PRN No.

Paper Code | U222-262 (ESE)

MAY 2022-ENDSEM EXAM
S.Y. B. TECH. (MECHENICAL) (SEMESTER - II)
COURSE NAME: APPLIED THERMODYNAMICS
COURSE CODE: MEUA22202
(PATTERN 2020)

Time: [1 Hr]

[Max. Marks: 30]

Instructions to candidates:
1) Figures to the right indicate full marks.
2) 'a' part of every question is compulsory
3) Use of scientific calculator is allowed
4) Use suitable data where ever required

Q.1   a) With neat sketch illustrate working principal of Impulse turbine.   [4]

b) A nozzle is to be designed to expand steam at the rate [6]
of 0.1 kg/s from 500 kPa, 210°C to 100 kPa. Neglect inlet velocity of steam.
For a nozzle efficiency of 0.9, determine exit area of nozzle.
Use: 500 kPa: h1 =2877 kJ/kg
       100 kPa: h2=2580 kJ/kg

OR

b) The steam is supplied to a impulse turbine at a velocity of 1000 m/s at an [6]
angle of 20°. The blade velocity is 300 m/s and the blades are symmetrical.
The mass-flow rate of the steam is 0.5 kg/s. Allowing a friction factor of 0.8,
determine, Power developed.

Q2   a) What is clearance ratio? Elaborate effect of clearance ratio on volumetric [4]
efficiency and work input.

b) A single-stage, single-acting reciprocating air compressor takes in air at 1 [6]
bar, 27°C and delivers at 7 bar, volume of air entering the compressor is 5
m³/min. Air is compressed according to $pV^{1.3}$ = C. Calculate isothermal
efficiency, power required to drive the compressor, neglecting clearance
volume.

OR

b) A single-stage, single-acting air compressor delivers 15 m³/min of free air [6] from 1 bar to 8 bar at 300 r.p.m. The clearance volume is 6.25% of the stroke volume and compression and expansion follow the law $pV^{1.3} = C$. Find the stroke volume. The temperature and pressure of air at suction are same as that of free air. Also determine indicated power of the compressor.

Q.3   a) Compare reciprocating and centrifugal air compressor. [4]

b) A centrifugal compressor running at 2000 rpm has internal and external [6] diameters of the impeller as 300 mm and 500 mm, respectively. The blade angles at inlet and outlet are 20° and 40°, respectively. The air enters the impeller radially. Determine the work done by the compressor per kg of air.

OR

b) A centrifugal compressor running at 1440 rpm, handles air at 101 kPa and [6] 20°C and compresses it to a pressure of 6 bar isentropically. The inner and outer diameters of the impeller are 14 cm and 28 cm, respectively. The width of the blade at the inlet is 2.5 cm. The blade angles are 16° and 40° at entry and exit. Calculate tangential force, axial thrust and power input.

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