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10ME52

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. A mild steel bracket as shown in Fig. Q1 (a) is subjected to a pull of 6000 N acting at 45° to the horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross sectional dimensions of the bracket, if the permissible stress in the material of the bracket is limited to 60 MPa. **(10 Marks)**

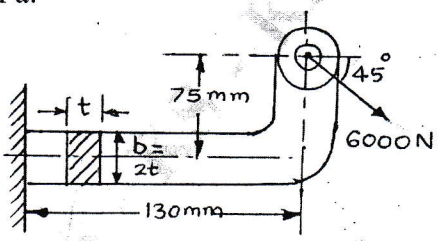

Fig. Q1 (a)

b. A point in a structural member is subjected to plane stress is shown in Fig. Q1 (b). Determine the following:

(i) Normal and tangential stress intensities on a plane inclined at 45°.
(ii) Principal stresses and their directions.
(iii) Maximum and minimum shear stresses and the direction of the plane on which they occur. **(10 Marks)**

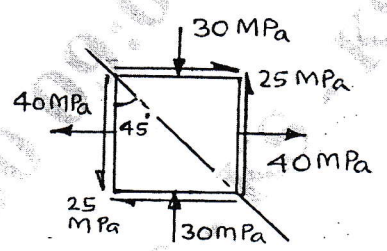

Fig. Q1 (b)

2 a. State and explain : (i) Maximum normal stress theory (ii) Distortion energy theory along with graphical representation. **(06 Marks)**

b. Find the diameter of the hole shown in Fig. Q2 (b), if the stress concentration factor at the hole is to be same as at the fillet. **(04 Marks)**

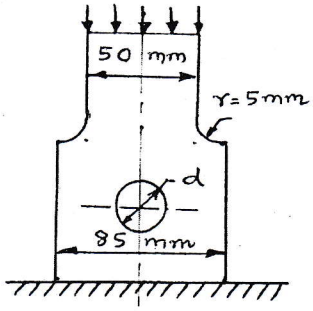

Fig. Q2 (b)

c. A weight of 20 kN falls from a height of 300 mm on a vertical steel pole of 6 meter long and 0.3 m diameter. The pole is fixed at the lower end. Take the modulus of elasticity of steel as 206 GPa. Determine : (i) Maximum compressive stress in the pole. (ii) Deformation of the pole due to impact load. (iii) Energy absorbed by the pole. **(10 Marks)**

3 a. Derive the Soderberg's equation for designing the members subjected to fatigue loading. **(08 Marks)**

b. A steel member of circular section is subjected to a torsional stress that varies from 0 to 35 MPa and at the same time it is subjected to an axial stress that varies from −14 MPa to +28 MPa. Neglecting stress concentration and column effect, and assuming that the maximum stresses in torsion and axial load occur at the same time, determine : (i) Maximum equivalent shear stress (ii) the design factor of safety based upon yield in shear. The material has an endurance limit of 206 MPa and an yield strength of $\sigma_y = 480$ MPa. The diameter of the member is less than 12 mm.

Take load correction factor = 1, surface finish factor = 1. **(12 Marks)**

4 a. A cover plate is bolted on to the flanged end of a pressure vessel through 8 bolts. The inner diameter of the pressure vessel is 250 mm and is subjected to an internal pressure of 10 MPa. Selecting the factor of safety as 2 and carbon steel C40 ($\sigma_y = 328.6$ MPa) as the material of the bolts; determine the size of the bolts, considering initial tension for the following cases : (i) metal to metal joint (ii) a copper gasket. **(10 Marks)**

b. A pulley bracket as shown in Fig. Q4 (b) is supported by 4 bolts, two at A – A and two at B – B. Determine the size of the bolts using an allowable shear stress of 25 MPa for the material of the bolts. **(10 Marks)**

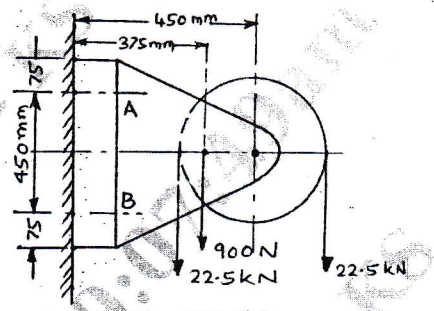

Fig. Q4 (b)

