

1102, 1104

M.Tech

INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

December 2017 End Semester Examinations
M.Tech. (Marine Engineering and Management)
First Semester

Applied Thermodynamics & Turbo-machinery (PG13T1101)

Time: 3 Hrs

Date: 04.12.2017

Maximum Marks: 100

Pass Marks : 40

Answer any **FIVE** questions. All questions carry equal marks.

Use of steam tables and Mollier diagram is permitted.

(5 x 20 = 100 Marks)

1. (a) In an oil-gas installation, it is taken at pressure of 1 bar and 27°C and compressed to a pressure of 4 bar. The oil with a calorific value of 42000 kJ/kg is burnt in the combustion chamber to raise the temperature of air to 550°C. If the air flows at the rate of 1.2 kg/s, find the net power of the installation. Also, find air-fuel ratio. Take $C_p = 1.05$ kJ/kg K. 10 M

(b) Differentiate between open and closed cycle gas turbine plants. 5M

(c) Differentiate between impulse and reaction turbines. 5M

[10+5+5=20]

2. (a) In a reheating cycle thermal plant, steam at a pressure of 15 MPa and temperature of 823 K is expanded in a steam turbine in first stage up to 40bar and reheated to its original temperature before expanding to the condenser pressure of 0.1bar. Find the condition of steam after expansion, the efficiency of the cycle and rate of steam per unit kWh. 12 M

(b) Explain the working of Rankine cycle regeneration with schematic and T-s diagrams. 8 M

[12+8=20]

3. (a) What are the advantages of internal combustion engine over the external combustion engines? 5M

(b) Differentiate between Two stroke and Four stroke engines. 7M

(c) A petrol engine uses 0.27 kg of fuel per B.P hr. Calorific value of fuel = 44000 kJ/kg. Mechanical efficiency is 0.8. Compression ratio is 5.6. Find brake thermal efficiency, indicated thermal efficiency, air standard efficiency, and relative efficiency. 8 M

[5+7+8=20]

4.(a) Obtain the expression for minimum work in a two stage compressor with perfect intercooling. 8 M

(b) In the testing of a single cylinder four stroke oil engine, fitted with a rope brake, the readings taken are: Effective diameter of brake wheel: 600 mm, Dead load on brake = 220 N, Spring balance reading = 40N, Speed = 500 rpm, Area of indicator diagram = 400 mm², Length of the indicator diagram = 60 mm, Spring scale = 1. 2 bar/mm, Dia of the cylinder = 120 mm, Stroke = 160 mm, Quantity of oil used = 0.75 kg/h, Calorific value of oil = 43000 kJ/kg.

Calculate B.P, I.P, Mechanical Efficiency, Brake Thermal efficiency and brake specific fuel consumption. 12 M

[8+12=20]

5. (a) Explain the working of a refrigeration system with a schematic diagram. Also, draw p-v and T-s diagrams. 6 M

(b) Describe the working of a nuclear power plant with a schematic diagram. 6 M

(c) Draw the schematic and T-s diagrams of a binary vapour cycle and explain its working. 8 M

[6+6+8=20]

6. (a) A compressor, draws in 42.5 m³ of air per minute into the cylinder at a pressure of 1.05 bar. It is compressed polytropically ($pv^{1.3} = \text{const}$) to a pressure of 4.2 bar before being delivered to a receiver. Assuming mechanical efficiency of 80%, find Indicated power, shaft power, and overall isothermal efficiency. 8 M

(b) Write short notes on thermodynamic availability and irreversibility. 6 M

(c) Name various types of power plants and compare their efficiencies on an x-y plot. 6M

[8+6+6=20]

7. (a) A gas turbine plant constitutes of two stage compressor with perfect intercooler and a single stage turbine. If the plant works between the temperature limits of 300 K and 1000 K and 1 bar and 16 bar, find the net power of the plant per kg of air. Take $C_p = 1 \text{ kJ/kg.K}$. 8 M

(b) Draw velocity triangles in an axial flow gas turbine stage. 6 M

(c) What are the applications of steam turbines in marine field? 6M

[8+6+6=20]

8. (a) Explain various types of turbines used in power generation and ship propulsion. 8 M

(b) Define the variables affecting IC engine efficiency. 6M

(c) Describe the working of a Compression Ignition engine. 6M

[8+6+6=20]
