Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2017

Course Code**: ME206**

Course Name**: FLUID MACHINERY (ME)**

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions.

1. a. Show that the maximum efficiency of a jet striking normally on a moving flat plate in the direction of jet is 8/27 (6)

   b. The angle of deviation of a jet striking the bucket of a Pelton wheel turbine is usually less than 180^0. Why? (4)

2. a. What is a draft tube? Why is it used in reaction turbine? What are the various types of it? (4)

   b. A jet of water moving with a velocity of 22m/s impinges on a curved vane at one end tangentially.The jet leaves vane at an angle of 120^0 to the direction of motion of the vane. The velocity of the vane is 10m/s and the angle of the nozzle is 20^0. Determine i) vane angle at inlet and outlet ii) work done per kg of water. (6)

3. a.Define the following terms with reference to water turbines. Obtain the relation between them.

   i) Hydraulic efficiency ii) Mechanical efficiency iii) Overal efficiency (4)

   b. Define Type number in water turbines. Whatis its significance?.Derive an expression for the same. (6)

4. A Francis turbine develops 160kW at 150rpm under a head of 10m. The peripheral velocity at inlet and flow velocity at inlet of turbine are $0.3\sqrt{2gH}$ and $0.9\sqrt{2gH}$ respectively. The overall efficiency of the turbie is 78% and hydraulic efficiency is 82%. Draw velocity triangle and find i) guide blade angle and runner vane angle at inlet and ii) diameter and width of the runner at inlet. (10)

PART B

Answer any three questions.

5. a. Explain the main operating characteristics of centrifugal pumps. (4)

   b. A double acting reciprocating pump is fitted with an air vessel on suction side close to pump. The suction lift of pump is 4.5m. The length and diameter of suction pipe

are 7.5m and 80mm respectively. The stroke of piston and its diameter both are 200mm each. Coefficient of friction is 0.01. The atmospheric head is 10.3m and separation pressure head 2.5m of water absolute. Determine i) The speed at which separation commence ii) Maximum permissible speed without air vessel. (6)

6. a. Prove from first principle that the work saved in a single acting reciprocating pump by fitting an air vessel is 84.8%. (5)

   b. The inlet and outlet diameter of impeller of a centrifugal pump are 40cm and 60cm. The velocity of flow at outlet is 2.5m/s and vane outlet angle is 30^0. Find the minimum speed of the pump to start the flow. Take manometric efficiency as 75%.(5)

7. a. Explain the following:

   i) Hydraulic Accumulator ii) Vane Pump (5)

   b. Explain NPSH and Thoma's cavitation factor in centrifugal pump (5)

8. a. Explain multistaging in centrifugal pumps. Where are they used? (5)

   b. The impeller of a centrifugal pump is 1m in diameter and rotates at 1500rpm. The blades are curved backward and make an angle of 30^0 to the tangent at the periphery. Calculate the power required if the velocity of flow at outlet is 20m/s. Determine the head to which water can be lifted when a diffuser casing reduces the outlet velocity to 60%. (5)

PART C

Answer any four questions.

9. a. How are compressors classified? List the practical applications of compressors. (4)

   b. A single stage single acting reciprocating air compressor compresses $7x10^{-3}$ m^3 of air per second from 1.0132 bar to 14 bar. The index of polytropic compression is 1.3 and mechanical efficiency 82%. If clearance is 3% of the swept volume, determine the volumetric efficiency and power required to drive the compressor and show the process on P-v diagram. (6)

10. a. What is meant by surging and chocking in centrifugal compressors? (4)

    b. A three stage single acting reciprocating compressor has perfect intercooling. The pressure and temperature at the end of suction stroke in LP cylinder is 1.013 bar and 15^0 C respectively. If $8.4m^3$ of free air id delivered by the compressor at 70 bar per minute and work done is minimum, calculate 1) L P and I P delivery pressure 2) Ratio of cylinder volume and 3) Total indicated power, assume n= 1.2 (6)

11. a.Explain the working of roots blower and obtain the expression for its efficiency. (4)

b. An axial flow compressor draws air at 20^0C and delivers at 50^0C. Assuming 50% reaction, calculate the velocity of flow if the blade velocity is 100m/s, Take work factor as 0.85. Assume $\alpha_1 = 10^0$, $\beta_1=40^0$. Also calculate the number of stages. (6)

12. A centrifugal compressor draws in air at temperature of 27^0C running at 18000rpm. The outer diameter of blade tip is 550mm, slip factor is 0.82, and isentropic total head efficiency is0.76. Calculate i) the temperature rise of air passing through the compressor ii) the static pressure ratio. Assume the velocities of air at inlet and outlet is same. Take Cp =1.005kJ/kgK. (10)

