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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E | **Semester: IV**

Branch: Aerospace Engineering | **Duration: 3 hrs.**

Course Code: 22AS4PCHMT | **Max Marks: 100**

Course: Heat and Mass Transfer

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Heat transfer data hand book is permitted

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Explain the modes of heat transfer.	CO1	PO 1,2	**6**
	b)	Explain the types of boundary conditions.	CO 1	PO 1,2	**6**
	c)	A composite wall consists of 10cm layer thick building brick of thermal conductivity 0.7 W/m-K and 3cm thick plaster of conductivity 0.5 W/m-K. An insulating material of thermal conductivity 0.08 W/m-K placed in between them is added to reduce the Heat transfer through the wall by 70%. Determine the thickness of insulating layer.	CO2	PO 2	**8**
		OR			
2	a)	Write a note on thermal diffusivity.	CO1	PO 1,2	**4**
	b)	Write the general 3-D Conduction equation and deduce the Poisson equation and Laplace equation.	CO1	PO 1,2	**8**
	c)	A furnace wall is made of three layers. 1^{st} layer is of insulation (K = 0.6 W/mK), 12 cm thick its face is exposed to gases at 870 o C with h = 110 W/m ^{2} K it is covered with a 10 cm thick layer of fire brick (k = 0.8 W/mK) with a contact resistance of 2.6 x 10 $^{-4}$ m ^{2} K/W between first and second layer. The third layer is a plate of 10cm thickness (k = 4 W/m-K) with a contact resistance between second and third layer of 1.5 X 10 $^{-4}$ m ^{2} K/W. The plate is exposed to air at 30°C with convection coefficient of 15 W/m^{2}K. Determine the heat flow rate, intermediate temperatures and overall heat transfer coefficient.	CO 2	PO 2	**8**
		UNIT - II			
3	a)	Derive an expression for temperature distribution and instantaneous heat transfer for the lumped system.	CO 2	PO 1,2	**10**
	b)	An iron cylinder of 60mm diameter is initially at 225°C. Suddenly it is exposed to a fluid at 25°C, with a heat transfer coefficient of 500W/m ^{2} K. Calculate i) the center and the surface temperature 2min after the start of cooling.	CO 2	PO 2	**10**

			ii) Temperature at a depth of 10 mm after 2 minutes. ii) Heat removed 2 min after the start of cooling.			
			UNIT - III			
	4	a)	Using the non-dimensional analysis, derive a correlation in terms of Nusselt number, Reynolds's number and Prandtl number for forced convection heat transfer.	CO 3	PO 3,4	**10**
		b)	Consider the flow of water at a rate of 0.015 kg/s through a square duct 2cm x 2cm whose walls are maintained at a uniform temperature of 100°C. Assuming that the flow is thermally developed, Determine the length of the duct required to heat water from 30°C to 70°C.	CO 3	PO 3,4	**10**
			OR			
	5	a)	Obtain the physical significance of i)Prandtl number ii)Reynolds number iii) Grashoff's number iv)Nusselt number	CO 3	PO 3,4	**10**
		b)	A vertical plate 15cm high and 10 cm wide is maintained at 140°C. Calculate the maximum heat dissipation rate by convection from both sides of the plate to ambient air at 20°C.	CO 3	PO 3,4	**10**
			UNIT - IV			
	6	a)	Explain i) Kirchhoff's law ii) Stefan-Boltzmann law iii) Radiation shield.	CO 1	PO 1	**8**
		b)	Explain briefly the concept of black body.	CO 1	PO1	**4**
		c)	Two large parallel planes having emissivity at 0.3 and 0.5 are maintained at temperature of 800 °C and 300 °C respectively. A radiation shield having an emissivity of 0.05 on both sides is placed between the two planes. Calculate i) heat transferred per unit area without shield. ii) find the temperature of shield and heat transferred per unit area with shield.	CO 3	PO 2	**8**
			UNIT V			
	7	a)	Water is heated from 30°C to 90°C in a counter flow double pipe heat exchanger. Water flows at the rate of 1.2 kg/s. The heating is accomplished by a geothermal fluid which enters the heat exchanger at 160°C at a mass flow rate of 2 kg/s. The inner tube is thin walled and has a dia of 15 mm. If the overall heat transfer coefficient of the heat exchanger is 600 $W/m^2{}^\circ C$. Determine the length of the heat exchanger required for the purpose. The specific heat of water and geothermal fluid are 4.18 and 4.31 kJ/kg °C respectively. Use LMTD method.	CO 3	PO 3	**8**
		b)	Explain the boiling regimes with neat sketch.	CO 4	PO 1	**8**
		c)	Differentiate between film wise and drop wise condensation.	CO 4	PO 1	**4**

