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06ME52

Fifth Semester B.E. Degree Examination, December 2012
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. Draw the stress-strain curve for mild steel and cast iron. Name the salient points. **(06 Marks)**

b. What are the important mechanical properties of metals? Explain each of them briefly. **(10 Marks)**

c. What is standardization? What are advantages of standardization? **(04 Marks)**

2 a. The stresses induced at a critical point in a machine component made of steel 45C8 with yield strength (σ_{yt}) of 380 MPa are as follows: $\sigma_x = 100$ MPa, $\sigma_y = 40$ MPa, $\tau_{xy} = 80$ MPa, Calculate factor of safety by:
i) the maximum normal stress theory.
ii) the maximum shear stress theory.
iii) the distortion energy theory. **(10 Marks)**

b. An unknown weight falls through 15 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 500 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight. Take E = 200 kN/mm^2. **(10 Marks)**

3 a. Define endurance limit. State and explain the factors for modifying it. **(06 Marks)**

b. The work cycle of a mechanical component subjected to completely reversed bending stresses consists of the following three elements:
i) ±350 MPa for 85% of time. ii) ±400 MPa for 12% of time.
iii) ±500 MPa for 3% of time.
The material for the component is 50C4 $(\sigma_u = 660\ N/mm^2)$ and the corrected endurance strength of the component is 280 MPa. Determine the life of the component. **(14 Marks)**

4 a. A cover plate is bolted on to the flanged end of a pressure vessel through 6 bolts. The inner diameter of the pressure vessel is 200 mm and is subject ot an internal pressure of 10 MPa. Selecting carbon steel C40 with $\sigma_y = 328.6$ MPa as the material for the bolts determine the size of the bolts, considering initial tension for the following cases:
i) Metal to metal joints,
ii) A copper gasket. **(10 Marks)**

b. A bracket is fixed to the wall by means of four bolts and loaded as shown in Fig. Q4 (a). Calculate the size of the bolts if the load is 10 kN and allowable shear stress in the bolt material is 40 MPa. **(10 Marks)**

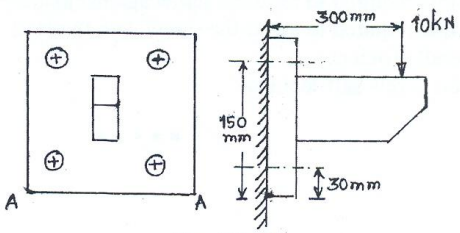

Fig. Q4 (b)

PART – B

5 a. Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 180° and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. **(10 Marks)**

b. A solid shaft of diameter d is used in power transmission. Due to modification of existing transmission system, it is required to replace the solid shaft by a hollow shaft of the same material and equally strong in torsion. Further, the weight of hollow shaft per meter length should be half of the solid shaft. Determine the outer diameter of hollow shaft in terms of d. **(10 Marks)**

6 a. Design a socket and spigot type cotter joint to sustain an axial load of 100 kN. The material selected for the joint has the following design stresses: $\sigma_t = 100$ MPa, $\sigma_c = 150$ N/mm^2 and $\tau = 60$ MPa. **(10 Marks)**

b. A rectangular sunk key 14 mm wide × 10 mm thick × 75 mm long is required to transmit 1200 N-m torque from a 50 mm diameter solid shaft. Determine whether the length is sufficient or not if the permissible shear stress and crushing stress are limited to 56 MPa and 168 MPa respectively. **(06 Marks)**

c. What is coupling? What are the requirements of a good coupling? **(04 Marks)**

7 a. Explain in detail the various possible modes of failure of a riveted joint. **(10 Marks)**

b. Determine the size of weld required for an eccentrically loaded weld as shown in Fig. Q7 (b). The allowable stress in the weld is 75 MPa. **(10 Marks)**

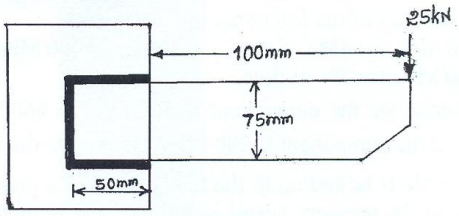

Fig. Q7 (b)

