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POLLACHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
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Degree / Branch: BE / Mechanical Engineering **Semester /Year: V / III**

Sub Code / Name: ME8595 / Thermal Engineering –II

Question Bank (2Mark & 16 Mark)

UNIT I - STEAM NOZZLES

1.What are the various types of nozzles and their functions?

Nozzle is a duct of varying cross-sectional area in which the velocity increases with the corresponding drop in pressure.

2. What are the effects of friction on the flow through a steam nozzle?

1. The final fraction of the steam is increased as the part of the kinetic energy gets converted into heat due to friction and absorbed by steam with n increase in enthalpy. 2. The expansion is no more isentropic and enthalpy drop is reduced thereby resulting in lower exit velocity. 3. The specific volume of steam is increased as the steam becomes drier due to this frictional reheating.

3. Define nozzle efficiency and critical pressure ratio.

Nozzle efficiency: It is defined as the ratio of actual enthalpy drop to the isentropic enthalpy drop Nozzle efficiency = Actual enthalpy drop / Isentropic enthalpy drop

4. Critical pressure ratio:

There is only one value of the ratio (P2/P1) which produces maximum discharge from the nozzle. The ratio is called critical pressure ratio. Critical pressure ratio P2 /P1 = (2/n+1) n/n+1 Where, P 1= Initial pressure P 2= Throat pressure.

5. What is Meta stable flow?

When the supersaturated steam is expanded in the nozzle, the condensation should occur in the nozzle. Since the steam has a great velocity, the condensation does not take place at the expected rate. So the equilibrium between the liquid and vapour phase is delayed and the steam continues to expand in a dry state.

6. What are the conditions that produce super saturation of steam in nozzles?

When the superheated steam expands in the nozzle, the condensation will occur in the nozzle. Since, the steam has more velocity, the condensation will not take place at the expected rate. So, the equilibrium between the liquid and vapour phase is delayed and the steam continues to expand in a dry state. The steam in such set of condition is said to be supersaturated or meta stable flow.

7. What are the effects of super saturation in a steam nozzle?

The following effects in a nozzle on steam, in which super saturation occurs, may be summarized as follows. 1. The dryness fraction of the steam is increased. 2. Entropy and specific volume of the steam are increased. 3. Exit velocity of the steam is reduced. 4. Mass of stream discharged is increased.

8. What are the differences between supersaturated flow and isentropic flow through steam nozzles?

Supersaturated flow Isentropic flow 1. Entropy is not constant Entropy is constant 2. Reduce in enthalpy drop . No reduce in enthalpy drop 3. We cannot use mollier diagram to solve problems We can use mollier diagram t

9. What are the different methods of compounding?

1. Velocity compounding 2. Pressure compounding 3. Pressure-velocity compounding

10. What is meant by carry over loss?

The velocity of steam at exit is sufficiently high thereby resulting in a kinetic energy loss called "Carry over loss" or "Leading velocity loss".

16 MARKS

1. Saturated steam ata pressure of 15bar is discharge through a C-D nozzle to a back pressure of 0.85bar. The mass flow rate is5kg/s.If the power developed is 220kW, determine the number of nozzle required assume throat areais 32mm^2 & also find maximum discharge , area at exit.

2. Steam at a pressure of 14bar & 250^{o}c is supplied to a C-D nozzle with a area of throat is 0.025m^2.Find the coefficient of discharge, if the rate of flow is 4600kg/hr.

3. Saturated steam at a pressure of 18bar & 380^{o}c is discharge through a C-D nozzle to a back pressure of 2bar. .If the power developed is 220kW, required assume throat areais 17mm^2 find maximum discharge , area at exit.use mollier diagram.

4. Explain type& shape of Nozzle, derive velocity of steam.

5 . A convergent divergent nozzle receives steam at 7bar and 200^{0}c and it expands Isentropically in to a space of 3bar neglecting the inlet velocity calculate the exit are a required for a mass flow of 0.1Kg/sec . when the flow is in equilibrium through all and super saturated with PV1.3=C.

6. Dry saturated steam at 6.5 bar with negligible velocity expands isentropically in a convergent divergent nozzle to 1.4 bar and dryness fraction 0.956. Determine the final velocity of steam from the nozzle if 13% heat is loss in friction. Find the % reduction in the final velocity.

7. A convergent divergent nozzle receives steam at 7bar and 200^{0}c nd it expands Isentropically in to a space of 3bar neglecting the inlet velocity calculate the exit are a required for a mass flow of 0.1Kg/sec . when the flow is in equilibrium through all and super saturated with PV1.3=C.

8. Steam having pressure of 10.5 bar and 0.95 dryness is expanded through a convergent-divergent nozzle and the pressure of steam leaving the nozzle is 0.85 bar. Find the velocity at the throat for maximum discharge conditions. Index of expansion may be assumed as 1.135. Calculate mass rate of flow of steam through the nozzle.

9. The nozzles of De-Laval stream turbine are supplied with dry saturated steam at a pressure of 9 bar. The pressure at the outlet is 1 bar. The turbine has two nozzles with a throat diameter of 2.5 mm. Assuming nozzle efficiency as 90% and that of turbine rotor 35%, find the quality of steam used per hour and the power developed.

10. Dry saturated steam at a pressure of 8 bar enters a convergent divergent nozzle and leaves it at a pressure of 1.5 bar. If the flow is isentropic and if the corresponding expansion index is 1.33, find the ratio of cross-sectional area at exit and throat for maximum discharge.