13. a. What is meant by the term FAD in compressors? How FAD is found ? (4)

    b. Obtain an expression for minimum work to be done on a two-stage reciprocating compressor with perfect intercooling. (6)

14. a. Explain the working of a screw compressor. Give their applications. (5)

    b. A single acting reciprocating air compressor with air entering at 1bar and leaving at 7bar following $pv^{1.3}$= constant. Free air delivered is 5.6m^3/min and mean piston speed is 150m/min. Take stroke to bore ratio of 1.3 and clearance volume to be $1/5^{th}$ of swept volume per stroke. The suction temperature and pressure are atmospheric. Determine i) the volumetric efficiency ii) Speed of rotation and iii) Stroke and bore. (5)

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Total Pages: 2

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code: ME206

Course Name: FLUID MACHINERY (ME)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions. Each question carries 10 marks.

1		Derive expression for the force exerted by the jet of water on a series moving flat plate placed on the periphery of a wheel. Also find the maximum efficiency?	(10)
2	a)	Give the comparison between impulse and reaction turbines	(4)
	b)	A Pelton wheel having a mean bucket diameter of 1.2m is running at 1000 r.p.m. The net head on the Pelton wheel is 840 m. If the side clearance angle is 15° and discharge through the nozzle is 0.12 m^3/s. Determine: - (i) Power available at the nozzle (ii) Hydraulic efficiency of the turbine.	(6)
3		An inward flow reaction turbine has external and internal diameters as 0.9m and 0.45 m respectively. The turbine is running at 200 r.p.m and the width of the turbine at the inlet is 0.2 m. The velocity of flow through the runner is constant and is equal to 1.8 m/s. The guide blades make an angle of 10° to the tangent of the wheel and discharge at the outlet of turbine is radial. Draw the inlet and outlet velocity triangles and determine:- (i) Relative velocity at inlet (ii) The runner blade angles (iii) Width of the runner at outlet (iv) Head at the inlet of the turbine (v) Power developed (vi) Hydraulic efficiency of the turbine.	(10)
4	a)	What is cavitation? On what factors does the cavitation in water turbines depend?	(4)
	b)	A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 m^3/s. If the overall efficiency is 90 percent. Determine: - (i) Power generated (ii) Specific speed of the turbine (iii) Type of turbine.	(6)

PART B

Answer any three questions. Each question carries 10 marks

5	a)	Define the following terms: - (i) Static head (ii) Manometric head (iii) Total Head	(4)
	b)	A centrifugal pump is running at 1000 r.p.m and working against head of 20 m. The rate of flow through the pump is 0.2 m^3/s. The outlet vane angle of impeller is 45º and velocity of flow at outlet is 2.5 m/s. If the Manometric efficiency of the pump is 80 percent, calculate the diameter and width of impeller at outlet.	(6)
6	a)	Define specific speed of a centrifugal pump. Derive expression for the same.	(5)
	b)	What is negative slip in a reciprocating pump? Explain with neat sketches the functions of air vessels in a reciprocating pump?	(5)

7		The diameter and stroke length of a single-acting reciprocating pump are 75 mm and 150 mm respectively. It takes its supply of water from a sump 3 m below the pump through a pipe 5 m long and 40 mm in diameter. It delivers water to a tank 12 m above the pump through a pipe 30 mm in diameter and 15 m long. If separation occurs 75 kN/m^2 below the atmospheric pressure. Find the maximum speed at which pump may be operated without separation. Assume that the piston has a simple harmonic motion.	(10)
8	a)	Describe with the aid of neat sketch the construction and working of a Hydraulic Ram.	(5)
	b)	With the aid of a sketch explain the working of a Hydraulic Accumulator?	(5)

PART C

Answer any four questions. Each question carries 10 marks.

9		A double acting air compressor works with an indicated power of 37kW. Air is drawn at 1 bar and 300 K and compressed, according to the law $PV^{1.2}$ = Constant to 7 bar. The compressor runs at 200 r.p.m with average piston speed 2.5 m/s. Neglect clearance. Find the dimensions of the cylinder.	(10)
10		Derive an expression for indicated work of a reciprocating air compressor by neglecting clearance volume.	(10)
11		Describe the principle of operation, construction and working of centrifugal compressor.	(10)
12	a)	Compare axial flow compressor with centrifugal compressor.	(5)
	b)	Distinguish surging and stalling phenomenon happens at off design condition in axial flow compressor?	(5)
13	a)	Derive expression of work done for axial flow compressor.	(6)
	b)	Draw the performance characteristics, pressure coefficient and flow coefficient for backward curved, radial and forward curved vane impeller of a centrifugal compressor?	(4)
14	a)	Draw the stage velocity triangles for an axial compressor with upstream guide vanes, rotor blades and diffuser blades.	(5)
	b)	Explain the construction and working of a roots blower.	(5)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: ME206
Course Name: FLUID MACHINERY (ME)

Max. Marks: 100 Duration: 3 Hours

PART A
Answer any three questions. Each question carries 10 marks.

