Code No: 137HZ **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, December - 2019
TURBO MACHINES
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	Give the classification of Turbo machines.	[2]
b)	What is static and stagnation conditions of Turbo machines.	[3]
c)	Define blade efficiency.	[2]
d)	Write the expression for energy balance in steam nozzles.	[3]
e)	What is super sonic flow in gas dynamics?	[2]
f)	Define slip factor.	[3]
g)	Draw the outlet velocity triangle for Axial flow compressor.	[2]
h)	Define incidence in Axial flow compressor.	[3]
i)	Define degree of reaction in axial flow gas turbines.	[2]
j)	Draw the inlet velocity triangle for Axial flow gas turbines.	[3]

PART – B

(50 Marks)

2.a) Define total to total, total to static, static to static and static to total efficiencies for power developing and power consuming turbomachines and write the T-s Diagrams.
b) Show Euler's isentropic and actual values of work in turbines and compressors on h-s coordinates. show the corresponding exit pressures in each case. [5+5]

OR

3.a) Derive the polytropic compression efficiency through an infinitesimal compression stage.
b) Define incompressible, compressible, steady and unsteady, inviscid, viscuss, laminar and turbulent flows. Give examples of each of these flowsmin turbomachines. [5+5]

4. The inlet condition to a steam nozzle is 10 bar and 250^0 C. The exit pressure is 2 bar. Assuming isentropic expansion and negligible inlet velocity, calculate the throat area, exit velocity and exit area of the nozzle. [10]

OR

5. A stage of an impulse turbine has two rows of moving blades separated in a row of fixed guide blades. The moving blades have tip angle of 38^0 , the velocity of discharge from the nozzle is 540 m/s. The relative velocity of steam drops by 10% during passage through each ring of blades and the final discharge is axial. Calculate the blade speed and blade efficiency. [10]

6.a) Calculate the maximum deflection angles for which the oblique shock remains attached to the wedge when M_1=2 and 3.

b) Why is the radial tipped impeller most widely used in centrifugal compressor stages? [6+4]

OR

7.a) A Centrifugal impeller has 17 radial blades in the impeller of 45 cm diameter. The tip diameter of the eye is 25cm. Calculate the slip factor making use of the two different formulae.

b) What is the purpose of inlet guide vanes and inducer blades in centrifugal compressor? explain briefly. [6+4]

8. Draw the inlet and outlet triangles for an axial flow compressor for which given (a) Degree of reaction =0.5 b) inlet blade angle =400 (c)axial velocity of flow which is constant throughout = 125m/s (d) RPM =6500 (e) Radius = 0.2m. Calculate the power required in kW at an air flow rate = 15kg/s. Find fluid angles at inlet and outlet. Blade speed is same at exit and inlet. [10]

OR

9.a) Explain the concept of surging in an axial flow compressor.

b) Why is it necessary to employ multi stage axial compressors to obtain moderate to high pressure ratios? [5+5]

10.a) What is matching of compressor and turbine performance in axial flow gas turbines?

b) What is an actuator disc? How is this concept used to predict the axial velocity distribution in the actuator disc flow region? How does it differ from radial equilibrium theory?[5+5]

OR

11. In a certain turbo machine, the blade speed at exit is twice that at inlet (u_2=2u_1), the meridian component of fluid velocity at inlet is equal to that at exit and the blade angle at inlet is 45^0. Show that the energy transfer per unit mass and degree of reaction are given by $E_m = -2V^2 m_1(2 - cot\beta 2)$ and $R = (cot\beta_2 + 2)/4$. [10]

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