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10ME52

Fifth Semester B.E. Degree Examination, June/July 2013
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 Hand book is permitted.***

PART – A

1 a. What are the basic requirements of machine elements? Explain briefly. **(05 Marks)**

b. What are the factors to be considered for selection of material for a machine component? **(05 Marks)**

c. A hollow shaft of 40 mm diameter and 25 mm inner diameter is subjected to a twisting moment of 118 N-m, a axial thrust of 9806 N and a bending moment of 79 N-m. Calculate the maximum compressive and shear stresses. **(10 Marks)**

2 a. The brasses of an automobile engine connecting rod have worn, so as to allow play which gives shock loading equivalent to a weight of 5886 N falling through a height of 0.2 mm. The connecting rod is 250 mm long and has a cross sectional area of 3×10^{-4} m^2. Determine the stress induced in the connecting rod. Compare the maximum stress induced with that of a static load of 5886 N. **(06 Marks)**

b. A bolt is subjected to a direct tensile load of 30 kN and a transverse shear force of 15 kN. Material of the bolt has a normal stress of 350 MPa at yield and Poisson's ratio of 0.25. Compute the root diameter of the bolt according to:
i) Maximum shear stress theory of failure and
ii) Von Mise's criterion for failure.
Hence suggest suitable size of the bolt. Take a value of 3 for factor of safety. **(07 Marks)**

c. Determine the maximum stress induced in the following cases taking stress concentration into account:
i) A rectangular plate 50 mm wide, 8 mm thick and with a central hole of 10 mm is loaded in axial tension of 14.7 kN.
ii) A stepped shaft, stepped down from 45 mm to 30 mm with a fillet radius of 6 mm is subjected to a twisting moment of 98 N-m. **(07 Marks)**

3 a. Derive Soderberg's equation for designing of a machine element, with change in cross section, to sustain loads that fluctuate between two limits. **(05 Marks)**

b. A hot rolled steel shaft is subjected to a torsional moment that varies from 300 N-m clockwise to 100 N-m counterclockwise as the bending moment at the critical section varies from 400 N-m to – 200 N-m. Neglecting the stress concentration effect, determine the required shaft diameter. The material has an ultimate strength of 550 MPa and a yield strength of 410 MPa. Take the endurance limit as half the ultimate strength and a factor of safety as 2. Assume surface, size and load factor for bending as 1.111, 1.1765 and 1 and that for torsion as 1.05263, 1.1765 and 1.7 respectively. **(15 Marks)**

4 a. An M20×2 steel bolt of 100 mm long is subjected to impact load. The energy absorbed by the bolt is 2 N-m,
i) Determine the stress in the shank of the bolt if there is no threaded portion between the nut and bolt head.
ii) Determine the stress in the shank if the entire length of the bolt is threaded.
Assume modulus of elasticity for steel as 206 GPa. **(08 Marks)**

4 b. Determine the size of the bolts for the loaded bracket shown in Fig. Q4 (b), if the allowable tensile stress in the bolt material is limited to 80 MPa. **(12 Marks)**

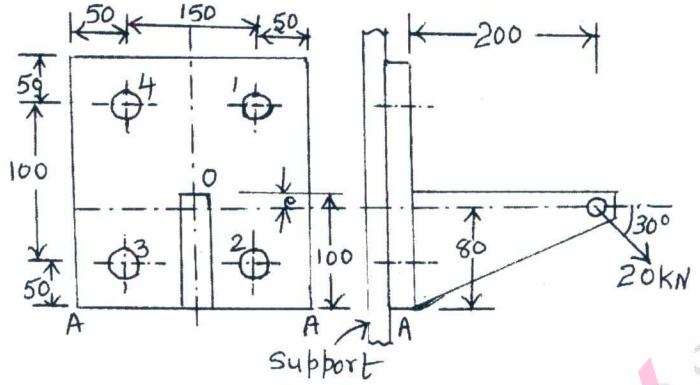

Fig. Q4 (b)

PART – B

5 a. Prove that a hollow shaft is stronger and stiffer than a solid shaft of same length, weight and material. **(08 Marks)**

b. A hollow propeller shaft of 0.6 m outside diameter and 0.3 m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearings 5 m apart and it transmits 6 MW power at 100 rpm. The maximum axial propeller thrust is 600 kN and shaft weighs 60 kN. Determine i) Maximum shear stress developed in the shaft and ii) Angle of twist of the shaft between the bearings. Assume the modulus of rigidity as 84 GPa. **(12 Marks)**

