Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – NOV. / DEC. 2016

SUBJECT: DESIGN OF MACHINE ELEMENTS (ME 232)

(BRANCH: MECHANICAL)

Monday, 28 Nov. 2016

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) With the help of block diagram explain the steps involved in the design of a machine element. **(10)**

1B) A flat bar shown in figure Q1B is subjected to a tensile load of 10kN. Determine the thickness of flat if the maximum permissible stress is 80 MPa. All dimensions are in mm. **(10)**

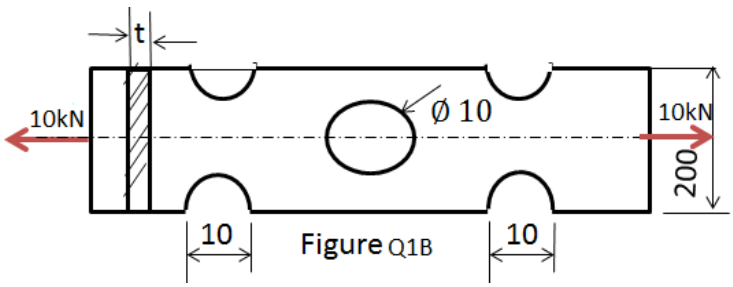


Figure Q1B

2A) Bending stress in a machine part fluctuates between tensile stress of 280 MPa and compressive stress of 140 MPa. What should be the minimum ultimate strength to carry this fluctuation indefinitely according to a) Goodman's formula b) Soderberg's formula. The factor of safety can be taken as 1.75. Assume that the yield point is never likely to be less than 55% of ultimate tensile strength. **(06)**

2B) Determine the size of two contacting cylindrical rollers, 150 mm long , required to transmit a load of 50 kN, if the maximum contact stress is limited to 10 N/mm^2. **(04)**

2C) A cold drawn steel rod of circular cross section is subjected to variable bending moment of 500 kN-mm to 1 MN-mm, as the axial load varies from 4500 N to 13500 N. The maximum bending moment occurs at the same instant that the axial load is maximum. Find the diameter of the rod assuming a factor of safety 2. Neglect stress concentration. Take σ_u= 560 N/mm^2 ; σ_{yp}= 476 N/mm^2 ;σ_{en}= 280 N/mm^2 . Consider factors A, B and C. **(10)**

3) A machine shaft shown in figure Q3 running at 600 RPM is supported on bearings, 700 mm apart. 20 kW power is supplied to the shaft through a 500 mm diameter pulley located at 250 mm to the right of the right bearing. The power is transmitted from the shaft through a spur gear of 200 mm diameter , which is located at 250 mm to the right of the left bearing. The belt drive is at an angle of 60^0 to the horizontal. The pulley weighs 700 N. The ratio of belt tension is 2.5.The gear has a pressure angle of 14.5^0 involute teeth and meshes with another spur gear located directly above the shaft. Determine the shaft diameter , assuming the permissible shear stress as 45 MPa.

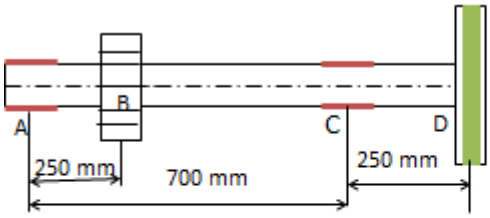
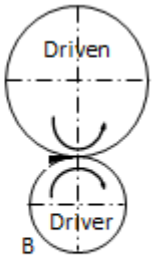


Figure Q3



Gears

(20)

4A) Design a taper key for a shaft of diameter 75 mm transmitting 45 kW at 225 rpm. The allowable compressive stress may be taken as 160 MPa. Also calculate the compressive force and the axial force necessary to drive the key home. Take μ_1= 0.25 and μ_2= 0.1. **(08)**

4B) Figure Q4B shows a pulley bracket which is supported by 4 bolts 2 at A and 2 at B. The weight W of the bracket is 850 N and the force F on the rope is 20kN. Determine the size of the bolt if the allowable shear stress of the material of the bolt is 40 MPa. All dimensions are in mm. **(08)**

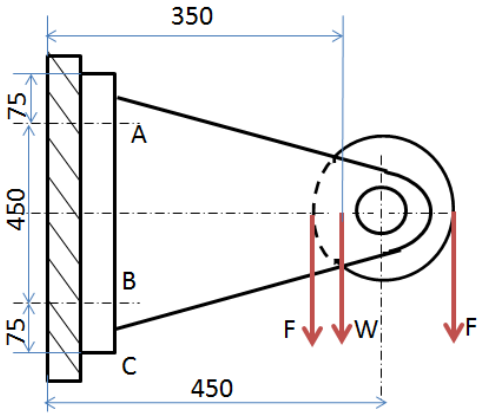


Figure Q 4B

4C) Draw the sectional view of the external thread of a bolt and define the following
a) Crest b) pitch diameter c) lead d) helix angle. **(04)**

5A) From the fundamentals derive the expression for the efficiency of the screw jack and show that the efficiency can not exceed 50%. Ignore collar friction. **(12)**

5B) A bumper, consisting of two helical springs of circular section, brings to rest a railway wagon of mass 1500 kg, and moving at 1.2m/s. While doing so, the deflection of the spring is 150 mm. The spring index is 6. The maximum permissible shear stress is 400 MPa. Determine,
i) maximum force on each spring
ii) wire diameter of the spring
iii) mean diameter of coils
iv) number of active coils . Take G = 0.84 E5 MPa. **(08)**

6A) A load of 1000 N is suddenly dropped axially on a vertical closed coiled helical spring from a height of 250 mm. The wire diameter is 20 mm , spring index 8 and the spring has 20 active coils. Determine the deflection and the stress induced in the spring. **(08)**

6B) A reciprocating compressor is to be driven by an electric motor by means of spur gear drive.The distance between the shaft must be close to 500mm. The speed of electric motor is 900 rpm and that of compressor shaft is 200rpm. The torque to be transmitted is 500Nm. Take starting torque to be 25% more than rated torque. Design the gear for compactness. Check for beam strength only**.** **(12)**

7A) For a spur gear of 24 teeth with involute profile , module 5 mm and pressure angle 14.5^0 calculate the following.
a) Pitch circle diameter,
b) Base circle diameter
c) Addendum circle diameter
d) Dedendum circle diameter
e) Clearance
f) Circular pitch
g) addendum
h) dedendum **(08)**

7B) Design a journal bearing for the shaft of an electric motor , to carry a radial load of 3000 N. The journal has a diameter of 50 mm and runs at a speed of 1500 rpm. The viscosity of oil at operating temperature is 25 cP. Take density $\boldsymbol{\rho = 900\frac{kg}{m3}}$ and c_p = 1700J/kg/^{0}C. **(12)**

8A) List the advantages and limitations of roller bearings **(08)**

8B) The details of a machine shaft supported by deep groove ball bearings is given below. Design a suitable bearing.
diameter d = 75 mm
Working period 8 h x360 days x10 years.

Cycle i	fraction of cycle r_i	Radial Load F_r N	Axial Load F_i N	Speed N_i rpm	Working Condition
1	0.25	3500	2000	1000	steady
2	0.25	2500	2000	1500	steady
3	0.5	4000	2000	800	Light shock

(12)