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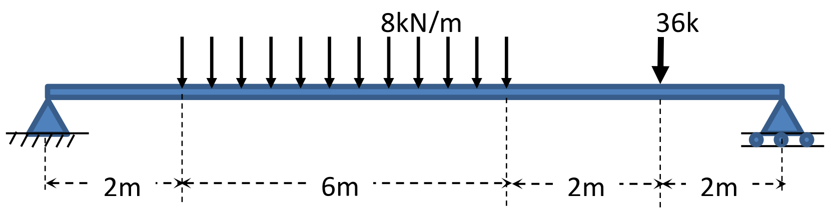
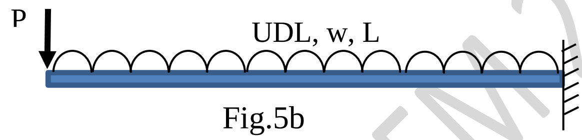
April 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 22AS4PCSDM **Max Marks: 100**
Course: Solid Mechanics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	***CO***	***PO***	**Marks**
1	a)	Define the a) Modulus of Elasticity, b) Modulus of Rigidity and c) Poisson's Ratio.	*CO* 1	*PO* 1	**6**
	b)	Derive the expression for a uniformly section circular bar tip extension under the effect of self-weight.	*CO* 1	*PO* 1	**6**
	c)	A compound bar consists of a circular rod of steel of 25mm diameter rigidly fixed into a coaxial copper tube of internal diameter 25 mm and external diameter 40 mm. If this compound bar is subjected to a load of 120 kN, find the stresses developed in the two materials.	*CO* 1	*PO* 1	**8**
		OR			
2	a)	Derive the relationship between the Modulus of Elasticity and the Modulus of Rigidity and Bulk Modulus.	*CO* 2	*PO* 1	**12**
	b)	A bar 30 mm in diameter was subjected to a tensile load of 54 kN and the measured extension on 300 mm gauge length was 0.12 mm and the change in diameter was 0.00366 mm. Calculate the ratio and the Poisson's values of three elastic moduli.	*CO* 2	*PO* 1	**8**
		UNIT - II			
3	a)	Derive the expression bending stress equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$with usual notation	*CO* 1	*PO* 1	**8**
	b)	Draw the SFD and BMD for the following simply supported beam with UDL and point loads for Fig.3b.  Fig.3b	*CO* 2	*PO* 1	**12**