PART – B

5 A horizontal piece of commercial shafting is supported by two bearings, 1.5 m apart. A keyed gear 20° involute and 175 mm in diameter is located 400 mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3 to 1, with the slack side on top. The drive transmits 45 kw at 330 rpm combined shock and fatigue factor in bending and torsion are equal to 1.5. Calculate the necessary diameter of the shaft and angular deflection in degrees. Use allowable shear stress as 40 MPa and modulus of rigidity, $G = 84$ GPa. **(20 Marks)**

6 a. Design a Cotter joint to support a load varying from 30 kN in tension to 30 kN in compression. The following allowable stress may be used for the material of the joint. Tensile stress = Compressive stress = 50 MPa; Shear stress = 35 MPa and Crushing stress = 90 MPa. **(10 Marks)**

b. Design a flange coupling to connect the shafts of a motor and centrifugal pump for the following specifications:

Pump output = 3000 litres per minute ; Total head = 20 meters

Pump speed = 600 rpm ; Pump efficiency = 70 %

Select C40 steel for shaft and key, and C-35 steel for bolts with factor of safety 2. Use allowable shear stress in cast iron flanges equal to 15 N/mm^2. **(10 Marks)**

7 a. Design a longitudinal double riveted double strap butt joint with unequal straps for a pressure vessel. The internal diameter of the pressure vessel is 1 m and is subjected to an internal pressure of 2.2 N/mm^2. The pitch in the outer row is to be double the pitch in the inner row. The allowable tensile stress in the plate is 124 N/mm^2. The allowable shear and crushing stress of the rivets are 93 N/mm^2 and 165 N/mm^2 respectively. The resistance of the rivets in double shear is to be taken as 1.875 times that of single shear. **(10 Marks)**

b. A solid circular shaft 25 mm in diameter is welded to a support by means of a fillet weld as shown in Fig. Q7 (b). Determine the leg dimensions of the weld if the permissible shear stress is 95 N/mm^2. **(10 Marks)**

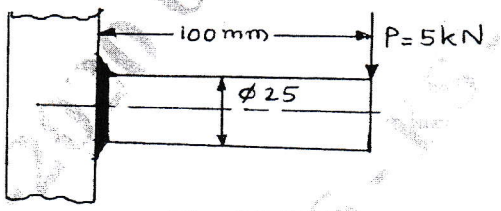

Fig. Q7 (b)

8 a. Obtain an expression for the torque required to raise the load in the case of a power screw. **(08 Marks)**

b. A triple threaded power screw is used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square shape and the length of the nut is 48 mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate : (i) The principle shear stresses in the screw rod ; (ii) the transverse shear stresses in the screws and the nuts ; (iii) the unit bearing pressure for threads; and (iv) State wether the screw is self locking? **(12 Marks)**

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10ME54

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Discuss the equilibrium of the following systems :
(i) Two force members (ii) Three force members
(iii) Members with two forces and a torque. **(09 Marks)**

b. With usual notations, explain the principle of virtual work, considering a Slider Crank Mechanism. **(11 Marks)**

2 a. Discuss the following terms:
(i) Turning Moment Diagram
(ii) Co-efficient of fluctuation of energy
(iii) Co-efficient of fluctuation of speed **(06 Marks)**

b. The turning moment diagram for an engine consists of 2 isosceles triangles, maximum height of each triangle represents turning moment 1000 Nm. The base of each triangle = π radians. If the engine runs at 200 rpm and total fluctuation of speed is not to exceed 3%. Find :
(i) Power of the engine
(ii) Mass of rim type flywheel concentrated at 0.25m radius, neglecting the effect of arms and boss. **(14 Marks)**

3 a. Derive an expression for the ratio of tensions in a flat belt drive. **(06 Marks)**

b. A Belt which is embracing 165° of a pulley of effective diameter 1000 mm is transmitting 10 kW. The pulley is running at 250 rpm. The coefficient of friction is 0.3, mass of belt material 0.0012 gm/mm^3, thickness of belt = 10 mm, considering centrifugal tension, find width of belt, safe working stress is 1.5 MPa. Also determine the initial tension in the belt drive. **(14 Marks)**

