USN | | | | | | | | | | |

10ME52

Fifth Semester B.E. Degree Examination, December 2012
Design of Machine Elements - I

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO question from each part.***
2. ***Use of design data handbook permitted.***
3. ***Assume missing data if any.***

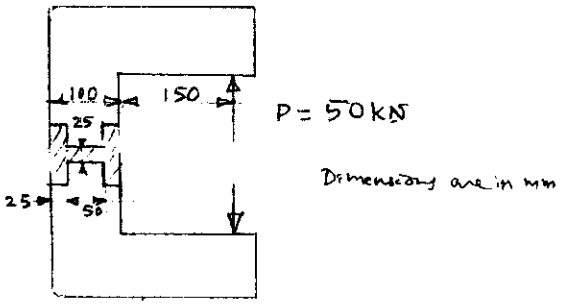
PART - A

1 a. What is mechanical engineering design? Explain. **(03 Marks)**

b. Explain the importance of standards in design. Give examples. **(03 Marks)**

c. Determine the extreme fibre stresses at the critical section of a machine member loaded as shown in fig. Q1(c). Also show the distribution of stresses at this section. **(14 Marks)**

Fig.Q1(c)



2 a. State and explain the following theories of failure :
i) Maximum principal stress theory ii) Maximum shear stress theory. **(05 Marks)**

b. A round rod of diameter 60mm is subjected to an axial tensile load of 10kN and a twisting moment of 3kN-m. The rod is made of steel C30. Factor of safety is 3. Determine whether the design is safe according to : i) Max. Principal stress theory of failure and ii) Max. shear stress theory of failure. **(10 Marks)**

c. A machine member can be considered as a simply supported beam of 1m length. Cross – section of the beam is 60mm × 60mm square. Determine the instantaneous maximum deflection and bending stress if a mass of 15kg falls from a height of 250mm at the mid point of the beam made of steel. **(05 Marks)**

3 a. Explain briefly the following : i) High cycle and low cycle fatigue ii) Stress concentration and its effects. **(04 Marks)**

b. A pulley is keyed to a shaft midway between two bearings. The shaft is made of steel (σ_y = 3890MPa). Bending moment at the pulley varies from -300 N-m to + 500 N – m and the torque varies from -100 N-m to + 200 N-m. The fatigue stress concentration factors for the key way in bending and torsion are 1.6 and 1.3 respectively. The factor of safety is 1.5. Determine the diameter of the shaft. **(16 Marks)**

4 a. Obtain an expression for total load on a bolt in a bolted joint with gasket. **(08 Marks)**

b. A cylinder head is fastened to the cylinder of a compressor using 6 bolts of M20 size. Bolt material is C20 steel. The maximum fluid pressure is 3.5MPa, cylinder diameter is 75mm. A soft gasket is used. Assuming the initial tension required in each bolt is 40kN, determine the factor of safety. **(12 Marks)**

PART - B

5 a. Briefly explain advantages of hollow shafts over solid shafts. **(03 Marks)**

b. A power transmission shaft 1300 mm long is supported in bearings at its extreme ends A & B. A power of 30kW is received at 500rpm through a gear drive located at 400mm to the right of the left extreme end of the shaft. The gear mounted on the shaft has a pitch diameter of 300mm and weights 800N. This gear receives power from a gear located exactly behind. The power is delivered through a belt drive located 500mm to the left of the right bearing. The pulley mounted on the shaft has a diameter of 400mm and weighs 1kN. The belt is directed towards the observer below the horizontal and inclined at 45^0. Ratio of belt tensions is 3. Material of the shaft is C40 steel. Assuming a factor of safety of 2.5 and loading to be with minor shocks, determine the diameter of the solid shaft. **(17 Marks)**

6 a. A mild steel shaft has to transmit 40kW power at 600rpm. The maximum torque to be transmitted is 30% greater than the average torque. Design a rigid flanged coupling for this application. **(10 Marks)**

b. Design a Knuckle joint to connect two mild steel rods. The joint has to transmit a tensile load of 80kN. Material for the rods has following allow the stresses :
$\sigma_t = 80MPa$, $\sigma_{cn} = 120MPa$, $\tau = 40MPa$. **(10 Marks)**

7 a. Design a diamond lap joint for a mild steel flat tie – bar 200mm × 10mm using 21mm diameter rivets. Number of rivets in the joint are g. Allowable stresses are :
$\sigma_t = 120MPa$, $\tau = 80MPa$, $\sigma_{cr} = 210MPa$. Assume hole diameter is equal to the rivet diameter. **(10 Marks)**

b. Determine the size of the fillet weld required for the flat plate loaded as shown in fig. Q7(b). Take allowable stress for weld material as 60MPa. **(10 Marks)**

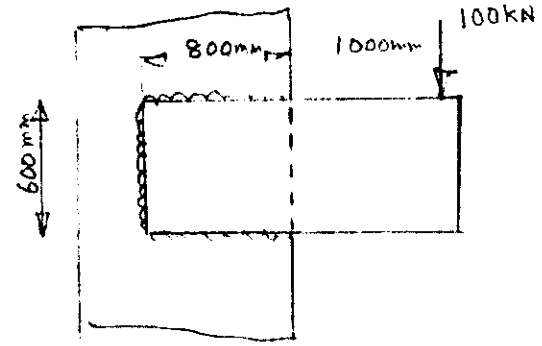


Fig.Q7(b)

8 a. Obtain an expression for torque required for raising the load in the case of a power screw. **(05 Marks)**

b. Design a screw jack to lift a load of 30kN with the following data : Allowable compressive stress in screw material is 160MPa, Coefficient of friction in threads = 0.14, Coefficient of collar friction = 0.2 , Height of lift = 150mm. **(15 Marks)**

*****

USN | | | | | | | | | | |

06ME53

Fifth Semester B.E. Degree Examination, December 2012
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Use of drawing sheets is permitted.