8 a. What is self-locking of power screw? What is the condition for self-locking? State the applications where self-locking is essential. **(05 Marks)**

b. A square threaded power screw has a nominal diameter of 30 mm and a pitch of 6 mm with double threads. The load on the screw is 6 kN and the mean diameter of the thrust collar is 40 mm. The coefficient of friction for the screw is 0.1 and the collar is 0.09. Determine :

i) Torque required to raise the screw against load.
ii) Torque required to lower the screw with the load.
iii) Overall efficiency.
iv) Is this screw self-locking? **(15 Marks)**

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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)**

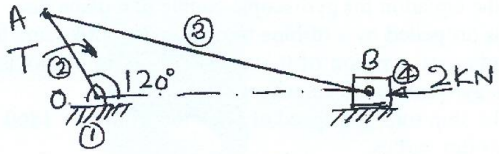

Fig.Q.1(c)

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 $\pm 5^{\circ}$ 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)**

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06ME54

Fifth Semester B.E. Degree Examination, December 2012
Energy Engineering

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. Sketch and explain overfeed and underfeed principle of firing coal. **(06 Marks)**

b. Explain with a neat diagram, of a cyclone furnace. State its important merit and limitation. **(08 Marks)**

c. List the ash handling equipments. With a neat sketch explain any one ash handling equipment. **(06 Marks)**

2 a. Draw a neat diagram of Benson and Velox boiler and explain its working. Discuss its relative merits and demerits. **(12 Marks)**

b. With a neat sketch, briefly explain air preheater and superheaters in thermal power plant. **(08 Marks)**

3 a. Draw a line diagram to show the layout of diesel power plant and explain. **(10 Marks)**

b. Briefly explain important applications of diesel engines in power field. **(05 Marks)**

c. Sketch and explain air exhaust system. What care is taken while designing exhaust system? **(05 Marks)**

4 a. State the important factors to be considered while selecting the site for hydro – electric power plant. **(05 Marks)**

b. Explain the following terms related to hydroelectric power plant :
i) Penstock ii) Surge tank iii) Draft tube. **(06 Marks)**

c. The runoff data of a river at a particular site is tabulated below :

Month	Mean discharge per month (millions of M^3)	Month	Mean discharge per month (millions of M^3)
January	40	July	75
February	25	August	100
March	20	September	110
April	10	October	60
May	0	November	50
June	50	December	40

i) Draw a hydrograph and find the mean flow.
ii) Also draw the flow duration curve.
iii) Find the power in MW available at mean flow if the head available is 80m and overall efficiency of generation is 85%. Take each month of 30 days. **(09 Marks)**

PART - B

5 a. With the help of a sketch, show all the important parts of a nuclear reactors. Describing briefly the functions of each part. **(08 Marks)**

b. What is a moderator in nuclear reactors? Explain the desirable properties of good moderator. **(06 Marks)**

c. Describe with working principle of pressurized water reactor, highlighting its advantages and disadvantages. **(06 Marks)**

6 a. With a sketch, explain the working of an instrument used to measure global radiation of solar energy. **(08 Marks)**

b. Sketch and explain horizontal axis wind mill. **(06 Marks)**

c. With a neat diagram, explain a solar pond electric power plant. **(06 Marks)**

7 a. Describe with a neat sketch of a closed cycle OTEC system and also mention the advantages over open cycle system. **(08 Marks)**

b. Explain with neat sketch, low and high tides and state important limitations of tidal power generation. **(06 Marks)**

c. With a sketch, explain the working of "Hot dry rock" geothermal plant. **(06 Marks)**

8 a. What is gasification? How are the gasifiers classified? With a schematic diagram, explain any one of the gasifiers. **(10 Marks)**

b. Write short notes on :

i) Anaerobic fermentation. **(05 Marks)**

ii) Photosynthesis. **(05 Marks)**

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06ME55

Fifth Semester B.E. Degree Examination, December 2012
Turbomachines

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
2. All notations have their usual meanings.
3. Thermodynamics data hand book and charts are permitted.