4 a. What do you mean by static balancing and dynamic balancing? **(04 Marks)**

b. A rotating shaft carries four radial masses A = 8 kg, B, C = 6 kg, D = 5 kg. The mass centres are 30, 40, 40 and 50 mm respectively from the axis of shaft. The axial distance between the planes of rotation of A and B is 400mm and between B and C is 500 mm. The masses A and C are at right angle to each other. Find for a complete balance (i) the angle of the masses B and D from mass A (ii) the axial distance between the planes of rotation of C and D and (iii) the magnitude of mass B. **(16 Marks)**

PART – B

5 The cranks and connecting rod of a 4 cylinder incline engine running at 1800 rpm are 50mm, 250mm each respectively and the cylinders are spaced 150mm apart. If the cylinders are numbered 1 to 4 in sequence from one end and the cranks appear at intervals of 90° in an end view in the order 1 - 4 - 2 – 3, the reciprocating mass corresponding to each cylinder is 1.5 kg. Determine (i) Unbalanced primary and secondary forces, if any (ii) Unbalanced primary and secondary couples with reference to central plane of engine. **(20 Marks)**

6 a. Explain the terms sensitiveness, stability, effort and power of a governor. **(08 Marks)**

b. The length of upper arm and lower arms of a Portar Governor are 200mm and 250mm respectively. Both the arms are pivoted to the axis of rotation. The central load is 150N, the weight of each ball is 20N and the of the sleeve together with the resistance of the operating gear is equivalent to a force of 30 N at the sleeve. If the limiting inclinations of the upper arm to the vertical are 30° and 40°, determine the range of speed of the governor. **(12 Marks)**

7 a. Derive an expression for the Gyroscopic couple. **(05 Marks)**

b. The motor of a marine having a mass of 1000 kg and radius of gyration 300mm rotates at 1550 rpm clockwise when looking from the bow. Determine the gyroscopic couple and its effect on the ship in the following cases:

(i) When the ship pitches with an angular velocity of 1 rad/sec when the bow a) Rising b) Falling

(ii) When the ship is speeding at 40 km/hr and takes a right turn in a circular path of 200m, radius

(iii) When the ship rolls at certain instant, it has an angular velocity 0.5 rad/sec when viewed from the stern. **(15 Marks)**

8 The following data relate to a symmetrical circular cam operating on a flat-faced follower, least radius = 25mm, nose radius = 8mm, lift of the valve = 10mm, angle of action of cam = 120°, cam shaft speed = 1000 rpm. Determine (i) Flank radius (ii) Maximum velocity (iii) Maximum acceleration (iv) Maximum retardation. If the mass of the follower and valve with which it is in contact is 4 kg, find the minimum force exerted by the spring to overcome the inertia of the moving parts. **(20 Marks)**

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10ME55

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020

Manufacturing Process – III

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data may be suitably assumed.***

PART – A

1 a. With a neat sketch, explain classification of metal working processes on the basis of force applied. **(10 Marks)**

b. Explain: i) Trescas yield criterion ii) Von-Mises yield criterion **(10 Marks)**

2 a. Discuss the effect of temperatures in metal forming. **(05 Marks)**

b. Explain the deformation processing system in metal working. **(05 Marks)**

c. What is workability? Explain. **(10 Marks)**

3 a. Explain any five types of forging operations. **(10 Marks)**

b. Discuss the defects in forgings. **(10 Marks)**

4 a. Explain the following methods of rolling with sketch:
i) Three high mill ii) Four high mill
iii) Cluster mill iv) Tandem mill **(10 Marks)**

b. Discuss the effects of front and back tension in rolling. **(10 Marks)**

PART – B

5 a. With neat sketches, explain (i) Rod drawing (ii) Wire drawing. **(10 Marks)**

b. Derive an expression for drawing force. **(05 Marks)**

c. A steel wire is drawn from an initial diameter of 12.5 mm to a final diameter of 10 mm at the speed of 120 m/min. The half cone angle of the die is 6° and the coefficient of friction at the die-wire interface is 0.12. A tensile test on the steel specimen has shown a yield stress of 210 N/mm^2. Determine the draw force and the power required, assuming that there is no back tension applied. **(05 Marks)**

6 a. With a neat sketch, explain the backward extrusion process. **(06 Marks)**

b. With neat sketches, explain the extrusion of seamless tubes, with a fixed mandrel and a floating mandrel in hollow billets. **(10 Marks)**

c. Write a note on extrusion dies. **(04 Marks)**

7 a. Explain the following types of dies used in sheet metal working:
(i) Combination die (ii) Gang die (iii) Follow die **(10 Marks)**

b. With neat sketches, explain the blanking, piercing and bending operations. **(10 Marks)**