1	a)	In a Pelton wheel turbine, the runner of the turbine is provided with double hemi-spherical cup shaped buckets instead of single curved blade. why?	4
	b)	A jet of 7.5cm diameter strikes a flat plate, normal of which is inclined at 45^0 to the axis of the jet with a velocity of 25m/s. Find the normal force exerted on the plate i) When the plate is stationery ii) When the plate is moving with a velocity of 15m/s in the direction of jet and away from the jet.	6
2	a)	Explain advantages and disadvantages of a Pelton turbine?	3
	b)	Prove that the hydraulic efficiency of a Pelton wheel turbine is maximum when the jet velocity striking the runner is twice the tangential velocity of the runner?	7
3	a)	What is meant by specific speed of a turbine? What is its significance?	4
	b)	With neat sketches, explain the working servo motor mechanism of governing of a pelton turbine.	6
4	a)	Explain the theory of draft tube in reaction turbine. How is the turbine performance affected in the absence of draft tube?	5
	b)	A Kaplan turbine is designed to develop 9MW power while operating under a net head of 7m. The speed ratio based on outer diameter and flow ratios are to be 2.09 and 0.68 respectively and the ratio of outer to hub diameter is 3. Assuming an overall efficiency of 85%, find the speed and specific speed of the turbine.	5

PART B
Answer any three questions. Each question carries 10 marks

5	a)	Reciprocating pumps are called positive displacement pump why?	3
	b)	A centrifugal pump lifts $2.5m^3$/min of water to a height of 20m through a pipe line of 10cm diameter. The total length of the pipe line is 11 0m. Assuming an overall efficiency of 75% and an inlet loss of 0.3m, find the power required to drive the pump. Take coefficient of friction f = 0.012	7

6	a)	What is meant by cavitation in centrifugal pump? What are the effects of cavitation? How it can be eliminated	5
	b)	Show that the saving in work done against friction in a double acting reciprocating pump fitted with air vessel is 39.2%	5
7	a)	Define minimum starting speed of a centrifugal pump. Write down the equation for the same with notations.	4
	b)	With the help of necessary sketch, explain the working of a jet pump? Where are they used?	6
8	a)	What is meant by manometric head of a centrifugal pump? What are the different ways of finding it?	4
	b)	The bore and stroke of a double acting reciprocating pump are 15cm and 30cm respectively. The suction and delivery heads are 3m and 30m and the pump delivers $0.62m^3$/min when running at 60rpm. Find the percentage slip and power required to run the pump if mechanical efficiency is 80%.	6

PART C

Answer any four questions. Each question carries 10 marks.

9	a)	Deduce an equation for the work done on a reciprocating compressor in terms of pressure ratio using P-v diagram. Assume the process of compression fallows polytropic according to pv^n = a constant.	5
	b)	A single stage single acting reciprocating air compressor is used to compress $7x10^{-3}$ m^3/min of air from a pressure of 1.013 bar to 14 bar. The index of polytropic compression is 1.3 and mechanical efficiency is 82%. Determine the volumetric efficiency and power required to drive the compressor if the clearance is 3% of the swept volume.	5
10	a)	Define the following with reference to reciprocating compressors i) Isothermal efficiency ii) Adiabatic efficiency iii) Volumetric efficiency	3
	b)	Obtain the expressions for volumetric efficiency of an air Compressor in terms of clearance ratio, index of compression and pressure ratio.	7
11	a)	What are the advantages and disadvantages of multistage compression?	4
	b)	Prove that for a multi stage compressor with perfect intercooling between stages, the work done is minimum when the intermediate pressure is the geometric mean of the suction and delivery pressure between successive stages.	6
12	a)	Define slip factor and pressure coefficient in centrifugal compressors	4

b) An axial flow compressor draws in air at 20^0C and delivers it at 50^0C. Assuming 50% degree of reaction, calculate the velocity of flow and number of stages if blade velocity is 100m/s, work factor as 0.85. Assume the blades are symmetrical and air inlet and exit angle $\alpha = 10^0$, $\beta = 40^0$ 6

13 A centrifugal compressor has a compression ratio of 4:1 with an isentropic efficiency 88% when running at 14000 rpm and including air at 25^0C. Curved vanes at inlet gives the air a pre -whirl of 18^0 to axial direction at all radii and the mean diameter of eye is 245mm. Absolute air velocity at inlet is 120m/s. Impeller tip diameter is 580mm. Calculate the slip factor. 10

