Hall Ticket No | | | | | | | | | | | Question Paper Code: ACE016

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - I

B. Tech V Semester End Examinations, November - 2019

Regulations: R16

HYDRAULIC AND HYDRAULIC MACHINERY

(CIVIL ENGINEERING)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. a) Give the various characteristics of the critical state of flow through a channel section. **[7M]**

   b) Water flows in a channel of the shape of isosceles triangle of bed width 'a' and sides making an angle of 45^0 with the bed. Find the relations between depth of flow 'd' and bed width 'a' for maximum velocity condition and for maximum discharge condition. Use Maning's formula and note that'd' is less than 0.5 a. **[7M]**

(OR)

2. a) 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. Also, find whether the section is located downstream or upstream with respect to the first section **[7M]**

   b) The depth of flow of water at a certain section of a rectangular channel of 2 m wide is 0.3 m. The discharge through the channel is 1.5 m^3/s. Determine whether a hydraulic jump will occur and if so find its height and loss of energy per kg of water. **[7M]**

UNIT – II

3. a) In 1:30 model of a spill way, the velocity and discharge are 1.5 m/s and 2 m/s. Find the corresponding velocity and discharge in the prototype. **[7M]**

   b) Explain in detail various types of dimensionless numbers. **[7M]**

(OR)

4. a) An air duct is to be modeled to a scale of 1:20 and tested with water which is 50 times viscous and 800 times denser than air. When tested under dynamically similar conditions, the pressure drop between the two sections in the model is 235kPa.What is the corresponding pressure drop in the prototype? **[7M]**

b) Explain the concept of similarities with suitable examples and discuss the different types of similarities with examples. **[7M]**

UNIT – III

5. a) State impulse momentum equation and derive an expression for the force exerted by the jet of water on a flat inclined plate moving with a velocity u. **[7M]**

   b) A jet of water 50 mm in diameter having a velocity of 20 m/s, strikes normally a flat smooth plate. Determine the thrust on the plate if (a) the plate is rest; (b) the plate is moving in the same direction as the jet with a velocity of 8 m/s. Determine work done per second on the plate and the efficiency of the jet when the plate is moving. **[7M]**

(OR)

6. a) Show that the efficiency of a free jet striking normally as series of flat plates mounted on the periphery of a wheel never exceeds 50 %. **[7M]**

   b) Water flows over series of curved vanes of a hydraulic turbine wheel, the diameter of which between inlet tips of vanes is 2 m and that outlet tips is 1 m. The wheel rotates at 240 r. p. m. Jet of water enters at an angle of 300 to the tangent to wheel at inlet with a velocity of 40 m / s and leaves with a velocity of 10 m / s at an angle of 300 to the tangent to wheel at outlet tip. Find (a) Vane angles at entry and exit; (b) Work done on the wheel per newton of water; (c) Hydraulic efficiency of wheel; (d) power developed by the wheel when the discharge flowing through it is 0.3 m^3 / s **[7M]**

UNIT – IV

7. a) Write the detailed procedure for the design of Pelton wheel with formulas by clearly explaining each of the terms involved in it. **[7M]**

   b) A Pelton wheel has to be designed for the following data: Power to be developed = 6000 kW. Neat head available = 300 m, speed = 550 r. p. m; Ratio of jet diameter to wheel diameter = 1 / 10 and overall efficiency = 85 %. Find the number of jets, diameter of jet, diameter of wheel and the quantity of water required. **[7M]**

(OR)

8. a) What are the uses of draft tube? Describe with a neat sketch different types of draft tubes. **[7M]**

   b) A Kaplan turbine runner develops 9300 kW under a net head of 7.4 m. Mechanical efficiency of the wheel is 86 %, speed ratio based on outer diameter is 2.2 and the flow ratio is 0.66, diameter of the boss is 0.35 times the external diameter of the wheel. Determine (a) Diameter of runner, (b) its synchronous speed; (iii) The specific speed of the runner. Assume mechanical efficiency equal to overall efficiency. **[7M]**

UNIT – V

9. a) Show the components of a centrifugal pump with a neat sketch and explain the function of each component in detail. **[7M]**

   b) Find the power required to drive a centrifugal pump which delivers 40 liters of water per second to a height of 20 m through a 150 mm diameter and 100 m long pipe line. The overall efficiency of pump is 70 % and Darcy's f = 0.06 for te pipe line. Assume inlet losses in suction pipe equal to 0.33 m. **[7M]**

(OR)

10. a) Define unit speed and specific speed of the pump and derive the expression for specific speed of the pump. **[7M]**

b) A single stage centrifugal pump with impeller diameter of 30 cm rotates at 2000 r. p. m and lifts 3 m^3 of water per second to a height of 30 m with an efficiency of 75 % . Find the number of stages and diameter of each impeller of a similar multistage pump to lift 5 m^3 of water per second to a height of 200 mwhen rotating at 1500 r. p. m. **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

I	Strengthen the knowledge of theoretical and technological aspects of hydrodynamic forces on jets.
II	Correlate the principles with applications in hydraulic turbines.
III	Apply the practical applications on Francis and Kaplan turbine.
IV	Analysis the similarities between prototype and model types of hydraulic similitude.