			OR			
	4	a)	Derive the shear stress formula for the beam sections. State the assumptions made.	*CO* 1	*PO* 1	**8**
		b)	A T-section of a simply supported beam has the following dimensions. Width of the flange =100 mm, overall depth =100 mm, and thickness of stem and flange =20 mm. (a) Determine the maximum stress in the beam when a bending moment at 1,200 N·m is acting on the section. (b) Calculate the shear stress at the neutral axis and at the junction of web and the flange when a shear force of 50kN acting on the beam. (c) Drawn bending stress, and shear stress diagrams along the section.	*CO* 2	*PO* 1	**12**
			UNIT - III			
	5	a)	Derive the deflection equation for the beams.	*CO* 1	*PO* 1	**10**
		b)	Determine the expression for deflection and slope for a cantilever beam with a concentrated load at the tip P (N) and UDL load w (N/m) for the entire length L (L) for Fig.5b  Fig.5b	*CO* 2	*PO* 1	**10**
			UNIT - IV			
	6	a)	Derive the torsional formula for circular shaft.	*CO* 1	*PO* 1	**7**
		b)	A circular shaft *AD* has different sections at *AB*, *BC* and *CD* with lengths *0.9m*, *0.7m* and *0.5m* respectively. Sections *AB* ad *CD* are solid with diameter *d* while section *BC* is hollow with inner and outer diameters *90 mm* and *120 mm* respectively. Determine maximum and minimum shearing stress in section *BC*, the required diameter *d* for section *AB* and *CD* if allowable shearing stress is *65 MPa*. Point *A*, *B*, *C*, and *D* has *6kN-m CCW*, *14kN-m CCW*, *26kN-m CW* and *6kN-m CW* when viewed from point *D*.	*CO* 2	*PO* 1	**7**
		c)	Determine the buckling load for a steel (E, 200 GPa) column of 5 m long and of 40 mm diameter with both ends hinged.	*CO* 2	*PO* 1	**6**
			UNIT - V			
	7	a)	At a point in a strained material the normal stresses are $\sigma_x = -120\text{MPa}$. and $\sigma_y = 180\text{MPa}$ and shear stress $\tau_{xy} = 80\text{MPa}$ CCW. Draw the (i) initial stress element, (ii) complete Mohr's circle, labeling critical points, (iii) complete principal stress element (iv) maximum shear stress element.	*CO*2	*PO* 1	**10**
		b)	Find the diameter of a rod subjected to a bending moment of 3 kNm and a twisting moment of 1.8 kNm according to the following theories of failures, taking normal yield stress as 420 MPa and factor of safety as 3. (i) Normal stress theory, (ii) Shear Stress theory.	*CO* 2	*PO* 1	**10**

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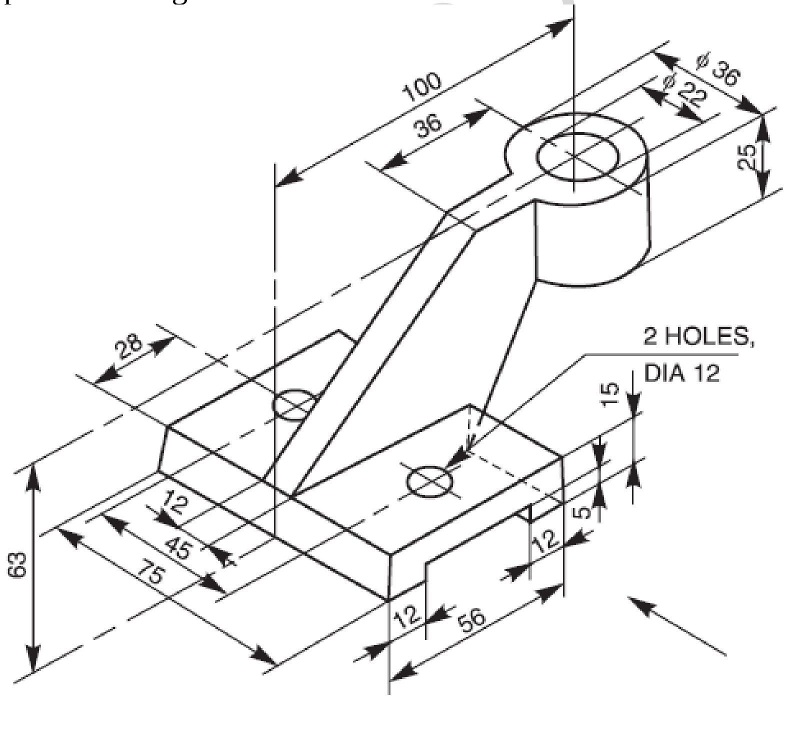
April 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 22AS4PCASD **Max Marks: 100**
Course: Aerospace Drafting