14 a) Explain the working of axial flow compressor and obtain the expression for the work done. 5

b) Explain surging and choking in centrifugal compressors. 5

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: ME206

Course Name: FLUID MACHINERY (ME)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions, each carries 10 marks Marks

1 a) Prove that the maximum efficiency of a jet impinging on a series of moving flat plate is 50%. (5)

b) Explain the constructional features of Pelton turbine. (5)

2 a) Define the following: (4)

i) Cross head ii) Net head iii) Hydraulic efficiency iv) Overall efficiency

b) Derive the expression for maximum hydraulic efficiency of a Pelton wheel. (6)

3 a) Explain the types and functions of draft tube. (4)

b) Kaplan turbine works under a head of 26.5 m, the flow rate of waterbeing 170m3/s. The overall efficiency is 90%. Determine the power and specific speed. The turbine speed is 150 rpm. (6)

4 a) What are unit quantities as applied to hydraulic turbines? Why are they important? (4)

b) In a draft tube arrangement for a reaction turbine the flow rate is 150m^3/s. Inlet area of the draft tube is 15 m^2 while the outside area is 22.5 m^2. The turbine runneroutlet or the draft tube inlet is 0.5 m below the tailrace level. If the kinetic head recovered by thedraft tube is 80% determine the pressure head at turbine outlet. (6)

PART B

Answer any three questions, each carries 10 marks

5 Differentiate between forced and free vortex Give some examples of occurrence. Show how the velocity and pressure vary with radius in free and forced vortex flow. (10)

6 a) What is Euler head of a centrifugal pump? (4)

b) The diameter and width of a centrifugal pump impeller are 50 cm and2.5 cm. The pump runs at 1200 rpm. The suction head is 6 m and the delivery head is 40 m. The frictional drop in suction is 2 m and in the delivery 8 m. The blade angle at out let is 30°. The manometric efficiency is 80% and the overall efficiency is 75%. Determine the power required to drive the pump. Also calculate the pressures at the suction and delivery side of the pump. (6)

7 a) Explain in brief how and when separation take place in a reciprocating pump also discuss the preventive measures to avoid that. (4)

b) The bore and stroke of a single acting reciprocating water pump are20 cm and 30 cm. The suction pipe is of 15 cm diameter and 10 m long. The delivery pipe is 12 cm diameter and 28 m long. The pump is driven at 32 rpm. Determine the (6)

accelerationheads and the friction head, f = 0.02. Sketch the indicator diagram. The suction and deliveryheads from atmosphere are 4 m and 16 m respectively.

8 a) What is an air vessel? Describeits functions. (4)

b) Show that in a double acting pump the work saved by fitting air vesselsis about 39.2%. (6)

PART C

Answer any three questions, each carries 10 marks

9 a) What is clearance ratio? Write the effect of clearance volume on the performance of an air compressor. (4)

b) Derive the volumetric efficiency of a reciprocating compressor considering clearance volume. (6)

10 A single acting reciprocating compressor has bore of 25cm and a stroke of 35cm. The compressor runs at 650rpm. The clearance volume is 4% of swept volume. The index of expansion and compression is 1.3. The suction conditions are 0.95 bar and 25^{o}C. The delivery pressure is 6 bar. The atmospheric pressure and temperature are 1.013 bar and 20^{o}C. Determine: (10)

i) FAD ii) Volumetric efficiency iii) Indicated power input.

11 Derive the condition for minimum work required for a 2-stage reciprocating air compressor. (10)

12 Explain the principle of operation, construction and working of a centrifugal compressor with necessary sketches. (10)

13 A centrifugal compressor running at 1500rpm has internal and external diameters of the impellers are 250mm and 500mm respectively the air enters the impeller radially. Determine the work done by the compressor per kg of air and degrees of reaction. (10)

14 a) Explain the working of diffuser in a centrifugal compressor. (4)

b) Explain the working of roots blower. (6)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: ME206
Course Name: FLUID MACHINERY (ME)

Max. Marks: 100 Duration: 3 Hours

PART A
Answer any three questions. Each question carries 10 marks.

