Total No. of Questions :6]

SEAT No. :

P5057

[Total No. of Pages : 3

T.E./Insem.-606
T.E.(Mechanical (Semester - I)
DESIGN OF MACHINE ELEMENT - I
(2015 Pattern)

Time : 1.30 Hours] *[Max. Marks :30*

Instructions to the candidates:

1) *Answer (Q1) or (Q2), (Q3) or (Q4), (Q5) or (Q6).*
2) *Draw neat labelled diagrams wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data if necessary and clearly mention the assumed data.*

Unit - I

Q1) a) State any eight factors deciding the magnitude of factor of safety. **[4]**

b) Figure 1 shows a C clamp which carries a load P of 25 kN. The cross section of the clamp is a rectangular section and the ratio of width to thickness (b/t) is 2:1. The clamp is made of cast steel of grade 20-40 (S_{ut} = 400 N/mm^2) and the factor of safety is 4. Determine the cross section of the clamp. **[6]**

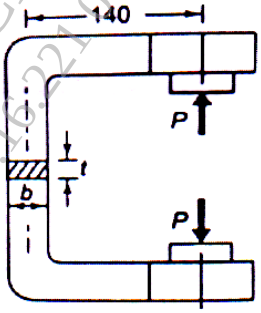

Fig. No. 1.

OR

Q2) A bell crank level is subjected to a force of 7.5kN at the short arm end. The lengths of the short and long arms are 100 and 500 mm respectively. The arms are at right angles to each other. The lever and pins are made of steel FeE 300 (Syt = 300 N/mm^2) and the factor of **[10]**

P.T.O.

safety is 5. The permissible bearing pressure on the pin is 10N/mm^2. The lever has rectangular cross-section and the ratio of width to thickness is 4:1. The length to diameter ratio of the fulcrum is 1.5:1 calculate,

i) Diameter and length of the fulcrum pin

ii) Shear stress in the pin

iii) Dimensions of cross section of the lever.

Unit - II

Q3) a) Explain shaft design on the basis of torsional rigidity derive the necessary equation **[4]**

b) A standard splined connection 8×36×40 is used for a gear and shaft assembly rotating at 700 rpm. The dimensions of the spline are as mentioned under.

Major diameter = 40 mm and Minor diameter = 36 mm

Number of splines = 08.

The length of the gear hub is 50mm and the normal pressure on the splines is limited to 6.5 N/mm^2. Calculate the power that can be transmitted from the gear to the shaft. **[6]**

OR

Q4) a) Differentiate between rigid and flexible couplings. **[4]**

b) Following are the specifications given for a rigid coupling: **[6]**

i) Outer diameter of flanges = 100 mm

ii) Diameter of recess = 095 mm

iii) Number of bolts = 06

iv) Pre-load on each bolt = 10kN

v) Coefficient of Friction = 0.15

vi) Speed of rotation = 100 r.p.m

The bolts are fitted in large clearance with the holes. Calculate the power transmitting capacity of the coupling.

Unit - III

Q5) a) State endurance limit modifying factors. Explain any two in detail. **[4]**

b) A forged steel bar, 50mm in diameter is subjected to a reversed Bending stress of 250N/mm^2. The bar is made of steel 40C8 (S_{ut} = 600N/mm^2). Calculate the life of bar for a reliability of 90%. **[6]**

OR

Q6) a) Explain with neat sketch S-N curve for steel material. **[4]**

b) A rotating bar made of steel 40C8 (S_{ut}= 580N/mm^2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 275 N/mm^2. Calculate the fatigue strength of the bar for a life of 90000 cycles. **[6]**

Total No. of Questions : 6] **SEAT No. :**

P5012 **[Total No. of Pages : 3**

T.E./Insem.-510

T.E. (Mechanical)

HYDRAULICS AND PNEUMATICS

(2012 Pattern) (Semester - I)

Time : 1 Hour] ***[Max. Marks : 30***

Instructions to the candidates:

1) ***Answer 3 questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Assume suitable data if necessary.***

Q1) a) State five advantages of using air as working fluid instead of oil in fluid power system. **[5]**

b) Explain the types of seals used in hydraulic system. Enlist commonly used materials for hydraulic seals. **[5]**

OR

Q2) a) Explain any five desirable properties of hydraulic fluid. **[5]**

b) Write a note on hydraulic house. **[5]**

Q3) a) Enlist important parameters to be considered for selecting pump in hydraulic circuit. **[5]**

b) Calculate accumulator size if 4.1 liters of hydraulic fluid must be stored between a pressure level of 10.4 MPa and 20.7 MPa. The pre-charge pressure is set to 90% of the minimum system pressure. Assume adiabatic pressure change and neglect effect of conversion of gauge pressure to absolute pressure. **[5]**

OR

P.T.O.

