B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025
Third Semester
Electronics and Instrumentation Engineering
(Common to Instrumentation and Control Engineering)
20ESME301 - APPLIED THERMODYNAMICS AND FLUID MECHANICS
Regulations - 2020
(Use of Steam Tables and Mollier Diagram is permitted)

Duration: 3 Hours   Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)
Answer ALL Questions

		Marks	K –Level	CO
1.	The enthalpy of a substance(denoted by h), is defined as	1	K2	CO1
	(a) h=u-pv (b) h=u+pv (c) h=-u+pv (d) h= -u-pv			
2.	All natural processes are	1	K1	CO1
	(a) Reversible (b) Irreversible (c) Isothermal (d) None			
3.	The gas turbine works on	1	K1	CO2
	(a) Rankine cycle (b) Otto cycle (c) Carnot cycle (d) Brayton cycle			
4.	Which of the following is the correct statement?	1	K2	CO2
	(a) For a given compression ratio, both Otto and Diesel cycles have the same efficiency			
	(b) For a given compression ratio, Otto cycle is more efficient than Diesel cycle			
	(c) For a given compression ratio, Diesel cycle is more efficient than Otto cycle			
	(d) The efficiency of Otto or Diessel cycle has nothing to do with compression ratio.			
5.	Rankine efficiency of a Steam Power Plant _____	1	K2	CO3
	(a) improves in Summer as compared to that in Winter			
	(b) improves in Winter as compared to that in Summer			
	(c) is unaffected by climatic conditions			
	(d) none of the mentioned			
6.	What is the function of a steam trap?	1	K2	CO3
	(a) It is used to store stem once the generation is complete			
	(b) It prevents the leakage of steam from the boiler			
	(c) It is used to increase the temperature of the steam			
	(d) It captures the condensed steam from steam pipes and steam separators			
7.	Which one of the following is a dimensionless quantity?	1	K2	CO4
	(a) Mass (b) Weight (c) Specific weight (d) Reynold's number			
8.	A model of with the same shape is known as	1	K1	CO4
	(a) geometric similarity (b) kinematic similarity			
	(c) dynamic similarity (d) conditional similarity			
9.	The mass density of mercury is…… kg/m³	1	K1	CO5
	(a) 136 (b) 1360 (c) 13600 (d) 13.600			
10.	With the increase in the input power, the efficiency will:	1	K1	CO6
	(a) Increases (b) Decreases (c) Same (d) Independent			

PART - B (12 × 2 = 24 Marks)
Answer ALL Questions

		Marks	K –Level	CO
11.	State the Zeroth law of thermodynamics and give an example for its application.	2	K1	CO1
12.	Compare Efficiency with COP.	2	K2	CO1
13.	For same compression ratio, Which air standard cycle offers higher efficiency? Justify your answer.	2	K2	CO2
14.	Distinguish Brayton Cycle from other air standard cycles.	2	K2	CO2
15.	List the important elements of vapor power cycle.	2	K1	CO3

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **13573**

16.	What is the difference between boiler mountings and boiler accessories?	2	K1	CO3
17.	Mention the merit of Buckingham theorem over Rayleigh method.	2	K1	CO4
18.	Define Similitude and name the types of similarities.	2	K1	CO4
19.	What is a manometer? How are they classified?	2	K1	CO5
20.	Elaborate the continuity equation used in fluid flow.	2	K2	CO5
21.	Classify hydraulic turbines.	2	K2	CO6
22.	List out the differences between centrifugal and reciprocating pumps.	2	K1	CO6

PART - C (6 × 11 = 66 Marks)
Answer ALL Questions

23. a) The velocity and enthalpy of a fluid at the inlet of a certain nozzle are 60 m/sec and 3000 kJ/kg respectively. The enthalpy at the exit of the nozzle is 2762 kJ/kg respectively. The nozzle is horizontal and there is negligible heat loss from it. Find (a) the velocity of the fluid at the exit of the nozzle, (b) Mass flow rate, if the inlet area is 0.1m^2 and the specific volume is 0.187 m^3/kg. (c) Exit area of the nozzle if the specific volume at the exit of the nozzle is 0.498 m^3/kg.   11   K2   CO1

OR

b) Two Carnot engines A and B are operated in series. The first one receives heat at 870 K and rejects to a reservoir at temperature T. The second engine receives heat rejected by the first engine and in turn rejects to a heat reservoir at 300 K. Find the intermediate temperature T in °C between two heat engines for the following cases: i) The work outputs of the two engines are equal. ii) The efficiencies of the two engines are equal.   11   K2   CO1

24. a) An Otto cycle has a compression ratio of 7. The initial pressure and temperature at the beginning of compression are 1 bar and 40° C. The heat supplied is 2510 kJ/kg. Find
(i) the maximum pressure and temperature
(ii) work done per kg of air
(iii) the cycle efficiency
(iv) mean effective pressure.
Take C_v = 0.713 kJ/kg K and R = 287 J/kg K.   11   K3   CO2

OR

b) Deduce an expression to find the air standard Diesel power cycle efficiency with necessary layout and T S diagram.   11   K3   CO2

25. a) Explain the construction and working of following,
(i) Water level indicator (ii) Pressure gauge (iii) Feed check value (iv) Blow of cock.   11   K3   CO3

OR

b) The following data was obtained in a steam boiler trial : Feed water supplied per hour 690 kg at 28°C, steam produced 0.97 dry at 8 bar, coal fired per hour 91 kg of calorific value 27,200 kJ/kg, ash and unburnt coal collected from beneath the fire bars 7.5 kg/hour of calorific value 2,760 kJ/kg, mass of flue gases per kg of coal burnt 17.3 kg, temperature of flue gases 325°C, room temperature 17°C, and the specific heat of the flue gases 1.026 kJ/kg K. Calculate : (a) the boiler efficiency (b) the percentage heat carried away by the flue gases, (c) the percentage heat loss in ashes, and (d) the percentage heat loss unaccounted for.   11   K3   CO3

26. a) The pressure difference Δp in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π theorem, obtain an expression for Δp.   11   K3   CO4

OR

b) The pressure drop in an aero-plane model of size 1/10 of its prototype is 80 N/cm^2. The model is tested in water. Calculate the corresponding pressure drop in the prototype. Take density of air = 1.24 kg/m^3. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise.   11   K3   CO4

27. a) A simple U-tube manometer containing mercury is connected to a pipe in which an oil of specific gravity 0.8 is flowing. The pressure in the pipe is vacuum. The other end of the manometer is open to the atmosphere. Find the vacuum, pressure in the pipe if the difference of mercury level in the two limbs is 20 cm and the height of oil in the left limb from the centre of the pipe is 15 cm below.   *11*   *K1*   *CO5*

<div align="center">**OR**</div>

   b) A hydraulic press has a ram of 30 cm diameter and a plunger of 5 cm diameter. Find the weight lifted by the hydraulic press when the force applied at the plunger is 400 N.   *11*   *K1*   *CO5*

28. a) A Pelton wheel is to be designed for the following specifications: Shaft power = 1172 kW, Head = 380 m, speed = 750 rpm, Overall efficiency = 86%, Jet diameter is not to exceed one – sixth of the wheel diameter. Find (i) The wheel diameter,   (ii) The number of jets required, (iii) Diameter of the jet.   *11*   *K2*   *CO6*

<div align="center">**OR**</div>

   b) Explain the working principle of double acting reciprocating pumps with neat diagram in detail.   *11*   *K2*   *CO6*