VIT
Vellore Institute of Technology

Continuous Assessment Test – II

Programme Name & Branch: B.Tech. (BME/BEM)

Course Name & Code: Thermal Engineering Systems (MEE2003)

Class Number: VL2019201001159 Slot: D2+TD2+V6 Exam Duration: 90 Mins. Max. Marks: 50

General instruction(s):

1. *Missing data, if any, may be standard data assumed.*
2. *Steam table and Mollier chart are permitted.*

Answer all the Questions

S.No.	Question
1.	Given a Rankine cycle with two open feedwater heaters operating as follows: Boiler Exit Conditions: 15 MPa, 500 °C, and 15 kg/s Condenser Operating Pressure: 100 kPa Open Feedwater Heater #1 Operating Pressure: 1.0 MPa Open Feedwater Heater #2 Operating Pressure: 500 kPa You may assume all devices are ideal. Determine: (a) mass flow rate of steam into OFWH #1 (b) mass flow rate of steam into OFWH #2 (c) heat transfer rate rejected by condenser (d) thermal efficiency of plant **[20 Marks]**
2.	A two-stage air compressor delivers 145 m^3 of free air per hour. The pressure and temperature in the cylinder at the start of compression are 1 bar and 34 °C respectively. The diameter of the low-pressure cylinder is twice that of the high pressure cylinder. The air enters the high-pressure cylinder at a temperature of 40 °C and is then compressed to 17.5 bar, the law of compression being $pv^{1.2}$ = constant for both stages. Neglecting the effects of clearance, estimate: (a) the intercooler pressure, (b) the indicated power required, and (c) the ratio of cylinder diameters for minimum work making the usual assumptions regarding the intercooler conditions. The free air conditions are 1.01325 bar and 15 °C. Take R = 0.287 kJ/kg K for air. **[10 Marks]**
3.	The 7FA gas turbine manufactured by General Electric is reported to have an efficiency of 35.9 percent in the simple-cycle mode and to produce 159 MW of net power. The pressure ratio is 14.7 and the turbine inlet temperature is 1288°C. The mass flow rate through the turbine is 1,536,000 kg/h. Taking the ambient conditions to be 20 °C and 100 kPa, determine: a) the isentropic efficiency of the turbine and the compressor, b) the thermal efficiency of this gas turbine if a regenerator with an effectiveness of 80 percent is added. **[20 Marks]**