U.S.N.										

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: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME4PCFME **Max Marks: 100**
Course: Fluid Mechanics

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

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)	State and prove Pascal's law.	CO1	PO1	**06**
	b)	A closed tank is 5 m tall and is filled with water to a depth of 4 m. The top portion of the tank is filled with air which, as indicated by pressure gage at the top of the tank is at a pressure of 20 kPa. Determine the pressure that the water exerts on the bottom of the tank.	CO2	PO2	**06**
	c)	The water in a tank is pressurised by air, and the pressure is measured by a multi fluid manometer as shown in Fig.1. Determine the gage pressure of air in the tank, if h_1=0.4 m, h_2=0.6 m and h_3=0.8 m. Take the densities of water, oil and mercury to be 1000 kg/m^3, 850 kg/m^3, and 13,600 kg/m^3, respectively.	CO2	PO2	**08**

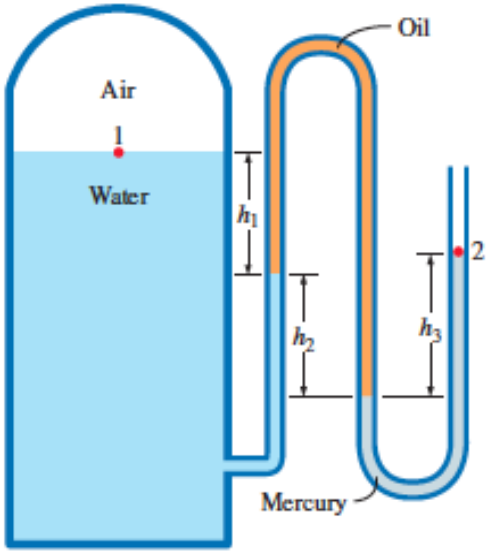
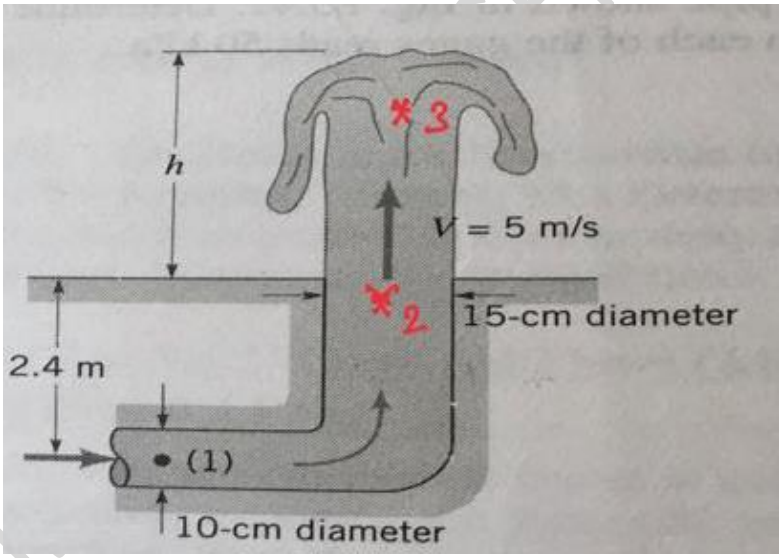
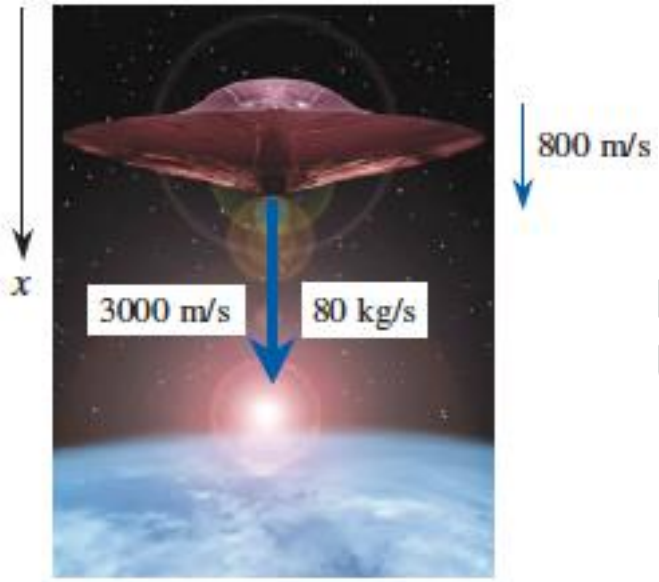