Instructions: Answer one question from each of parts A, B and C

I. Use First angle projection only
II. Missing data if any may be suitably assumed
III. All the calculation should be on answer sheet supplied
IV. All the dimensions are in mm

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		PART-A	*CO*	*PO*	**Marks**
1		A machine component is shown in Fig.1 Draw the front view, top view and right view.  **Fig. Q1**	*CO 1* *CO 2*	*PO 1* *PO 10*	**20**
		OR			
2		Draw the profile of the following threads and indicate all the dimensions i) Sellers thread having pitch 50 mm, ii) Square thread pitch 60 mm	*CO 1* *CO 2*	*PO 1* *PO 10*	**20**

			PART-B			
	3		Draw the three views of ISO threaded hexagonal bolt 120 mm long, 25 mm diameter and a thread length of 60 mm and hexagonal nut assembly in the axis horizontal position. Indicate all the proportions and the actual dimensions.	*CO 1* *CO 2*	*PO 1* *PO 10*	**20**
			OR			
	4		Draw to 1:1 scale, the top and front views of a double riveted lap joint with zig-zag riveting. The thickness of the plates is 8 mm. Show at-least three rivets. Indicate all the dimensions. Use snap head rivets.	*CO 1* *CO 2*	*PO 1* *PO 10*	**20**
			PART-C			
	5		Fig. Q 5 shows the details of Landing gear (Dual Type) without tires. Assemble the parts and draw i) Front view ii) Top view, with suitable scale.	*CO 1* *CO 3*	*PO 1* *PO 10*	**60**
			OR			
	6		The details of wing is shown in the FIG.Q6. Draw front, top and left views of the assembly with suitable scale.	*CO 1* *CO 3*	*PO 1* *PO 10*	**60**

