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

M.E. / M.TECH. DEGREE EXAMINATIONS, MAY/JUNE 2017

SECOND SEMESTER
MECHATRONICS ENGINEERING

MS16204- DESIGN OF MACHINE ELEMENTS
(Regulation 2016)

Q. Code: 767354

(Use of approved data book is permitted)

Time: Three Hours **Maximum : 100 Marks**

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

1. List the factors to be considered in the selection of materials for a machine element.
2. What are the factors involved in arriving a factor of safety?
3. What is a size factor in endurance strength?
4. Differentiate between repeated stress and reversed stress.
5. State the significance of flexible coupling.
6. What is self-locking property of threads? State its necessity.
7. Sketch the cross-section of a *V*-belt and label its important parts.
8. What are the advantages and disadvantages of *V*-belt drive over flat belt drive?
9. How do you express the life of a bearing? What is an average or median life?
10. List any four modelling packages used to model a 3D component.

PART B - (5 X16 = 80 Marks)

11. (a) (i) Define 'mechanical property' of an engineering material. State any six mechanical properties, give their definitions and one example of the material possessing the properties. **(8)**

(ii) What are the common materials used in Mechanical Engineering Design? How can the properties of steel be improved? **(8)**

(OR)

(b) (i) What are fits and tolerances? How are they designated? **(6)**

(ii) Elaborate the procedure involved in designing a Passenger Car. **(10)**

12. (a) A machine component is subjected to a flexural stress which fluctuates between + 300 MN/m^2 and – 150 MN/m^2. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and factor of safety = 2. **(16)**

(OR)

(b) A mild steel shaft transmits 20 kW at 200 r.p.m. It carries a central load of 900 N and is simply supported between the bearings 2.5 m apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum **(16)**

tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads?

13. (a) Design and make a neat dimensioned sketch of a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 r.p.m. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa. **(16)**

(OR)

(b) A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The teeth has 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. Check the design for dynamic and wear loads. The deformation or dynamic factor in the Buckingham equation may be taken as 80 and the material combination factor for the wear as 1.4. **(16)**

14. (a) A flat belt is required to transmit 30 kW from a pulley of 1.5 m effective diameter running at 300 r.p.m. The angle of contact is spread over 0.458 of the circumference. The coefficient of friction between the belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1100 kg / m^3 and the related permissible working stress is 2.5 MPa. **(16)**

(OR)

(b) A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 900 r.p.m. and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find: 1. The amount of artificial cooling required, and 2. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of the oil as 1850 J / kg / °C. **(16)**

15. (a) (i) 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 × 106 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing. **(10)**

(ii) How finite element analysis tools will be helpful for a design engineer when compared with modelling packages with a simple example. **(6)**

(OR)

(b) (i) Discuss how extrude, revolve, sweep and blend option can be effectively used in 3D modelling with simple sketch. **(10)**

(ii) Discuss how effectively principles of design optimization can be used in manufacturing a steering wheel. **(6)**