**Reg. No. :** | | | | | | | | | | |

# Question Paper Code: 12014

M.E. DEGREE EXAMINATION, DECEMBER 2013.

First Semester

CAD / CAM

01PCD103 - INTEGRATED MECHANICAL DESIGN

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Approved Design data book may be permitted

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. List out the important features of BIS.
2. State Distortion energy theory and hence write the equation for Von-misses stress.
3. What is an interference fit? Give examples.
4. Under what circumstances, a shaft will be designed based on rigidity?
5. Specify the reasons for backlash in gears.
6. List out the basic rules to be followed for optimum gear box design.
7. Why is an equivalent coefficient of friction used while designing long shoe brake drums?
8. What is the difference between self-energizing and self-locking in case of block brakes?
9. List the practical applications for the various types of springs.
10. Write any four advantages of rolling contact bearings over sliding contact bearings.

PART – B (5 x 14 = 70 Marks)

11. (a) A solid shaft is supported on two bearings 1.8 m apart and rotates at 250 rpm. Three pulleys P, Q and R are located on the shaft at distances of 0.6 m, 1.35 m

and 1.65 m respectively to the right of the left hand bearing. The diameters of the pulleys P, Q are 0.75 m and 0.6 m respectively. 29.5 kW power is supplied to the pulley R out of which 18.5 kW is taken off by pulley Q and the remaining goes to the other. The drive from P is vertically downward while from Q is downward at an angle of 60° to the horizontal. For pulley P and Q the tension ratio is 2 and angle of lap is 100°. The magnitude of load at R is 8 kN and is downward at an angle of 20° to the vertical. The shaft is required to work with minor shock load. Design the shaft made up of C45 steel. (14)

Or

(b) A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure $F_t$C of the gear C and $F_t$D of the gear D act vertically downwards. Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gears C and D weigh 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively. (14)

12. (a) In a drilling machine, 12 different speeds in the range of 100 rpm and 355 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 on each gear. The gear box receives 5 kW from an electric motor running at 360 rpm. Sketch also the speed diagram. (14)

Or

(b) Design a 9 speed gear box for the following data:-
Minimum speed : 100 rpm, Step ratio : 1.25. The input used from a 4 kW, 1400 rpm motor. Draw the speed diagram and indicate the number of teeth on each gear in a kinematic diagram. Determine 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. (14)

13. (a) A four-wheeled automobile car has a total mass of 1000 kg. The moment of inertia of each wheel about a transverse axis through its centre of gravity is 0.5 kg-$m^2$. The rolling radius of the wheel is 0.35 m. The rotating and reciprocating parts of the engine and transmission system are equivalent to a moment of inertia of 2.5 kg-$m^2$, which rotates at 5 times the road-wheel speed.

The car is travelling at a speed of 100 kmph on a plane road. When the brakes are applied, the car decelerates at 0.5 g. There are brakes on all four wheels. Calculate :

(i) the energy absorbed by each brake and

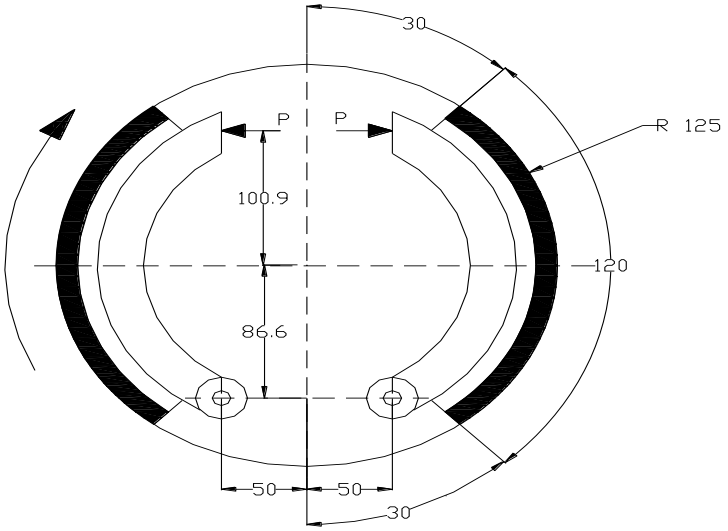
(ii) the torque capacity of each brake. (14)

Or

(b) An automotive type internal expanding shoe brake is shown in Fig.1. The face width of the friction lining is 40 mm and the maximum intensity of normal pressure is limited to 1 $N/mm^2$. The coefficient of friction is 0.32. The angle $\theta_1$ can be assumed to be zero. Calculate:

(i) The actuating force 'P'

(ii) The torque absorbing capacity of the brake. **(**14)




All dimensions are in 'mm'

Fig. 1

14. (a) Design the Wire rope for a high speed hoist, which has the following data: The maximum weight of the unloaded cage is equal to 970 kg and weight of the rope to be balanced in 6% of the weight of the cage. A speed of 42 kmph is to be reached while traveling at a distance of 10 m from rest. The sheave is carried on 2 similar (RSJ) rolled steel joists, where the centre distance is 340 mm. the location of the sheave on the middle of the beam of span 3.8 m. (14)

Or

(b) Design a V-belt to the following specifications:-

Power to transmitted = 75 kW,

Speed of driving wheel = 1440 rpm,
Speed of driven wheel = 400 rpm,
Diameter of driving wheel = 300 mm,
Centre distance = 2500 mm and
Service = 16 hours/day. (14)

15. (a) A bearing for an axial flow compressor is to carry a radial load of 2500 N and a thrust load of 1500 N. The service imposes light shock and the bearing will be in use of 40 hours/week for 5 years. The speed of the shaft is 1000 rpm. Select suitable ball bearing for the purpose and give the required tolerance on the shaft and the housing. Diameter of the shaft is 50 mm. (14)

Or

(b) Design a helical spring for a spring loaded safety valve for the following conditions :

Operating pressure = 1 $N/mm^2$

Maximum pressure when the valve blows off freely = 1.075 $N/mm^2$

Maximum lift of the valve when the pressure is 1.075 $N/mm^2$ = 6 mm

Diameter of valve seat = 100 mm

Maximum Shear stress = 400 MPa

Modulus of rigidity = 86 $KN/mm^2$

Spring index = 5.5 (14)

PART - C (1 x 10 = 10 MARKS)

16. (a) In a machine tool application, 12 different speeds are required from 125 rpm to 450 rpm in the output. The motor speed is 630 rpm.

(i) Determine the 12 standard speed in G.P.

(ii) Draw the ray diagram.

(iii) Sketch the Kinematics' layout

(iv) Determine the number of teeth on the gears to be used. (10)

Or

(b) The transporter of a heat treatment furnace is driven by a 4 kW, 1440 rpm, induction motor through a chain drive with a speed reduction ratio of 2.5. The transmission is horizontal with bath type of lubrication. Rating is continuous with 3 shifts per day. Design the complete chain drive assuming simplex type and centre distance of approximately 500 mm. (10)