Register Number:……………..

KUMARAGURU
college of technology
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B.E DEGREE EXAMINATIONS: NOV/DEC 2022	
(Regulation 2018)	
Third Semester	
AERONAUTICAL ENGINEERING	
U18AEI3202**:** Engineering Thermodynamics	

<u>COURSE OUTCOMES</u>

CO1:	Analyse open and closed systems using first law of thermodynamics.
CO2:	Apply the second law of thermodynamics for various engineering systems.
CO3:	Analyse Otto, Diesel, Dual and Bryton cycle under various operating conditions.
CO4:	**Calculate the stoichiometric air fuel ratio required for combustion.**

Time: Three Hours	**Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	A site evaluated for a wind farm is observed to have steady winds at a speed of 8.5 m/s. Determine the wind energy (a) per unit mass, (b) for a mass of 10 kg, and (c) for a flow rate of 1154 kg/s for air.	CO1	[K_3]
2.	A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of the fluid is 800 kJ. During the cooling process, the fluid loses 500 kJ of heat, and the paddle wheel does 100 kJ of work on the fluid. Determine the final internal energy of the fluid. Neglect the energy stored in the paddle wheel.	CO1	[K_3]
3.	Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the net power output and the thermal efficiency for this heat engine.	CO2	[K_3]
4.	The food compartment of a refrigerator is maintained at $4^{O}C$ by removing heat from it at a rate of 360 kJ/min. If the required power input to the refrigerator is 2 kW, determine (a) the coefficient of performance of the refrigerator and (b) the rate of heat rejection to the room that houses the refrigerator.	CO2	[K_3]
5.	The efficiency of an Otto cycle is 60% and $\gamma = 1.5$. What is the compression ratio?	CO3	[K_3]
6.	State the assumptions in air standard cycles.	CO3	[K_1]
7.	List out the properties of an ideal refrigerant.	CO2	[K_1]

8.	Differentiate between heat pump and refrigerator.			CO2	[K_1]
9.	What is meant by combustion triangle?			CO4	[K_1]
10.	Define stoichiometric air fuel ratio.			CO4	[K_1]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.	a)	Air at a temperature of 20°C passes through a heat exchanger at a velocity of 40 m/s where its temperature is raised to 850°C. It then enters a turbine with the same velocity of 40 m/s and expands until the temperature falls to 600°C. On leaving the turbine, the air is taken at a velocity of 65 m/s to a nozzle where it expands until the temperature has fallen to 450°C. If the air flow rate is 2 kg/s, calculate (a) The rate of heat transfer to the air in the heat exchanger (b) The power output from the turbine assuming no heat loss (c) Velocity at the exit from the nozzle assuming no heat loss. Take the enthalpy of air as h=CpT. where Cp=1.005 kJ/kgK.	12	CO1	[K_4]
	b)	Derive the work done equation for isothermal process.	04	CO1	[K_3]
12.	a)	A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40^{O}C and -20^{O}C .The heat transfer to the engine is 2000 kJ and the network output the combined engine refrigerator plant 360 kJ. (a)Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40^{O}C. (b) Reconsider (a) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible values.	12	CO1	[K_4]
	b)	Differentiate between reversible and irreversible process.	04	CO2	[K_3]
13.		The minimum pressure and temperature in an Otto cycle are 100 kPa and 27°C. The amount of heat added to the air per cycle is 1500 kJ/kg.(i) Determine the pressures and temperatures at all points of the air standard Otto cycle. (ii) Also calculate the specific work and thermal efficiency of the cycle for a compression ratio of 8 : 1.Take for air : Cv = 0.72 kJ/kg K, and γ = 1.4.	16	CO3	[K_4]

14.	a)	With the help of a neat sketch, explain the working of a simple vapour compression refrigeration system.	08	CO2	[K_2]
	b)	Show the Brayton cycle on P-V and T-S diagrams, explain the thermodynamic process. Derive expressions for the efficiency.	08	CO3	[K_3]
15.		The gasoline C_8H_{18} is burnt with dry air. The volumetric analysis of products on dry basis CO_2=10.02%, O_2=5.62%, CO=0.88% and N_2=83.38%, Determine a) A/F ratio b) Equivalence ratio and c) % of stoichiometric air used.	16	CO4	[K_4]
16.	a)	A gas flows steadily through a rotary compressor. The gas enters the compressor at a temperature of 16°C, a pressure of 100 kPa, and an enthalpy of 391.2 kJ/kg. The gas leaves the compressor at a temperature of 245°C, a pressure of 0.6 MPa, and an enthalpy of 534.5 kJ/kg. There is no heat transfer to or from the gas as it flows through the compressor. (a) Evaluate the external work done per unit mass of gas assuming the gas velocities at entry and exit to be negligible. (b) Evaluate the external work done per unit mass of gas when the gas velocity at entry is 80 m/s and that at exit is 160 m/s.	08	CO1	[K_4]
	b)	Derive an expression of steady state steady flow energy equation (SSSFEE) and mentions its applications.	08	CO4	[K_3]

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