Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2017

Course Code**: CE206**

Course Name**: FLUID MECHANICS II (CE)**

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any 2 questions. Each question carries 15 marks.

1. A Kaplan turbine working under a head of 20 m develops 11772 kW shaft power. The outer diameter of the runner is 3.5 m and hub diameter 1.75 m. The guide blade angle at the inlet at the extreme edge of the runner is 35º. The hydraulic and the overall efficiencies of the turbines are 88% and 84% respectively. If the velocity of whirl is zero at the outlet, determine:
   a) Runner vane angles at the inlet and outlet at the extreme edge of the runner.
   b) Speed of the turbine.

2. a. Show that the force exerted by a fluid jet in its direction of flow on a semicircular vane is twice that exerted on a flat vertical plate, both plates being fixed in position. (9)

   b. What are the different types of draft tubes? (6)

3. A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 35 m. The velocity of flow through the impeller is constant and equal to 2.4 m/s. The vanes are set back at an angle of 40º at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine:
   i) Vane angle at inlet
   ii) Work done by impeller on water per second, and
   iii) Manometric efficiency.

PART B

Answer any 2 questions. Each question carries 15 marks.

4. a. Derive Chezy's equation for uniform flow in a channel section. (8)

   b. For a constant specific energy of 2.4 N.m/N, calculate the maximum discharge that may occur in a rectangular channel of 4.0 m wide. (7)

5. a. Explain the velocity distribution in an open channel. (5)

b. A trapezoidal irrigation channel, having side slopes 3 horizontal to 2 vertical, is to carry a flow of 10 cumecs on a longitudinal slope of 1 in 5000. The channel is to be lined for which the value of Manning's coefficient is 0.012. Find the dimensions of the most economic section of the channel. (10)

6. Derive the expression for conjugate depths and energy loss associated with hydraulic jump in rectangular channels.

PART C

Answer any 2 questions. Each question carries 20 marks.

7. a. Derive the dynamic equation of gradually varied flow in a channel, stating the assumptions involved. (10)

   b. A rectangular channel of 8.0 m wide has a uniform depth of flow of 2.0 m and has a bed slope of 1 in 3000. If due to weir constructed at the downstream end of the channel, water surface at a section is raised by 0.5m, determine the water surface slope with respect to horizontal at this section. Assume Manning's n= 0.02. (10)

8. a. Explain, with sketches, the various surface profiles that are possible in an open channel. (12)

   b. Derive the equation for the computation of length of backwater curve by step method. (8)

9. For laminar flow in a pipe, the pressure drop ΔP in pipe of diameter D and length L depends on the density ρ and viscosity μ of the flowing fluid, mean velocity of flow V and the average height of surface roughness of pipe (t). Show by Rayleigh's method, the pressure drop ΔP is given by

$$\Delta P = \rho V^2 f[(L/D)(t/D)(\mu/\rho V D)] \quad (20)$$

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code: CE206

Course Name: FLUID MECHANICS II (CE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions. Each question carries 15 marks.

1	a)	Derive the expression for work done by the jet per second on a moving flat plate.	(5)
	b)	A Pelton wheel has a mean bucket speed of 15 m/s and is supplied with water at a rate of 0.850 m^3/s under a head of 40m. If the bucket deflects the jet through an angle of 150º, find the power developed by the turbine and its hydraulic efficiency. Take the coefficient of velocity as 0.98. Neglect friction in the bucket. Also determine the overall efficiency of the turbine if its mechanical efficiency is 78%.	(10)
2	a)	Compare the velocity triangles for a Francis turbine and that of a Centrifugal pump.	(5)
	b)	A jet of water moving at 18 m/s impinges on a symmetrical curved vane shaped to deflect the jet through 120^0. If the vane is moving at 4m/s, find the angle of the jet so that there is no shock at inlet. Also calculate the work done per unit weight of water.	(10)
3	a)	What is priming of a centrifugal pump. Why is it necessary?	(5)
	b)	A centrifugal pump delivers water against a net head of 15m and a design speed of 1200 rpm. The vanes are curved back at an angle of 30^0 with the periphery. The impeller diameter at the outlet is 300mm and the outlet width is 60mm. Determine the discharge of the pump if manometric efficiency is 96%. Assume outflow as radial at outlet.	(10)

PART B

Answer any two full questions. Each question carries 15 marks.