Fig.1

			UNIT - II			
	2	a)	The stream function for a given two dimensional flow field is $\psi = 5x^2y - (5/3)y^3$. Determine the corresponding velocity potential.	*CO2*	*PO2*	**07**
		b)	Determine an expression for the vorticity of the flow field described by $= -xy^3\hat{i} + y^4\hat{j}$. Is the flow irrotational?	*CO2*	*PO2*	**07**
		c)	The velocity along the centreline of a nozzle of length l, is given by $V = 2t(1 - x/2l)^2$ where V is the velocity in m/s, t is the time in seconds from commencement of flow, x is the distance from inlet to nozzle. Calculate, convective, local and total acceleration at t =6s, x=1m and l=1.6m	*CO2*	*PO2*	**06**
			UNIT - III			
	3	a)	Derive continuity equation considering 3-D cartesion co-ordinate system.	*CO2*	*PO1*	**08**
		b)	Water exits a pipe as free jet and flows to height h above the exit plane as shown if Fig. 2. The flow is steady, incompressible and frictionless. Determine the height, (h) and velocity and pressure at section (1).  Fig. 2	*CO2*	*PO2*	**08**
		c)	In a hydroelectric power plant, waters enters the turbine nozzle at 800 kPa absolute pressure with a low velocity. If the nozzles exit are exposed to atmospheric pressure of 100 kPa, determine the maximum velocity to which water can be accelerated by the nozzles before striking the turbine blades.	*CO2*	*PO2*	**04**
			OR			
	4	a)	Derive an expression for Reynold's transport theorem.	*CO3*	*PO1*	**10**
		b)	A spacecraft with a mass of 12,000 kg is dropping vertically towards a planet at a constant speed of 800 m/s (Fig. 3). To slow down the spacecraft, a solidfuel rocket at the bottom is fired, and combustion gases leave the rocket at a constant rate of	*CO3*	*PO2*	**10**

			80 kg/s and at a velocity of 3000 m/s relative to the spacecraft in the direction of motion of the spacecraft for a period of 5 s. Disregarding the small change in the mass of the spacecraft, determine (a) the deceleration of the spacecraft during this period, (b) the change of velocity of the spacecraft, and (c) the thrust exerted on the spacecraft. Also state the assumptions made.  Fig. 3			
			UNIT - IV			
	5	a)	Derive an expression for plane Poiseuille flow.	*CO3*	*PO1*	**10**
		b)	An oil of viscosity 0.02 Ns/m^2 is flowing between two stationary plates of 1 m wide maintained 10 mm apart. The velocity in the midway between the plates is 2 m/s. Calculate the pressure gradient, the average velocity, discharge, shear stress at the wall and pressure drop per unit length.	*CO3*	*PO2*	**10**
			OR			
	6	a)	Derive displacement thickness and momentum thickness expression for boundary layer flow.	*CO3*	*PO1*	**10**
		b)	Explain with a neat sketch, mechanism of boundary layer separation.	*CO3*	*PO1*	**05**
		c)	Water flows over a flat plate at free stream velocity of 0.15 m/s. There is no pressure gradient and laminar boundary layer is 6 mm thick. Assume a sinusoidal velocity profile $\frac{U}{U_\infty} = sin\frac{\pi}{2}(\frac{y}{\delta})$. For the flow conditions stated above, calculate the local wall shear stress and skin friction co-efficient ($\mu = 1.02 \times 10^{-3} kg/ms,\ \rho = 1000\ kg/m^3$).	*CO3*	*PO2*	**05**

			UNIT - V			
	7	a)	At a sudden contraction in a pipe the diameter changes from D_1 to D_2. The pressure drop (Δp), which develops across the contraction, is a function of D_1 and D2, as well as velocity (V), in the larger pipe and the fluid density,(ρ) and viscosity, (μ). Use D_1, V, and μ as repeating variables to determine a suitable set of dimensionless parameters. Use Buckingham's method.	*CO4*	*PO2*	**10**
		b)	Derive dimensionless numbers based on inertia force, viscous force, gravity force, pressure force, surface tension force and elastic force.	*CO4*	*PO2*	**10**

****

U.S.N.										

