Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERONAUTICAL & AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2017

SUBJECT: THERMODYNAMICS [AAE 2104]

REVISED CREDIT SYSTEM
(30/12/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. What do you understand by macroscopic and microscopic viewpoints? Explain **03**

1B. What is a thermodynamic system? Explain the thermodynamic equilibrium of a system **02**

1C. What is the zeroth law of thermodynamics? How is it useful in measurement of temperature? **02**

1D. Distinguish with suitable examples why the free expansion and a constant volume process has zero work transfer? Are these 2 process one and the same? **03**

2A. What is the difference between First law applied to a system undergoing a '*cycle*' and that undergoing a '*process*' **02**

2B. Prove that 'Energy' is a property of the system **03**

2C. A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfers is -170 kJ. The system completes 100 cycles per min. Complete the following table showing the method for each item, and compute the net rate of work output in kW. **05**

Process	Q (kJ/min	W (kJ/min	ΔE (kJ/min)
a-b	0	2,170	---------
b-c	21,000	0	---------
c-d	-2,100	---------	-36,600
d-a	--------	---------	----------

3A. Air at a temperature of 25^{o}C passes through a heat exchanger at a velocity of 50m/s where its temperature is raised to 1000^{o}C. It then enters a turbine with the same velocity of 50m/s and expands until the temperature falls to 600^{o}C. On leaving the turbine, the air is taken at a velocity of 75m/s to a nozzle where it expands until the temperature has fallen to 490^{o}C. If the air flow rate is 132 kg/min, calculate (a) the rate of heat transfer to the air in the heat exchanger, (b) the power output from the turbine assuming heat loss of 10kW, and (c) the velocity at exit from the nozzle, assuming no heat loss. Take enthalpy of air as $h=c_pt$, where c_p is the specific heat equal to 1.005kJ/kgK and 't' is the temperature. **05**

3B. Show that the enthalpy of a fluid before throttling is equal to that after throttling **02**

3C. Show that the violation of Clausius statement also violates Kelvin-Planck statement of second law Thermodynamics **03**

4A. The COP of a carnot refrigerator can be increased either by decreasing the temperature of the high temperature reservoir, while the low temperature reservoir is held at constant temperature or by increasing the temperature of the low temperature reservoir while the high temperature reservoir is held at constant temperature. Determine which of the above two possibilities is more effective? **03**

4B. Why the second law called the directional law of nature? **02**

4C. Prove that $\oint \frac{dQ}{T} \leq 0$ and explain the significance of clausius inequality **05**

5A. Steam of dryness fraction 0.82 is expanded in a cylinder according to $pv^{1.08}$=constant. The pressure at the beginning of expansion is 16 bar and is continued till the pressure reduces to 1.4 bar. Determine (i) the final condition of the steam, (ii) the work done during expansion (iii) the change in internal energy (iv) the heat exchange that occurs between the steam and cylinder walls per kg. **05**

5B. A four stroke SI Engine has the compression ratio of 6 and swept volume of 0.15m^3. Pressure & temperature at the beginning of compression are 98 kPa and 60^{o}C. Determine the pressure, volume & temperature at all salient points if heat supplied to it is 150 kJ/kg. Also find out entropy change, work done, efficiency & Mean effective pressure of cycle assuming C_p= 1kJ/kgK & C_v=0.71 kJ/kg K. Plot the cycle on T-S and P-V diagram **05**