Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – APRIL / MAY 2017

SUBJECT: DESIGN OF MACHINE ELEMENTS (ME 232)

(BRANCH: MECHANICAL)

Thursday, 11 May 2017

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed.**
- ✓ **Use of Design data hand book is permitted.**

1A. On what basis factor of safety is decided? Explain.

1B.

An offset link subjected to a force of 25 kN is shown in figure Q1B. It is made of grey cast iron FG 300 and the factor of safety is 3.Determine the dimensions of the link. The dimensions are in mm. **(10+10)**

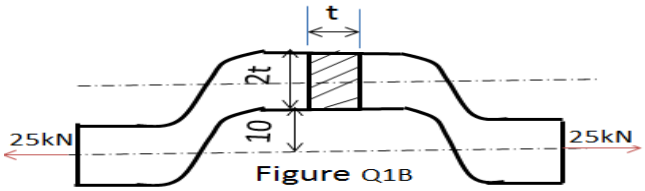

Figure Q1B

2A. A steel shaft of diameter 40 mm and length200 mm , shown in the figure Q2A is subjected to an transverse load of 500N and an axial load of 10 kN. Determine the following, a) Principle normal tensile stress; b) Principle normal compressive stress c) Principle shear stress

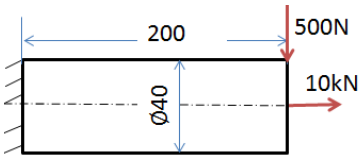

Figure Q2A

2B. A shaft is subjected to bending moment that varies from 400 N-m to -200 N-m and a twisting moment at the critical section varies from 300 N-m clockwise to 100 N-m counter clockwise. Determine the shaft diameter ,assuming stress values and other needed information. Take a factor of safety of 2. The material properties are as follows

σ_u= 560 MPa ; σ_{yp}= 320 MPa; σ_{en}= 280 MPa;K_{tf}=1.4. **(8+12)**

3A. Determine the inside and outside diameters of a hollow shaft which will replace a solid shaft made of the same material. The hollow shaft should be equally strong in torsion , yet weigh half as much per metre length.

3B. A cold rolled steel shaft, 2 m long between bearings carries a 1200 N pulley at the mid span. The pulley is keyed to the shaft and receives 20kW at 150 RPM which is transmitted to the flexible coupling just outside the right bearing. The belt drive is horizontal. The ratio of belt tension is 3:1. The diameter of the pulley is 600 mm. Assume C_m= C_t= 1.5. Calculate the shaft size. **(8+12)**

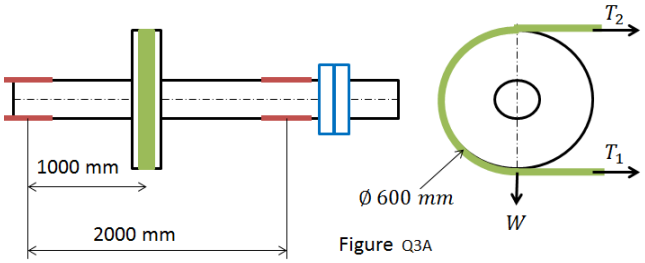

Figure Q3A

4A. Design a spline which is required in an automotive vehicle gear box to transmit 45 kW at 1200 rpm. The shaft is made of SAE 1045 annealed oil quenched steel. The factor of safety is 2.4 and stress concentration factor is 1.5. The yield strength in shear for SAE 1045 steel is 240 MPa. Take coefficient of friction $\mu = 0.15$.

Standard Proportions Of Splines n

Number of splines	Width b	Height h		
		Fitting A (p= 21MPa)	Fitting B (p=14MPa)	Fitting C (p=7MPa)
4	0.241D	0.075D	0.125D	-------
6	0.25D	0.05D	0.075D	0.1D
10	0.15D	0.045D	0.07D	0.095D

4B. The inner diameter of a cylindrical pressure vessel is 500mm and subjected to internal pressure of 2MPa. The cylinder cover is fixed to the cylinder body by means of 16 bolts of M20 size. Each bolt is initially tightened with a preload of 20kN.The yield strength of the bolt material is 320 MPa. Soft packing through bolts is used for fixing the cover to the cylinder. Determine the factor of safety for the bolts. **(12+8)**

5A. Design a screw jack for lifting a load of 20 kN through a distance of 200 mm. Take material C45 steel which has σ_{yp}= 350MPa. The coefficient of friction between bolt and nut and also between collars is 0.15. Also calculate torque required to drive the screw.

5B. Explain the following terms pertaining to compression springs
i) Spring stiffness ii) spring index iii) free length
iv) solid length v) active number of coils

(10+10)

6A. Design a helical compression spring, to be used for a balance to measure 0 to 1200 N over a scale of length 100mm. The spring is enclosed in a space of 35mm diameter. Approximate number of turns is 25. Take G = 0.84E5 MPa. Also calculate maximum shear stress induced.

6B. Design a spur gear which is required to transmit 10 kW power. The speeds of the driving motor and the driven machine are 400 rpm and 200 rpm respectively. The approximate centre distance may be taken as 600 mm. The teeth have 20^0 full depth involute profile. Assume that the gear is made of Cast Iron FG200, having allowable strength of 75 N/mm^2 and 180 BHN core hardness. Check for beam strength and dynamic load only. **(8+12)**

7A. With neat sketch explain the nomenclature of spur gear

7B. A journal bearing 100 mm long and 150 mm long, carries a radial load of 7kN at 1200 RPM. The diametral clearance is 0.075 mm. Find the viscosity of the oil being used at the operating temperature, if 1.2 kW of power is lost in friction. **(12+8)**

8A. List the advantages and limitations of journal bearing

8B. A 407 radial ball bearing , with inner race rotation, has a 12 seconds of work cycle as mentioned below.

Time t s	Radial load F_r N	Axial load F_a N	Speed N rpm	Working condition
3	5000	3500	900	Light shock
9	2000	0	1200	steady

If the dynamic load capacity of the bearing is 42500 N, determine the expected average life of the bearing. Take X = 0.56 and Y = 1.43. **(8+12)**