4	a)	Compare Open channel flow and pipe flow.	(5)
	b)	A flow of 150 litres per second flows through a rectangular flume of width 0.5m and having adjustable bottom slope. If Chezy`s constant, C is 50, determine the bottom slope necessary for uniform flow with a depth of 0.4m. Also determine the conveyance and state of flow.	(10)
5	a)	What is meant by most economical section of an open channel? Enumerate the conditions for rectangular and trapezoidal channel to be most economical.	(5)
	b)	Draw the specific energy diagram showing critical point where the specific energy is minimum. Prove that $E_{min} = (3/2)\ y_c$ for a rectangular channel section, where y_c is the critical depth.	(5)
	c)	A 4m wide rectangular channel discharges $16m^3/s$ of water at a depth of 3m. Calculate (i) specific energy (ii) critical depth (iii) minimum specific energy.	(5)

6 a) Define hydraulic jump. What are the practical applications of a hydraulic jump? (5)

b) A horizontal rectangular channel 3.5m wide carries discharge of $15m^3/s$. Check whether a jump may occur at an initial depth of 0.55m or not. If a jump occurs, determine the sequent depth to this initial depth. Also calculate the energy loss in the jump. (10)

PART C

Answer any two full questions. Each question carries 20 marks

7 a) Derive the dynamic equation for gradually varied flow. (8)

b) Assuming that the rate of discharge Q of a centrifugal pump is dependent upon the mass density ρ of the fluid, pump speed N (rpm), diameter of the impeller D, the pressure p and the viscosity of fluid μ, show using the Buckingham`s π theorem that it can be represented by (12)

$$Q = (ND^3)\ \phi\ [(gH/N^2D^2), (\upsilon/ND^2)]$$

Where H= head and υ= kinematic viscosity of the fluid, g = acceleration due to gravity.

8 a) Sketch the water surface profiles occurring in mild slope channel and steep slope channel. (10)

b) Design a concrete lined channel to carry a discharge of $500m^3/s$ at a slope of 1 in 4000. The side slopes of the channel may be taken as 1:1. The Manning`s roughness coefficient for the lining is 0.014. Assume permissible velocity in the section as 2.5m/s. (10)

9 a) What is dimensional homogeneity? (4)

b) A 1:10 scale model of a passenger car is tested in a wind tunnel. The prototype velocity is 40kmph. If the model drag is 350N, what is the drag and the power required to overcome the drag in the prototype. Assuming the air in the model and prototype to have the same properties. (10)

c) Explain the different types of similarities. (6)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: CE206

Course Name: FLUID MECHANICS II (CE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1	a)	Explain the functions of draft tube.	(4)
	b)	List down the classification of turbines.	(3)
	c)	A jet of water 75 mm diameter having a velocity of 20 m/s strikes normally a flat smooth plate. Determine the thrust on the plate if: i) if the plate is at rest ii) if the plate is moving in the same direction as the jet with a velocity of 5 m/s. Also find the work done per second on the plate in each case and the efficiency of jet when the plate is moving	(8)
2	a)	What do you mean by specific speed of a centrifugal pump?	(3)
	b)	Obtain an expression for minimum speed to start a centrifugal pump.	(8)
	c)	Explain cavitation in centrifugal pump.	(4)
3	a)	Derive an expression for hydraulic efficiency of a Pelton wheel.	(7)
	b)	A centrifugal pump having outer diameter equal to two times the inner diameter andrunning at 1200 rpm works against a total head of 48m. The velocity of flow through theimpeller is constant and equal to 3m/s. The vanes are set back at an angle of 40^0 atoutlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50mm,determine the vane angle at inlet, work done by impeller on water per second andmanometric efficiency.	(8)

PART B

Answer any two full questions, each carries 15 marks.

4	a)	Define Conveyance of a channel section.	(2)
	b)	Write a short note on velocity distribution in open channels.	(5)
	c)	A circular drainage pipe 0.8m in diameter conveys a discharge at a depth of 0.3m. If the pipe is laid on a slope of 1 in 1000, estimate the discharge. N=0.02.	(8)
5	a)	Define section factor for critical flow.	(3)
	b)	What are the applications of hydraulic jump?	(4)
	c)	Obtain an expression for energy loss due to a hydraulic jump in horizontal rectangular channels.	(8)
6	a)	Prove that the most economical trapezoidal section is a half hexagon.	(7)
	b)	A 3m wide rectangular channel carries a total discharge of 12 m^3/s. Calculate: i) the critical depth ii) the minimum specific energy iii) the alternate depths when E = 4 m.	(8)

PART C

Answer any two full questions, each carries 20 marks.