1	a)	In a Pelton wheel turbine, the runner of the turbine is provided with double hemi-spherical cup shaped buckets instead of single curved blade. why?	4
	b)	A jet of 7.5cm diameter strikes a flat plate, normal of which is inclined at 45^0 to the axis of the jet with a velocity of 25m/s. Find the normal force exerted on the plate i) When the plate is stationery ii) When the plate is moving with a velocity of 15m/s in the direction of jet and away from the jet.	6
2	a)	Explain advantages and disadvantages of a Pelton turbine?	3
	b)	Prove that the hydraulic efficiency of a Pelton wheel turbine is maximum when the jet velocity striking the runner is twice the tangential velocity of the runner?	7
3	a)	What is meant by specific speed of a turbine? What is its significance?	4
	b)	With neat sketches, explain the working servo motor mechanism of governing of a pelton turbine.	6
4	a)	Explain the theory of draft tube in reaction turbine. How is the turbine performance affected in the absence of draft tube?	5
	b)	A Kaplan turbine is designed to develop 9MW power while operating under a net head of 7m. The speed ratio based on outer diameter and flow ratios are to be 2.09 and 0.68 respectively and the ratio of outer to hub diameter is 3. Assuming an overall efficiency of 85%, find the speed and specific speed of the turbine.	5

PART B
Answer any three questions. Each question carries 10 marks

5	a)	Reciprocating pumps are called positive displacement pump why?	3
	b)	A centrifugal pump lifts $2.5m^3$/min of water to a height of 20m through a pipe line of 10cm diameter. The total length of the pipe line is 11 0m. Assuming an overall efficiency of 75% and an inlet loss of 0.3m, find the power required to drive the pump. Take coefficient of friction f = 0.012	7

6	a)	What is meant by cavitation in centrifugal pump? What are the effects of cavitation? How it can be eliminated	5
	b)	Show that the saving in work done against friction in a double acting reciprocating pump fitted with air vessel is 39.2%	5
7	a)	Define minimum starting speed of a centrifugal pump. Write down the equation for the same with notations.	4
	b)	With the help of necessary sketch, explain the working of a jet pump? Where are they used?	6
8	a)	What is meant by manometric head of a centrifugal pump? What are the different ways of finding it?	4
	b)	The bore and stroke of a double acting reciprocating pump are 15cm and 30cm respectively. The suction and delivery heads are 3m and 30m and the pump delivers $0.62m^3$/min when running at 60rpm. Find the percentage slip and power required to run the pump if mechanical efficiency is 80%.	6

PART C

Answer any four questions. Each question carries 10 marks.

9	a)	Deduce an equation for the work done on a reciprocating compressor in terms of pressure ratio using P-v diagram. Assume the process of compression fallows polytropic according to pv^n = a constant.	5
	b)	A single stage single acting reciprocating air compressor is used to compress $7x10^{-3}$ m^3/min of air from a pressure of 1.013 bar to 14 bar. The index of polytropic compression is 1.3 and mechanical efficiency is 82%. Determine the volumetric efficiency and power required to drive the compressor if the clearance is 3% of the swept volume.	5
10	a)	Define the following with reference to reciprocating compressors i) Isothermal efficiency ii) Adiabatic efficiency iii) Volumetric efficiency	3
	b)	Obtain the expressions for volumetric efficiency of an air Compressor in terms of clearance ratio, index of compression and pressure ratio.	7
11	a)	What are the advantages and disadvantages of multistage compression?	4
	b)	Prove that for a multi stage compressor with perfect intercooling between stages, the work done is minimum when the intermediate pressure is the geometric mean of the suction and delivery pressure between successive stages.	6
12	a)	Define slip factor and pressure coefficient in centrifugal compressors	4

b) An axial flow compressor draws in air at 20^0C and delivers it at 50^0C. Assuming 50% degree of reaction, calculate the velocity of flow and number of stages if blade velocity is 100m/s, work factor as 0.85. Assume the blades are symmetrical and air inlet and exit angle $\alpha = 10^0$, $\beta = 40^0$ 6

13 A centrifugal compressor has a compression ratio of 4:1 with an isentropic efficiency 88% when running at 14000 rpm and including air at 25^0C. Curved vanes at inlet gives the air a pre -whirl of 18^0 to axial direction at all radii and the mean diameter of eye is 245mm. Absolute air velocity at inlet is 120m/s. Impeller tip diameter is 580mm. Calculate the slip factor. 10

14 a) Explain the working of axial flow compressor and obtain the expression for the work done. 5

b) Explain surging and choking in centrifugal compressors. 5

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: ME206

Course Name: FLUID MACHINERY (ME)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions, each carries 10 marks Marks

1 a) Find an expression for the efficiency of a series of moving curved vanes when a jet of water strikes the vanes at one of its tips and show that the maximum efficiency is 50%. (4)

b) (i) Find the force exerted by the jet on a stationary vertical plate. (3)

(ii) find the force exerted by a jet of water of diameter 75mm on a stationary flat plat, when the jet strikes the plate normally with velocity of 20m/s. (3)