6 a. If a shaft and key are made of same material, determine the length of the key required in terms of shaft diameter, taking key width $b = \frac{d}{4}$ and key thickness $h = \frac{3d}{16}$. Assume keyway factor as 0.75. **(06 Marks)**

b. Design a rigid flange coupling to transmit 18 kW at 1440 rpm. The allowable shear stress in the cast iron flange is 4 MPa. The shaft and keys are made of AISI 1040 annealed steel with ultimate strength and yield stress values as 518.8 MPa and 353.4 MPa, respectively. Use ASME code to design the shaft and the key. **(14 Marks)**

7 a. A bracket is supported by means of four rivets of same size as shown in Fig. Q7 (a). Determine the diameter of the rivet if the maximum shear stress in the rivet is 90 N/mm^2. **(10 Marks)**

b. Determine the maximum normal stress and the maximum shear stress in the weld shown in Fig. Q7 (b) **(10 Marks)**

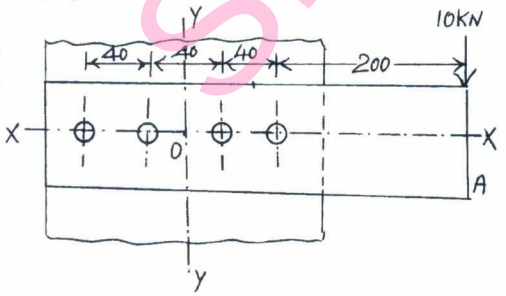

Fig. Q7 (a)

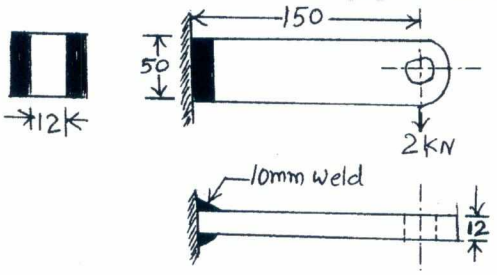

Fig. Q7 (b)

8 Design completely the screw, handle and the nut of a screw jack of capacity 40 kN. The maximum lift is limited to 0.2 m. The screw and the handle are made of C40(40C8) steel and the nut and the cup are made of cast iron. Also find the efficiency of the screw. Check the screw for buckling load. **(20 Marks)**

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10ME53

Fifth Semester B.E. Degree Examination, June/July 2013
Energy Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What the advantages are of stokes firing? With the help of a neat diagram, explain the working of traveling Grate stokes. **(10 Marks)**

b. Sketch and explain the following pulverized fuel handling systems: i) Unit system and ii) Central or Bin system. **(10 Marks)**

2 a. Explain the Benson boiler with a neat sketch. What are its advantages? **(10 Marks)**

b. A 30 m high Chimney is used to discharge hot gases at 297°C to the atmosphere which is at 27°C. Find mass of air actually used per kg of fuel. If the draught produced in 15 mm of watts. If the coal burnt in the combustion chamber contains 80% carbon, 6% moisture and remaining ash, determine the percentage of excess air supplied. **(10 Marks)**

3 a. Draw a general layout of diesel power plant and explain all the system employed in it. **(10 Marks)**

b. Explain the important functions of lubrication system. **(04 Marks)**

c. State the application of diesel engines in power field. **(06 Marks)**

4 a. What are hydrographs? With the help of a graph, explain a unit hydrograph. Mention the limitations for its usage. **(10 Marks)**

b. With the help of a neat diagram, explain pumped storage hydro-electric power plant. What are their advantages? **(10 Marks)**

PART – B

5 a. Draw a schematic sketch of a gas cooled reactor, briefly explain its principle of working. Lists its merits and demerits. **(10 Marks)**

b. A nuclear reactor consumes 10 kg of U^{235} per day. Calculate its power output if the average energy released per U-235 fission is 200 MeV. Take Avagadro's constant = 6.02×10^{26}. **(06 Marks)**

c. Write short notes on disposal of radio active wastes. **(04 Marks)**

6 a. What is pyranometer? With a neat sketch, explain its working principle. **(08 Marks)**

b. Write short notes on the following:
i) Solar pond ii) Application of wind energy iii) Vertical type wind mill. **(12 Marks)**

