

INTERNATIONAL CENTRE FOR APPLIED SCIENCES MAHE, MANIPAL B.Sc. (Applied Sciences) in Engg. End – Semester Theory Examinations – Nov./ Dec. 2020 III SEMESTER - THERMAL ENGINEERING (IME 231) (Branch: Mechanical)

Time: 3 Hours		Date: 19 November 2020	Max. Marks: 50	1	
✓ ✓ ✓	 ✓ Answer ALL the questions. ✓ Missing data, if any, may be suitably assumed ✓ Use of the thermodynamics data hand book and steam tables permitted. 				
1A)	Write steady flow ener	gy equation and simplify that for (a)Bo	iler (b) Turbine	(03)	
1B)	Write a note on (a) Per	petual motion machine (b) Quasi-static	process.	(03)	
1C)	Fluid is placed in a confined cylinder obey the relation $p = a + bV$. Internal energy of the fluid is given by U = 58 +3.15 pV, Where U (internal energy) in kJ, p (pressure) in kPa and V (volume) in terms of m ³ . If the pressure and volume changes from 170kPa, 0.03 m ³ to 400 kPa, 0.06 m ³ . Assume that only spring loaded piston work on the fluid. Find the magnitude and direction of heat and work transfer.		(04)		
2A)	Derive the equation fo	r a critical radius of insulation for a cyli	ndrical pipe.	(03)	

- 2B) Explain in detail why the Carnot cycle is not practical and what are the differences (03) between Rankine cycle and Carnot cycle.
- 2C) A spherical balloon has an initial diameter of 25 cm and contain air at 1.2 bar. Because (04) of heating, the diameter of the balloon increases to 30 cm, and during the heating process the pressure is found to be proportional to the diameter. Calculate the work done during the process.
- 3A) Explain a simple vapor compression refrigeration cycle using flow diagram and P-h (03) diagram.
- 3B) List the methods of increasing the thermal efficiency of a Rankine cycle and explain (03) any two of them.
- 3C) In a steam turbine steam at 20 bar, 360°C is expanded to 0.08 bar. It then enters a (04) condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes, find per kg of steam the network and the cycle efficiency.

- 4A) Define with respect to IC engine (i) Mean effective pressure (ii) Specific Fuel (03) Consumption (iii) Volumetric efficiency
- 4B) Derive an expression for air standard efficiency of a Diesel cycle in terms of (03) compression ratio, cutoff ratio and specific heat ratio.
- 4C) An air refrigeration open system operating between 1 MPa and 100 kPa is required (04) to produce a cooling effect of 2000 kJ/min. Temperature of the air leaving the cold Chamber is 5°C and at leaving the cooler is 30°C. Neglect losses and clearance in the compressor and expander. Determine : (i) Mass of air circulated per min ; (ii)Compressor work, expander work, cycle work; (iii)COP and power in kW required.
- 5A) Define the Second law of thermodynamics and differentiate between Heat pump, Heat (03) engine and refrigerator.
- **5B**) With a neat schematic and P-V diagram explain the effect of intercooling on the (03) performance of a multi–stage compression.
- **5C**) (a) State the first law of thermodynamics for open and closed system (04)
 - (b) A system undergoes the process listed in the Table, compute the missing values.

Process	Q (kJ)	W (kJ)	$\Delta E (kJ)$
1-2		200	100
2-3		-50	
3-1	100		-200