8 a. With neat figures, explain the following types of high energy rate forming methods:
i) Contact type explosive forming ii) Electro hydraulic tubular part forming **(10 Marks)**

b. With the help of a block diagram, explain the basic steps in the powder metallurgy process. **(10 Marks)**

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10ME56

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Turbomachines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define Turbomachine. Differentiate between a turbomachine and positive displacement machine. **(08 Marks)**

b. Derive the equation for specific speed of pump. **(04 Marks)**

c. A turbine develops 10000 kw , under a head of 25m at 135 rpm. What is the specific speed? What would be its normal speed and output under a head of 20 meters? **(08 Marks)**

2 a. What is Reheat factor? Show that the reheat factor is greater then unity in a multistage turbine. **(10 Marks)**

b. A low pressure compressor develop a pressure of 1200 mm of meter. If the initial and find state of air use $P_1 = 1.02$ bar , $T_1 = 27^0C$, $T_2 = 42^0C$. Determine the compressor and infinitesimal stage efficiencies. **(10 Marks)**

3 a. Derive alternate form of Euler's turbine equation and explain the significance of each energy component. **(10 Marks)**

b. Identify turbines and compressor from the following data for various machines :

i) $u_1 = u_2 = 50$m/sec $Vn_1 = 4$m/sec ; $Vn_2 = 5$m/sec.

ii) $vn_1 = vn_2 = 12$m/sec $u_1 = 102$ m/sec ; $u_2 = 118$ m/sec.

iii) $Ho_2 - Ho_1 = -4$ kJ/kg.

iv) $Po_2 - Po_1 = 37.5$ mm of W.G. **(10 Marks)**

4 a. For the power generating machine show that $R = \frac{2+\cot\beta_2}{4}$ with usual notation and show the effect of discharge angle and energy transfer and degree of reaction. **(10 Marks)**

b. A jet of water having a velocity of number, Impinges on a series of vanes moving with a velocity of number. The jet makes an angle of 30^0 to the direction of motion of vanes when entering and leaves at an angle of 120^0. Draw the velocity triangle at inlet and outlet and find the angle of vane tips so that water enters and leaves without stock. **(10 Marks)**

PART – B

5 a. What is the need of compounding? Explain any two methods with sketch, showing variation of velocity and pressure. **(10 Marks)**

b. The rotor of an impulse turbine is 60cm diameter and runs at 9600 rpm. The nozzle are at 20^0 to the plane of the wheel and the steam leaves them at 600 meter. The blades outlet angle are 30^0 and the friction factor is 0.8. Calculate the power developed per kg of steam per second and the diagram efficiency. **(10 Marks)**

6 a. With neat sketch, explain the working principle of transic turbine. State the importance of draft tube. **(10 Marks)**

b. It is desired to produce 1500 kw of power at a head of 200m. Assuming an overall efficiency of turbine to be 0.80. Find what will be the required size of jet, the diameter of runner and its speed. Assume Cv = 0.98 , Jet ratio = 12 , φ = 0.45. **(10 Marks)**

7 a. Obtain an expression for the minimum starting speed of a centrifugal pump and give a brief ideal about cavitation. **(10 Marks)**

b. A centrifugal pump with 1.2m diameter runs at 200 rpm and pumps 1.88 m^3/s. The average lift being 6m. The angle which the vane make at exit with the tengent to the impeller is 26^0 and the radial velocity is 2.5m/sec. Determine the manometric efficiency and the least speed to start pumping if the inner diameter of the impeller is 0.6m. **(10 Marks)**

8 a. What is the function diffuser? Name different types of diffuser used in centrifugal compressor and explain them with simple sketches. **(10 Marks)**

b. A centrifugal compressor runs at a speed of 15000 rpm and delivers 30kg/sec of air. The exit diameter is 70cm relative velocity at exit is 100m/sec at an exit angle of 75^0. Assume axial inlet and inlet temperature is 300K, inlet total pressure = 1 bar. Determine

i) Power required to drive compressor.
ii) Work done.
iii) Ideal head developed.
iv) Total exit pressure. **(10 Marks)**

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