UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 1 Examination in Engineering: August 2014

Module Number: ME 1202 **Module Name: Fundamentals of Engineering Thermodynamics**

[Three Hours]

[This question paper has Part A and Part B. Answer all questions.
Steam tables are provided]

Part A –02 hours

- **Twenty questions**
- **Write answers within the limits of the space below the question.**
- **Each question carries maximum 02 marks.**

Q1. What are the similarities and the differences between a Thermodynamic cycle and a Thermodynamic process?

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Q2. Write down the general expression of First Law of Thermodynamics for an open system.

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Q3. What are state functions? Give 03 examples for state functions.

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Q4. Steam at 3 MPa and 450 °C enters a turbine at a flow rate of 8 kg/s, and leaves at 0.2 MPa and 150 °C. The turbine loses 300 kW of heat during this process. Calculate the work done by the turbine.

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Q5. When a heat quantity of 10 kJ is supplied to a heat engine per cycle, it rejects 3.5 kJ of it to the surroundings during the cycle. Calculate the cycle thermal efficiency.

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Q6. Write an expression for the thermal efficiency of a heat engine using the temperatures of low temperature reservoir and high temperature reservoir.

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Q7. A Carnot engine has the same efficiency (i) between 100 K and 500 K, and, (ii) between T K and 900 K. Calculate the temperature T of the sink.

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Q8. Write down the expression of entropy balance for a closed system.

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Q9. A cup of tea is cooled from 100°C to 20°C by leaving it on a table. The mass of tea is 0.25 kg and its specific heat is 4.2 kJ. kg^{-1}. K^{-1}. Calculate the change in entropy of tea.

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Q10. Two kilograms of a gas is compressed in a piston-cylinder assembly from P_1=106 kPa and V_1=0.200 m^3 to a volume of V_2=0.100 m^3. The process is polytropic where n=1.50. Determine the final pressure and the work for the compression process.

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Q11. Give examples for intensive and extensive properties.

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Q12. Sketch on a *P-v* diagram for water, a constant pressure process where subcooled water being heated till it becomes superheated vapour. Also indicate the corresponding isothermal lines at initial and final states on the same *P-v* diagram.

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Q13. Sketch the isentropic compression process of an ideal gas on temperature-entropy *(T-s)* and pressure-volume *(P-v)* diagrams

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Q14. Under what condition(s) a simple and pure substance such as water can obey very closely the ideal gas equation.

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Q15. A gas expands in a constant pressure process and does 25 kJ of expansion work on the surroundings. During the process, 60 kJ of heat is absorbed by the system. Determine the changes in internal energy and enthalpy.

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Q16. What is the difference between a closed system, an open system and an isolated system?

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Q17. What additional information does the Second Law of Thermodynamics provide with reference to the First Law?

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Q18. Cooling water in a heat exchanger receives energy at the rate of 2500 kW. Determine the mass flow rate of the cooling water if the water experiences a temperature rise of 10°C. Note: The specific heat of the water is 4.2 kJ/kgK.

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Q19. A Heat Engine is to be operated between two thermal reservoirs at temperatures 1200 °C and 30 °C. Determine the maximum possible thermal efficiency of this Heat Engine.

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Q20. A perfect gas expands from 5 bar to 1 bar by the law $pV^{1.2} = C$. The initial temperature of the gas is 200°C. Calculate the change in specific entropy. Take R = 287 J/kg K and γ =1.4.

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---------- **End of Part A** ---------