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Question Paper Code	11684

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV/DEC 2022

Third Semester

Mechanical Engineering

(Common to Electronics and Instrumentation Engineering & Instrumentation and Control Engineering)

20ESME301 - APPLIED THERMODYNAMICS AND FLUID MECHANICS

(Regulations 2020)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	Describe the limits of the first law of thermodynamics.	2,K1,CO1
2.	State Kelvin Planck's statement of second law of thermodynamics.	2,K1,CO1
3.	Mention how the Otto cycle is more efficient than the Diesel engine for a particular compression ratio.	2,K1,CO2
4.	Illustrate why gas turbines are employed in the Brayton Cycle.	2,K1,CO2
5.	Represent the relationship between fluid compressibility and bulk modulus.	2,K1,CO3
6.	List out the assumptions made in Bernoulli's energy equation.	2,K1,CO3
7.	Define the term dimensional homogeneity.	2,K1,CO4
8.	Mention the three different forms of similitude that are employed in dimensional analysis.	2,K1,CO4
9.	Justify the reason why Kaplan turbines are used in low head and high flow conditions.	2,K1,CO5
10.	Indicate a pump that is appropriate for applications requiring high pressure and low flow.	2,K1,CO6

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	(i) Formulate the mathematical expressions for calculating heat and work transfer in the closed system's five basic thermodynamic processes.	6,K2,CO1
		(ii) A system undergoes the following three processes as a cycle (a) 1-2 in which it absorbs 200 kJ of heat and does 100 kJ of work, (b) 2-3 in which 50 kJ of heat is rejected and 80 kJ of work is received and (c) 3-1 in which work transfer occurs under adiabatic conditions. Calculate the work transfer in the process 3-1, net work transfer and net heat transfer from the cycle.	7,K2,CO1

OR

b) (i) Formulate the mathematical expressions for calculating the COP of refrigerator and heat pump in terms of temperature. *6,K2,CO1*

(ii) A refrigerator maintains the cooled space at 2°C when the ambient air around the refrigerator is 25°C. The refrigerator has a COP of 2.5. The rate of cooling in the refrigerator space is 8000 kJ/h. (a) Determine the power consumption of refrigerator and the heat transfer rate to the surrounding air. (b) Also find the COP of reversible refrigerator. *7,K2,CO1*

12. a) (i) Construct the p-V diagram and mathematical expressions for calculating the efficiency of Otto cycle in terms of temperature. *6,K2,CO2*

(ii) Summarize the Diesel cycle's operation using a schematic diagram and a T-S diagram. *7,K2,CO2*

OR

b) (i) Compute the T-S diagram and mathematical expressions for calculating the efficiency of Rankine cycle in terms of enthalpy. *6,K2,CO2*

(ii) Illustrate the working principle of reheat Rankine cycle with its schematic diagram and TS diagram. *7,K2,CO2*

13. a) (i) Illustrate any three fluid properties and compare their values for petrol and water with its units. *6,K2,CO3*

(ii) Compare the working principle of U-tube manometer and inverted U-tube manometer with its schematic diagram. *7,K2,CO3*

OR

b) (i) Compute the continuity equation for a nozzle and justify how the velocity is varying with respect to cross sectional area of a nozzle. *6,K2,CO3*

(ii) Formulate the Bernoulli's energy equation for a fluid flow through the pipe and mention any two applications of Bernoulli's energy equation. *7,K2,CO3*

14. a) Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that thrust 'P' depends upon angular velocity 'w', speed of advance 'V', diameter 'D', dynamic viscosity 'μ', mass density 'ρ', elasticity of fluid medium which can be denoted by the speed of sound in the medium 'C'. *13,K2,CO4*

OR

b) A 1:15 model of a flying boat is towed through water. The prototype is moving in sea-water of density 1024 kg/m at a velocity of 20 m/s. Find the corresponding speed of the model. Also determine the resistance due to waves on model if the resistance due to waves of prototype is 600 N. *13,K2,CO4*

15. a) (i) Structure the velocity diagram with the nomenclature for a jet striking a unsymmetrical moving curved vane at one of the tips. *6,K2,CO5*

(ii) Interpret the working principle of inward radial flow reaction turbine with its schematic diagram and mathematical expression for hydraulic efficiency. *7,K2,CO5*

OR

b) (i) Structure the performance characteristics with the nomenclature for a centrifugal pump. *6,K2,CO5*

(ii) Summarize the working principle of multistage centrifugal pump with its schematic diagram and mathematical expression for specific speed. *7,K2,CO5*

PART - C (1 × 15 = 15 Marks)

16. a) A turbine is powered by steam generated by a thermal power plant at 8.0 MPa and 500°C. The turbine output enters a condenser at 15 kPa and is condensed to a saturated liquid, which is then pumped to the boiler. At these conditions, evaluate the thermal efficiency of a Rankine cycle with a reversible adiabatic turbine. *15,K3,CO6*

OR

b) The Pelton wheel has a mean bucket speed of 10 m/s and a water jet that flows at a rate of 700 lps under a head of 30 m. The buckets deflect the jet at a 160° angle. Calculate the power delivered by water to the runner as well as the turbine's hydraulic efficiency. Assume the nozzle coefficient is 0.98. *15,K3,CO6*