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Question Paper Code: 41214

M.E. DEGREE EXAMINATION, DECEMBER 2014.

First Semester

CAD / CAM

14PCD103 – INTEGRATED MECHANICAL DESIGN

(Regulation 2014)

(Use of Standard and Approved Design Data Book is permitted)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions.

PART A - (5 x 1 = 5 Marks)

- Factor of safety for fatigue loading is the ratio of
 - elastic limit to the working stress
 - Young's modulus to the ultimate tensile strength
 - endurance limit to the working stress
 - elastic limit to the yield point
- In helical gears, the distance between similar faces of adjacent teeth along a helix on the pitch cylinders normal to the teeth, is called
 - normal pitch
 - axial pitch
 - diametral pitch
 - module
- The coefficient of friction for material used in brake lining should have.
 - Low
 - high
 - low at high temperature and high at low temperature
 - none of the above
- The Purpose of the flywheel is :
 - To balance the shaft
 - to provide initial torque
 - to store the energy
 - none of the above

5. When a machine member is subjected to torsion, the torsional shear stress set up in the member is:

- (a) zero at both the centroidal axis and outer surface of the member
- (b) Maximum at both the centroidal axis and outer surface of the member
- (c) zero at the centroidal axis and maximum at the outer surface of the member
- (d) none of the above

PART - B (5 x 3 = 15 Marks)

- 6. Define modular construction.
- 7. Specify the reason for the backlash in the bears.
- 8. Define: a) partially energizing brake b) self-locking brake.
- 9. Differentiate between escalators and elevators.
- 10. Why bending strength is considered for the design of the module in the gearing?

PART - C (5 x 16 = 80 Marks)

- 11. (a) (i) Discuss the system of fit and different types of fits. (6)
- (ii) What is the concept of tolerance? State its importance in engineering. (4)
- (iii) What is the difference between the hole basis and shaft basis tolerances? Which one is preferred? (6)

Or

- (b) Design a shaft to transmit power from an electric motor of 30kW at 300rpm to two machine tools through a pulleys. The power taken by the one pulley is 12kW and the remaining power is supplied to the second pulley. The first pulley have 300mm diameter with 40kg and the second pulley have 600mm diameter with 75kg. Assume the belt tension ratio 2 for both pulleys and the shaft material is 30C8 steel. The K_m and K_t are assumed to be 2 and 1.5 respectively. Draw the bending moment and torque diagrams, assuming maximum shear stress theory. (16)

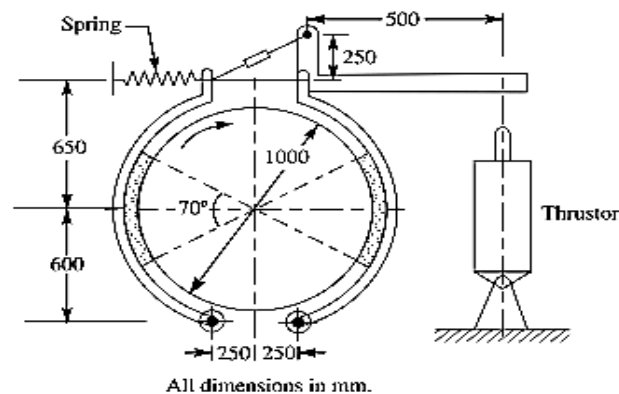
- 12. (a) A pair of helical gears subjected to moderate shock loading is to transmit 37.5kW at 1750 r.p.m. of the pinion. The speed reduction ratio is 4.25 and the helix angle is 15° . The service is continuous and the teeth are 20^0 in the normal plane. Design the gears, assuming a life of 10,000 hours. (16)

Or

(b) Design a 12 speed gear box. The speeds can be laid from 10 to 450rpm with $\phi=1.4$. The power of the motor is 7.4kW at 1450rpm.

- 1.) Construct the best ray diagram such that $[U_{min} \geq \frac{1}{4}]$.
- 2.) Calculate the No. of teeth of the gear at all stages.
- 3.) Find the diameter of the shaft.
- 4.) Determine the module of the gears by assuming suitable materials constant. (16)

13. (a) A spring closed thruster operated double shoe brake is to be designed for a maximum torque capacity of 3000 N-m. The brake drum diameter is not to exceed 1m and the shoes are to be lined with Ferrodo having a coefficient of friction 0.3. The other dimensions are as shown in Fig.



- 1.) Find the spring force necessary to set the brake.
- 2.) If the permissible stress of the spring material is 500 MPa, determine the dimensions of the coil assuming spring index to be 6. The maximum spring force is to be 1.3 times the spring force required during braking. There are eight active coils. Specify the length of the spring in the closed position of the brake. Modules of rigidity is 80 KN/ mm²
- 3.) Find the width of the brake shoes if the bearing pressure on the lining material is not to exceed 0.5 N/ mm² (16)

Or

(b) A band brake acts on the $\frac{3}{4}$ th of circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the

anticlockwise direction. If the brake lever and pins are to be made of mild steel having permissible stresses for tension and crushing as 70 MPa and for shear 56 MPa, design the shaft, key, lever and pins. The bearing pressure between the pin and the lever may be taken as 8 N/mm^2 . (16)

14. (a) A cross belt arrangement has centre distance between pulleys as 1.5 m. The diameter of bigger and smaller pulleys are 'D' and 'd' respectively. The smaller pulley rotates at 1000 rpm. and the bigger pulley at 500 rpm. The flat belt is 6 mm thick and transmits 7.5 kW power at belt speed of 13 m/s approximately. The coefficient of belt friction is 0.3 and the density of belt material is 950 kg/m^3 . If the permissible tensile stress for the belt material is 1.75 MPa, calculate: 1. Diameters of pulleys; 2. Length and width of belt. (16)

Or

- (b) A rope drive is to transmit 250 kW from a pulley of 1.2 m diameter, running at a speed of 300 r.p.m. The angle of lap may be taken as π 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 overhang 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. (16)

15. (a) A single cylinder double acting steam engine develops 150 kW at a mean speed of 80 r.p.m. The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is $\pm 2\%$ of mean speed. If the mean diameter of the flywheel rim is 2 metres and the hub and spokes provide 5% of the rotational inertia of the wheel, find the mass of the flywheel and cross-sectional area of the rim. Assume the density of the flywheel material (which is cast iron) as 7200 kg / m^3 . (16)

Or

- (b) 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 60° of cam rotation. The valve should remain in the fully open position for 20° 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. (16)