Hall Ticket Number:

1	6	0	2	1	5	7	3	6	0	8	2

Code No. : 17536 S

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) VII-Semester Supplementary Examinations, July-2022

Thermal Turbo Machines

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

*Note: **1) Answer all questions from Part-A and any FIVE from Part-B***
2) Use of Gas tables permitted.

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Draw the Mach cone and indicate Mach angle, zone of silence and zone of action.	2	1	1	1
2.	Find the stagnation temperature of air at the nose of an aircraft flying at Mach number 1.20 in air at 30°C.	2	1	1	1
3.	Define slip and slip factor in centrifugal compressor.	2	1	2	1
4.	List various applications of rotary compressors.	2	1	2	1
5.	List the advantages of compounding of impulse turbines.	2	1	3	1
6.	Sketch the combined velocity triangles of two stage impulse turbine.	2	1	3	1
7.	In a gas turbine power plant, the cycle maximum temperature is 800°C and air inlet temperature is 27°C, the ratio of specific heats=1.4, find the optimum pressure ratio.	2	3	4	2
8.	Draw the open cycle gas turbine power plant with intercooling and reheating process.	2	1	4	1
9.	What is meant by air bleeding system in turbojet engine?	2	1	5	1
10.	Classify jet and rocket propulsion systems.	2	2	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	A stream of air flows with a velocity of 300m/sec in a duct of 150mm diameter. Its temperature and pressure are 15°C 1bar respectively. Determine i) stagnation pressure ii) stagnation temperature iii) mass flow rate of air in kg/hr iv) If the density of air is doubled then what is the effect of density on the mass flow rate of air?	4	4	1	2
b)	The air on upstream of a normal shock is given by T=273K, P_1=1bar and velocity is 500m/sec undergoes a normal shock. The temperature down stream of shock is 350K.Determine i) Mach number ii) velocity and iii) stagnation pressure downstream of shock wave.	4	4	1	2
12. a)	A centrifugal compressor delivers 20kg/sec of air with a total head pressure ratio of 5:1. The speed of the compressor is 12500rpm.Inlet total head temperature is 300K, slip factor is 0.95, power input factor is 1.042 and isentropic efficiency is 92%, Estimate i) Diameter of the impeller ii) Power input to compressor.	4	4	2	2

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b)	Explain working of axial flow compressor with a neat diagram.	4	2	2	2
13. a)	Steam leaves the nozzle of a single stage impulse turbine at 840m/sec. The nozzle angle is 18° and the blade angles are 29° at the inlet and outlet. The blade friction coefficient is 0.90. Calculate i) Blade velocity ii) Steam mass flow rate in kg/hr to develop 300kW power.	4	4	3	1
b)	Discuss the variation of Diagram efficiency against blade speed ratio for i) Impulse turbine and ii) Reaction turbine and discuss.	4	3	3	2
14. a)	In a constant pressure open cycle gas turbine air enters at 1 bar and 310K and leaves the compressor at 6.5bar. Temperature of gases entering the turbine=1000K, isentropic efficiency of compressor=82%, isentropic efficiency of turbine=92%, efficiency of combustion=96%. Take Cp =1.005kJ/kg for air and gases and γ=1.4, find i) work of compression per kg of air ii) Work of turbine per kg of air iii) Heat supplied per kg of air iv) Thermal efficiency of the cycle.	4	4	4	2
b)	Derive the expression for the thermal efficiency of open cycle gas turbine power plant and discuss the effect of increase in pressure ratio on the plant thermal efficiency.	4	4	4	2
15. a)	A turbojet has a speed of 800kmph consumes air at the rate of 60kg/sec. Enthalpy changes for the nozzle is 250kJ/kg, Air fuel ratio is 80:1, Calorific value of the fuel is 42.5MJ/kg. Calculate i) Exit velocity of the jet ii) Fuel flow rate iii) Propulsive efficiency iv) Thermal efficiency.	4	2	5	2
b)	Explain the working of liquid propellant rocket engine with a line diagram and mention its advantages.	4	2	5	2
16. a)	Derive the expression for the Rankine-Hugoniot equation for density ratio and pressure ratio across normal shock.	4	4	1	1
b)	Compare centrifugal compressors with axial flow compressors.	4	2	2	1
17.	Answer any ***two*** of the following:				
a)	Show that for a Parson's reaction turbine the degree of reaction is 50%.	4	3	3	1
b)	Explain the working of Gas turbine power plant with regenerator with a line diagram and sketch the process on T-s plane.	4	2	4	1
c)	Illustrate the working of Scramjet engine with a schematic diagram and list its advantages.	4	2	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	30%
iii)	Blooms Taxonomy Level – 3 & 4	50%

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