7 a. Explain single basin and double basin arrangement of tidal power plants. **(08 Marks)**

b. With sketch describe the closed cycle OTEC system. Mention its advantages. **(08 Marks)**

c. What are the advantages and disadvantages of geothermal energy? **(04 Marks)**

8 a. With a neat sketch, explain the construction and working of KVIC digestor. **(08 Marks)**

b. Write a short notes on the following:
i) Photosynthesis ii) Anaerobic digestion iii) Biomass gasifier. **(12 Marks)**

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10ME54

Fifth Semester B.E. Degree Examination, June/July 2013

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/graph sheets is permitted.***
3. ***Missing data assume accordingly.***

PART – A

1 a. i) Explain the equilibrium of two force members and three force members. **(04 Marks)**
ii) Give significance of static force analysis of mechanisms. **(02 Marks)**

b. For the static equilibrium of the mechanism shown in Fig.Q1(b), find the required input torque T_2. The dimensions are AB = 150 mm, BC = AD = 500 mm, DC = 300 mm, CE = 100 mm and EF = 450 mm. **(14 Marks)**

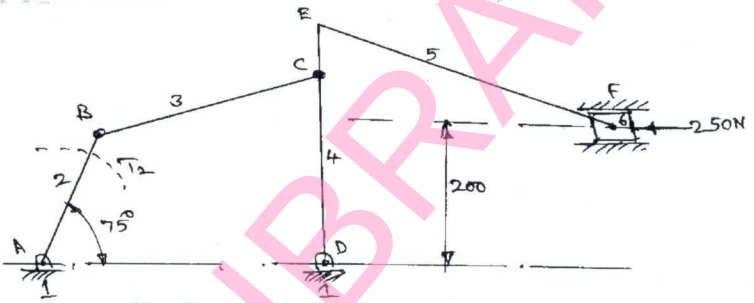

Fig.Q1(b)

2 a. What is the function of a flywheel? How does it differ from that of a governor? **(05 Marks)**

b. A single cylinder, four stroke I.C. engine develops 30 KW of power at 300 rpm. The turning moment diagram for the expansion and compression strokes may be taken as isosceles triangles on bases 0 to π and 3π to 4π radius respectively and the work done during compression is 25% of that of during expansion. Work done during suction and exhaust is neglected. Find the massmoment of inertia of flywheel to keep the speed fluctuations 1.5% on either side of the mean speed. Sketch the T.M. diagram and mark the points of max. and min speed on the diagram. **(15 Marks)**

3 a. Explain: i) Slip, ii) Creep, iii) Initial tension and iv) Centrifugal tension in belt drive. **(06 Marks)**

b. An open belt drive is required to transmit 10 KW from a motor running at 600 rpm. The belt is 12 mm thick and has a mass density of 0.001 gm/mm^3. Safe stress in the belt is not to exceed 2.5 N/mm^2. Effective diameter of the driving pulley is 250 mm whereas the speed of the driven pulley is 220 rpm. The two shafts are 1.25 m apart. If the coefficient of friction is 0.25, determine the width of the belt. **(14 Marks)**

4 A shaft carries four masses A, B, C and D, 200, 300, 240 and 360 kg respectively, revolving at radii 90, 70, 100 and 120 mm respectively. The distance from the plane A, other planes are at 270 mm, 420 mm and 720 mm respectively. Angle between the crank A and B is 45°, B and C is 75°, C and D is 130°. Balancing masses are replaced 120 mm and 100 mm from D and A respectively. The distance between them being 500 mm. Find the balancing masses and their angular positions if they are placed at a radius of 100 mm. **(20 Marks)**

PART – B

5 a. Explain the terms primary balancing and secondary balancing as used in balancing of reciprocating masses. **(05 Marks)**

b. The piston of a 4-cylinder vertical inline engine reach their uppermost position at 90° interval in order of their axial position. Pitch of the cylinder = 0.35 m, crank radius = 0.12 m, length of CR = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg, find the unbalanced primary and secondary forces and couples. Take the central plane of the engine as reference plane. **(15 Marks)**