2 a) A Pelton wheel is to be designed for a head of 60m when running at 200r.p.m. The Pelton wheel develops 95.6475kw shaft power. The velocity of the buckets is 0.45 times the velocity of the jet, overall efficiency is 0.85 and co-efficient of the velocity is equal to 0.98 (6)

b) Define the following terms of Turbine: (4)

(i) Gross head

(ii) Net head

(iii) Hydraulic efficiency

(iv) Mechanical efficiency

3 a) i) What is governing of turbines? (1)

ii) With neat sketch explain the governing of impulse turbine. (4)

b) What is the function of draft tube? With neat sketch explain draft tube theory (5)

4 a) A turbine is operating under a head of 25m at 200r.p.m. The discharge is 9m³/s. If the efficiency is 90%, determine: (6)

(i) Power generated

(ii) Specific speed of the turbine, and

(iii) Type of turbine.

b) (i) what is the significance of Type number in Turbines (4)

(ii) Define specific speed of a turbine. Derive an expression for the same.

PART B

Answer any three questions, each carries 10 marks

5 a) The diameter of an impeller of a centrifugal pump at inlet and outlet are 30cm and 60cm respectively. Determine the minimum starting speed of the pump if it works against a head of 30cm. (4)

b) With neat sketch explain the performance characteristic curves of a centrifugal pump. (6)

6 a) Define the following terms of centrifugal pump (4)

(i) Suction head

(ii) Delivery head

(iii) Static head

(iv) Manometric head.

b) (i) With neat sketch explain various losses in pumps. (3)

(ii) What is priming and explain the necessity of priming (3)

7 a) i) Define ideal indicator diagram. (2)

ii) Show that area of indicator diagram is proportional to the work done by the reciprocating pump (4)

b) A single acting reciprocating pump, running at 50 r.p.m delivers 0.01m³/s of water. The diameter of the piston is 200mm and stroke length 400mm. (4)

determine:

i) The theoretical discharge of the pump.

ii) Co-efficient of discharge

iii) Slip and percentage slip of the pump.

8 a) Show from first principle that work saved against friction in the delivery pipe of a double – acting reciprocating pump, by fitting air vessel is 39.2%. (4)

b) With neat sketch explain the following

(i) Hydraulic Ram (3)

(ii) Lobe pump (3)

PART C

Answer any four questions, each carries 10 marks

9 a) A single acting, single cylinder reciprocating air compressor has a cylinder diameter of 200mm and a stroke of 300mm. Air enters the cylinder at 1bar, 27ºC. It is then compressed polytropically to 8 bar according to the law $PV^{1.3}$ = Constant. If the speed of the compressor is 250rpm, calculate (i) the mass of air compressed per minute and (ii) the power required in KW for driving the compressor, if mechanical efficiency is 80%. Neglect clearance. (5)

b) Prove that the work done per Kg of air in a compressor is given by (5)

W= $RT_1 \frac{n}{n-1} [(r_p)^{\frac{n}{n-1}} - 1]$ where (r_p) = pressure ratio.

10 a) A single stage reciprocating air compressor is compressing 2kg of air per minute at 1 bar 20ºC and it delivers it at 7 bar. Assuming compression process follows the law $PV^{1.3}$ = Constant. Calculate indicated power input to compressor, neglect clearance. (5)

b) Prove that for complete inter - cooling between two stages, the compression work would be minimum when intermediate pressure $p_2 = \sqrt{p_1 \times p_3}$ where p_1 and p_3 are suction and delivery pressure respectively. (5)

11 a) State how are the air compressors classified? (4)

b) Describe with a neat sketch the construction and working of a single-stage, single-acting reciprocating air compressor? (6)

12 a) With neat sketch explain surging and chocking (5)

b) Explain the methods to improve the isothermal efficiency of an air compressor (5)

13 a) `Air at a temperature of 305^0K flows in a centrifugal compressor running at 16000 rpm. Isentropic efficiency of the compressor is 80%. Outer diameter of the blade tip is 600mm. Take slip factor as 0.85. Calculate (6)

(i) The temperature rise of air passing through the compressor

(ii) The static pressure ratio.

b) Derive the expression for width of impeller blade for centrifugal compressor (4)

14 a) With neat sketch explain the construction and working of a vane compressor (4)

b) Discuss the merits and demerits of a centrifugal compressor over axial flow compressor. (6)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: ME206

Course Name: FLUID MACHINERY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions, each carries 10 marks Marks

