ME -101 Roll No.

B.Tech (Section C, D & E) Semester –I Examination 2023-24

Basics of Mechanical Engineering

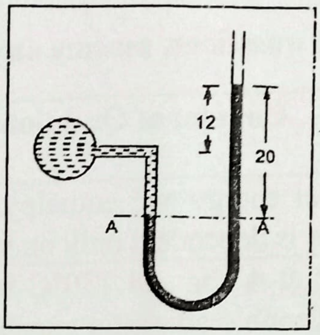
Paper No. BME- 101

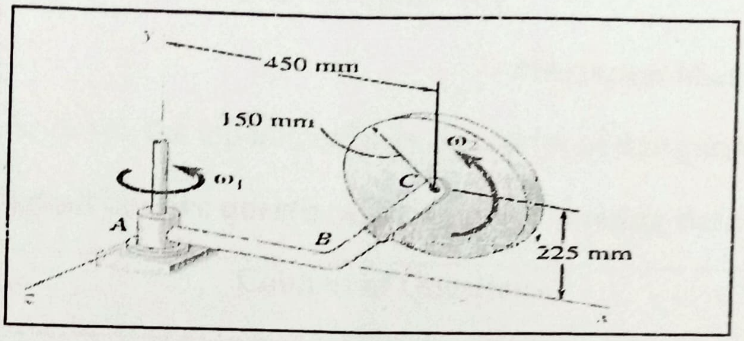
Time : 3 Hours **Maximum Marks : 45**

(Write your Roll no on the top immediately on receipt of this question paper)

Note : Attempt all the five questions, assume any missing data suitably.

Unit No	Cos No	Content of Questions	Marks
1	Q.1A CO1	Define internal energy and enthalpy. Why enthalpy of an ideal gas is dependent only on temperature.	4
	Q.1B CO1	0.2 m^3 of air at 4 bar and 130°C is contained in a system. A reversible adiabatic expansion takes place till the pressure falls to 1.02 bar. The gas is then heated at constant pressure till enthalpy increases by 72.5 kJ. Calculate: (i) The work done (ii) The index of expansion, if the above processes are replaced by a single reversible polytropic process giving the same work between the same initial and final states. Take $C_p = 1$ kJ/kg K, $C_v = 0.714$ kJ/kg K.	5
		OR	
	Q.1B' CO1	The steam supply to an engine comprises of two streams which mix before entering the engine. One stream is supplied at the rate of 0.01 kg/sec with an enthalpy of 2950 kJ/kg and a velocity of 20 m/sec. The other stream is supplied at the rate of 0.1 kg/sec with an enthalpy of 2565 kJ/kg and a velocity of 120 m/sec. At the exit of engine the fluid leaves as two streams, one of water at the rate of 0.001 kg/sec with an enthalpy of 421 kJ/kg and the second stream have negligible the fluid velocity. The engine develops a shaft power of 25 kW. The heat transfer is negligible. Evaluate the enthalpy of exit stream.	5
2	Q.2A CO2	Derive an Expression for total pressure force and depth of pressure for a vertical surface submerged in water.	5
		OR	

	Q.2A' CO3	Using a neat sketch, state and derive the expression for Pascal's law	5
	Q.2B CO2	The right limb of a simple U-tube manometer containing mercury is open to the atmosphere, while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe, if the difference of mercury level in the two limbs is 20 cm. 	4
3	Q.3A CO3	Derive an expression for general one-dimensional heat conduction equation in cartesian coordinates. Also, discuss the case for steady state with no heat generation.	5
	Q.3B CO3	A carbon steel plate (thermal conductivity = 45 W/m°C), 600 mm x 900 mm x 0.25 mm is maintained at 310°C. Air at 15°C blows over the hot plate. If convective heat transfer co-efficient is 22 $W/m^2 °C$ and 250 W heat is lost from the plate surface by radiation, calculate the inside plate temperature.	4

4	Q.4A CO4	A thin disk of mass 4 kg rotates at the constant rate ω_2 = 15 rad/sec with respect to arm ABC (given in Fig.) which itself rotates at the constant rate ω_1 = 5 rad/sec about the y- axis. Determine the angular momentum of the disk about its center C. 	5
	Q.4B CO4	Deduce the expression for angular momentum of rigid body in three dimensions using a neat sketch.	4
		OR	
	Q.4B' CO4	What is a gyroscope, and how are Euler angles utilized to describe its orientation in space. Also discuss the applications of gyroscope.	4
5	Q.5A CO5	List the various terminologies used in a gear with the help of a neat sketch of a gear profile.	4
	Q.5B CO5	A crank and slotted lever mechanism used in a shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of the time of cutting to the time of return stroke.	5