6 a. Define: i) Sensitiveness ii) Stability iii) Isochronism iv) Effort of a governor. **(04 Marks)**

b. The arms of a porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 35 mm from the axis rotation. The mass of the Sleeve is 54 kg and the mass of each ball is 7 kg. Determine the equilibrium speed when the radius of rotation of the ball is 225 mm. What will be the range of speed for this position if the frictional resistance to the motion of the sleeve is equivalent to a force of 30 N at the sleeve. **(16 Marks)**

7 a. Derive an expression for the gyroscopic couple $C = I\omega\omega_p$ from the first principle. **(05 Marks)**

b. Explain the gyroscopic effect of steering, pitching and rolling of a naval ship in a sea. **(09 Marks)**

c. Analyze the stability of a two wheel vehicle taking a turn and derive the necessary equation. **(06 Marks)**

8 For a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and the roller radius is 15 mm. the angle of ascent is 60°, the total lift is 15 mm and the speed of the cam shaft is 300 rpm. Calculate:

i) Principal dimensions of the cam (i.e., the distance between the cam centre and the nose centre, nose radius and the angle of contact of cam with straight front)

ii) Acceleration of the follower at the beginning of the lift, where the roller just touches the nose (i.e., flank merges into the nose) and the apex of the circular nose. Assume that there is no dwell between ascent and descent. **(20 Marks)**

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10ME55

Fifth Semester B.E. Degree Examination, June/July 2013

Manufacturing Process - III

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. How are metal forming processes classified? Explain with sketches. **(08 Marks)**
b. Explain Tresed and Von-Mises criteria. **(06 Marks)**
c. Discuss the plane stress and plane strain concepts. **(06 Marks)**

2 a. Explain the effects of following parameters in metal working processes:
i) Temperature ii) Strain rate iii) Friction and lubrication **(10 Marks)**
b. Comment on: i) Deformation zone geometry,
ii) Residual stresses in wrought products. **(10 Marks)**

3 a. Derive an expression for forging pressure and load acting in plane strain considering Coulomb's friction at the interface. **(08 Marks)**
b. List and explain die design parameters in forging. **(06 Marks)**
c. Briefly explain forging defects and residual stresses in forging. **(06 Marks)**

4 a. Sketch and explain different types of rolling mills. **(06 Marks)**
b. Discuss maximum possible reduction in rolling process. **(04 Marks)**
c. A steel sheet is hot rolled 30% from a 40 mm thick slab using 900 mm diameter roll. The slab is 760 mm wide. The plane flow stress is 140 MPa at entrance and 200 MPa at the exit from the roll gap due to the increasing velocity. Assume $\mu = 0.30$. Calculate:
i) Rolling load
ii) Rolling load with sticking friction. **(10 Marks)**

PART – B

5 a. Derive an expression for drawing load by slab analysis. **(08 Marks)**
b. Explain optimal cone angle and dead zone formation in drawing. **(06 Marks)**
c. Sketch and explain tube drawing process. **(06 Marks)**

6 a. Write a note on extrusion equipment, die design and lubrication. **(08 Marks)**
b. Sketch and explain extrusion of seamless tubes. **(08 Marks)**
c. Discuss extrusion variables. **(04 Marks)**

7 a. Explain with figures working of progressive and compound die arrangements in sheet metal working. **(10 Marks)**
b. With sketches, explain the operations: i) Rubber forming, ii) Deep drawing. **(10 Marks)**

8 a. With a neat figure, explain the following forming methods:
i) Explosive forming
ii) Electromagnetic forming **(10 Marks)**
b. Discuss with flow chart powder metallurgy process. **(10 Marks)**

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10ME56

Fifth Semester B.E. Degree Examination, June/July 2013
Turbo Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain at least six differences between turbomachines and positive displacement machines. **(06 Marks)**

b. Two geometrically similar pumps are running at same speed of 1000 rpm. One pump has an impeller diameter of 0.3 m and lifts water at the rate of 20 litres/sec against a head of 15 m. Determine the head and impeller diameter of other pump to deliver half the discharge. **(08 Marks)**

c. Define specific speed of a turbine. Obtain an expression for the same in terms of P shaft power, speed and head. **(06 Marks)**

2 a. Air enters a compressor at a static pressure of 15 bar and static temperature of 15°C and a flow velocity of 50 m/s. At exit, the static pressure is 30 bar, static temperature is 100°C and flow velocity is 100 m/s. The outlet is 1 m above the inlet. Find i) Isentropic change in total enthalpy ii) Actual change in total enthalpy. Take C_P for air as 1005 J/kgK. **(10 Marks)**

b. Obtain an expression for polytropic efficiency for a compressor in terms of pressure ratio and temperature ration. Further express stage efficiency in terms of polytropic efficiency and pressure ratio. Also draw the relevant T-S diagram. **(10 Marks)**