1	a)	Estimate the force exerted by a jet of water on an unsymmetrical moving curved plate when jet strikes tangentially at one of the tips. Also obtain the expression for work done. Assume, blade angles at inlet and exit are θ and φ and the blade is moving with a velocity $\boldsymbol{u}$.	6
	b)	Differentiate the construction and working of an impulse and a reaction turbine.	4
2		The water fed from Idukki reservoir to Moolamattam power house is 6 m^3/s at a total head of 250 m through a single penstock of 500 m long. The turbine has four Pelton wheels with two nozzles each. The efficiency of power transmission through the penstock is 90% and overall efficiency is 85%. The coefficient of velocity for each nozzle may be assumed as 0.95 and the friction factor as 0.02. Determine the (a) power output of the plant (b) diameter of each nozzle (c) penstock diameter. Assume that all the nozzles have same diameter. Assume radial outlet.	10
3		An outward flow reaction turbine has the inner and outer diameters as 1.50m and 2.0 m, respectively, and is rotating at 300 rpm operating under an effective head of 60 m. The runner has 30 vanes 10 mm thick at inlet and at the outlet. The width of the passage is 30 cm throughout. The discharge through the turbine is 10 m^3/s. Determine (a) the blade angles at inlet and outlet and (b) power developed by the runner.	10
4	a)	Define the specific speed of a turbine and derive the expression for it. Explain the significance of specific speed in the selection of a turbine.	6
	b)	Explain the working of a draft tube in a axial reaction turbine with neat sketch. What is the reason for the absence of draft tube in an impulse turbine?	4

PART B

Answer any three questions, each carries 10 marks

5	a)	The construction details of a centrifugal pump is a follows Impeller diameter = 50 cm Impeller width = 2.5 cm Speed = 1200 rpm Suction head = 6 m Delivery head = 40 m Outlet blade angle = 30°. Manometric efficiency = 80% Overall efficiency = 75%. Determine the power required to drive the pump. Also calculate the pressures at the suction and delivery side of the pump. Assume the frictional drop in suction is 2 m and in the delivery 8m and inlet swirl as zero.	6
	b)	Classify different types of vortex fluid flows and write down the relevant governing equations.	4
6	a)	Draw the performance curves of a centrifugal pump. Also discuss the effect of	6

		blade outlet angles	
	b)	Explain the significance of NPSH in the installation of a centrifugal pump	4
7	a)	Determine the maximum speed of a single-acting reciprocating pump if separation head is 3 m of water (abs). The pump is placed 3 m above the sump level and it delivers water to a tank placed 15 m above its centre line. The pump has 100 mm bore and 180 mm stroke. The diameter of suction and deliver pipe is 40 mm whereas the length of suction pipe is 4 m and that of delivery pipe 18 m.	5
	b)	How does the slip phenomenon occur in a reciprocating pump? Quantify the slip factor and comment whether the negative slip-factor is possible.	5
8		A single acting reciprocating pump of 200 mm bore and 300 mm stroke runs at 30 rpm. The suction head is 4 m and the delivery head is 15 m. Considering acceleration determine the pressure in the cylinder at the beginning and end of suction and delivery strokes. Take the value of atmospheric pressure as 10.3 m of water head. The length of suction pipe is 8 m and that of delivery pipe is 20 m. The pipe diameters are 120 mm each.	10

PART C

Answer any four questions, each carries 10 marks

9		Draw the indicator diagram of a single acting reciprocating compressor with clearance volume and explain the working. Also derive the expression for work done in terms of pressure ratio and effective swept volume.	10
10		A double acting single-stage reciprocating compressor delivers air at the rate of 15 m^3/min. (at 1 bar and 15^0C). The suction pressure and temperature in the cylinder are 1 bar and 32^0C. The delivery pressure is 7 bar and compression and expansion index is 1.3. The clearance volume is 5% of the swept volume. Calculate indicated power and volumetric efficiency.	10
11		Write short notes on (i) FAD (ii) isothermal efficiency (iii) intercooler (iv) clearance-ratio in connection with a reciprocating compressor.	10
12		With a neat sketch elaborate the working of a centrifugal compressor and derive the Euler's equation.	10
13		A centrifugal compressor running at 1440 rpm handles air at 101kPa and 21^0C and isentropically compresses it to a pressure 6 bar. The inner and outer diameters of impeller are 14cm and 28cm respectively. The width of the blade at the inlet is 250 mm. The blade angles are 16^0 and 40^0 at entry and exit. Calculate the mass flow rate of air, degree of reaction, power input and width of blades at outlet.	10
14	a)	Derive the expression of degree of reaction of an axial flow air compressor in terms of blade angles and blade velocity.	6
	b)	Explain the working of (i) vane compressor and (ii) screw compressor	4

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth semester B.Tech examinations (S), September 2020

