Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES (MAHE)

III SEMESTER B.Sc. (Applied Sciences) MAKE -UP EXAMINATION – January 2022

SUBJECT: THERMAL ENGINEERING (IME 231)

(BRANCH: MECHANICAL)

Timing: 3 hours **Date: 08th January 2022** **Max. Marks: 50**

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

1.A An air refrigerator working on Bell-Coleman cycle takes air from cold chamber at 1 bar and -5^{0}C and compresses to 6 bar following the law $pv^{1.25}$=C. The compressed air is cooled to 37^{0}C in the cooler before entering into the expander. The expansion is isentropic. Determine (a) COP of the cycle (b) Mass of air circulated per minute if 500 kg of ice is produced per day at 0^{0}C when water is supplied at 20^{0}C and (c) Refrigeration capacity of the plant in tons. Neglect the clearances in compressor and expander. **05**

Take gamma(Ɣ)=1.4 and C_p= 1 kJ/kg-K for air, latent heat of ice= 335 kJ/kg and C_p (water)= 4.1868 kJ/kg-K

1.B What is PMM-I? explain. Drive the SFEE for an open system **05**

2.A A reversible HE operates between a source temperature of 1000 K and a sink temperature of 300 K. The engine drives a reversible refrigerator which operates between 300 K and 250 K. The heat transfer to the engine is 1000 kW and the net work output of the engine refrigerator plant is 200 kW. Determine the cooling effect produced by the refrigerant and the net heat transfer to the reservoir at 300 K. Also determine these values by assuming the engine efficiency to be 50% of ideal efficiency and COP of the refrigerator to be 50% of ideal COP. **05**

2.B What is Quasi static process? Derive the equation for work transfer for an adiabatic expansion process undergoing Quasi static process. **05**

3.A A single acting two stage compressor with complete inter cooling delivers 5 kg/min of air at 15 bar pressure. Assuming an intake state of 1 bar and 15^{0}C and that the compression and expansion processes are polytropic with n=1.3, calculate the power required and the isothermal efficiency if the speed is 420 rpm. Assuming the clearance volumes of LP and HP cylinders to be 5% and 6% of the respective cylinder swept volumes, calculate swept and clearance volumes for cylinders. **05**

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

a. What is PMM II
b. Define: Isentropic process
c. Define: Specific heat at constant pressure
d. What is macroscopic approach in thermodynamics
e. Write the Clausius statement of second law of thermodynamics

4.A An engine operating on Diesel cycle has the pressure and volume at the beginning of compression= 100 KPa and 0.03 m^3, pressure after Isentropic compression= 4.2 MPa, pressure after Isentropic expansion= 200 KPa. Determine: compression ratio, cut-off ratio, expansion ratio, cycle work, cycle efficiency and mep, take gamma (Y)=1.4, C_v=0.718 kJ/kg-K **05**

4.B A 4-cylinder, 4-stroke SI engine is designed to develop 44 kW IP at a speed of 3000 rpm. The compression ratio used is 6. The law of compression and expansion is $pv^{1.3}$ = constant and heat addition and rejection takes place at constant volume. The pressure and temperature at the beginning of compression stroke are 1 bar and 50^0C. The maximum pressure of the cycle is limited to 30 bar. Calculate the diameter and stroke of each cylinder assuming all cylinders have equal dimensions. Take diagram factor as 0.8 (Actual imep=0.8 x theoretical imep) and L/d=1.5 **05**

5.A Define heat transfer. What are the modes of heat transfer? Explain with related equations. **05**

The inner surface of a plane brick wall is at 60^0C and the outer surface is at 35^0C. Calculate the rate of heat transfer per m^2 of surface area of the wall, which is 220 mm thick. The thermal conductivity of the brick is 0.51 W/m ^{0}C

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**