Code: 20A03401T

R20

B.Tech II Year II Semester (R20) Regular & Supplementary Examinations August/September 2023

APPLIED THERMODYNAMICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a)	Name the two general classes of combustion engine.	2M
(b)	Define Knocking.	2M
(c)	List the application of compressed air.	2M
(d)	How the compressors are classified?	2M
(e)	What is the difference between an ideal and actual cycle?	2M
(f)	What is relative effiency?	2M
(g)	Define the term 'steam nozzle'.	2M
(h)	Define the steam turbine.	2M
(i)	Define refrigeration.	2M
(j)	What is meant by Relative humidity?	2M

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

2 Explain about Four stroke engine with neat sketch. List the advantages and dis advantages. 10M

OR

3 Explain in detail about the different stages of CI engine in combustion. 10M

4 Explain the working of multistage compressor with neat sketch. 10M

OR

5 Explain the working of axial compressor with neat sketch. 10M

6 The pressure limits in a steam power cycles are 10kPa and 17500kPa. The peak temperature is 500℃. If the adiabatic efficiency of the turbine is 80%, determine. 10M
(i) Thermal efficiency, (ii) The steam rate.

OR

7 Air enters the compressor of a gas turbine plant operating on Brayton cycle at 1 bar, 27℃. The pressure ratio in the cycle is 6. If $W_T = 2.5\ W_c$ where W_T and W_c are the turbine and compressor work. Calculate the maximum temperature ant the cyclic efficiency. 10M

8 In a steam nozzle, dry and saturated steam is expanded from 10 bar to 0.1 bat. Using steam table, Calculate. 10M
(i) Dryness fraction of steam, (ii) Heat drop, (iii) The velocity of steam at the exit from the nozzle when intial velocity is 135 m/s.

OR

9 Explain in brief about the difference between an impulse turbine and reaction turbine. 10M

10 Explain the vapour compression refrigeration cycle with neat sketch. 10M

OR

11 Define the term of air conditioning. Explain the neat sketch of air-condition cycle. 10M

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Code: 20A03401T

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B.Tech II Year II Semester (R20) Regular & Supplementary Examinations April/May 2024

APPLIED THERMODYNAMICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1		Answer the following: (10 X 02 = 20 Marks)	
	(a)	Brief on Radial Engine.	2M
	(b)	How does atomisation affect ignition delay? Brief with respect to physical phenomenon.	2M
	(c)	Concise on Polytrophic efficiency.	2M
	(d)	What is the purpose of Intercooling?	2M
	(e)	State the significance of condenser pressure on Rankine cycle efficiency.	2M
	(f)	Brief on the regenerative Brayton cycle.	2M
	(g)	For a convergent-divergent nozzle sketch variation of specific volume, velocity, area and pressure along the nozzle axis.	2M
	(h)	List the methods that are used in reducing the speed of the Turbine Rotor.	2M
	(i)	Define – One TR.	2M
	(j)	Brief on Chemical Dehumidification.	2M

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

2	(a)	Compare between SI and CI Engines.	3M
	(b)	A twelve-cylinder four-stroke cycle gasoline engine, with a 160 mm bore and 170 mm stroke, delivers 900 kW at 2400 rpm while burning 580 lit of fuel per hour. The density of the fuel is 750 kg/m^3. The engine produces 1125 kW of indicated power. Find bmep, imep, bsfc and mechanical efficiency.	7M
		OR	
3	(a)	Discuss on the stages of combustion in CI Engines.	4M
	(b)	A two-stroke engine has a swept volume of 1.2 litres. At a speed of 5400 rpm the full-load torque is 115 Nm and the brake specific fuel consumption is 285 g/kWh. Calculate brake power the brake mean effective pressure and the brake thermal efficiency if the calorific value of the fuel is MJ/kg. If the torque is reduced to 38 Nm (at the same speed) and the brake specific fuel consumption rises to 320 g/kWh, calculate the brake efficiency.	6M
4	(a)	Brief on the factors that affect the performance of Compressors.	4M
	(b)	The indicated power of a double acting air compressor is 38 kW. Air is drawn in at 1 bar and 298 K and compressed, according to the law $pv^{1.2}$ = constant to 6 bar. The compressor runs at 300 rpm with average piston speed pf 2.5 m/s. Neglecting clearance, find the dimensions of the cylinder.	6M
		OR	
5	(a)	Explain the working of axial flow compressors.	4M
	(b)	Air at a temperature of 305 K flows in a centrifugal compressor running at 18000 rpm. Given data: Isentropic total head efficiency: 0.75; Outer diameter of blade tip: 0.5 m; Slip factor: 0.8. Estimate the temperature rise of air passing through the compressor and the static pressure ratio. Assume absolute velocities at inlet and outlet are same. Take Cp of air as 1.005kJ/kg K.	6M

