M.Tech Even Semester Examination, May, 2025

Agricultural Engineering

Water Resources Development Management

(2nd Semester)

Course No: 4AG-151

(Well Water and Pump Engineering)

Full Marks: 70
Pass Marks: 28
Time: 3 hours

Note:

1. Attempt any five questions taking one from each unit.
2. Begin each answer in a new page
3. Answer parts of a question at a place
4. Assume reasonable data wherever required
5. The figure in the right margin indicates full marks for the question
6. All the mathematical symbols and abbreviations have their usual meanings.

UNIT-I

1. Define an aquifer. Describe the different types of aquifers with suitable diagrams. 3+11=14

2. a) Write the definitions of porosity, permeability, specific yield, and transmissivity in detail. 10

   b) Explain Darcy's law. 4

UNIT-II

3. a) Differentiate between open well and tube well. 4

UNIT-V

9. a) What is pump characteristic curve? Write the effect of speed variation and the change in diameter of impeller of centrifugal pump. 4+4=8

   b) A pump lifts 90,000 litres of water per hour against a total head of 30 m. Compute the WHP. If the pump efficiency is 75 %, what size of prime mower is required to operate the pump? If a direct electric motor having an efficiency of 80 % is used to operate the pump, compute the cost of electrical energy in a month of 30 days. The pump is operated for 10 hrs daily for 30 days. The cost of electrical energy is 50p per unit. 6

10. a) Determine the maximum practical suction lift for a centrifugal pump if the discharge is 0.05 the water temperature is 20°C and vapour pressure at this temperature is 0.25m, friction losses in suction line (pipe and pipe fittings) is 1.5 m, NPSH (net positive suction head) of the pump is 3.2 m. The pump is at an altitude of 1500 m above sea level. 6

    b) Explain the slotted type and strainer type of well screen. 8

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b) Explain the different methods which are used for drilling tubewells. 10

4. a) Write short note on:

i) Well screen

ii) Lined and unlined open well

iii) Well casing

iv) Pack aquifer ratio

v) Area of influence 2*5=10

b) A 25cm diameter well is pumped at a uniform rate of 300 l/min. The drawdown observed at 1m and 100m distance from the centre of the well are 8m and 0.4m, respectively. Determine the hydraulic conductivity of the water bearing strata, assuming the thinness of the saturated part of the aquifer is 25m. 4

UNIT-III

5. a) Derive an expression for drawdown due to interference between two or more wells pumping from the same confined aquifer. 10

b) Three wells, each having a diameter of 10 cm, are installed at the vertices of an equilateral triangle 10 m apart, in a confined aquifer. The radius of influence of each well is 500m, and K is 20m per day. The drawdown is 2 m. The thickness of the confined aquifer is 15m. Find the discharge of each well, and the percentage decrease in discharge because of well interference. 4

6. Explain the procedure ofpumping tests of well, write the criteria oftheir site selection as well as observations. 4+5+5=14

UNIT-IV

7. a) What is a hydraulic ram pump? Explain the working principle of operation of hydraulic ram pump with proper illustration. 2+6=8

b) A single acting reciprocating pump has its diameter 10 cm and stroke 20 cm. The piston makes 50 double strokes per minute. The suction and delivery heads are 5 m and 15 m, respectively. Find

i. Discharge capacity of the pump in l/min

ii. The force required to work the piston during suction and delivery strokes if the efficiency of suction and delivery strokes are 50 % and 75 %.

iii. The HP required by the pump for its operation. 6

8. a) Explain the working principle of a reciprocating pump with neat figure. 6

b) A centrifugal pump works against static suction and delivery heads of 5 m and 10 m, respectively, and yields a discharge of 25 l/s. The lengths of suction and delivery pipes are 10m and 50m; respectively and the corresponding diameters are 125 mm and 100 mm. The suction pipe is fitted with a foot valve and delivery pipe is fitted with a 90° long radius elbow. Friction factor for headloss in pipes equals 0.028 and coefficient k for 90° long radius elbow equals to 1.5. Calculate the horsepower of the pump if overall efficiency is 45 %. 8