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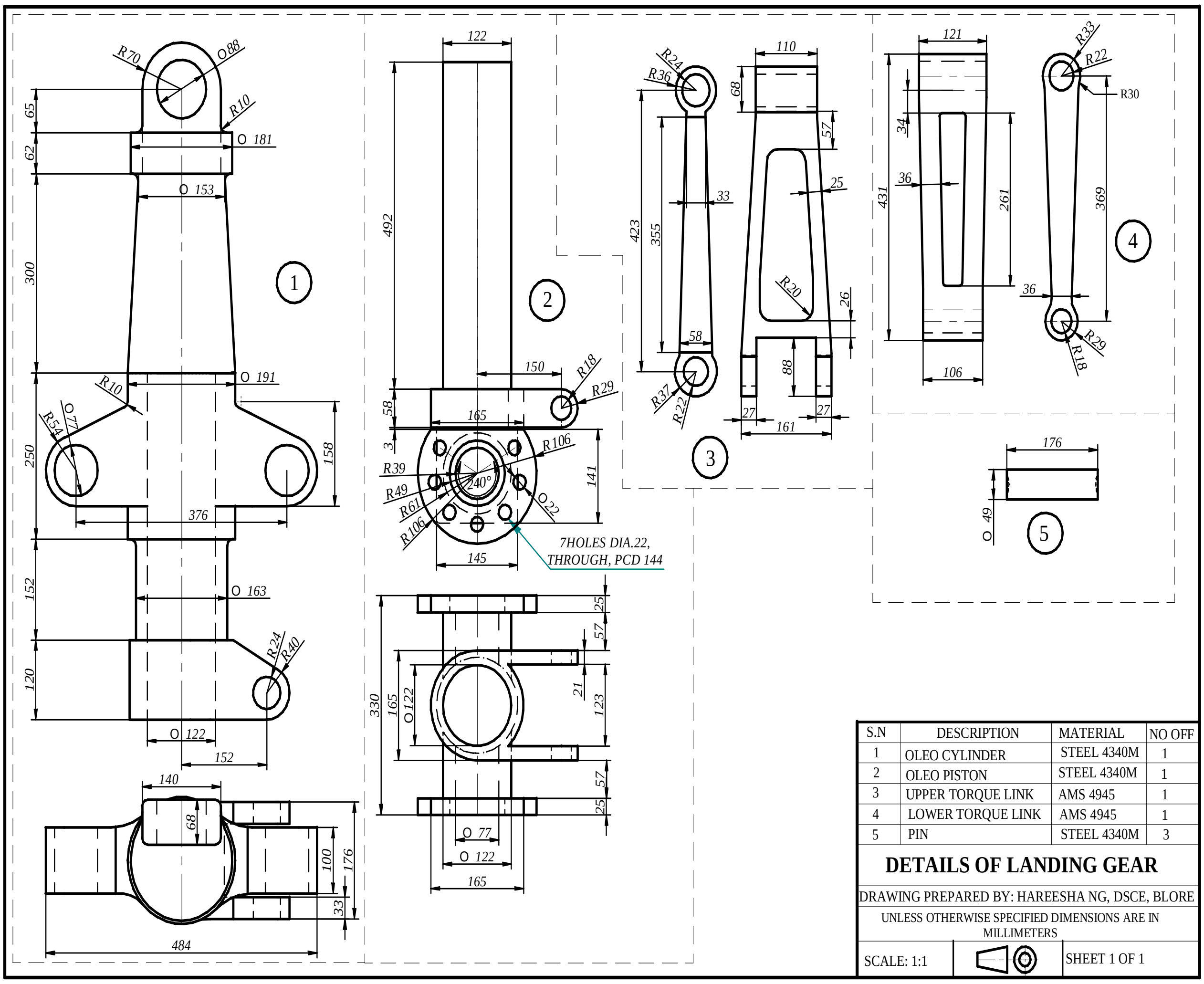


S.N | DESCRIPTION | MATERIAL | NO OFF
1 | OLEO CYLINDER | STEEL 4340M | 1
2 | OLEO PISTON | STEEL 4340M | 1
3 | UPPER TORQUE LINK | AMS 4945 | 1
4 | LOWER TORQUE LINK | AMS 4945 | 1
5 | PIN | STEEL 4340M | 3
DETAILS OF LANDING GEAR
DRAWING PREPARED BY: HAREESHA NG, DSCE, BLORE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS
SCALE: 1:1
SHEET 1 OF 1
7HOLES DIA.22, THROUGH, PCD 144

