Code No: **19CET402** **R19**

II B. TECH II SEMESTER REGULAR EXAMINATIONS, AUGUST 2021
HYDRAULICS AND HYDRAULIC MACHINERY
(Civil Engineering)

Time: 3 hours Max. Marks: 60

Note: Answer **ONE** question from each Unit (**5 × 12 = 60 Marks)**

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UNIT - I

1. a) Consider steady fully developed flow in an open channel of rectangular cross section with a constant slope of 5^0 for the bottom surface. Will the slope of the free surface also be 5^0? Explain. [3M]

   How does the pressure change along the free surface in an open-channel flow? [3M]

   b) How does uniform flow differ from nonuniform flow in open channels? In what kind of channels is uniform flow observed? [3M]

   A single wave is initiated in a sea by a strong jolt during an earthquake. Taking the average water depth to be 2km and the density of seawater to be 1.030kg/m3, determine the speed of propagation of this wave. [3M]

(OR)

2. a) During the monsoon, heavy rain takes place in your town and water flows on a concrete surface.at an average velocity of 1.3m/s. If the water depth is 2cm, determine whether the flow is subcritical or supercritical. [6M]

   b) A student conducting open channel test in the laboratory, and he plotted graph between the specific energy and depth of the flow. He considers steady flow of water through two identical open rectangular channels at identical flow rates. If the flow in one channel is subcritical and in the other supercritical, can the specific energies of the water in these two channels be identical? Explain. [6M]

UNIT – II

3. a) A student conducting a boundary layer experiment in the laboratory. He placed the object at the front edge of the plate at a position of 15cm. He wanted to fit the data by using a parabolic boundary layer profile. What is the boundary layer thickness? For air viscosity of $1.5 \times 10^{-5} m^2/s$ and the density of air of $1.23 kg/m^3$. [6M]

   b) A smooth two-dimensional flat plate is exposed to a wind velocity of 100 km per hour. If laminar boundary layer exists up to a value of Reynolds number equal to 3×10^5, find the maximum distance up to which laminar boundary layer persists, and find its maximum thickness. Assume kinematic viscosity of air as $1.49 \times 10^{-5} m^2/s$. [6M]

(OR)

4. a) Which bicyclist is more likely to go faster: one who keeps his head and his body in the most upright position or one who leans down and brings his body closer to his knees? Why? [6M]

   b) A car is moving at a constant velocity of 110km/h. Determine the upstream velocity to be used in fluid flow analysis if (a) the air is calm, (b) wind is blowing against the direction of motion of the car at 30km/h, and (c) wind is blowing in the same direction of motion of the car at 30km/h. [6M]

UNIT – III

5. a) Describe Buckingham pi theorem, why it is preferred over Rayleigh's method? [6M]

   b) A wind tunnel is used to test 5:1 scale model of a car. The velocity with prototype is 60km/hr and for the dynamic similar conditions, the model drag is 240N. If air is used with model as well as the prototype, then determine the drag and the power required for the prototype. [6M]

(OR)
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6. a) An overflow structure 550m long is designed to pass a flow of 4400m^3/s. A 1: 20 model of the cross-section of the structure is built in a laboratory channel 0.5m wide. Calculate the corresponding flow rate for the model if the action of viscosity and surface tension may be neglected. When the model is tested at this flow rate the pressure at a point on the model is observed to be 50mm of mercury vacuum, how should this be interpreted. [6M]

b) As a civil engineer, you planned to construct an overflow structure to safeguard your city and also to store water. The length of the structure is 0.550km long and is designed to pass a flow of 4400m^3/s. For this, a 1:20 model of the cross-section of the structure is built in a laboratory channel 0.5m wide. Calculate the corresponding flow rate for the model if the action of and surface tension may be neglected. When the model is tested at the flow rate, the pressure at the point is 0.05m of mercury vacuum. How should this be interpreted? [6M]

UNIT –IV

7. a) What is a draft tube, and what is its purpose? Describe what would happen if turbomachinery designers did not pay attention to the design of the draft tube. [6M]

b) Name and briefly describe the differences between the two basic types of dynamic turbine. [6M]

(OR)

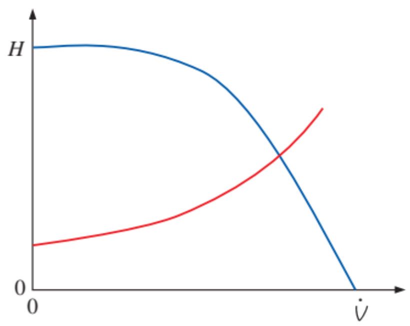
8. a) The Pelton wheel is being designed for a hydroelectric dam to develop 5520kW under a head of 240m at an overall efficiency of 80% when revolving at a speed of 200rpm. Find the unit discharge, unit power, and unit speed. Assume peripheral coefficient = 0.46. The engineers decided to scale up a previously designed hydro turbine that has an excellent performance history. If the new turbine works at a head of 150m, find the discharge, power, and speed for this head. [6M]

b) As a one of the working engineers at the hydroelectric power station. How characteristic curves of a hydraulic turbine useful to you at the site? How are small scale models useful in obtaining these curves for a proposed turbine of a hydroelectric installation? [6M]

UNIT –V

9. a) Define net positive suction head and required net positive suction head and explain how these two quantities are used to ensure that cavitation does not occur in a pump. [6M]

b) In Fig. is shown a plot of pump net head as a function of pump volume flow rate, or capacity. On the figure, label the shutoff head, the free delivery, the pump performance curve, the system curve, and the operating point. [6M]



(OR)

10. a) Discuss the primary difference between a positive displacement turbo machine and a dynamic turbomachine. Give an example of each for both pumps [6M]

b) A centrifugal pump handles liquid whose kinematic viscosity is three times that of water. The dimensionless specific speed of the pump is 0.83rev, and it has to discharge 2m^3/s of liquid against a total head of 15m. Determine the speed, test head, and flow rate for a one-quarter scale model investigation of the full size pump if the model uses water. [6M]

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