REG.NO.: 22BME0483

VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

NAME OF THE SCHOOL
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2024-2025

SLOT:B1+TB1

Programme Name & Branch	**: B-Tech (BMM, BMA AND BME)**
Course Code and Course Name	**: BMEE303L THERMAL ENGINEERING SYSTEMS**
Faculty Name(s)	**: Dr. NISHANT TIWARI, Dr. LALIT KUMAR B, Dr. SENTHIL KUMAR M, Dr. N. GOVINDHA RASU and Dr. PRAKASH R**
Class Number(s)	**:VL2024250103781, 3782, 3783, 3784, 3785**
Date of Examination	**:14.10.2024**
Exam Duration	**: 90 minutes** **Maximum Marks: 50**

GDN 120 – 30

General instruction(s):

- Answer All Questions.
- Use of Steam Tables and Mollier Chart is permitted.
- Assume suitable data if any missing.
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1- Remember, 2 – Understand, 3 – Apply, 4 – Analyze, 5 –Evaluate, 6 – Create)
- Course Outcomes
  CO3: Design a steam nozzle for thermal power plant and analyze the performance of reciprocating air compressors.
  CO4: Analyze the performance parameters of steam and gas power cycles.

Q. No	Question	M	CO	BL
1.	It is required to compress the air from 1 bar and 293 K to 150 bar using multistage compressor and intercoolers. The maximum temperature after compression should not exceed 120°C and the temperature of air coming out of intercooler should not fall below 38°C. The compression in all stages follow the law $pv^n=C$. Determine (a) the number of stages required (b) the work input per kg of air and (c) the heat rejected in the intercooler.	10	3	5
2.	Steam enters a converging nozzle at 3.0 MPa and 500°C with a negligible velocity, and it exits at 1.8 MPa. For a nozzle exit area of 32 cm^2, determine the exit velocity, mass flow rate, and exit Mach number if the nozzle (a) is isentropic and (b) has an efficiency of 90 percent.	10	3	5
3.	Steam at 15 bar and 0.97 dry is discharged through a convergent-divergent nozzle to a back pressure of 0.2 bar. The flow rate is 9 kg/kWh. If the power developed is 220 kW, determine (a) throat pressure (b) No of nozzles required if each nozzle throat area is 32 mm^2, (c) if 12% of overall isentropic enthalpy drop reheats the steam by friction in divergent part only then find out cross sectional area to the exit of the nozzle.	10	3	4
4.	Consider a simple ideal Brayton cycle with air as the working fluid. The pressure ratio of the cycle is 6, and the minimum and maximum temperatures are 300 and 1300 K, respectively. Now the pressure ratio is doubled without changing the minimum and maximum temperatures in	10	4	4

	the cycle. Determine the change in (a) the network output per unit mass and (b) the thermal efficiency of the cycle as a result of this modification. Assume variable specific heats for air.			
5.	An ideal Brayton cycle with regeneration has a pressure ratio of 10. Air enters the compressor at 300 K and the turbine at 1200 K. If the effectiveness of the regenerator is 100 percent, determine the network output and the thermal efficiency of the cycle.	10	4	4

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