

**M.Tech Odd Semester (CBCS) Exam.,
December—2016**

AGRICULTURAL ENGINEERING

(1st Semester)

Course No. : MAECC-02

Full Marks : 50

Pass Marks : 15

Time : 2 hours

Candidates of WRM will answer MAE1CC-02,
FPE students will answer MAE2CC-02 and
FMP students will answer MAE3CC-02

- Note : 1. Answer *any five* questions.
2. Begin answer to each question in a new page of your answer script.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the margin indicate full marks for the questions.

**WATER RESOURCES DEVELOPMENT
AND MANAGEMENT**

Course No. : MAE1CC-02

(Water Wells and Pump Engineering)

1. (a) Explain the working of a propeller pump with a diagram. 5

- (b) Write a short note on sub-surface methods of groundwater investigation. 5

2. (a) A centrifugal pump is used to pump water to an overhead tank at a height of 8 m from the central line of pump. The overhead tank supplies water to 4 carp hatchery units with peak requirement of 20 L/s per unit. Water is conveyed through a 15 cm diameter, 100 m long PVC pipe which includes 1 gate valve and 2 elbows. The outlet is submerged. Also given that $\nu = 1.054 \times 10^{-6} \text{ m}^2/\text{s}$, $k_{\text{elbow}} = 0.8$, $k_{G.V} = 0.2$, $f = 0.003 (0.25/\text{Re}^{0.24})$.

(i) Find pressure at delivery end of pump.

(ii) If total suction head = 6m, efficiency = 50%, calculate the power requirement. 7

- (b) Explain the working principle of reciprocating pump. 3

3. (a) Calculate the cost of pumping 4×10^6 litres of water from a well with a centrifugal pump from the following data: 4

Suction head = 4 m

Delivery head = 8 m

(3)

Friction head = 1.5 m
Pump output = 4×10^4 litres
per hour
Pump efficiency = 70%
Motor efficiency = 85%
Cost of electricity = ₹ 3 per unit

- (b) With the help of figures, explain the combined characteristics of different pumps when connected in series and in parallel. Also cite the cases in which each is done. 6
4. List the various troubles and their causes that may be experienced during the operation of centrifugal pumps. 10
5. Write short notes on the following : 10
- (a) Casing
(b) Well filters
(c) Screens
(d) Hand-dug wells
6. (a) With the help of sketch, explain the various components of an irrigation well. 4
- (b) What do you understand by well testing? Explain any one method of well testing. 2+4

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(Turn Over)

(4)

7. (a) List the differences between direct circulation rotary drilling and reverse circulation drilling. 5
- (b) With the help of a sketch, describe the principle of jetting. 5
8. An industrial estate is supplied from a well field of three wells. The well locations form an equilateral triangle having a length of 30 m on each side. The 200 mm diameter wells fully penetrate a confined limestone aquifer having a known transmissivity of $250 \text{ m}^2/\text{day}$. When the wells are all pumped at the same rate of 10 lps ($860 \text{ m}^3/\text{day}$), the equilibrium drawdown (as defined by the Thiem equation) in each of the wells is 7.5 m.
- The industrial estate needs to increase the capacity of the well field in order to meet increasing demand. One option is to drill a new well at the centre of the well group, equidistant from the other wells. Assuming the new well has the same diameter and is pumped at the same rate as the existing wells, what effect would this new well have on the specific capacities of the original wells? 10

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(Continued)

(5)

FOOD PROCESS ENGINEERING

Course No. : MAE2CC-02

(Food Process and Products Technology—I)

1. Define the types of vitamins. Explain any three under the following headings : 10
- (a) Source
 - (b) Type
 - (c) Symptoms of deficiency
2. Explain the following terms : 10
- (a) Carbohydrate
 - (b) Racemic mixture
 - (c) Anomers
 - (d) Denaturation
3. Define browning. Discuss the types of browning in brief with suitable examples. 10
4. (a) What is fermentation? Explain different fermentation processes. 5
- (b) Write down the different steps involved in tea and coffee processing. 5

