wind resistances of 20 kg acting parallel to the road and a height of 75 cm from the road. Calculate the normal reaction on each wheel when the engine is switched off and the rear wheels are applied so as to give a retardation of 0.6 m/s^2. What must be the coefficient of friction between the rear wheels and the road if the rear wheels are not to skid under these conditions?