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***B.Tech. Degree IV Semester Examination in Marine Engineering
May 2018***

**MRE 1402 THERMODYNAMICS AND HEAT TRANSFER
(2013 Scheme)**

Time: 3 Hours

Maximum Marks: 100

(5 × 20 = 100)

- I. (a) Explain the two statements of second law of thermodynamics using block diagram. (8)
- (b) Write notes on: (12)
- (i) Entropy (ii) Availability (iii) Reversibility.

OR

- II. (a) Define fuel and explain combustion. What are combustion equations? (8)
- (b) Show that the percentage of carbon dioxide in gas can never exceed 21% by volume. (12)

- III. (a) Describe the carnot cycle, illustrating your answer with pv diagram. (8)
- (b) Dry saturated steam at 7 bar is supplied to a single cylinder double acting non condensing steam engine at the rate of 2 kg/min. The exhaust pressure is 1.4 bar. Determine the relative efficiency when the engine is developing 3.75 W. (12)

OR

- IV. (a) Write notes on "Flow of steam through nozzle". (8)
- (b) Briefly describe (i) Lubrication of turbines. (12)
- (ii) Condition for maximum energy transfer in impulse turbines.

- V. (a) How do compressed air motors work? (8)
- (b) A single stage air compressor is required to compress 1.2 m³ of air per minute from 1 bar and 15°C to 8 bar. Determine the temperature at the end of compression, I.P. and heat rejected if compression follows the following processes (i) Isothermal (ii) Adiabatic. (12)

OR

- VI. (a) Draw p.v diagram from two stage compressor with perfect inter cooling and explain. (8)
- (b) A two cylinder single acting air compressor is to deliver 15 kg of air per minute at 6.5 bar. The pressure and temperature of air at the suction condition are 1 bar and 13° C. The clearance is 4% of stroke volume. The compressor is directly coupled to a petrol engine running at 1800 rpm. Assuming L = 1.1 d for compressor cylinder mechanical efficiency 85% determine the capacity of petrol engine required. The compression and re-expansion follow the law $pv^{1.3} = C$. (12)

(P.T.O.)

- VII. (a) Explain Fourier's law of heat conduction. (8)
 (b) Write notes on: (12)
 (i) Heat transfer from fluids to fluids through walls.
 (ii) Thermal conductivity of insulating materials cylindrical surfaces in series.

OR

- VIII. (a) Explain Stephan-Boltman's equation in radiation. (8)
 (b) Liquid oxygen is stored in a spherical insulated vessel, 2 m internal diameter, well lagged on the outside. What thickness of magnesia lagging ($k = 0.07 \text{ w/m} \cdot ^\circ\text{C}$) must be used so that more than 1% of liquid O_2 should not be evaporated during a journey of 3 hours if the vessel is initially 80% full? (12)
- IX. (a) Write notes on prediction of convection heat transfer rates. (8)
 (b) A single pass surface condenser is used to condense F_{12} in a refrigeration system by using water available at 15°C . The quantity of F_{12} condensed per minute is 20 kg. Using the following data, find the number of tubes each 120 cm long required in the condenser. (12)

Heat removed per kg of F_{12}	= 280 kJ/kg
F_{12} side heat transfer coefficient	= $550 \text{ w/m}^2 \cdot ^\circ\text{C}$
Water side heat transfer coefficient	= $1250 \text{ w/m}^2 \cdot ^\circ\text{C}$
Outside diameter of tube	= 12 mm
Inside diameter of tube	= 10 mm
Rate of water circulation	= 100 kg/minute
Temperature of F_{12} entering the condenser	= 50°C
Quality of F_{12} entering the condenser	= dry saturated

Neglect the losses in the system.

OR

- X. (a) Write notes on application of heat transfer in marine field. Specify any two devices on board. (8)
 (b) Explain the significance of: (12)
 (i) Prandtl Number.
 (ii) Nusselt Number.
 (iii) Reynolds Number.