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5. (a) What is the unit operations involved in fruit juice making with the help of neat flow diagram? 5
- (b) Explain the following terms : 5
- (i) Deaeration
 - (ii) Carbonated beverages
 - (iii) Acetification
 - (iv) Racking
6. (a) Explain all the factors considered for food processing plant design with flowchart. 5
- (b) List the different types of leavening agents and their functions in baking industry. 5
7. (a) Explain the different stages of bakery unit operations. 5
- (b) Write the different steps involved for the processing of biscuits. 5
8. (a) Explain novel packaging technologies for food preservation. What are their limitations? 4
- (b) What are the different criteria for methods of quality control? 3
- (c) Write short notes on the following : 3
- (i) HACCP
 - (ii) GMP

FARM MACHINERY AND POWER

Course No. : MAE3CC-02

(Design and Testing of Farm Machinery Systems—I)

1. (a) With neat sketches, explain the forces acting on the moldboard plow during operation. 6
- (b) Determine—
- (i) the percent increase in the draft of a plow bottom if the pull is at 10° to the left from the direction of travel rather than straight ahead. Assume that horizontal component of soil reaction forces is at 15° to the right and the soil-metal friction is 0.3; 4
- (ii) the percent increase in the perpendicular force on the landside. 4
2. (a) Explain the forces acting on the disc harrow during operation. Derive the expression for the amount of offset obtainable. 6

- (b) A right hand offset disc harrow is operating with disc angles of 15° and 21° , respectively, for the front and rear gangs. The centers of the two gangs are 2.45 m and 4.25 m behind a transverse line through the hitch point on the tractor drawbar. The horizontal soil force components are : L_f 3.1 kN, S_f 2.65 kN, L_r 3.35 kN, S_r 3.8 kN. Calculate (i) the horizontal angle of pull, (ii) the horizontal pull and (iii) the amount of offset of the center of cut with respect to the hitch point. 4
3. (a) Explain the kinematics of rotary tillage implement. 5
- (b) Explain the procedure for the design of shank for the shovel type and sweep type furrow openers. 5
4. (a) Design a hopper for the 11cm x 18 cm seed drill used for sowing wheat crop. Assume the relevant data. 6
- (b) A horizontal plate planter has 54 cells on 160 mm diameter circle. The effective radius of the ground drive wheel is 0.45 m. A 20-tooth sprocket on the drive wheel drives a 10-tooth sprocket on the

(9)

feed shaft. A 15-tooth bevel gear on the feed shaft drives a 24-tooth gear on the plate shaft. Calculate—

- (i) seed spacing in the row for 100% cell fill
- (ii) the desired forward speed in km/h for 100% cell fill if the plate speed is 15 m/min. 4

5. (a) Explain various types of nozzles used in a sprayer. 4

(b) A field sprayer having a horizontal boom with 20 nozzles spaced 46 cm apart is to be designed for a maximum application rate of 750 L/ha at 520 kPa and 6.5 km/h.

- (i) Determine the required pump capacity in liters per minute, assuming 10% of the flow is bypassed under the above maximum conditions.
- (ii) If mechanical agitation requires 375 input watts and the pump efficiency is 50%, what should be the engine rating if the engine is to be loaded to not more than 80% of its rated power?

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(iii) What discharge rate per nozzle is required under the above conditions?

(iv) If the nozzles have 70° spray angles and the pattern is such that 50% overlap is needed for uniform coverage, at what height above the tops of the plants should the boom be operated? 6

6. (a) Explain the working of air-blast sprayer. What is electrostatic spraying? 6

(b) An air-blast sprayer is to be operated at 4 km/h and the desired application rate is 19 L per tree. The tree spacing is 9 m 9 m and each nozzle delivers 4 L/min at the operating pressure of 415 kPa.

(i) If one-half row is sprayed from each side of the machine, how many nozzles will be needed?

(ii) How many hectares can be covered with a 2 m³ tank full of spray? 4

7. Assuming relevant data, determine the cost of plowing one hectare area by a 2 cm 35 cm mould board plow by ASABE procedure. 10

8. Write short notes on the following : 5+5

(a) Modern trends in design and development of farm power and machinery systems

(b) Status of farm mechanization in India

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