PART – A

1 a. State the condition for a member to be in equilibrium.
i) When two forces act.
ii) When three forces act. **(04 Marks)**

b. What is principle of virtual work? Explain. **(06 Marks)**

c. A slider crack mechanism is acted up on by a force 2 kN at 'B' as shown in Fig.Q.1(c). OA = 100mm and AB = 450mm. Determine the input torque required on the crank OA for the static equilibrium of the mechanism. **(10 Marks)**

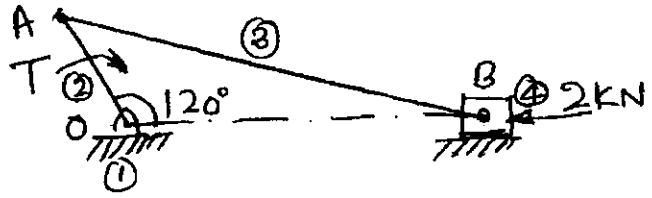


Fig.Q.1(c)

2 a. Show that the max fluctuation of energy $e = 2EK_S$ where E = is the mean kinetic energy of the flywheel, K_S = co-efficient of fluctuation of speed. **(06 Marks)**

b. The turning moment dia for a multicylinder engine is drawn to a scale of 1mm = 500 N-m torque and 1mm = 6° of the crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end are -30, +410, -280, +320, -330, +250, -360, +280, -260, sq-mm. when flywheel rotating at 800 rpm.
The engine has a stroke of 300mm a fluctuation speed is not to exceed ± 2% of mean speed. Determine the dia and c/s area of the flywheel rim for a limiting safe stress of 7×10^6 N/m^2. The material density is 7200 kg/m^2. The width of the rim is to be 5 times the thickness. **(14 Marks)**

3 a. Derive the relation $\frac{T_1}{T_2} = e^{\mu\theta}$ for a flat belt drive. **(08 Marks)**

b. Calculate the power lost in overcoming the friction and number of collars required for a thrust bearing whose contact surfaces are 20cm external radius and 15cm in internal radius. The coefficient of friction is 0.08. The total axial load is 30 kN. Intensity of pressure is not to exceed 3.5×10^5 N/m^2. Speed of the shaft is 420 rpm. **(12 Marks)**

4 a. Explain static and dynamic balancing of rotating masses. **(08 Marks)**

b. Four masses A, B , C and D carried on a shaft at radii 100mm, 125mm, 200mm and 150mm respectively. The planes at which masses are rotating are placed 600mm apart. The mass B, C and D are 10kg, 5kg and 4kg respectively. Find the mass of A and relative angular position of the four masses so that the shaft will be in equilibrium. **(12 Marks)**

PART – B

5 a. What do you mean by primary and secondary unbalance in reciprocating engines? **(04 Marks)**

b. The stroke of each piston of a six cylinder two stroke inline engine is 320mm and the connecting rod is 800 mm long. The cylinder centre lines are spaced at 500mm apart. The cranks are at 60° apart and the firing order is 145236. The reciprocating masses per cylinder is 100 kg and rotating masses are 50 kg per cylinder. Determine the out of balance forces and couples about the mid plane, if the engine rotates at 200 rpm. **(16 Marks)**

6 a. Explain sensitiveness, stability and isochromism of a governor. **(06 Marks)**

b. The arms of a porter governor is 200mm long and is hinged at a distance of 40mm from the axis of rotation. The mass of each ball is 1.5 kg and the sleeve is 2.5kg. When the links are 30° to the vertical. The sleeve begins to raise at 260 rpm. Assuming that the friction force is constant, Find max and min speeds, when the inclination of the arm to the vertical is 45°. **(14 Marks)**

7 a. Derive the equation for gyroscopic couple of a plane disc. **(05 Marks)**

b. A ship is propelled by a turbine rotor of mass 500kg and has a speed of 2400 rpm. The rotor has a radius of gyration of 0.5m and rotates in clockwise direction as viewed from stern. Find the gyroscopic effects when:

i) The ship runs at a speed of 1.5 knots (1 knot = 1860 m/h), it steers to the left in a curve of 60m radius.

ii) The ship pitches ± 5° from the horizontal position with the time period of 20 S of SHM.

iii) The ship rolls with angular velocity of 0.04 rad/sec. Clockwise when viewed from stern. Also calculate the max acceleration during pitching. **(15 Marks)**

8 The following data relate to a circular cam operating a flat faced follower.
Least radius = 40mm, lift = 12mm, angle of action = 160°, speed = 500 rpm.
If the period of acceleration of the follower is 60° of the retardation during the lift, determine

i) Principle dimensions of CAM.

ii) Acceleration at the main points.

What is the max accelaraiton and deacceleration during the lift? **(20 Marks)**

* * * * *