

M. Tech Odd Semester Examination, February, 2023

Agricultural Engineering
(3rd Semester)

Course No.: 3AE-126
(Design of Pumps for Irrigation and Drainage)

Full Marks: 50

Pass Marks: 25

Time: 2 hours

- Note :**
1. Question No. 1 is compulsory.
 2. Answer any four questions excluding Question No. 1.
 3. Answer parts of a question at a place.
 4. Assume reasonable data wherever required.
 5. The figures in the right margin indicate full marks for the question.

- 1 a. Discuss the construction of jet pump. 6
- b. Briefly discuss the principle of operation of jet pump. 4
2. a. An axial flow pump is driven at 1750 rpm. The impeller has an outer diameter of 50 cm and a hub diameter of 20 cm. The vane inlet and outlet angles at the mean effective radius are 15 and 25° respectively. The hydraulic and manometric efficiencies are 90 and 85% respectively. Knowing that the flow approaches the impeller in the axial direction, determine
 - i. Mean effective radius
 - ii. Flow-rate
 - iii. Actual head developed by the pump
 - iv. Degree of pump reaction

Turn Over

- v. Unbalanced axial thrust. 10
3. a. A windmill is to be designed to develop 0.60 hp at a wind speed of 20 Km/hr. Determine the diameter of the rotor. 5
- b. A hydraulic ram operates at a drive head of 5 m and a delivery head of 25 m. The flow through the drive pipe is 12 l/s and the discharge at the outlet of the delivery pipe is 1.5 l/s. Compute the efficiency, adopting
- i. D'Aubuisson's ratio and
- ii. Rankine's formula 5
4. a. Briefly explain the working of a solar photovoltaic pumping system with proper figure. 7
- b. What are the unique requirements in adopting non-conventional energy sources in water pumping? 3
5. a. In a tube well and pump project, the initial cost is Rs. 6,00,000. The project period is 20 years. The annual net benefit is Rs. 80,000. Estimate the internal rate of return. 5
- b. A diesel engine, costing Rs. 10,000 initially, is to be replaced after 10 years during a project period of 20 years. What would be the present worth value of replacement if the rate of interest is 10% and the projected escalation rate of costs is 8%. 5
6. a. Determine the power output of a windmill, having a rotor diameter of 4m, at a wind velocity of 20 km/h on the windward side and 17 km/h on the leeward side. Density of air is 1.293 kg/m³. 5
- b. Write short note on benefit cost method and present worth method of economic feasibility. 5
7. a. Design a jet pump for a driving head of 30 m, and a jet head of 7 m. The suction head H_s , may be assumed to be zero. The estimated efficiency of the pump is 30 %. The combined discharge Q , (Q_1+Q_2) is 0.05 m³/s. 7
- b. What are the various damages caused by water hammering? What are the various protective measures to prevent these damages? 3
8. A deep well turbine pump installed in a tubewell has a discharge of 22 litres per second. The discharge pipe is 12.0 cm in diameter. The pumping water level is 20 m below the centre line of the discharge head. The delivery pipe is 15 m long., measured from the end of the discharge head. A sluice valve and two long sweep bends, each of 12.5 cm inside diameter, are fitted on the delivery pipe. The delivery pipe outlet is 4.6 m above the discharge end of the pump. Determine the brake horse power of the directly connected vertical electric motor required to operate the pump if the pump efficiency is 68 %. 10
