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

Question Paper Code : 92217

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fifth Semester

Robotics and Automation Engineering

RO 6503 – MECHANICAL DESIGN

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Use of Approved Data Book is permitted

Any missing data can suitably be assumed

Answer ALL questions

PART – A (10×2=20 Marks)

1. What is helix angle ?
2. What is meant by bevel gears ?
3. Define critical speed of a shaft.
4. What is rigid coupling ?
5. State any two merits and demerits of belt drives over gear drives.
6. Draw the construction of roller chain and mention their parts.
7. What do you understand by cubic mean load ?
8. What are angular contact ball bearings ?
9. What is the difference between a coupling and clutch ?
10. What are the roles of clutches ?

PART – B (5×13=65 Marks)

11. a) 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 55 RC and core hardness less than 350 BHN. Ultimate strength is 720 N/mm^2 and yield strength is 360 N/mm^2.

(OR)

b) A pair of parallel helical gears consists of a 23 teeth pinion meshing with a 46 teeth gear. The helix angle is 24° and the normal pressure angle 21°. The normal module is 4 mm. Calculate : (i) the transverse module (ii) the transverse pressure angle (iii) the axial pitch (iv) the pitch circle diameters of the pinion and the gear (v) the center distance and (vi) the addendum and dedendum circle diameters of the pinion.

12. a) The armature shaft of a 40 kW, 720 rpm electric motor, mounted on two bearings A and B is shown in Fig. 12 (a). The total magnetic pull on the armature is 7 kN and it can be assumed to be uniformly distributed over a length of 700 mm midway between the bearings. The shaft is made of steel with an allowable shear stress of 103.95 N/mm^2. Determine the shaft diameter using the ASME code if, k_m = 1.5 and k_t = 1.0. Assume that the pulley is keyed to the shaft. The dimensions given in the diagram are in mm.

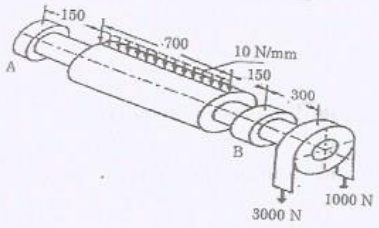

Figure – 12 (a)

(OR)

b) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa.

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13. a) Design a suitable V-belt for a centrifugal pump running at 350 rpm is to be driven by 100 kW motor at 1440 rpm. The drive is to work at least 20 hours every day. Centre distance is 1.2 m.

(OR)

b) A roller chain drive is used between a driver shaft running at 1440 rpm and a driven shaft running approximately at 720 rpm. The power transmitted is 15 kW. The drive is to be used for 2 shifts/day with 8 hours/shift. The centre distance is approximately 1000 mm and the chain tension can be adjusted by moving the motor in the rails. Design the drive.

14. a) A shaft rotating at constant speed is subjected to variable load. The bearings, supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing. **(13)**

(OR)

b) A single row angular contact ball bearing number 310 is used for an axial flow compressor. The bearing is to carry a radial load of 2500 N and an axial or thrust load of 1500 N. Assuming light shock load, determine the rating life of the bearing. **(13)**

15. a) A multi disc clutch has three discs on the driving shaft and two on the driven shaft is to be designed for a machine tool, driven by an electric motor of 22 kW, running at 1440 r.p.m. 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 $\mu = 0.3$; $n_1 = 3$; $n_2 = 2$. Assume 32 engagements per shift.

(OR)

b) A car engine has its rated output of 12 kW. The maximum torque developed is 100 Nm. The clutch used is of single plate type having two active surfaces. The axial pressure is not to exceed 85 kN/m^2. The external diameter of the friction plate is 1.25 times the internal diameter. Determine the dimensions of the friction plate and the axial force exerted by the springs. Assume 48 engagements/shift and Coefficient of friction is 0.3.

PART – C **(1×15=15 Marks)**

16. a) Discuss types and selection of clutches.

(OR)

b) Explain design of square keys.

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