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: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME4PCMFT **Max Marks: 100**
Course: Manufacturing Technology

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

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)	Name the diagram which involves cutting forces during cutting of a metal with sharp cutting tool. Also explain the procedure for constructing such a diagram.	*CO1*	*PO1*	**10**
	b)	Draw and explain in brief the single point cutting tool showing all the nomenclature on it.	*CO2*	*PO1*	**10**
		OR			
2	a)	List the differences between shaper and planer machines	*CO2*	*PO1*	**10**
	b)	With a neat sketch explain the working of hydraulic shaper mechanism	*CO2*	*PO1*	**10**
		UNIT - II			
3	a)	Name the types of drill bit. With neat sketch explain the drill bit nomenclature.	*CO1*	*PO1*	**10**
	b)	Explain with neat sketch, the construction of a column and knee type milling machine.	*CO2*	*PO1*	**10**
		UNIT - III			
4	a)	Discuss with neat sketches the Board hammer and Power hammer forging processes.	*CO1*	*PO1*	**10**
	b)	With neat sketch, explain any three rolling mill configurations	*CO2*	*PO1*	**10**
		OR			
5	a)	Discuss the various process variables of rolling process	*CO2*	*PO1*	**10**
	b)	List and explain the defects in forging operations	*CO2*	*PO1*	**10**
		UNIT - IV			
6	a)	Explain with neat sketches the direct and indirect extrusion processes	*CO3*	*PO2*	**10**

		b)	Discuss in brief, the process parameters in extrusion process	*CO3*	*PO2*	**10**
			UNIT - V			
	7	a)	Explain with neat sketches, the different types of shearing operations in sheet metal forming process	*CO3*	*PO1*	**10**
		b)	What are Jigs & Fixtures? Explain the fundamental concepts in the design of jigs & fixtures.	*CO3*	*PO3*	**10**

****

U.S.N.										

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

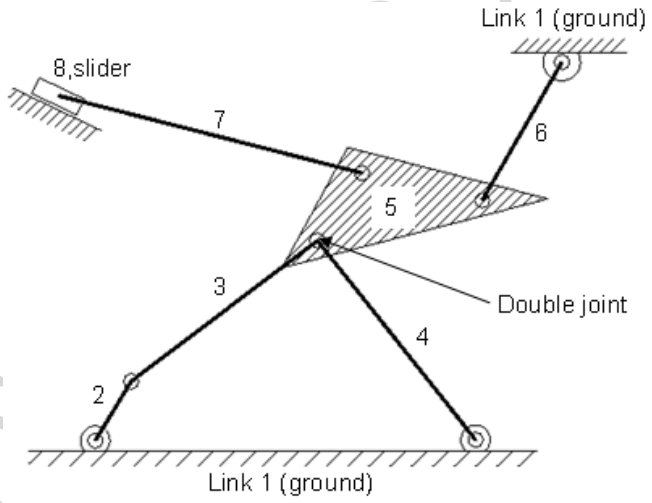
Autonomous Institute Affiliated to VTU

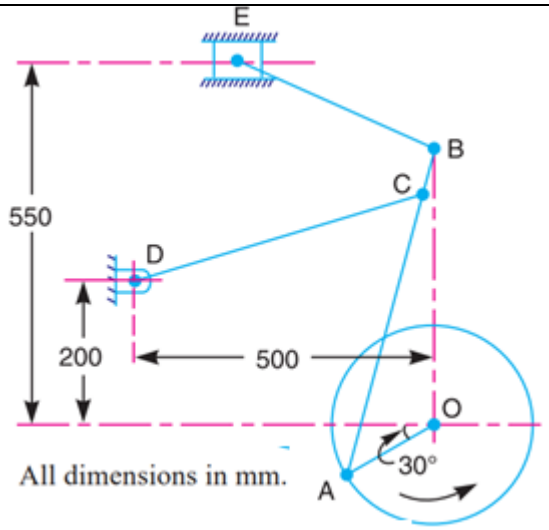
April 2024 Semester End Main Examinations

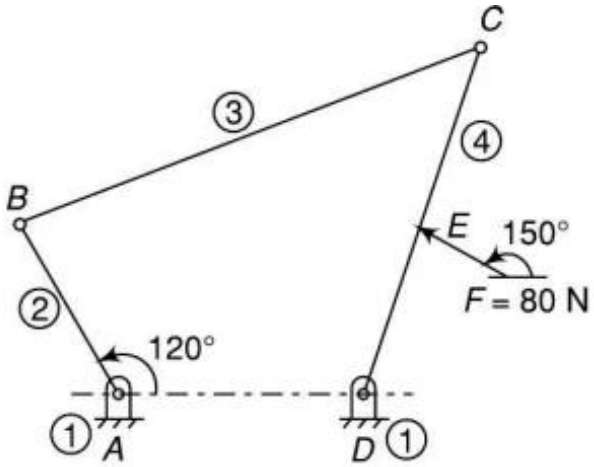
Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME4PCTOM **Max Marks: 100**
Course: Theory of Machines

