

**INDIAN MARITIME UNIVERSITY**  
(A Central University, Government of India)

M.Tech. (Marine Engineering and Management)  
May 2018 End Semester Examinations

Semester I

**Applied Thermodynamics & Turbo-Machinery (PG13T1101)**

**Date: 28-05-2018**

**Time: 3 Hrs**

**Maximum Marks : 100**

**Pass Marks: 50**

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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 a gas turbine plant, air is compressed in a single stage compressor from 1 bar and 15°C to 5 bar and heated to a temperature of 800°C in the heating chamber. The hot air expands in a turbine back to 1 bar. Find the power developed per kg of air supplied per second. Cp of air as 1 kJ/kg K. 8M

- (b) What are the differences between open and closed cycle gas turbine plants? 6M

- (c) Compare gas turbines with IC engines. 6M

[8+6+6=20]

2. (a) In a steam station, the following cycle is used:

steam at boiler outlet – 150 bar, 550°C,

reheating at 40bar to 550°C,

condenser at a pressure of 0.1bar.

Find the condition of steam after expansion, the efficiency of the cycle and rate of steam. 12M

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

[12+8=20]

3. (a) Compare petrol and diesel engines. 6M
- (b) Draw the valve timing diagram for 4-s petrol engine. 6M
- (c) In case of a spark ignition engine that uses 0.2 kg of fuel per B.P hr with 42000 kJ/kg CV and mechanical efficiency of 0.85 with compression ratio 6.5, identify brake and indicated thermal efficiencies. Also find relative efficiency as well as air standard efficiency.  $\gamma = 1.4$ . 8M

[6+6+8=20]

- 4.(a) Write short notes on turbocharging engines. 6M
- (b) What is naturally aspirated engine? 4M
- (c) During the test on single cylinder oil engine, working on the four stroke cycle and fitted with a rope brake, the following readings are taken:

Effective diameter of brake wheel: 630 mm, Dead load on brake = 220 N, Spring balance reading = 30N, Speed = 450 rpm, Area of indicator diagram = 420 mm<sup>2</sup>, Length of the indicator diagram = 60 mm, Spring scale = 1.1 bar/mm, Diameter of the cylinder = 100 mm, Stroke = 150 mm, Quantity of oil used = 0.815 kg/h, Calorific value of oil = 42000 kJ/kg.

Calculate Brake Power, Indicated Power, Mechanical Efficiency, Brake Thermal efficiency and brake specific fuel consumption. 10M

[6+4+10=20]

5. With a schematic diagram, explain the working of
- (a) simple refrigeration plant. 6M
- (b) nuclear power plant. 6M
- (c) combined binary vapour cycle. 8M

[6+6+8=20]

6. (a) Find the expression for minimum work in a two stage reciprocating air compressor. 8M

- (b) List various power generation systems and compare their efficiencies. 6M  
(c) What are the applications of steam turbines in marine field? 6M

[8+6+6=20]

7. (a) A closed cycle gas turbine consists of a two stage compressor with perfect intercooling and a two stage, with a reheater. All the components are mounted on the same shaft. The pressure and temperature at the inlet of the low pressure compressor are 2 bar and 300 K. The maximum pressure and temperature are limited to 8 bar and 1000 K. The gases are heated in the reheater to 1000 K. Calculate mass of fluid circulated in the turbine, if the net power developed by the turbine is 370 kW. Also find the amount of heat supplied per second from the external source. 12M

- (b) Draw velocity triangles in an axial flow compressor stage. 8M

[12+8=20]

8. (a) Derive the expression for gas turbine cycle efficiency. 8M  
(b) What are the different I.C engine efficiencies possible? 6M  
(c) Describe the working of a spark ignition engine. 6M

[8+6+6=20]

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