Q4) a) Explain with a help of hydraulic circuit use of accumulator as a shock absorber or pressure surge damping device. **[5]**

b) Pump having a displacement volume of 14 cm^3/rev runs at 2000 rev/min. It operates against the maximum system pressure of 15MPa. The volumetric and overall efficiency of pump are 90 and 80 percentage respectively. Determine **[5]**

i) Actual flow rate delivered in liter/min

ii) The power required to drive the pump.

iii) The drive torque at the pump shaft.

Q5) a) Explain end cushioning provided in hydraulic cylinder with a neat sketch. **[5]**

b) The winch shown in Fig. 1 is driven by hydraulic motor with the direct drive. Calculate speed, the flow requirement in liter per minute and output torque. The load is to be lifted a distance of 157 meters in 30 seconds. The motor has swept volume of 0.74 liters and operates at a pressure of 20 MPa. The overall efficiency and hydraulic efficiency of motor is 85 and 90 % respectively. **[5]**

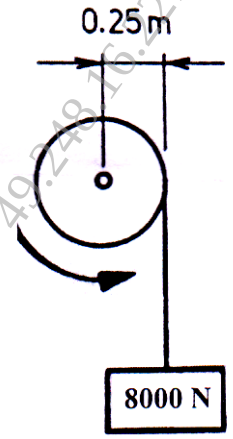

Fig 1

OR

Q6) a) Explain with the help of neat sketch the operation of swash plate piston motor. **[6]**

b) Calculate the force output and pump flow rate during extension and retraction of linear actuator for the following specifications. **[4]**

Piston diameter = 50mm

Rod diameter = 25mm

Stroke = 600mm

Piston speed = 12 mm/s

Hydro mechanical efficiency of cylinder = 95%

Operating pressure = 4000 kPa

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Total No. of Questions :6]

SEAT No. :

P5058

[Total No. of Pages : 3

T.E./Insem.-607
T.E.(Mechanical) (Semester - I)
HEAT TRANSFER
(2015 Pattern)

Time : 1 Hour] *[Max. Marks :30*

Instructions to the candidates:

1) ***Solve Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6***
2) ***Draw Neat diagrams wherever necessary.***
3) ***Use of scientific calculator is allowed.***
4) ***Assume suitable data where ever necessary.***
5) ***Figures to the right indicate full marks***

Q1) a) Two large parallel plates with surface conditions approximating those of a blackbody are maintained at 816°C and 260°C, respectively. Determine the rate of heat transfer by radiation between the plates in W/m^2 and the radiative heat transfer coefficient in $W/(m^2K)$. [Take Stefan-Boltzmann constant (σ) = $5.7 \times 10^{-8} W/(m^2K^4)$] **[4]**

b) Define and explain significance of each in heat transfer: **[6]**

i) Thermal conductivity

ii) Thermal contact resistance

iii) Thermal diffusivity

OR

Q2) a) With increasing emphasis on energy conservation, the heat loss from buildings has become a major concern. For a small tract house the typical exterior surface areas and R-factors (area × thermal resistance) are listed below: **[6]**

Element	Area (m^2)	R-factors (m^2K/W)
Walls	150	2.0
Ceiling	120	2.8
Floor	120	2.0
Windows	20	0.1
Doors	5	0.5

P.T.O.

i) Calculate the rate of heat loss from the house when the interior temperature is 22°Cand the exterior is —5°C.

ii) Suggest ways and means to reduce the heat loss and show quantitatively the effect of doubling the wall insulation and the substitution of double glazed windows (thermal resistance= 0.2m²K/W) for the single glazed type in the table above.

b) Show that the radial heat conduction through a hollow cylinder depends on logarithmic mean area of inside and outside surface? **[4]**