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

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)	Differentiate Lower pair and Higher pair with suitable examples.	*CO1*	*PO1*	**04**
	b)	What do you understand by degrees of freedom of a mechanism? For a plane mechanism, write the relation between degrees of freedom and number of links. Compute the degrees of freedom of the mechanisms shown in Fig.1.  Fig.1	*CO1*	*PO1*	**08**
	c)	In what way Oldham's coupling is useful in connecting two shafts when the distance between their axes is small?	*CO1*	*PO1*	**08**
		UNIT - II			
2		Figure.2 shows the mechanism of a radial valve gear. The crank OA turns uniformly at 150 r.p.m. and is pinned at A to rod AB. The point C in the rod is guided in the circular path with D as centre and DC as radius. The dimensions of various links are: OA = 150 mm ; AB = 550 mm ; AC = 450 mm ; DC = 500 mm ; BE = 350 mm. Determine velocity and acceleration of the ram E for the given position of the mechanism.	*CO2*	*PO2*	**20**

			 Fig.2			
			OR			
	3	a)	What is Coriolis component of the acceleration? Obtain the expression for the same.	*CO3*	*PO1*	**08**
		b)	The crank and connecting rod of a reciprocating engine are 200 mm and 700 mm respectively. The crank is rotating in clockwise direction at 120 rad/s. Find with the help of Klein's construction: 1. Velocity and acceleration of the piston, 2. Velocity and acceleration of the midpoint of the connecting rod, and 3. Angular velocity and angular acceleration of the connecting rod, at the instant when the crank is at 30° to I.D.C. (inner dead centre).	*CO2*	*PO2*	**12**
			UNIT - III			
	4	a)	"Path-of-Approach is dependent on driven gear properties, while, Path-of-Recess is dependent on driving gear properties". Do you agree? If yes, then prove the same with the help of neat diagrams. If you disagree, then justify the same.	*CO2*	*PO2*	**07**
		b)	In an epicyclic gear train, the internal wheels A & B and compound wheels C & D rotate independently about axis O. The wheels E & F rotate on pins fixed to the arm G. E gears with A & C and F gears with B& D. All the wheels have the same module and the numbers of teeth are T_C=28; T_D=26; T_E=T_F=18. 1. Sketch the arrangement; 2. Find the number of teeth on A and B; 3. If the arm G makes 100r.p.m. clockwise and A is fixed, find the speed of B.	*CO2*	*PO2*	**13**
			UNIT - IV			
	5	a)	Apply principle of virtual work on Internal combustion engine mechanism and find the expression of torque required for static equilibrium.	*CO2*	*PO2*	**06**
		b)	A four-link mechanism (Fig.3) with the following dimensions is acted upon by a force 80 N at angle 150 degrees on the link DC are: AD =500mm, AB=400mm, BC=1000mm, DC=750mm,	*CO2*	*PO2*	**14**

			DE=350mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration.  Fig.3			
			UNIT - V			
	6	a)	Explain the method of finding the countermasses in two planes to balance the dynamic unbalance of rotating masses	*CO2*	*PO1*	**06**
		b)	A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of end pulleys is 48 kg and 20 kg and their centre of gravity are 15 mm and 12.5 mm respectively from the shaft axis. The centre pulley has a mass of 56 kg and its centre of gravity is 15 mm from the shaft axis. If the pulleys are arranged so as to give static balance, determine: 1. relative angular positions of the pulleys, and 2. dynamic forces produced on the bearings when the shaft rotates at 300 r.p.m.	*CO2*	*PO2*	**14**
			OR			
	7		In an in-line six-cylinder engine working on two stroke cycle, the cylinder centre lines are spaced at 600 mm. In the end view, the cranks are 60° apart and in the order 1-4-5-2-3-6. The stroke of each piston is 400 mm and the connecting rod length is 1 metre. The mass of the reciprocating parts is 200 kg per cylinder and that of rotating parts 100 kg per crank. The engine rotates at 300r.p.m. Examine the engine for the balance of primary and secondary forces and couples. Find the maximum unbalanced forces and couples.	*CO2*	*PO2*	**20**

******

U.S.N.										