3 a. Show that the alternate form of Euler's turbine equation can be expressed as follows:

$$W = \frac{\left(V_1^2 - V_2^2\right) + \left(U_1^2 - U_2^2\right) - \left(V_{r_1}^2 - V_{r_2}^2\right)}{2}$$

Draw the relevant velocity triangles. **(10 Marks)**

b. In an axial flow turbine dischange blade angles are 20° each for both stator and rotor. The steam speed at the exit of fixed blade is 140 m/s. The ratio $\frac{V_{ax}}{U} = 0.7$ at entry and 0.76 at exit of rotor. Find the inlet blade rotor angle, power developed for a flow rate of 2.6 kg/s and degree of reaction. **(10 Marks)**

4 a. Draw the velocity triangles for axial flow compressor. From the triangles show that degree of reaction for axial flow compressor is given by, $R = \frac{V_{ax}}{2U}\left(\tan\gamma_1 + \tan\gamma_2\right)$. Assume axial velocity to remain constant. γ_1 and γ_2 are angles made by relative velocities with the axial direction. **(10 Marks)**

b. A radial outward flow turbomachine has no inlet whirl. The blade speed at exit is twice that at the inlet. The radial velocity remains constant. Inlet blade angle is 45°. Show that the degree of reaction for this machine is given by, $R = \frac{2 + \cot\beta_2}{4}$. **(10 Marks)**

PART – B

5 a. Draw the inlet and exit velocity triangles for a pelton wheel turbine. Show that maximum hydraulic efficiency is given by, $(\eta_{hyd})_{max} = \frac{1+\cos\beta_2}{2}$. Assume that relative velocity remains constant. **(10 Marks)**

b. The internal and external diameters of an inward flow reaction turbine are 1.2 m and 0.6 m respectively. The head on turbine is 22 m and velocity of flow through the runner is constant and is equal to 2.5 m/s. The guide blade angle is 10° and the runner vanes are radial at inlet. If the discharge at outlet is radial. Find i) Speed of turbine ii) Vane angle at outlet iii) Hydraulic efficiency iv) Draw velocity triangles. **(10 Marks)**

6 a. Explain the following with reference to centrifugal pump:
i) Manometric efficiency with expression.
ii) Cavitation in pumps.
iii) Need for priming.
iv) Pumps in series. **(10 Marks)**

b. Outer diameter of a pump is 50 cm and inner diameter is 25 cm and runs at 1000 rpm, against a head of 40 m. Velocity of flow is constant and is equal to 2.5 m/s. Vanes are set back at an angle of 40° at the outlet. Width at outlet is 5 cm. Find, i) Vane angle at inlet ii) Work done by impeller iii) Manometric efficiency. **(10 Marks)**

7 a. Draw the inlet and exit velocity triangles for a single stage steam turbine. Further prove that maximum blade efficiency is given by,
$(\eta_b)_{max} = \cos^2\alpha_1$
Assume $V_{r_1} = V_{r_2}$ and $\beta_2 = \beta_1$ **(10 Marks)**

b. The following data refer to a 50% reaction turbine. D = 1.5 m, $\rho\left(\frac{U}{V_1}\right) = 0.72$, $\beta_2 = 20^0$, N = 3000 rpm, find i) Blade efficiency ii) Determine percentage increase in blade efficiency and rotor speed if the rotor is designed to run at its best theoretical the rotor is designed to run at its best theoretical speed, the exit angle (α_1) is 20°. Blade efficiency for best speed is given by, $\eta_b = \frac{z\cos^2\alpha_1}{1+\cos^2\alpha_1}$ **(10 Marks)**

8 a. With the help of H-Q plot explain the phenomena of surging in centrifugal compressors. **(10 Marks)**

b. A centrifugal compressor delivers 18.2 kg/s of air with a total pressure ratio of 4 : 1. Speed is 15000 rpm. Inlet total temperature is 15°C. Slip coefficient is 0.9, power input factor is 1.04. Efficiency is 0.8. Calculate overall diameter of impeller. **(10 Marks)**

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