Q3) a) Consider a long resistance wire of radius r_1= 0.2 cm and thermal conductivity k_{wire} =15 W/m°C in which heat is generated uniformly as a result of resistance heating at a constant rate of g = 50 W/cm³. The wire is embedded in a 0.5 cm thick layer of ceramic whose thermal conductivity is $k_{ceramic}$ = 1.2 W/m°C. If the outer surface temperature of the ceramic layer is measured to be T_S= 45°C, determine the temperatures at the center of the resistance wire and the interface of the wire and the ceramic layer under steady conditions. **[6]**

b) A solid cylinder and sphere are of the same radius and material. These have same outside surface temperature with same amount of heat generation. Prove that the maximum temperature at center of cylinder and sphere is,

$$T_c = \frac{g}{4k} R^2 + T_w \text{ [cylinder]}$$

$$T_c = \frac{g}{6k} R^2 + T_w \text{ [sphere]}$$

Where,
g = uniform heat generation (W/m³)
T_c = Temperature at center (k)
T_w = Surface Temperature (k)
R = Outer radius (m)

OR

Q4) a) Explain how the fin enhances heat transfer from a surface. Also, explain how addition of fins may actually decrease heat transfer from a surface. **[4]**

b) Obtain relation for the fin efficiency for a fin of constant cross sectional area A_C; perimeter P; length L and thermal conductivity k, exposed to convection to a medium at T_∞ with heat transfer coefficient h. Assume fins are very sufficiently long so that the temperature of the fin tip is nearly T_∞. Take temperature of fin at base to be T_b and neglect heat transfer at fin tips. Simplify the relation for (i) a circular fin of diameter "D" (ii) a rectangular fin of thickness "t"

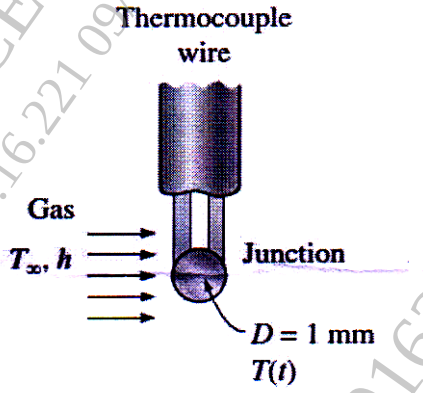
Q5) a) Classify Thermal Insulations. **[2]**

b) A salesman for insulation material claims that insulating exposed steam pipes in the basement of a large hotel will be cost effective. Suppose saturated steam at 5.7 bars flows through a 30 cm OD steel pipe with a 3cm wall thickness. The pipe is surrounded by air at 20°C. The convective heat transfer coefficient on the outer surface of the pipe is estimated to be 25 W/(m^2K). The cost of generating steam is estimated to be Rs. 5 per 109 J and the salesman offers to install a 5 cm thick layer of 85% magnesia insulation on the pipes for Rs. 200/m or a 10 cm thick layer for Rs. 300/m. Estimate the payback time for these two alternatives assuming that the steam line operates all year long and make a recommendation to the hotel owner. Assume that the surface of the pipe as well as the insulation have a low emissivity and radiative heat transfer is negligible. **[8]**

OR

Q6) a) What is lumped system analysis? When is it applicable? **[4]**

b) The temperature of a gas stream is to be measured by a thermocouple whose junction can be approximated as a 1-mm-diameter sphere, as shown in figure. The properties of the junction are k = 35 W/m°C, ρ =8500 kg/m^3, and C_P = 320 J/kg °C, and the convection heat transfer coefficient between the junction and the gas is h = 210 W/m^2 °C. Determine how long it will take for the thermocouple to read 99 percent of the initial temperature difference. **[6]**



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Total No. of Questions :6]

SEAT No. :

P5061

[Total No. of Pages : 2

T.E./Insem.-610
T.E.(Mechanical)
METROLOGY & QUALITY CONTROL
(2015 Pattern) (Semester - I)

Time : 1 Hour] *[Max. Marks :30*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4 & Q.5 or Q.6.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***
4) ***Assume suitable data, if necessary.***

Q1) a) Explain different types of errors in the measurement. **[6]**

b) Explain the term 'Calibration. Why it is required? What is traceability. **[4]**

OR

Q2) a) Define the terms: Straightness, Flatness, Squareness, Roundness. **[4]**

b) Design a general purpose Go-No Go plug gauge for checking hole of diameter 70H8.

