Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

III SEMESTER B.TECH (IP ENGG.) END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: THERMAL ENGINEERING [MME 2113]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Use of Thermodynamics data hand book is permitted

1A. A cylinder contains 1 kg of certain fluid at an initial pressure of 1 bar. The fluid is reversibly expanded according to the law $p V^2 = C$ until the volume is doubled. Fluid is then cooled reversibly at constant pressure to its original position. Heat is then supplied reversibly at constant volume to a final pressure of 20 bar. The initial volume is 0.05 m^3, find the net work done by the fluid. 4

1B. What is a quasistatic process? Give an example. 2

1C In a gas turbine unit, the gases flow at a rate of 15kg/s and the power developed by the turbine is 12000 kW. The enthalpies at inlet and outlet are 1260kJ/kg and 400kJ/kg respectively. The velocities at inlet and outlet are 50m/s and 110m/s respectively. Calculate 4

a) The heat transfer rate from the turbine.
b) Area of the inlet pipe if Specific volume of the gas at inlet is 0.45 m^3/kg

2A. State and prove Carnot theorem with necessary sketches. 4

2B. State Kelvin Plank and Clausius statements on 2nd law of thermodynamics. 2

2C. 0.04 m^3 of air contained in a cylinder behind a piston is initially at 1.05 bar and 15°C. The gas is compressed isothermally and reversibly until the pressure is 4.8 bar. Calculate: 4

i) The change in entropy
ii) The heat flow
iii) The work done
Sketch the process on a p-V diagram.

3A. Explain Diesel cycle with the help of a pV diagram and derive the expression for thermal efficiency for the same. 4

3B. Explain the effect of boiler pressure, condenser pressure and superheating of steam on Rankine cycle. 3

3C. 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 : 3

i) Pump work and turbine work
ii) Dryness fraction at the end of expansion
iii) Rankine efficiency

4A.	In an Otto cycle, the pressure at the end of compression is 15 times to that at the start, temperature of air at the beginning of compression is 38^{o}C and maximum temperature attained in the cycle is 1950^{o}C. Determine i) Compression ratio ii) Thermal efficiency iii) Work done	4
4B.	Derive the expression for minimum work and intermediate pressure in a two stage reciprocating compressor with perfect intercooling, with necessary sketches.	4
4C.	Mention the advantages of multi staging over single stage compressor.	2
5A.	A Bell Coleman cycle operating between 1 MPa and 100 kPa is required to produce 200 kJ/min. Temperature of air leaving the cold chamber is -5^{o}C and leaving the cooler is 30^{o}C.Determine: i) Mass of air circulated per minute ii) Compressor work, expander work and work done per cycle iii) COP and power in kW required	5
5B.	Derive the expression for overall heat transfer coefficient for conduction through a plane wall with fluid interactions on both sides.	3
5C.	What is emissivity and state the concept of black body.	2