KUMARAGURU
college of technology
character is life

B.E DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

Third Semester

AERONAUTICAL ENGINEERING

U18AEI3202**:** Engineering Thermodynamics

(Use of approved refrigeration tables, gas chart is permitted)

COURSE OUTCOMES

CO1:   Analyze open and closed systems using first law of thermodynamics.

CO2:   Apply the second law of thermodynamics for various engineering systems.

CO3:   Analyze Otto, Diesel, Dual and Brayton cycle for various operating conditions.

CO4:   Calculate the stoichiometric air fuel ratio required for combustion.

CO5:   Conduct experiments on various thermodynamic systems.

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

Answer all the Questions: -

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

1.	Differentiate between open and closed system.	CO1	[K_2]
2.	State three modes of heat transfer.	CO1	[K_1]
3.	State Clausius and Kelvin-Planck statement of second law of thermodynamics.	CO2	[K_2]
4.	Define entropy with examples.	CO2	[K_2]
5.	Draw the P-V and T-S diagram of otto cycle and indicate the various processes.	CO3	[K_2]
6.	Define cut-off ratio.	CO3	[K_2]
7.	Name the different types of gas refrigeration cycles.	CO4	[K_2]
8.	Define air- conditioning.	CO4	[K_2]
9.	Define stoichiometric air-fuel ratio.	CO5	[K_2]
10.	Name the different types of exhaust gas analyser.	CO5	[K_2]

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

11. a) Derive an expression for work done of the quasi- static process pv^n = constant.   6   CO1   [K$_2$]

    b) A turbine operates under steady flow conditions, receiving steam at the following. State: Pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine. at the following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29. kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?   10   CO1   [K$_3$]

12. a) A mass of 8 kg gas expands within a flexible container so that the p–$r$elationship is of the from $pv^{1.2}$ = constant. The initial pressure is 1000 kPa and the initial volume is 1 m^3. The final pressure is 5 kPa. If specific internal energy of the gas decreases by 40 kJ/kg, find the heat transfer in magnitude and direction   6   CO1   [K$_3$]

    b) Derive an expression for Steady Flow Energy Equation along with assumptions made.   10   CO1   [K$_3$]

13. a) Derive an expression for thermal efficiency of Carnot cycle with the help of P-V and T-S diagram.   6   CO2   [K$_2$]

    b) Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200 kJ at a temperature of 421°C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4°C. If the work output of A is twice that of B, find.
(a) The intermediate temperature between A and B
(b) The efficiency of each engine
(c) The heat rejected to the cold sink   10   CO2   [K$_3$]

14. a) Derive an expression for thermal efficiency of actual brayton cycle with the help of T-S diagram.   6   CO3   [K$_3$]

    b) An engine of 250 mm bore, and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50ºC, If the maximum pressure is limited to 25 bar, Calculate (i) The air standard efficiency of the cycle. (ii) The mean effective pressure for the cycle.   10   CO3   [K$_3$]

15. a) An oil fuel is composed of 85% carbon, 12% hydrogen, 2% oxygen and 9% incombustible solid matter if air supply is 50% more than the theoretical amount for perfect combustion. Find the mass of each product of combustion per kg of fuel burned and percentage mass and analysis of the flue gases.   10   CO5   [K$_3$]

    b) Discuss (i) Enthalpy of formation (ii) Adiabatic flame temperature.   6   CO5   [K$_2$]

16. a) Explain the construction and working principle of vapor compression refrigeration system with neat sketch.   10   CO4   [K$_2$]

    b) Discuss briefly the working of air-conditioning system.   6   CO4   [K$_2$]

****