

Unit 9 - Week 7:

Course outline

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Lecture 31: Basic Principles and Energy Transfer in Centrifugal Compressor Part – II

Lecture 32: Basic Principles and Energy Transfer in Centrifugal Compressor Part – III

Lecture 33: Basic Principles and Energy Transfer in Centrifugal Compressor Part – VI and Losses in Centrifugal Compressors

Lecture 34: Performance Characteristics of Centrifugal Compressors Part - I

Lecture 35: Performance Characteristics of Centrifugal Compressors Part II

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Details Solution

Assignment 7

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2019-10-16, 23:59 IST.

- 1) A centrifugal air compressor of an impeller diameter of 0.5 m and is running at 7000 rpm. The stagnation temperature at the inlet is 290 K. Assuming the slip factor and power input factor to be unity, the process of compressor is isentropic and for air constant pressure specific heat, $c_p = 1.005 \text{ J/kgK}$, specific heat ratio $\gamma = 1.4$, the pressure ratio developed and the specific work input are:
 - (a) 4.46 and 53.58 kJ/kg
 - (b) 2.46 and 23.58 kJ/kg
 - (c) 0.46 and 3.58 kJ/kg
 - (d) 1.46 and 33.58 kJ/kg

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: d
- 2) Air at a temperature of 27°C flows into a centrifugal compressor which is running at 20,000 rpm. The following data are given: slip factor=0.8, power input factor=1, isentropic efficiency = 80% and outer diameter of blade=0.5 m. Assuming the absolute velocities of air entering and leaving the compressor are same, the static temperature rise of air passing through the compressor is (for air take constant pressure specific heat, $c_p = 1.005 \text{ J/kgK}$, specific heat ratio $\gamma = 1.4$):
 - (a) 418.23^o C
 - (b) 218.23^o C
 - (c) 318.23^o C
 - (d) 118.23^o C

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: b
- 3) With the given data and assumptions of the previous problem, the static pressure ratio is obtained as
 - (a) 2
 - (b) 5
 - (c) 7
 - (d) 4

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: b
- 4) Consider the following statements regarding the characteristics of a centrifugal compressor:
 - (i) Surging takes place only when the operational point on the pressure ratio vs mass flow rate curve is on the side of positive slope
 - (ii) Surging takes place only when the operational point on the pressure ratio vs mass flow rate curve is on the side of negative slope
 - (iii) Choking represents a point on the characteristics curve having limit of maximum mass flow rate
 - (iv) Choking represents a point on the characteristics curve having limit of minimum mass flow rate

Out of the above statements:

 - (a) (i) and (ii) are correct
 - (b) (i) and (iii) are correct
 - (c) (ii) and (iii) are correct
 - (d) (ii) and (iv) are correct

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: b
- 5) Consider the following statements regarding the diffuser in a centrifugal compressor and choose the correct one:
 - (a) It consists of a number of diverging passages in which the air is accelerated with a consequent fall in the static pressure.
 - (b) A significant amount of work is done on the air in the diffuser.
 - (c) Incorrect design of a diffuser may lead to boundary layer separation and cause huge power loss due to eddy formation.
 - (d) None of these.

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: c
- 6) Consider the following statements regarding the losses in a centrifugal compressor:
 - (i) The incidence losses attain the minimum value at the designed mass flow rate
 - (ii) The shock losses are maximum at the designed flow rate
 - (iii) The incidence losses comprise both shock losses and impeller entry loss due to a change in the direction of fluid flow from the axial to the radial direction in the vaneless space before entering the impeller blades
 - (iv) The impeller entry loss is very large as compared to other losses.

Out of the above statements:

 - (a) (i) and (ii) are correct
 - (b) (i) and (iii) are correct
 - (c) (i), (ii) and (iii) are correct
 - (d) (i), (ii), (iii) and (iv) are correct

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: b
- 7) At the eye tip of a centrifugal impeller, blade velocity is 200 m/s while the uniform axial velocity at the inlet is 150 m/s. If the sonic velocity at the inlet is 300 m/s, the inlet relative Mach number of the flow will be
 - (a) 0.50
 - (b) 0.66
 - (c) 0.83
 - (d) 0.87

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: c
- 8) Air at a stagnation temperature of 27°C enters the impeller of a centrifugal compressor in the axial direction. The rotor which has 15 radial vanes, rotates at 20000 rpm. The stagnation pressure ratio between the diffuser outlet and the impeller inlet is 4 and the isentropic efficiency is 85%. The air mass flow rate is 2 kg/s, power input factor=1.05, slip factor, $\sigma = 1 - 2/n$, where n is the number of vanes. The impeller tip speed at the outlet is:

(take $\gamma = 1.4, R = 287 \text{ J/kg K}$)

 - (a) 415 m/s
 - (b) 435 m/s
 - (c) 465 m/s
 - (d) 535 m/s

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: b
- 9) With the giver data in the previous problem, the power input to the compressor is obtained as:
 - (a) 244.52 kW
 - (b) 144.52 kW
 - (c) 344.52 kW
 - (d) 444.52 kW

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: c
- 10) Consider the following statements regarding centrifugal compressor:
 - (i) Slip factor is defined as the ratio of tangential component of fluid velocity at outlet to peripheral velocity of rotor at outlet
 - (ii) The value of slip factor is always less than unity
 - (iii) The slip is the consequence of fluid friction

Out of the above statements:

 - (a) Only (i) is correct
 - (b) (i), (ii) and (iii) are correct
 - (c) (i) and (iii) are correct
 - (d) (i) and (ii) are correct

a
 b
 c
 d

No, the answer is incorrect.
 Score: 0
 Accepted Answers: d