Use:
- $i = 0.45\sqrt[3]{D} + 0.001D$
- IT 8 = 25i
- Diameter steps – 50 – 80mm
- Gauge tolerance = 10% of work tolerance
- Wear allowance = 10% of gauge tolerance

Draw & label the sketch indicating tolerance zones & sizes. **[6]**

Q3) a) What is a comparator? Explain with a neat labelled sketch, construction, working, advantages & limitations of Johanson Mikrokatar. **[6]**

b) Calculate the effective dia. for M24×3 screw plug gauge by using floating carriage micrometer for which readings were taken as below- **[4]**

i) Diameter of standard cylinder = 22.001 mm.

ii) Micrometer readings over standard cylinder with two wires of same diameter was = 12.9334 mm.

iii) Micrometer readings over plug screw gauge & same wires was = 12.1124 mm.

Best size wire was used for above measurement. Neglect rake & compression errors.

P.T.O.

OR

Q4) a) Explain with a neat labelled sketch, construction, working & applications of

i) Parkinson gear tester **[3]**

ii) Profile projector **[3]**

b) Calculate the constant chord length & its distance below the tooth tip for gear of module 5mm & pressure angle 20°. **[4]**

Q5) a) Explain with a neat labelled sketch, construction, working, advantages, limitations & applications of co-ordinate measuring machine. **[6]**

b) Explain machine - vision system with advantages & applications. **[4]**

OR

Q6) a) What is Interferrometry? Explain with neat sketch, construction and working of NPL flatness interferrometer. **[6]**

b) What is LASER? How it is useful in metrology?State the applications. **[4]**

Total No. of Questions :6]

SEAT No. :

P5060

[Total No. of Pages : 2

T.E./Insem.-609
T.E.(Mechanical) (Semester - I)
TURBO MACHINES
(2015 Pattern)

Time : 1 Hour] *[Max. Marks :30*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4 & Q.5 or Q.6.***
2) ***Figures to the right indicate full marks.***
3) ***Use of scientific calculator is allowed.***
4) ***Assume data wherever necessary and mention it.***
5) ***Draw neat and suitable figures wherever necessary.***

Q1) a) A 7.5 cm diameter jet having velocity of 12 m/s impinges on a smooth plate at an angle of 60°,to the normal to the plate. What will be the force when (I) the plate is stationary and (II) when the plate is moving in the direction of jet at 6 m/s. Determine also the work done per second on the plate in each case. **[6]**

b) Derive the expression for the force exerted by a jet of water on an inclined fixed plate in the direction of jet. **[4]**

OR

Q2) a) Derive the expression of work done per sec for symmetrical moving curved vane with tangential entry of jet. **[4]**

b) A circular jet of water having velocity of 60 m/s impinges tangentially on a series of curved vanes moving uniformly at 25 m/s. The jet makes an angle of 30 degrees with the direction of motion of the vanes. Relative to a vane, the jet turns through an angle of 100 degrees as it flows over the vane. The flow speed along the vane drops by 15% due to frictional loss. Draw neat inlet and outlet velocity triangles showing all the relevant details and determine: **[6]**

i) Vane tip angles at inlet and outlet for the smooth flow,

ii) Absolute velocity of water leaving the vanes.

P.T.O.

Q3) a) Sketch Pelton wheel bucket giving its approximate dimensions and answer question in brief: The ideal jet deflection angle is 180 degree, however bucket deflects the jet through 160 to 165 degree. **[4]**

b) A Pelton wheel of 2.5 m diameter operates under the following conditions: Net available head = 300m; Speed = 300r.p.m.; Blade angle at outlet = 165°; C_v of nozzle = 0.98; Mechanical Efficiency = 95%. Determine: i) The Power developed ii) Specific speed iii) Hydraulic Efficiency. **[6]**

OR

Q4) a) Define

1) Gross head 2) Jet ratio 3) Hydraulic efficiency 4) Mechanical Efficiency. **[4]**

b) Show that the maximum efficiency of the Pelton wheel is given by $(1+k\cos\phi)/2$ where K= Bucket friction factor, Φ = Bucket outlet angle. **[6]**

Q5) a) Compare Francis turbine & Kaplan turbine. **[4]**

b) Design a Francis turbine runner with the following data.