PART – A

1 a. Define a turbomahcine. Write a schematic diagram showing principal parts of a turbomachine. **(06 Marks)**

b. Compare a turbomachine and a positive displacement machine. **(06 Marks)**

c. Define:
i) Adiabatic efficiency
ii) Mechanical efficiency.
For power generating and power absorbing turbomachines. **(08 Marks)**

2 a. Derive Euler turbine equation, state the assumptions made. **(10 Marks)**

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

3 a. Define utilization factor. Obtain a relation between degree of reaction and the utilization factor. **(08 Marks)**

b. Sketch velocity diagrams for R = 0 and R = 0.5 and label. **(06 Marks)**

c. The velocity of steam out flow from a nozzle in a Delaval turbine is 1200 m/s. The nozzle angle being 22°. If the rotor blades are equiangular and the rotor tangential speed is 400 m/s. Compute:
i) Power output assuming $V_{r_1} = V_{r_2}$.
ii) Utilization factor. **(06 Marks)**

4 a. Define static and stagnation states. **(06 Marks)**

b. Give classification of fluid flow based on Mach number and explain in brief. **(06 Marks)**

c. Air enters a compressor at a static pressure of 1.5 bar, a static temperature of $15^\circ C$ and a flow velocity of 50 m/s. At the exit the static pressure is 3 bar, the static temperature is $100^\circ C$ and the flow velocity is 100 m/s. The outlet is 1m above the inlet. Evaluate:
i) The isentropic change in enthalpy.
ii) The actual change in enthalpy.
iii) Efficiency of the compressor.
Take $C_p = 1005$ J/kg K. **(08 Marks)**

PART – B

5 a. Discuss the following for a centrifugal compressor:
   i) Compressibility and prewhirl.
   ii) Diffuser design. **(10 Marks)**

   b. The following data refer to a centrifugal compressor: Impeller tip diameter = 100cm, speed = 5950 rpm, mass rate of air flow 30 kg/s, static pressure ratio $\frac{P_3}{P_1} = 2.125$, atmospheric pressure and temperature 1 atm and 25°C, slip coefficient = 0.90 and mechanical efficiency = 0.97, C_p = 1004 J/kg K. Find: i) the adiabatic efficiency of the impeller; ii) the temperature of the air at the exit; iii) the shaft power input and iv) the pressure coefficient. **(10 Marks)**

6 a. Define the following for a centrifugal pump:
   i) Static head
   ii) Suction head
   iii) Delivery head
   iv) Total head and
   v) Manometric head (with the help of a schematic diagram). **(10 Marks)**

   b. A centrifugal pump with an impeller outer diameter of 1.05 m runs at 1000 rpm. The blades are backward curved and they make an angle of 20° with the wheel tangent at the blade tip β_2. If the radial velocity of flow at the tip is 8 m/s and the slip coefficient is 0.86, find:
   i) The actual work input/kg of water flow.
   ii) The absolute velocity of fluid at the impeller tip.
   iii) The hydraulic efficiency, considering the kinetic energy at the outlet as wasted.
   If the pump is fitted with a diffusion chamber with an efficiency of 0.75 so that the exit velocity is reduced to 5 m/s, find the new hydraulic efficiency. **(10 Marks)**

7 a. With sketches explain velocity and pressure compounding. **(08 Marks)**

   b. Define: i) rotor efficiency and ii) stage efficiency of a steam turbine. **(04 Marks)**

   c. Steam issues from a single stage steam turbine with a velocity of 1200 m/s, the nozzle angle is 22°. If the rotor blades are equiangular and the rotor tangential speed in 400 m/s compute, assume $V_{r_1} = V_{r_2}$.
   i) Rotor blade angles.
   ii) Power developed for a flow rate of 900 kg/hr. **(08 Marks)**

8 a. Mention the general characteristic features of Pelton, Francis and Kalpan turbines. **(06 Marks)**

   b. Explain the function of a draft tube and mention its types. **(06 Marks)**

   c. A Pelton wheel is to be designed for a head of 60m when running at 200 rpm. The Pelton wheel develops 95.65 kW shaft power. The velocity of the buckets = 0.45 times the velocity of the jet, overall efficiency = 0.85 and coefficient of velocity is equal to 0.98. Find diameter of jet, diameter of wheel, size of buckets and number of buckets. **(08 Marks)**

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