7 a) With neat sketches explain the classification of water surface profiles. (10)

b) Design a lined canal to carry 100 m^3/s on a slope of 1 in 2500. The maximum permissible velocity is 2 m/s, N=0.013 and side slope is 1.25 H to 1 V. (10)

8 a) Differentiate between distorted models and undistorted models. (4)

b) Obtain scale ratios for time, acceleration, force and power based on Froude model law. (6)

c) Define the following: (3)
i) Mach Number ii) Weber number iii) Euler's number

d) A pipe of diameter 1.5 m is required to transport an oil of specific gravity 0.90 and viscosity 3×10^{-2} poise at a rate of 3000litre/s. Tests were conducted on a 15cm diameter pipe using water at 20^0C. Find the velocity and rate of flow in the model. Viscosity of water at 20^0C = 0.01poise. (7)

9 a) The frictional torque T of a disc of diameter D rotating at a speed of N in a fluid of viscosityμ and density ρ in a turbulent flow is given by $T=D^5N^2\ \rho\phi(\mu/D^2N\rho)$. (10)

b) A trapezoidal channel having bottom width 6m, side slope 2H to 1 V, N=0.025 and bottom slope 0.0016 carries a discharge of 10 m^3/s. Compute the back water profile created by a dam which backs up the water to a depth of 2m immediately behind the dam. Use the direct step method for computation. (10)

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Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: CE206

Course Name: FLUID MECHANICS -II.

Max. Marks: 100 Duration: 3 Hours

Answer any two Questions from each part.

PART A

1. a) Derive an expression for maximum hydraulic efficiency of a Pelton wheel. (5)
   b) A jet of water having a velocity of 45m/s impinges without shock a series of vanes moving at 15m/s, the direction of motion of the vanes being inclined at 20^0 to that of the jet. The relative velocity at outlet is 0.9 of that at inlet, and the absolute velocity of the water at exit is to be normal to the motion of the vanes. Find: (a) vane angles at entrance and exit (b) work done on vanes per unit weight of water supplied by the jet; and (c) the hydraulic efficiency. (10)
2. a)Explain with figure the function of a surge tank in a hydroelectric plant. (5)
   b)Determine the overall efficiency of a Kaplan turbine developing 3000kW under a net head of 5m.It is provided with a draft tube with its inlet diameter 3m set 1.6m above the tail race level. A vacuum gauge connected to the draft tube indicates a reading of 5m of water. Assume draft tube efficiency as 78%.Neglect losses in the draft tube. (10)
3. a) Define the terms (i) Specific speed of a centrifugal pump and (ii) Net Positive Suction Head. (5)
   b)The diameter of an impeller of a centrifugal pump at the inlet and outlet are 36cm and 72cm respectively. The velocity of flow at outlet is 2.4m/s and the vanes are set back at angle of 45^0 at outlet. Determine the minimum starting speed if the manometric efficiency is 70%. (10)

PART B

4. a) Differentiate between (i) Gradually varied flow and rapidly varied flow, (ii)subcritical and supercritical flow. (6)
   b) A trapezoidal channel with side slopes of 2 horizontal : 1 vertical has to be designed to carry 15 m^3/s at a slope of 1/5000. Determine the dimensions of the efficient section.Manning's coefficient is 0.014. (9)
5. a) A rectangular channel 3.5m wide is laid on a slope of 0.0005. Calculate the normal depth of flow for a discharge of $5m^3/s$ in this channel. The Manning's coefficient can be taken as 0.02. (7)

b)On what slope should one construct a 3m wide rectangular channel (Manning's coefficient is 0.014) so that critical flow will occur at a normal depth of 1.2m? (8)

6. a) Differentiate between alternate depths and conjugate depths. (5)
   b) In a hydraulic jump on a horizontal rectangular channel the depth and Froude number before the jump are 0.2 m and 9 respectively. Estimate the energy loss and specific energy head at the end of the jump. (10)

PART C

7. a) Sketch the water surface profiles that can occur in a steep slope channel. (7)
   b) In a rectangular channel 12 m wide and 3.6 m deep water is flowing with a velocity of 1.2 m/s. The bed slope of the channel is 1 in 4000. If flow of water through the channel is regulated in such a way that energy line is having a slope of 0.00004, find the rate of change of depth of water in the channel. (8)
   c) Differentiate between backwater curve and drawdown curve. (5)
8. a) The resisting force F of a plane during flight can be considered as dependent upon the length of aircraft L, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force using dimensional analysis. (8)
   b) The normal depth of flow of water, in a rectangular channel 1.5 m wide, is one metre. The bed slope of the channel is 0.0006 and Manning's roughness co-efficient is 0.012. Find the critical depth. At a certain section of the same channel the depth is 0.92 m while at a second section the depth is 0.86 m. Find the distance between the two sections. (12)
9. a) Explain the different types of similarities to be ensured between the model and prototype. (5)
   b) Explain the Froude model law and Reynolds model law. (5)
   c) A model of rectangular pier 1.5m wide and 4.5m long in a river is built to a scale of 1: 25.The average depth of water in the river is 3m. The model was tested in a laboratory, where the velocity of flow was maintained constant at 1.65m/s.It was observed that the force acting on the model was 3.92 N and the height of the standing wave was 3.5cm. Determine for the prototype a) the corresponding speed, b) the force acting, c) the height of the standing wave at nose. (10)

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