Reg. No.										

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
MAHE, MANIPAL

B.Sc. (Applied Sciences) in Engg.

End – Semester Theory Examinations – NOV 2021

III SEMESTER - THERMAL ENGINEERING (IME 231)

Time: 3 Hours **Date: 19 NOV 2021** **Max. Marks: 50**

- ✓ **Answer ALL questions.**
- ✓ **Missing data, if any, may be suitably assumed.**
- ✓ **Use of Steam tables is permitted**

1.A In a Bell-Coleman refrigerating plant air is drawn into cylinder of compressor at atmospheric pressure of 1 bar and temperature -7^0C and it is compressed adiabatically to 5.5 bar at which it is cooled to 18^0C. It is then expanded in an expansion cylinder to atmospheric pressure and discharged into the refrigerating chamber. Find the COP of the plant if (a) the expansion is adiabatic; (b) the expansion follows the law $pv^{1.25}$=constant. Draw the pv diagrams as applicable. **05**

1.B State the first law of thermodynamics. For a Polytropic process derive the relation between (a) V and T (b) p and T **05**

2.A Two reversible heat engines A and B are arranged in series. A rejects heat directly to B. Engine A receives 200 kJ at a temperature of 421^0C from the hot source while engine B is in communication with a cold sink at a temperature of 5^0C. If the work output of A is twice that of B, find intermediate temperature between A and B, efficiency of each engine and heat rejected to the sink. **05**

2.B Define heat and work. Derive the equation for work transfer for a hyperbolic expansion process. **05**

3.A A two stage double acting air compressor, operating at 200 rpm takes in air at 1.013 bar and 27^0C. The size of the LP cylinder is 350 x 380 mm, the stroke of HP cylinder is same as that of LP cylinder and the clearance of both the cylinders is 4%. The LP cylinder discharges the air at a pressure of 4.052 bar. The air passes through the inter cooler so that it enters HP cylinder at 27^0C and 3.85 bar, finally it is discharged from the compressor at 15.4 bar. The value of n in both the cylinders is 1.3. C_p=1.0035 kJ/kg-K and R=0.287 kJ/kg-K. Calculate- **05**

a. The heat rejected in the inter-cooler
b. The diameter of HP cylinder

3.B Answer the following: **05**

a. State Zeroth law of thermodynamics,
b. Write Clausius statement of second law of thermodynamics
c. Write the statement of Third law of thermodynamics
d. Reversible process
e. What is microscopic approach in thermodynamics

4.A A four stroke, single cylinder oil engine, operating on the Diesel cycle and running at 480 rev/min has a piston diameter of 25 cm, a stroke of 40 cm and a clearance volume of 1560 cc. Fuel oil is injected during first $1/12^{th}$ of the expansion stroke. If the pressure and temperature at the beginning of compression are 1 bar and 47^0C, find the ideal indicated power and the thermal efficiency. Neglect the increase in mass of the charge due to oil injection. **05**

4.B A 4-cylinder, 4-stroke Diesel engine runs at 1000 rpm. The bore and stroke of each cylinder are 100 mm and 160 mm respectively. The cut-off is 6.67% of the stroke. Assuming the initial condition of air inside the cylinder are 1 bar and 20^0C and mechanical efficiency of 75%. Calculate the air-standard efficiency and brake power developed by the engine. Also, compute the brake specific fuel consumption if the air/fuel ratio is 20:1. Take R for air as 0.287 kJ/kg-K and clearance volume as 84 cc. **05**

5.A Define heat transfer. What are the modes of heat transfer? Explain in brief. **05**

Water flows inside a tube 45 mm in diameter and 3.2 m long at a velocity of 0.78 m/s. Determine the heat transfer co-efficient and the rate of heat transfer if the mean water temperature is 50^0C and the wall is isothermal at 70^0C. For water at 50^0C take k=0.66 W/m-K, $\upsilon = 0.478 \times 10^{-6}$ m^2/s and Prandtl number=2.98.

5.B A power generating plant uses steam as a working fluid and operates at a boiler pressure of 50 bar, dry saturated and a condenser pressure of 0.05 bar. Calculate for these limits (a) the cycle efficiency and (b) the work ratio and specific steam consumption for (i) Carnot cycle and (ii) Rankine cycle taking pump work into account. Draw Ts diagrams. **05**

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