Fig. Q5

Details of wing assembly

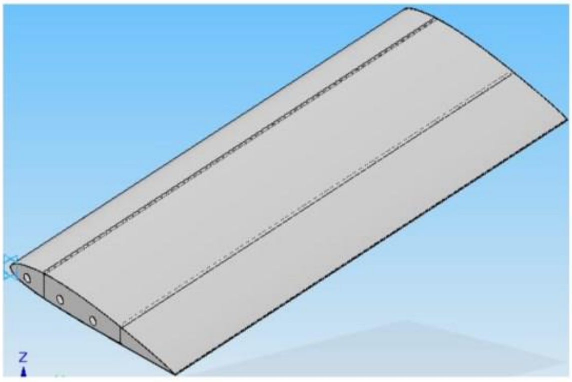
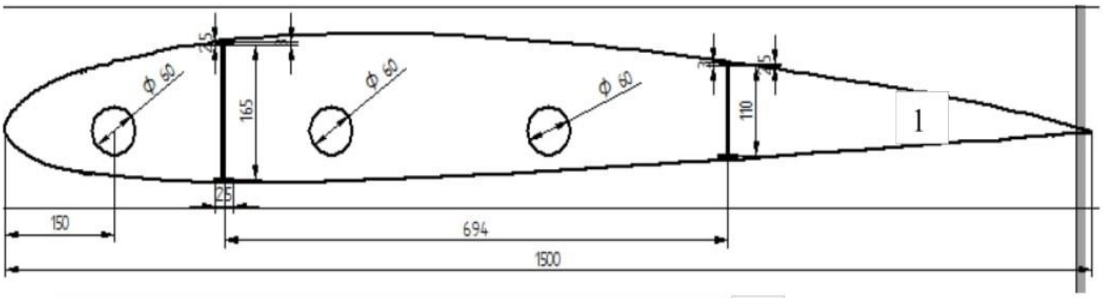
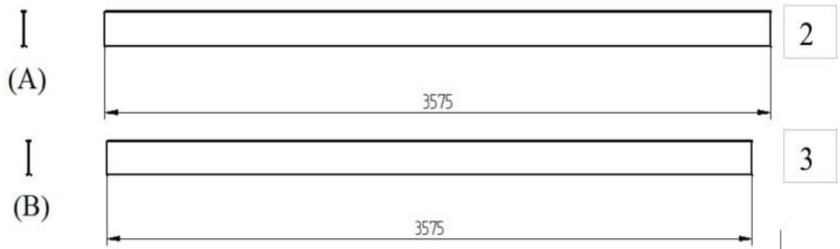
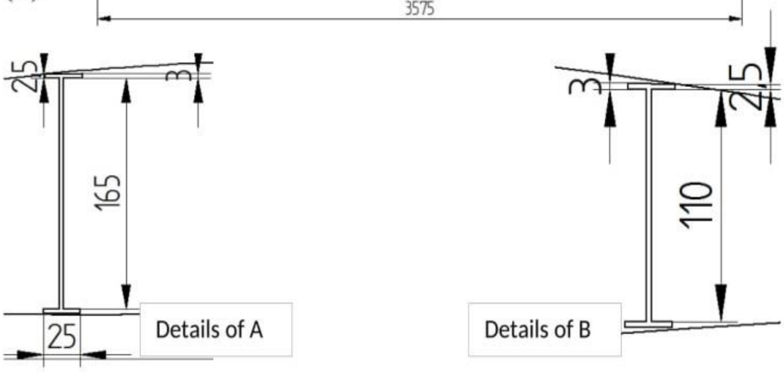


TABLE 1.BILL OF MATERIALS

Item Number	Title	Material	Quantity
1	RIB	Aluminum, 6061-T6	2
2	SPAR FRONT	Aluminum, 6061-T6	1
3	SPAR REAR	Aluminum, 6061-T6	1
4	SKIN	Aluminum, 6061-T6	1







AEROFOIL COORDINATES DETAILS-2412		
X	Y	Z
1500	0	-1.95
1425	0	17.1
1200	0	56.25
900	0	95.4
600	0	117
375	0	115.05
225	0	99.15
112.5	0	74.4
37.5	0	44.85
0	0	0
37.5	0	-34.05
112.5	0	-51.9
225	0	-61.5
375	0	-63.3
600	0	-57
900	0	-41.4
1200	0	-22.5
1425	0	-7.2
1500	0	-1.95

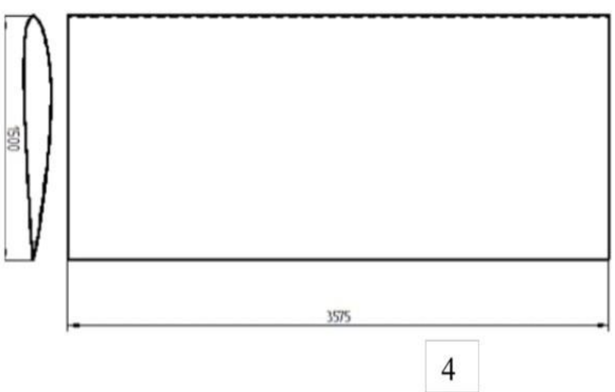


Fig. Q6