Hall Ticket Number:

Code No. : 17552 N/O

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) VII-Semester Main & Backlog Examinations, Dec.-23/Jan.-24

Thermal Turbo Machines

Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Define stagnation pressure and stagnation temperature.	2	1	1	1
2.	Find the Mach number when the fluid stream (γ=1.3, R=0.26 kJ/kg K) at 30°C moves with a velocity of 500 m/s.	2	2	1	2
3.	Write the function of impeller and diffuser in centrifugal compressor.	2	1	2	1
4.	In a compression process n =1.5 and γ = 1.4; find its polytropic efficiency.	2	2	2	2
5.	Define blade efficiency and stage efficiency.	2	1	3	1
6.	In a reaction turbine enthalpy drop in moving blades = 50 kJ/kg and enthalpy drop in fixed blades = 50 kJ/kg. Find its degree of reaction.	2	2	3	1
7.	Define work ratio and thermal efficiency of gas turbine power plant.	2	1	4	1
8.	Sketch gas turbine power plant with regenerator and label the parts.	2	1	4	1
9.	Give examples of each in i) Direct reaction engine ii) Indirect reaction engine iii) Direct plus indirect reaction engine.	2	1	5	1
10.	Classify rocket engines.	2	2	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	Sketch the flow pattern of sound waves in the medium for i) stationary source ii) source moving at subsonic speeds iii) source moving at speed of sound iv) source moving at supersonic speed.	4	2	1	1
b)	Air is flowing in a duct has a velocity of 350 m/s, pressure 1 bar and 310 K. Taking specific heat ratio as 1.4 and R=287 J/kg K Determine i) Stagnation pressure ii) Stagnation temperature iii) Velocity of sound in dynamic condition and iv) Velocity of sound at stagnation condition.	4	4	1	2
12. a)	Discuss the constructional details, advantages, and applications of an axial flow compressor.	4	2	2	1
b)	Air at a temperature of 17 °C flows into the centrifugal compressor running at 20,000 rpm. Using the following data, Slip factor=0.80; Work input factor =1.0; Isentropic efficiency=70%; outer diameter of the blade tip = 500mm. Assuming absolute velocities of air entering and leaving the compressor are same. Determine i) The temperature rise of air passing through the compressor ii) Static pressure ratio.	4	4	2	2

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13. a)	A single stage impulse turbine is supplied steam at a velocity of 950 m/s at the rate of 1 kg/s. The blade speed is 250 m/s and nozzles are inclined at 20° to the plane of the wheel. The blade angle at the exit of the moving blade is 30°. Neglecting frictional losses in the moving blades, determine i) Power developed ii) Blade efficiency.	4	4	3	2
b)	Explain the working of a four-stage reaction turbine with a schematic diagram.	4	2,3	3	1
14. a)	Explain the working of open cycle gas turbine power plant with Intercooling with a schematic and T-s diagram and mention its advantages.	4	2,3	4	1
b)	An open cycle gas turbine power plant works between the pressure range of 1bar and 6 bar and the temperature range of 300 K and 1023 K. The calorific value of the fuel 43890 kJ/kg. Find i) Air Fuel ratio ii) Thermal efficiency of the plant. Assume the compression and expansion are isentropic and pressure losses are neglected. Take $Cp_{(gases)}$=1.147 kJ/kg K and $Cp_{(air)}$=1.005 kJ/kg K.	4	4	4	2
15. a)	For a turbojet engine with a flight velocity of 1000 kmph at an ambient pressure of 80 kPa, the properties of air entering the nozzle are 300 kPa and 225 °C. The mass flow rate of air is 25 kg/s. Take γ =1.4, R = 287 kJ/kg K for air, find i) Jet velocity ii) thrust produced iii) thrust power iv) propulsive efficiency.	4	4	5	2
b)	Describe the working of liquid propellant rocket engine with a neat sketch.	4	4	5	1
16. a)	Sketch the symmetrical & cambered airfoil and label i) Chord length ii) Camber iii) Leading edge iv) Angle of attack.	4	2	1	1
b)	Explain the phenomenon of surging and choking in centrifugal compressors.	4	1,4	2	1
17.	Answer any ***two*** of the following:				
a)	Explain the working of velocity compounding of steam turbines.	4	2	3	1
b)	Compare open cycle gas turbine power plants with closed cycle gas turbine power plants.	4	1,3	4	1
c)	List different types of thrust augmentation techniques used in jet propulsion systems and explain anyone.	4	1	5	1

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	40%
iii)	Blooms Taxonomy Level – 3 & 4	40%

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