Contd. in Page 2

6 Steam enters the high-pressure turbine of a steam power plant that operates on the ideal reheat Rankine cycle at 60 bar and 480°C and leaves as saturated vapor. Steam is then reheated to 435°C before it expands to a pressure of 7.5 kPa. Heat is transferred to the steam in the boiler at a rate of 6.5 x 104 kJ/s. Steam is cooled in the condenser by the cooling water from a nearby river, which enters the condenser at 10°C. Show the cycle on a T-s diagram with respect to saturation lines, and determine the pressure at which reheating takes place, the net power output and thermal efficiency, and the minimum mass flow rate of the cooling water required. 10M

OR

7 In a gas turbine installation air is supplied at 1 bar, 25ºC into compressor having compression ratio of 8. The air leaving combustion chamber is heated upto 1150 K and expanded upto 1 bar. A heat exchanger having effectiveness of 0.82 is fitted at exit of turbine for heating the air before its inlet into combustion chamber. Assuming polytropic efficiency of the compressor and turbine as 0.86 and 0.90 determine cycle efficiency, work ratio and specific work output of plant. Take Cp = 1.0032 kJ/kg K for air. 10M

8 (a) In a steam nozzle, steam expands from 16 bar to 5 bar with initial temperature of 300^{o}C and mass flow of 1 kg/s. Determine the throat and exit areas considering expansion to be frictionless and, friction loss of 10% throughout the nozzle. 7M

(b) Dry saturated steam enters a frictionless adiabatic nozzle with negligible velocity at a temperature of 300°C. It is expanded to a pressure of 5000 kPa. The mass flow rate is 1 kg/s. Calculate the exit velocity of steam. 3M

OR

9 Single row impulse turbine operates between 10 bar and 5 bar with expansion efficiency of 95%. 10 kg of dry saturated steam per second enters into nozzle and leaves nozzle at angle of 20° to the axis of rotation of blades. The blade velocity coefficient is 0.90, blade speed is 200 m/s and internal losses due to disc friction and windage losses is 0.5 kJ/kg of steam. Consider that there is no axial thrust on the blades. Determine, Blade angles, Stage efficiency, Stage output in kW and prepare heat balance sheet. Also reason out the error if any by solving using velocity diagram. 10M

10 (a) A vapour-compression refrigeration system works with a reciprocating compressor which has a bore of 130 mm, stroke of 160 mm and a speed of 400 rev/min. The pressure in the evaporator is 1.6 bar and that in the condenser is 14 bar. The volumetric efficiency of the compressor is 80%. The system works on simple cycle with NH_3. Find the mass flow of refrigerant, the refrigerating effect and the power required to drive the compressor. 7M

(b) A cold storage is to be maintained at – 7°C while the surroundings are at 33°C. The heat leakage from the surroundings into the cold storage is estimated to be 30 kW. The actual C.O.P. of the refrigeration plant used is one third that of an ideal plant working between the same temperatures. Find the power required to drive the plant. 3M

OR

11 (a) An air-conditioning system is designed for industrial process for hot and wet summer conditions: Out-door conditions: 30 DBT and 70% R.H; Required conditions: 25 DBT and 70% R.H; Amount of free air circulated: 190 m^3/min; Coil dew-point temperature: 13°C. The required condition is achieved first by cooling and dehumidifying and then by heating. Find the cooling capacity of the cooling coil and its bypass factor. Also find the heating capacity of the heating coil in kW and surface temperature of the reheating coil if the by-pass factor is 0.2. 7M

(b) 28 kg of air at 25°C DBT and 60% R.H. is mixed with 6 kg of air at 5°C DBT and 30% R.H. Find the conditions of mixed air. 3M

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