

**Instructions to candidates**

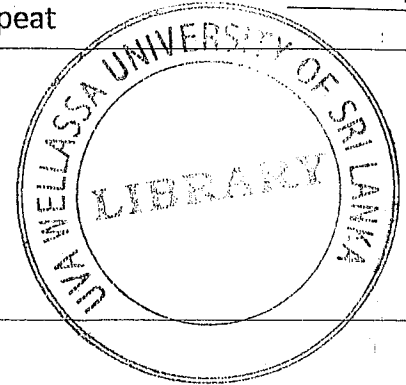
**Duration:** One (01) hour

**Number of questions:** Three (03) Essay Questions

**Mark allocation:** 50

**Answer any two (02) questions.**

Thermodynamic property tables will be provided.



1. A certain quantity of air at a pressure of 1 bar and temperature of 70°C is compressed adiabatically until the pressure is 7 bar in Otto cycle engine. 465 kJ of heat per kg of air is now added at constant volume. Take for air  $c_p = 1.0$  kJ/kg K,  $c_v = 0.706$  kJ/kg K. Show each operation on p-V and T-s diagrams.

(Note: For an adiabatic process from 1 to 2 we can write  $P_1 V_1^K = P_2 V_2^K$ , K is specific heat ratio)

Determine:

- compression ratio of the engine. (6 mark)
  - temperature at the end of compression. (6 mark)
  - temperature at the end of heat addition. (6 mark)
  - thermal efficiency of the cycle (7 mark)
2. Consider a 250-MW steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 10 MPa and 500°C and is cooled in the condenser at a pressure of 10 kPa. Show the cycle on a T- S diagram with respect to saturation lines, and determine
- the quality of the steam of the turbine exit. (10 mark)
  - the thermal efficiency of the cycle. (10 mark)
  - the mass flow rate of steam (5 mark)