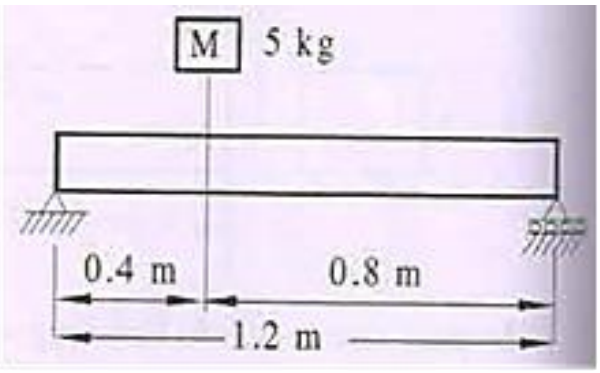
B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME4PCDM1 **Max Marks: 100**
Course: Design of Machine Elements - 1

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

		UNIT - I	CO	PO	Marks
1	a)	Obtain the expression for instantaneous stress due to impact under axial stress.	CO1	PO1	**8**
	b)	A mild steel shaft of 60 mm diameter is subjected to a bending moment of 25 X 10^5 N-m and torque M_t. If the yield point of steel in tension is 230 N/mm^2, determine the maximum value of this torque without causing yielding of the shaft according to:(i) Maximum principal stress theory of failure, (ii) Maximum shear stress theory of failure & (iii) Maximum distortion energy theory of failure. Adopt a factor of safety of 1.5	CO1	PO2	**12**
		OR			
2	a)	List and discuss the factors which influence the selection of a suitable material for a machine element.	CO1	PO1	**4**
	b)	Define the following: (i) Normal stress, (ii) Shear stress & (iii) Principal stress.	CO1	PO1	**6**
	c)	A 5 kg block is dropped from a height of 200 mm on to a beam as shown in Fig. 1 below. The material has an allowable stress of 50 MPa. Determine the dimensions of the rectangular cross section whose depth is 1.5 times the width. Take E= 70 Gpa.  Fig:1	CO1	PO2	**10**

			UNIT - II			
	3	a)	Derive Soderberg's equation when a member is subjected to fatigue axial loading.	*CO2*	*PO1*	**8**
		b)	A piston rod is subjected to a maximum reversed axial load of 110 kN. It is made of steel having an ultimate strength of 900 MPa and surface is rough machined. The endurance limit is 50% of the ultimate strength. Take the size correction coefficient as 0.85 and a factor of safety of 1.75. Estimate the diameter of the rod.	*CO2*	*PO3*	**12**
			UNIT - III			
	4	a)	A shaft is supported by two bearings placed 1m apart. A 500 mm diameter pulley is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 3 kN. The pulley weighs 1 KN. Another pulley 300 mm diameter is placed 300 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right when viewed from the left bearing. This pulley weighs 500 N. The angle of contact for both the pulleys is 180 degree and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, assume that the torque on one pulley is equal to that on the other pulley. Choose C15 steel as shaft material. Ultimate stress = 425 N/mm^2, Yield stress = 235.4 N/mm^2 and use ASME code for the design. Assume minor shock condition	*CO3*	*PO3*	**20**
			OR			
	5	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. σ_c = 150 N / mm2, τ = 60 N / mm^2 and σ_t = 100 N / mm^2	*CO3*	*PO3*	**10**
		b)	Design protected type cast flange coupling for a steel shaft transmitting 30 kW at 200 rpm. The allowable shear stress in the shaft and key material can be assumed as 40 N / mm^2. The maximum torque transmitted is to be 20 % greater than the full load torque. The allowable shear stress in the bolt is 60 N/mm^2 and allowable shear stress in the flange is 40 N / mm^2.	*CO3*	*PO3*	**10**
			UNIT - IV			
	6	a)	Design a double riveted Butt joint with two cover plates for longitudinal seam of a boiler shell 1.5 m in diameter subjected to steam pressure of 0.95 N/mm^2. Assume an efficiency of 75% If the allowable working stresses in tensile, crushing and shear are 90 Mpa, 140 Mpa and 56 Mpa respectively, design and sketch the riveted joint.	*CO3*	*PO3*	**20**

			UNIT - V			
	7	a)	With neat sketch explain Threaded screw terminology.	*CO3*	*PO1*	**8**
		b)	A triple-threaded power screw used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square 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 at the threads is 0.12 and the collar friction is negligible. Calculate, i). The principal shear stress in the screw body ii.) The transverse shear stresses in the screw and the nut, and iii.) The unit bearing pressure. Iv)Also state whether the screw is self-locking	*CO3*	*PO3*	**12**

****