Roll No. | | | | | | | | | | | |

Total No. of Pages: 02
Total No. of Questions: 09

B.Tech (IE, ME) (Sem.-3rd)

APPLIED THERMODYNAMICS-I

Subject Code: ME-209
Paper ID: [A0805]

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

INSTRUCTION TO CANDIDATES:
1) ***Section-A is Compulsory.***
2) ***Attempt any four questions from Section-B.***
3) ***Attempt any two questions from Section-C.***

SECTION-A

(10x2=20)

Q.1. a) What is saturation temperature and saturation pressure?

b) How are steam generator classified?

c) State the advantages of Lancashire boiler used for steam generation?

d) Define simple Rankine cycle with P-V diagram

e) Differentiate between jet condenser and surface condenser. Give example.

f) Classify the air compressor.

g) What do you mean by superheated flow through nozzle?

h) Define degree of reaction with the help of diagram.

i) Define stage efficiency of a simple impulse turbine and write a mathematical for it.

j) Write the best index value for air compressor with P-V diagram.

SECTION – B

(4x5=20)

Q.2. Steam issues from the nozzle of a De-Leval turbine at a velocity of 1000 m/s at an angle of 20., The blade velocity is 300 m/s and the blades are symmetrical. The mass flow rate is 0.5kg/so. Allowing a friction factor of 0.8, determine:

a) Blade efficiency,
b) Power developed, and
c) Stage efficiency if the nozzle efficiency is 95%.

Q.3. A single stage, double acting air compressor is required to deliver $14m^3$ of air per minute measured at 1.013 bar and 15^0C. The delivery pressure is 7 bar and speed 300 rev/min. Take the clearance volume as 5% of swept volume with a compression and re-expansion index n=1.3. Calculate the swept volume of the cylinder, the delivery temperature and indicator power.

Q.4. What are the sources of air leakage into a condenser? Briefly state the effects of air leakage on the performance of a condenser.

Q.5. Draw T-s diagram of Rankine cycle using dry-saturated steam and develop the equation for Rankine cycle efficiency.

Q.6. Write short note on the following:
a) Triple point
b) Critical point

SECTION - C

(2x10=20)

Q.7. (a) Show that for maximum diagram efficiency of a reaction turbine the blade speed rations is equal to cos α where α is the angle of absolute velocity at inlet. State the assumption made. Hence derive an expression for maximum efficiency.

b) Describe the various losses in steam turbines.

Q.8. a) Determine the mass flow rate of steam through a nozzle having isentropic flow through it. Steam enters nozzle at 10 bar, 500^0C and leaves at 6 bar. Cross-section area at exit of nozzle is $20cm^2$. Velocity of steam entering nozzle may be considered negligible. Show the process on h-s diagram also.

b) Derive the relationship between area, velocity and pressure in nozzle flow.

Q.9. a) A Coal fired boiler plant consumes 400 kg of coal per hour. The boiler evaporates 3200 kg of water at 44.5^0C into superheated steam at a pressure of 12 bar and 274.5^0C. If the calorific value of the fuel is 32600 kJ/kg of coal, determine:
(i) Equivalent evaporation
(ii) Thermal efficiency of boiler.
Assume specific heat of superheated steam as 2.1 kj/kg k.

b) Explain the working principle of Lancashire boiler with the help of neat sketch.

----END----