## SET 8em-III / MECH/ Thermodynamics / May 14

QP Code: NP-18643

	(3 Hours)	tal Marks:	80
	N. B.: (1) Question No. 1 is compulsory.		
	(2) Solve any three questions from remaining five questions.		
	(3) Assume suitable data if required.		
	(4) Use of Mollier Chart, Steam table is permitted.		
1.	(a) What is cut-off ratio? How does it affect the thermal efficiency of Dies	sel cycle?	4
	(b) State the Clausius-Clapeyron equation.		4
	(c) I kg of steam at a pressure of 17 bar and dryness 0. 95 is heated at a pressure until it is completely dry. Determine: (i) Increase in volume (ii) of heat added.		4
	(d) Differentiate between non-flow and flow process. What is steady flow	process?	1
	(e) Define adiabatic flame temperature and explain its practical significan	_	4
			7
2.	(a) Derive Maxwell's equations.		4
	(b) Show that the efficiency of all reversible heat engines operating between	the same	8
	temperature limits is same.		
	(c) 0.06 m <sup>3</sup> air at 5 bar and 200°C expands isentropically until the pressure	becomes	8
	2 bar. It is then heated at constant pressure until the enthalpy increase d process is 80 KJ. Calculate work done in each process and total work		
3.	(a) What are the four processes which constitute the Stirling cycle? Show	v that the	6
	regenerative Stirling cycle has same efficiency as the Carnot cycle.		
	(b) An engine with 30% efficiency drives a refrigerator having COP of 5		6
	the heat input into the engine if 10 MJ of heat is removed from the o	17.7	
	by the refrigerator? Find total quantity of heat rejected to the surroun		
	(c) The products of combustion of an unknown hydrocarbon C <sub>x</sub> H <sub>y</sub> have the	following	8
	composition as measured by an Orsat apparatus:		
	$CO_2 = 8.0\%$ , $CO = 0.9\%$ $O_2 = 8.8\%$ and $N_2 = 82.3\%$		
	Determine: (i) The composition of the fuel.		
	(ii) The air-fuel ratio.	9	
	(iii) The percentage excess air used.	*	
1	(a) Define (i) Deminage function		
4.	(a) Define: (i) Dryness fraction (ii) Critical point		4
	(iii) Critical point		
	(iii) Triple point (iv) Degree of superheat		,
	(b) 0.6 m <sup>3</sup> of air at 37°C and I bar is heated at constant volume until the	nressure	_
	becomes 2 bar. It is then cooled at constant pressure to its original ten		6

Calculate the change of entropy in each process.

- In an air standard cycle pressure at the beginning of compression is I bar, while temperature is 310 K. Compression ratio is 10:1, Heat added is 2800 KJ/Kg of charge. The maximum pressure limit is 70 bar. If heat is added partially at constant volume and partially at constant pressure, find:

  - (i) Air standard efficiency (ii) Mean effective pressure.
- Explain: (i) Enthalpy of reaction (ii) Enthalpy of formation (iii) Heating value.

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- How much of the 1200 KJ of thermal energy at 700 K can be converted to useful work if the environment is at 25°C
- A turbocompressor delivers 2.33 m<sup>3</sup>/s of air at 0.276 MPa, 43°C which is heated at this pressure to 430°C and finally expanded in a turbine which delivers 860 kW. During expansion there is a heat transfer of 0.09 MJ/s to the surroundings. Calculate the turbine exhaust temperture if changes in kinetic and potential energy are negligible.
- Derive an expression for availability of a non flow process. 6.

- In a reheat cycle steam at 500°C expands in H.P. turbine till it is saturated vapour. It is reheated at constant pressure to 400°C and then expands in L. P. turbine to 40°C.If the maximum moisture content is limited to 15% at the turbine exhaust, find
  - (i) Reheat pressure.
  - (ii) The pressure of steam at inlet to H.P. turbine.
  - (iii) Net specific work output.
  - (iv) Cycle efficiency.
  - (v) Steam rate.