Net Head = 68 m ; Speed=750RPM Power output = 330 kW; Hydraulic efficiency = 94 %; Overall Efficiency = 85%; Flow ratio = 0.15: Ratio of breadth to diameter = 0.1; Inner diameter of the runner is half of outer diameter of the runner. 6% of circumferential area of the runner is occupied by the thickness of the vanes. Assume velocity of flow remains constant and flow is radial at exit. **[6]**

OR

Q6) a) In an inward flow reaction turbine the head on the turbine is 32 m. The external and internal diameters are 1.44 m and 0.72 m. The velocity of flow through the runner is constant and equal to 3 m/s. The guide blade angle is 10 degree and the runner vanes are radial at inlet. If the discharge at outlet is radial. Determine: **[6]**

i) The speed of the turbine

ii) The vane angle at outlet of the runner and

iii) Hydraulic efficiency.

b) What is the significance of specific speed? Derive the relation for the same. **[4]**

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Total No. of Questions :6]

SEAT No. : ____

P5059

[Total No. of Pages : 2

T.E./Insem.-608
T.E.(Mechanical Automobile) (Semester - I)
THEORY OF MACHINES - II
(2015 Pattern)

Time : 1 Hour] ***[Max. Marks :30***

Instructions to the candidates:

1) ***Answer (Q1) or (Q2), (Q3) or (Q4), (Q5) or (Q6).***
2) ***Neat diagrams must be drawn whenever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of calculator is allowed.***
5) ***Assume suitable data whenever necessary.***

Q1) a) Two 20° involute spur gears have a module of 8mm, The addendum of pinion and gear is standard. The numbers of teeth on pinion are 20 and on gear are 40. Does the interference will occur or not? **[6]**

b) What is contact ratio? State its significance. **[4]**

OR

Q2) a) Derive an expression for maximum workdone and minimum frictional work by considering friction between gear teeth. **[6]**

b) A pair of involute gears is in mesh. The application restricts the space to accommodate these gears with a centre distance of 106 mm. If the gears have a module of 3mm and a ratio of speeds of driver to the driven is limited to 2.2:1, determine the number of teeth on these gears. **[4]**

Q3) a) A spiral gear drive with the speed ratio of 3:2 with an angle between the shafts 80°.The approximate centre distance between the shafts is 125mm.The normal pitch of the teeth is 9 mm and gear diameters are equal. Find the number of teeth on each gear, pitch circle diameter and spiral angles. Find the efficiency of the drive if friction angle is 5°. **[6]**

b) A pair of helical gears is used in machine tool application with a speed reduction of 4.2:1.The gears are to have a normal module of 3mm, a pressure angle of 20° and a helix angle of 30°. If the centre distance between shafts is approximately 400mm, determine the number of teeth on each wheel and the exact centre distance. **[4]**

P.T.O.

OR

Q4) a) A three start worm has a pitch diameter of 85 mm and a pitch of 25 mm. It rotates at 600 rpm and drives worm gear of 40 teeth. Assume coefficient of friction 0.05. **[6]**

Determine:

i) Helix angle of worm

ii) Speed of the gear

iii) Centre distance

iv) Efficiency and max. efficiency.

b) Differentiate between worm and worm gear and bevel gears. **[4]**

Q5) a) In a reverted epicyclic train, the arm E carries two wheels A and D and a compound wheel B-C. The wheel A meshes with wheel B and the wheel D meshes with wheel C. The number of teeth on wheel A, D and C is 78, 46 and 70 respectively. If arm makes 250 rpm and wheel A is fixed, find the speed and directions of wheel D. **[6]**

b) Draw and explain epicyclic gear train. **[4]**

OR

Q6) In an epicyclic gear train, the internal gears A and B and compound gears C and D rotate independently about point O. All the gears have same module and the number of teeth are $Z_C = 28$, $Z_D = 26$, $Z_E = Z_F = 18$.The gears E and F rotate on pins fixed to the arm G. Gear E meshes with gear A and C whereas gear F meshes with B and D. Draw the arrangement and find **[10]**

i) Number of teeth on gears A and B.

ii) Speed of gear B if arm G makes 200 rpm clockwise and gear A is fixed.

iii) Speed of gear B if arm G makes 200 rpm clockwise and gear A makes 20 rpm in anticlockwise direction.