BT MRE-II(R/S)-06-24-3234 Reg. No. | | | | | | | | | |

B

B.Tech. Degree II Semester Regular/Supplementary Examination in Marine Engineering June 2024

19-208 0202 APPLIED THERMODYNAMICS

(2019 Scheme)

Time: 3 Hours Maximum Marks: 60

Course Outcome
On successful completion of the course, the students will be able to:

CO1: Understand the basics of thermodynamics and find the work done and heat transferred in different thermodynamic process.
CO2: Understand the different types of boilers and vapor power cycles and calculate their efficiencies.
CO3: Gain knowledge on the working of steam nozzles and steam turbines and calculate the work output.
CO4: Identify the different ideal gas cycles used in IC engines and calculate their efficiencies.
CO5: Calculate the properties of gas mixture as applied to air conditioning.
Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 –Analyze, L5 – Evaluate, L6 – Create
PI – Programme Indicators

Answer *ALL* questions (5 × 15 = 75)

			Marks	BL	CO	PI
I.	(a)	State Kelvin Plank and Claussius statement of second law of thermodynamics. Derive the equation for efficiency of heat engine and COP of refrigerator with sketches.	7	L2	1	1.3.1
	(b)	In a gas turbine installation, the gases enter the turbine at the rate of 5 kg/sec with a velocity of 50 m/sec and enthalpy of 900 kJ/kg and leave the turbine with 150 m/sec. and enthalpy of 400 kJ/kg. The loss of heat from the gases to the surroundings is 25 kJ/kg. Assume R = 0.285 kJ/kgK, Cp = 1.004 kJ/kgK and inlet conditions to be at 100 kPa and 27°C. Determine the diameter of the inlet pipe.	8	L3	1	1.3.1
		OR				
II.	(a)	State and show the Clausius inequality is valid for all thermodynamic cycles.	5	L2	1	1.3.1
	(b)	A heat engine is supplied with 19 kW of heat from 565 K reservoir and rejects heat to 282.5 K reservoir. Which of the following engine is irreversible engine, reversible engine and impossible engine? Case (a): If 14.0833 kW of heat is rejected. Case (b): If 4.75 kW of heat is rejected. Case (c): If 9.5 kW of heat is rejected. Use Carmot method and Clausius inequality method.	10	L3	1	1.3.1
III.		Explain the working of any three type of fire tube boiler with suitable sketches.	15	L2	2	1.3.1
		OR				
IV.		Calculate the internal energy of 1kg of steam at a pressure of 10 bar when the condition of steam is (i) wet and dryness fraction of 0.85 (ii) dry and saturated (iii) super heated with degree of super heat being 50°C. The specific heat of super heated steam at constant pressure is 2.26 kJ/kgK.	15	L3	2	1.3.1

(P.T.O.)

			Marks	BL	CO	PI
V.	(a)	Derive an expression for power developed and blade efficiency of impulse turbine.	8	L2	3	1.3.1
	(b)	With a H-S diagram explain reheat factor in a reaction turbine.	7	L2	3	1.3.1
		OR				
VI.		Steam at 5 bar and 200°C is first made to pass through nozzles. It is then supplied to an impulse turbine at the rate of 30 kg/minute. The steam is finally exhausted to a condenser at 0.2 bars. The blade speed is 300 m/s. The nozzles are inclined at 25° with the direction of motion of the blades and the outlet blade angle is 35°. Neglecting friction, find the theoretical power developed by the turbine.	15	L3	3	1.3.1
VII.	(a)	Explain the valve timing diagram for a four-stroke cycle petrol engine with a neat sketch.	7	L2	4	1.3.1
	(b)	A four cylinder two stroke cycle petrol engine develops 23.5 kW brake power at 2500 rpm. The mean effective pressure on each piston is 8.5 bars and the mechanical efficiency is 85%. Calculate the diameter and stroke of each cylinder, assuming the length of stroke equal to 1.5 times the diameter of cylinder.	8	L3	4	1.3.1
		OR				
VIII.	(a)	List the advantages and disadvantages of a two stroke cycle engine over a four stroke one.	5	L2	4	1.3.1
	(b)	During the test on single cylinder oil engine, working on the four stroke cycle and fitted with a rope brake, the following readings are taken: Effective diameter of brake wheel = 630 mm; Dead load on brake = 200 N; spring balance reading = 30 N; speed = 450 rpm; Area of indicator diagram = 420 mm^2; Length of indicator diagram = 60 mm; Spring scale = 1.1 bar per mm; Diameter of cylinder = 100 mm; stroke = 150 mm; Quantity of oil used = 0.815 kg/h; calorific value of oil = 42000KJ/kg. Calculate brake power, indicated power, mechanical efficiency, brake thermal efficiency and brake specific fuel consumption.	10	L3	4	1.3.1
IX.		Atmospheric air at 101.324 kPa and 288.15 K contains 21% oxygen and 79 % nitrogen by volume. Calculate the: (i) Mole fraction, mass fractions, partial pressure of oxygen and nitrogen and (ii) Molar mass, gas constant and density of air. Take molar mass of oxygen and nitrogen as 32 and 28 kg/k mol.	15	L3	5	1.3.1
		OR				
X.	(a)	Draw a psychometric chart and explain how we can find the Dew point and Relative humidity if Dry bulb and Wet bulb temperatures are known.	6	L2	5	1.3.1
	(b)	A mixture of ideal gases consists of 3 kg of Nitrogen and 5 kg of carbon dioxide at a pressure of 300 kPa and a temperature of 20°C. Find: (i) Mole fraction of each constituent (ii) Equivalent molecular weight of the mixture (iii) The equivalent gas constant of the mixture (iv) The partial pressure and the partial volume.	9	L3	5	1.3.1

Bloom's Taxonomy Levels
L2 = 40%, L3 = 60%.

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