INDIAN MARITIME UNIVERSITY

(A CENTRAL UNIVERSITY, GOVT. OF INDIA)

SEMESTER- II, B.TECH. (MARINE ENGINEERING) – JUNE 2014 EXAMS

APPLIED THERMODYNAMICS - I (T 2203)

(AY 2013-14 batch onwards)

Time:- 3 Hrs **Max Marks : 100**
Date: 23.06.2014 **Pass Marks : 50**

PART - A **(3 X10 = 30 Marks)**
Compulsory Questions

1. a) State Kelvin-Planck statement of second law of Thermodynamics. (3)

b) What is Entropy? Write down the unit of Entropy in SI system. (3)

c) Draw the h-s diagram for the Rankine cycle with superheated steam. (3)

d) What is Mean Effective Pressure (MEP) of a Steam Engine? Write the expression of (MEP) for a steam Engine with clearance volume. (3)

e) What is volumetric efficiency and clearance ratio of a reciprocating compressor? (3)

f) What is meant by free air delivered? (3)

g) Define Indicated power of s steam Engine. (3)

h) What is multistaging of a compressor? Explain the function of high pressure (HP) cylinder, intercooler, low pressure (LP) cylinder in multistaging. (3)

i) What are theoretical and actual indicator diagram? (3)

j) Explain relative humidity. (3)

PART - B **(5 X14 = 70 Marks)**
Answer Any Five of the following

2. a) Draw the P-V diagram of a single stage reciprocating compressor without the clearance volume and explain the processes briefly. (7)

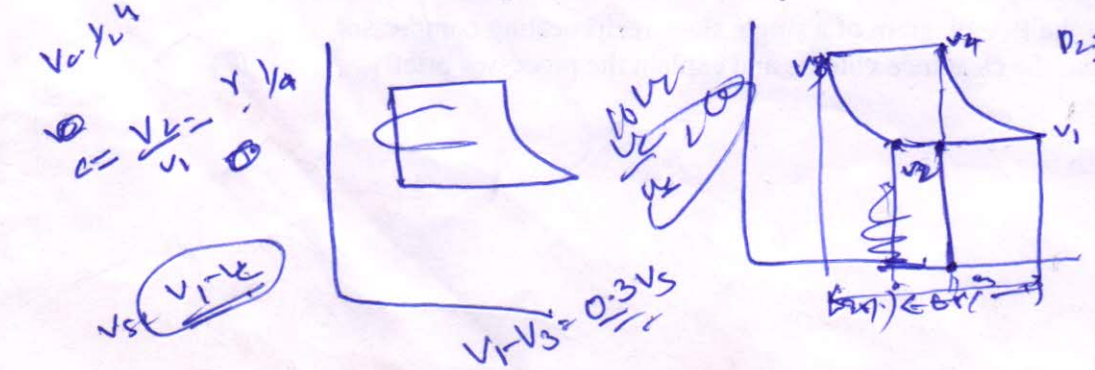
b) A single stage reciprocating compressor takes 1 m^3 of air per minute at 1.013 bar and 15° C and delivers it at 7 bar. Assuming that the law of compression is $PV^{1.35} = C$ and clearance is negligible, calculate the indicated power of the compressor. (7)

3. A single-stage single-acting air compressor delivers 0.6 kg of air per minute at 6 bar. The temperature and pressure at the end of suction stroke are 30° C and 1.0 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance volume is 3 % of the swept volume. Assume the expansion and compression index to be same and having value 1.3. Find the following: (14)
i) Volumetric efficiency of the compressor
ii) Power required to run the compressor if he Mechanical efficiency is 85%
iii) The RPM of the compressor

4. Air at 103 KPa and 27° C is drawn in the LP cylinder of a two-stage air compressor and is isentropically compressed to 700 KPa. The air is then cooled at constant pressure to 37° C in an intercooler and is then again compressed isentropically to 4 MPa in the high pressure (HP) cylinder and is delivered at this pressure. Determine the power required to run the compressor if it has to deliver 30 m^3 of air per hour measured at inlet condition. (14)

5. The cylinder of a non-condensing steam engine is supplied with steam at 11.5 bar. The clearance volume is $1/10^{th}$ of the stroke volume and the cut-off takes place at $1/4^{th}$ of the stroke. If the pressure at the end of the compressor is 5.4 bar, compute the Mean Effective Pressure (M. E. P.) of the steam of piston. Assume that the expansion and compression are hyperbolic. The back pressure is given as 1.1 bar. (14)

6. A steam engine having swept volume 0.034 m^3 and clearance volume 20% of the piston displacement, consumes 2725 kg of steam per hour at 250 R. P. M. The Engine is double acting and the pressure of steam near cut-off is 8.8 bar, when the piston has traversed 30 % of working stroke. If the compression commences at 65 % of the return stroke when the steam remaining in the cylinder is dry at 0.14 bar, estimate the mass of cushion steam at this point. Also find the dryness fraction of steam at cut-off. (14)



7. a) Draw the T-S diagram of the Carnot Cycle and Rankine cycle and explain the processes. (7)

b) The following data refer to a simple steam power plant: The steam is supplied at 15 bar and the steam is dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect the feed pump work. (7)

8. In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine the following: (14)

i) The feed pump work
ii) The Turbine work
iii) The Rankine Efficiency
iv) The condenser heat flow
v) The dryness fraction of the steam at the end of expansion.

9. a) A Carnot cycle operates between source and sink temperatures of 250°C and -15°C. If the system receives 90 KJ from the source, find: (7)

i) Efficiency of the system
ii) The net work transfer
iii) Heat rejected to the sink.

b) An inventor claims that his engine has the following specifications: (7)

Temperature limits	750° C and 25° C
Power Developed	75 KW
Fuel burned per hour	3.9 kg
Heating value of the fuel	74500 KJ/kg

State whether the claim is valid or not.

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4.182 KW