COURSE OUTCOMES (COs):

CO 1	Describe the concept of different types of flows, designing of most economical sections of the Open Channel and to understand the concept of specific energy.
CO 2	Describe the concept of dimensional quantities and application of similitude concept in designing model and prototype.
CO 3	Understand the concept, working applications of impact of jets with the importance of constructing velocity triangles.
CO 4	Explore the design concept of Pelton, Francis and Kaplan turbines, Centrifugal pumps along with the design of most economical designs.
CO 5	Understand the working mechanism of different types of the pumps with their important characteristic curves

COURSE LEARNING OUTCOMES (CLOs):

ACE011.01	Explain the concept for types of flows, type of channels, Non uniform flow - Dynamic equation for G.V.F., Mild, Critical, and Steep channels
ACE011.02	Understand concept of velocity distribution, energy and momentum correction factors for different flows.
ACE011.03	Understand Chezy's, Manning's and Basin formulae for uniform flow.
ACE011.04	Explain the concepts based on Specific energy, critical depth, critical, subcritical and super critical flows.
ACE011.05	Understand and designing for the computation of economical sections based on flow parameters and channel characteristics.
ACE011.06	Understand the Dimensional quantities and analysis for various parameters.
ACE011.07	Derive the problems based on Rayleigh's method and Buckingham's pi theorem with applications.
ACE011.08	Explain the concept of similitude with examples and different types of similitude concepts.
ACE011.09	Remember the concepts of dimensionless numbers to solve numerical problems.
ACE011.10	Explain the practical problems associated with model and prototypes based on concept of similitude.

ACE011.11	Explain the different types of jets used in construction of turbines and machinery and their importance.
ACE011.12	Demonstrate the formulation of velocity triangles at inlet and out let of vanes with different combinations of jet.
ACE011.13	Derive the expressions based on Angular momentum principle, work done and efficiency for various types of vanes.
ACE011.14	Explaining the concepts of hydro power plant with various components and their functioning.
ACE011.15	Deriving numerical problems based on power developed in Hydro power plant, efficiency of jet, stationary and moving vanes.
ACE011.16	Demonstrating different types of turbines with their principles and practical applications
ACE011.17	Remember the concept of work done, efficiency for different vanes and application to the concept of turbines.
ACE011.18	Deriving the expressions for most economical design of turbines to withstand for the designed discharge.
ACE011.19	Understand the working principles for various and working of different components of Kaplan, Francis and Pelton turbines.
ACE011.20	Understand the working mechanism of different types of pumps, importance and functioning of various components.
ACE011.21	Explain characteristic curves for pumps with their practical applications
ACE011.22	Understand the concept of NPSH, performance of pumps and working efficiency.
ACE011.23	Explain the designing of reciprocating pump and centrifugal pump.
ACE011.24	Understand the practical problems associated during the installation of pumps
ACE011.25	Understand the concept ANOVA to the real world Problems to measure the atmospheric tides.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	ACE011.05	Understand and designing for the computation of economical sections based on flow parameters and channel characteristics	CO 1	Understand
	b	ACE011.03	Understand Chezy's, Manning's and Basin formulae for uniform flow	CO 1	Understand
2	a	ACE011.05	Understand and designing for the computation of economical sections based on flow parameters and channel characteristics	CO 1	Understand
	b	ACE011.01	Explain the concept for types of flows, type of channels, Non uniform flow - Dynamic equation for G.V.F., Mild, Critical, and Steep channels	CO 1	Understand
3	a	ACE011.10	Explain the practical problems associated with model and prototypes based on concept of similitude	CO 2	Understand
	b	ACE011.09	Remember the concepts of dimensionless numbers to solve numerical problems	CO 2	Remember
4	a	ACE011.10	Explain the practical problems associated with model and prototypes based on concept of similitude	CO 2	Understand
	b	ACE011.09	Remember the concepts of dimensionless numbers to solve numerical problems	CO 2	Understand

5	a	ACE011.12	Demonstrate the formulation of velocity triangles at inlet and out let of vanes with different combinations of jet.	CO 3	Understand
	b	ACE011.13	Derive the expressions based on Angular momentum principle, work done and efficiency for various types of vanes.	CO 3	Understand
6	a	ACE011.12	Demonstrate the formulation of velocity triangles at inlet and out let of vanes with different combinations of jet.	CO 3	Understand
	b	ACE011.15	Deriving numerical problems based on power developed in Hydro power plant, efficiency of jet, stationary and moving vanes.	CO 3	Understand
7	a	ACE011.17	Remember the concept of work done, efficiency for different vanes and application to the concept of turbines.	CO 4	Understand
	b	ACE011.19	Understand the working principles for various and working of different components of Kaplan, Francis and Pelton turbines.	CO 4	Understand
8	a	ACE011.18	Deriving the expressions for most economical design of turbines to withstand for the designed discharge.	CO 4	Understand
	b	ACE011.19	Understand the working principles for various and working of different components of Kaplan, Francis and Pelton turbines	CO 4	Understand
9	a	ACE011.24	Understand the practical problems associated during the installation of pumps and turbines	CO 5	Understand
	b	ACE011.24	Understand the practical problems associated during the installation of pumps and turbines	CO 5	Understand
10	a	ACE011.22	Understand the concept of NPSH, performance of pumps and working efficiency	CO 5	Understand
	b	ACE011.22	Understand the concept of NPSH, performance of pumps and working efficiency	CO 5	Understand

Signature of Course Coordinator **HOD, CE**