Hall Ticket Number:

Code No. : 17546 S N/O

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) VII-Semester Supplementary Examinations, May/June-2023

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 static and stagnation properties.	2	1	1	1
2.	Define cone angle.	2	1	1	1
3.	Draw inlet and outlet velocity diagrams of forward blade of centrifugal compressor.	2	1	2	1
4.	How surging is formed in rotary compressors?	2	2	2	1
5.	Draw pressure-velocity variations in a velocity compounded turbine.	2	1	3	1
6.	Define stage efficiency and blade efficiency for a steam turbine.	2	1	3	1
7.	Draw T-s diagram and configuration diagram for Joule cycle incorporated with regeneration.	2	1	4	1
8.	What are the merits and demerits of gas turbine cycle over IC engines?	2	1	4	1
9.	What are the merits and demerits of liquid propellant over solid propellant?	2	1	5	1
10.	How jet engines are classified?	2	1	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	Prove Prandtl & Meyer equation of normal shocks.	4	3	1	2
b)	At a certain location in flow of air, the static pressure P=2.4 bar and stagnation pressure, P_o=3 bar. Measurement of the total temperature is to be T_o=468 K. Consider C_p= 1005 J/kg-K. C_v= 718 J/kg-K for air. Estimate Mach number and flow rate per unit area.	4	4	1	1
12. a)	Define degree of reaction of axial flow compressor. Derive the expression for the same. What are the conclusions?	4	3	2	1
b)	A single eye, single stage centrifugal compressor delivers 16.5 kg of air per second with a total head pressure ratio of 4:1 when running at 15000 rpm. The inlet total head temperature of the air at the suction side is 293K. Assume slip factor=0.9, work input factor=1.04, Isentropic efficiency =80%. Find i) the input power required to drive the compressor and ii) overall diameter of the impellor.	4	4	2	2

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13. a)	Explain with the help of neat sketch a single stage impulse turbine.	4	2	3	1
b)	A simple impulse turbine has one ring of moving blades running at 150 m/s. The absolute velocity of steam at exit from the stage is 85 m/s at an angle of 80° from the tangential direction. Blade velocity coefficient is 0.82 and the rate of steam flowing through the stage is 2.5 kg/s, if the blades are equiangular, determine (i) blade angles, (ii) Nozzle angle, (iii) absolute velocity of steam.	4	4	3	2
14. a)	Discuss the methods employed for improvement of thermal efficiency of open cycle gas turbine plant.	4	2	4	1
b)	The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature of 20 °C. The pressure of the air after compression is 4.0 bar. The isentropic efficiency of compressor and turbine are 80% and 85% respectively. Air fuel ratio is 90:1. If the flow rate of air is 3.0 kg/s, find the power developed and thermal efficiency of the cycle. Assume Cp=1.0 kJ/kg for air and gasses.	4	4	4	2
15. a)	Explain the working principle of Ram jet with the help of neat sketch.	4	2	5	1
b)	How rocket engine is different from jet engine and explain the working of solid propellant rocket with a neat sketch.	4	1	5	1
16. a)	How normal shock waves are formed?	4	2	1	1
b)	Differentiate between centrifugal and axial flow compressors.	4	2	2	1
17.	Answer any ***two*** of the following:				
a)	How balancing of end thrust is provided for steam turbines.	4	2	3	1
b)	Differentiate between open cycle and closed cycle gas turbines.	4	2	4	1
c)	Explain the working principle of turbo jet engine with a neat sketch.	4	1	5	1

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

i)	Blooms Taxonomy Level – 1	21%
ii)	Blooms Taxonomy Level – 2	40%
iii)	Blooms Taxonomy Level – 3 & 4	39%

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