PAPER ID-310471

Roll No:

B. TECH.
(SEM VII) THEORY EXAMINATION 2020-21
THERMAL TURBOMACHINES

Time: 3 Hours   *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

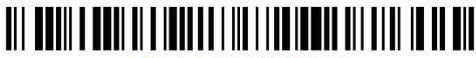**1.   Attempt *all* questions in brief.   2 x 10 = 20**

a.	What is second law of thermodynamics?
b.	What are the advantages of turbojet engines?
c.	What is cascade testing?
d.	Write Euler's energy equation for turbo machine
e.	What is priming of a centrifugal pump?
f.	What are the effects of cavitation?
g.	What are the losses occur in steam turbines?
h.	Differentiate between impulse and reaction turbine.
i.	Why water injection is used in gas turbine power plants?
j.	What are the factors that affect stage pressure ratio?

SECTION B

2.   Attempt any *three* of the following: 10 x 3 = 30

a.	Why radial gas turbines and compressors are not suitable for large power applications?
b.	How Centrifugal compressor are differed from Axial flow compressor? Differentiate between them.
c.	What is the need for compounding in steam turbines? What are the various methods of compounding of steam turbines? Explain any one of them.
d.	Explain the principle, construction and working of reciprocating pump with neat sketch.
e.	What are the techniques used for cooling turbine blades? Also explain the starting ignition system for gas turbine.

SECTION C

3.   Attempt any *one* part of the following: 10 x 1 = 10

a.	What is extended turbomachines? Give three examples and sketches of such machines.
b.	Define the following terms related to turbine: (i) Blade efficiency (ii) Stage efficiency (iii) Blade velocity coefficient (iv) Carry over coefficient

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4. **Attempt any *one* part of the following:** **10 x 1 = 10**

a.	A centrifugal compressor delivers free air of 18 kg/min. Air is sucked at static stages of 1 bar, 27° with inlet velocity of 50 m/s. The total head pressure ratio is 4 and isentropic efficiency of compressor is 0.75. The mechanical efficiency of motor attached to it is 0.90. Determine total head temperature of air at exit of compressor and brake power required to drive compressor.
b.	What is the principle of operation of axial flow compressor? Explain with suitable sketch. Also explain the performance characteristics curve of axial flow compressor.

5. **Attempt any *one* part of the following:** **10 x 1 = 10**

a.	The data for an axial turbine stage is given below: Air angle at nozzle exit = 75° Air angle at rotor entry = 45° Air angle at rotor exit = 76° Hub diameter = 450 mm Tip diameter = 750 mm Rotor speed = 6000 rpm Assuming radial equilibrium and free vortex flow in the stage, determine for mean section: (i) The relative and absolute air angles (ii) Degree of reaction (iii) Blade-to-gas speed ratio (iv) Specific work
b.	How degree of reaction of an axial turbine stage is defined? Prove that: $$R = \frac{1}{2}\emptyset(tan\beta_3 - tan\beta_2)$$ Where, β_2, β_3 is rotor blade angle.

6. **Attempt any *one* part of the following:** **10 x 1 = 10**

a.	In a single stage impulse turbine, the steam flows at rate of 5kg/s. It has rotor of 1.2 m diameter running at 300 rpm. Nozzle angle is 18°, blade speed ratio is 0.4, velocity coefficient is 0.9, outlet angle of blade is 3° less than inlet angle. Determine blade angles and power developed.
b.	What do you mean by 'characteristics of centrifugal pump'? Also explain various types of characteristics curves of centrifugal pump.

7. **Attempt any *one* part of the following:** **10 x 1 = 10**

a.	What are the criteria for the selection of material in turbo machines? Explain in brief.
b.	On which cycle Gas turbine plant works? Explain constant pressure and constant volume cycle with p-v and T-s diagram.