P P SAVANI UNIVERSITY

Fifth Semester of B. Tech. Examination

November 2022

SEME3041 Thermal Engineering

02.12.2022, Friday **Time: 10:00 a.m. To 12:30 p.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

			CO	BTL
Q - 1	Classify air compressor. Describe the working of a single stage reciprocating air compressor	**[06]**	**1**	**2**
Q - 2 (a)	Explain the effect of intercooling in a multistage reciprocating compressor.	**[06]**	**1**	**2**
Q - 2 (b)	Prove that the volumetric efficiency of a single-stage compressor is given by $n_{vol} = 1 + k - k\left(\frac{p_2}{p_1}\right)^{\frac{1}{n}}$, where $k = \frac{V_c}{V_s}$	**[06]**	**1**	**3**
	OR			
Q - 2 (a)	What is a centrifugal compressor? How does it differ from axial flow compressor?	**[06]**	**1**	**2**
Q - 2 (b)	In a steam nozzle the steam expands from 4 bar to 1 bar. The initial velocity is 60 m/s and the initial temperature is 2000C. Determine the exit velocity if the nozzle efficiency is 92%.	**[06]**	**2**	**5**
Q - 3 (a)	Starting from fundamentals, show that the maximum discharge through a nozzle, the ratio of throat pressure to inlet pressure is given by $\left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ where n is the index for isentropic expansion through the nozzle	**[06]**	**2**	**3**
Q - 3 (b)	Draw a schematic diagram of a "Pulse Jet Engine" and describe its operation. What are the advantages and disadvantages of Pulse Jet Engine?	**[06]**	**4**	**2**
	OR			
Q - 3 (b)	Define the following terms as applied to propulsion: (1) Thrust (2) Specific thrust (3) Specific impulse (4) Total impulse (5) Thrust power (6) Propulsive power	**[06]**	**4**	**2**

SECTION – II

Q - 1	The air enters the compressor of an Open cycle constant pressure gas turbine plant at constant pressure of 1 bar and temperature of 28°C. The pressure of the air after compression is 4 bar. The isentropic efficiency of the compression is 80% and 85%. The air fuel ratio used is 90:1. If the flow rate of air is 2.6 kg/sec, Find: 1. Power develops 2. Thermal Efficiency Assume Cp = 1.0 kj/kgK and Y= 1.4 for air and Gases. Calorific value of fuel : 41,800 kJ/Kg.	**[06]**	**2**	**5**

Q - 2 (a)	Define blade efficiency and derive an expression for maximum blade efficiency for single stage impulse steam turbine.	**[06]**	**3**	**2**
Q - 2 (b)	Differentiate gas turbine and steam turbine. (Any 6 points)	**[06]**	**3**	**3**
	OR			
Q - 2 (a)	Derive the condition for maximum efficiency blade efficiency for impulse turbine.	**[06]**	**2**	**3**
Q - 2 (b)	Air enters the compressor of a gas turbine plant operating on Brayton cycle at 100 kPa and 300 K with a volumetric flow rate of 5 m3/sec. The compression pressure ratio is 10. The turbine inlet temperature is 1300 K. The turbine and compressor has an isentropic efficiency of 0.82 and 0.8 respectively. Calculate (i) thermal efficiency of the cycle (ii) back work ratio (iii) net power developed in kW Assume Cp = 1.005 kJ/kg K and y = 1.4 for air and gases	**[06]**	**2**	**4**
Q - 3 (a)	What is compounding of turbine? Explain the principle, construction and working of Velocity compounding of an Impulse turbine with neat sketch.	**[06]**	**2**	**3**
Q - 3 (b)	Explain the process and purpose of reheating steam cycle in steam turbine application.	**[06]**	**2**	**2**
	OR			
Q - 3 (a)	Steam at pressure 15 bar with 250 0C is allow to expand through a nozzle. the exit pressure is 1 bar. If the nozzle is required to supply2kg/sec of steam to the turbine, then Calculate: 1. Velocities at throat and Exit 2. Areas of throat and exit.	**[06]**	**3**	**5**
Q - 3 (b)	What is the need of governing system used in steam turbine? State the different governing system used in steam turbine. Explain any one of governing system with neat sketch.	**[06]**	**2**	**2**

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CO : Course Outcome Number BTL : Blooms Taxonomy Level

Level of Bloom's Revised Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create