Course Code: ME206

Course Name: FLUID MACHINERY (ME)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions, each carries 10 marks Marks

1	a)	A nozzle forming a jet of 50 mm diameter is supplied with water under a constant head of 75 m. The jet is directed to strike perpendicularly on to a fixed flat plate. Calculate the force exerted by the jet on the plate. Take velocity coefficient of the nozzle as 0.92.	4
	b)	Show that the maximum efficiency for a semi-circular vane when the jet strikes at the centre is 59.26 %.	6
2	a)	Differentiate between inward flow and outward flow reaction turbines.	3
	b)	Water flows through a vertical Francis turbine at the rate of 15.5 m^3/s and makes its runner to rotate at 428.4 rpm. The velocity and pressure head at the inlet of the spiral casing are 8.5 m/s and 240 m respectively and the centre line of its inlet is 3 m above the tail race level. The diameter and width of the runner at inlet are 2 m and 300 mm respectively, determine output power, guide vane angle and runner vane angle at inlet.	7
3	a)	Give the significance of unit and specific quantities.	3
	b)	Define unit speed, unit discharge and unit power of a turbine.	3
	c)	In a projected low head hydroelectric scheme 283 m^3/s of water are available under a head of 3.66 m. Alternative schemes to use Francis turbines having a specific speed of 400 or Kaplan turbines with a specific speed of 686 are investigated. The normal running speed is 50 rpm in both the schemes. Compare the proposals so far as the numbers of machines are concerned and estimate the power to be developed by each machine. The units in either installations are to be of equal power and the efficiency of each type may be assumed to be 90%.	4
4	a)	Illustrate the functions of surge tanks.	4
	b)	Illustrate cavitations in hydraulic turbines.	6

PART B

Answer any three questions, each carries 10 marks

5	a)	State the differences between a radial flow turbine and a rotodynamic pump.	3
	b)	Write short note on 'multi stage centrifugal pumps'.	7
6	a)	What do you mean by NPSH?	3
	b)	Derive an expression for the minimum starting speed of a centrifugal pump.	4
	c)	Find the number of pumps required to take water from a deep well under a total head of 89 m. All pumps are identical and running at 800 rpm. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m^3/s.	3
7	a)	Distinguish between rotodynamic pump and positive displacement pump.	4
	b)	The diameter and stroke of a single acting reciprocating pump are 200 mm and 400 mm respectively. The pump runs at 60 rpm and lifts 12 litres of water per second through a height of 25 m. The delivery pipe is 20 m long and 150 mm in diameter. Find the theoretical power required to run the pump, percentage of slip and acceleration head at the beginning and middle of the delivery stroke.	6
8	a)	With a neat diagram illustrate the working of 'hydraulic accumulator'.	6
	b)	Illustrate the working of 'jet pump'.	4

PART C

Answer any four questions, each carries 10 marks

9		A single acting reciprocating air compressor delivers air at 7.5 bar. The pressure and temperature at the end of suction stroke are 1 bar and 25^0C. It delivers 2.2 m^3 of free air when running at 310 rpm. The clearance volume is 5% of stroke volume. The pressure and temperature of ambient air are 1.03 bar and 20^0C. If the compression follows $PV^{1.25} = C$ and expansion follows $PV^{1.3} = C$ determine the volumetric efficiency of the compressor, diameter and stoke of the cylinder if both are equal, indicated power and brake power if the mechanical efficiency is 85%.	10
10	a)	With the help of neat diagrams illustrate the working of a multi stage reciprocating air compressor. List the advantages of multi stage compression over single stage compression.	6
	b)	Define and derive volumetric efficiency of a reciprocating compressor in terms of clearance ratio.	4
11	a)	Derive the relation between suction pressure, intermediate pressure and delivery	7

pressure for a two stage reciprocating air compressor with perfect intercooling.

b) Compare reciprocating and rotary air compressors. 3

12 A single inlet type centrifugal compressor handles 528 kg/min. of air. The ambient air conditions are 1 bar and 20^0C. The compressor runs at 20000 rpm with isentropic efficiency of 80%. The air is compressed in the compressor from 1 bar static pressure to 4 bar total pressure. The air enters the impeller eye with a velocity of 145 m/s with no pre-whirl. Assuming that the ratio of whirl speed to tip speed is 0.9, calculate rise in total temperature during compression if the change in kinetic energy is negligible, the tip diameter of the impeller, power required and eye diameter if the hub diameter 12 cm. 10

13 a) Explain the construction and working of an axial flow air compressor. 7

b) Define degree of reaction. Discuss the significance of 50% reaction blading. 3

14 a) Explain surging and choking in centrifugal compressors. 5

b) Explain the construction and working of roots blower. 5

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