



CBCS SCHEME

15AU33

Third Semester B.E. Degree Examination, July/August 2021 Engineering Thermodynamics

Time: 3 hrs.

Max. Marks:80

Note: Answer any FIVE full questions.

- 1 a. Define the following terms, with respect to thermodynamic :
i) Open system ii) Closed system iii) Isolated system iv) Quasi static process. (08 Marks)
b. State and explain zeroth law of thermodynamics. (04 Marks)
c. A temperature 'T' on a thermometric scale is defined in terms of property 'P' by relation $T = a \log_e P + b$ where 'a' and 'b' are constants. The temperature at ice point and steam point are 0°C and 100°C respectively. Instrument gives values of P as 1.86 and 6.81 at ice point and steam point respectively. Evaluate temperature corresponding to reading of $P=2.5$. (04 Marks)
- 2 a. Derive an expression for work done during quasi static process and explain its significance with the help of P-V diagram. (04 Marks)
b. Write thermodynamic definitions of work and heat. Also write similarities between them. (04 Marks)
c. A gas has an initial volume of 0.4m^3 and expands to a final volume of 0.2m^3 . The initial pressure at the gas is 0.1MPa. Find the work done if the gas is held at a constant temperature of 300K and the pressure between the initial and final states of the system,
i) constant ii) inversely proportional to volume. (08 Marks)
- 3 a. Represent schematically heat engine, heat pump and refrigerator. Give their performance. (08 Marks)
b. A nozzle is a device for increasing the velocity of a steadily flowing steam. At the inlet to a certain nozzle. The enthalpy of the fluid passing is 3000kJ/kg and velocity is 60m/s. At the discharge and the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there negligible heat loss from it.
i) Find the velocity at the exit section of the nozzle
ii) If the inlet area is 0.1m^2 and specific volume at inlet is $0.187\text{m}^3/\text{kg}$, find the mass flow rate.
iii) If the specific volume at the nozzle exit is $0.498\text{m}^3/\text{kg}$, find diameter at the exit section of the nozzle. (08 Marks)
- 4 a. Prove that entropy is a property of a system. (06 Marks)
b. Write Kelvin plank and Clausius statement. (04 Marks)
c. A heat engine working on Carnot cycle converts $\frac{1}{5}$ of the heat i/p into work when the temperature of the sink is reduced by 80°C . The efficiency gets doubled. Calculate for the temperature of source and sink. (06 Marks)
- 5 a. Define the followings :
i) Stoichiometric air ii) Enthalpy of combustion iii) Air Fuel ratio (A/F). (04 Marks)
b. With neat sketch explain the analysis of fuel gasses by Orsat apparatus. (08 Marks)
c. An air standard diesel cycle has a compression ratio of 18 and the heat transferred to the working fluid per cycle is 2000kJ/kg. At the beginning of the compression stroke. The pressure is 1 bar and the temperature is 300K calculate the thermal efficiency. (04 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg. $42+8=50$, will be treated as malpractice.

- 6 a. Define the following terms with respect to IC engine and write the formula :
- Brake power
 - Indicated power
 - Friction power
 - Specific fuel consumption
 - Mechanical efficiency
 - Heat balance sheet. (08 Marks)
- b. Explain the Morse test method of determining the indicated power and hence the frictional power of IC engine. (04 Marks)
- c. A single cylinder four stroke gasoline engine is to operate at 400rpm and deliver 75KW. Determine : i) the bore and stroke ii) indicated power and BMEP = 8.4bar, $\eta_{\text{mech}} = 80\%$
 $\frac{l}{d} = 1.5$. (04 Marks)
- 7 a. Explain steam jet refrigeration system with a neat sketch, write its draw back. (08 Marks)
- b. Write desirable properties of a good refrigerant. (04 Marks)
- c. 2KW per ton of refrigeration is required to maintain the temperature of (-40°C) in the refrigerator. IF the refrigerator works on Carnot cycle determine :
 COP of the cycle
 Temperature of the sink
 Heat rejected in the sink per ton of refrigeration
 Heat supplied. (04 Marks)
- 8 a. With a neat sketch, describe the winter air conditioning system. (08 Marks)
- b. Air at 30°C DBT and 25°C WBT is heated to 40°C . If the air is $300\text{m}^3/\text{min}$. Find the amount of heat added/min and RH and WBT of air. Take air pressure to be 1bar. (08 Marks)
- 9 a. Derive the expression for work done in a single stage compressor neglecting clearance volume. For the polytrophic and isothermal compression. (08 Marks)
- b. A single stage acting air compressor 30cm bore and 40cm stroke is running at a speed of 100RPM. It takes in air at 1bar and 20°C and compresses it to a pressure of 5 bar. Find the power required to drive it when the compression i) Isothermal ii) $PV^{1.2} = c$ and neglecting clearance and draw PV diagram. (08 Marks)
- 10 a. Explain turbo jet with the help of a neat sketch. Write its advantages and disadvantages. (08 Marks)
- b. Explain open and closed cycle gas turbines with a neat sketch. (04 Marks)
- c. In a simple gas turbine plant air is compressed from 1bar and 25°C through a pressure ration of 4 : 1. It is then heated by 150°C in a combustion chamber and expanded back to atmospheric pressure of 1bar in the turbine calculate the cycle efficiency and turbine outlet temperature. (04 Marks)

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