M.Tech Even Semester (CBCS) Exam., April—2017

AGRICULTURAL ENGINEERING

(2nd Semester)

Course No. : MAE-CC–07

Full Marks : 50
Pass Marks : 15

Time : 2 hours

[Water Resources Development and Management Students will answer MAE1-CC–07.
Food Processing Engineering Students will answer MAE2-CC–07.
Farm Machinery and Power Engineering Students will answer MAE3-CC–07.]

Note : 1. Attempt *any* **five** questions.
2. Begin each answer in a new page.
3. Assume reasonable data wherever required.
4. The figures in the margin indicate full marks for the questions.

Course No. : MAE1-CC–07

(HYDROLOGY AND WATER RESOURCES ENGINEERING—II)

1. *(a)* List and explain the approaches of flood control measures. 5

(b) Briefly explain the measures of flood preparedness, relief and recovery. 5

2. *(a)* Write short notes on the following : 1×5=5
(i) Global Hydrologic System
(ii) Benefit Cost Ratio
(iii) Flood Forecasting Computer Model
(iv) Cutoff
(v) Flood Warning

(b) Write down the steps involved in engineering economy study. 5

3. List and explain the categories of losses caused by floods. 10

4. *(a)* What return period would you adopt in the design of a culvert on a drain if you are allowed to accept only 5% risk of flooding in the 25 years of expected life of the culvert? 5

(b) Explain the formulae used for design of storm sewers involving rainfall intensity and drainage area. 5

5. Describe the different surface water sources and storage reservoirs directly available for water supplies. 5+5=10

6. Write down the classification of reservoir depending upon the purpose served. 10

7. Draw a schematic diagram for storage zones of a reservoir and also explain all the storage zones. 10

8. *(a)* Define sediment and list the sources of sediments. 5

(b) List and explain the factors which affect the sediment yield. 5

Course No. : MAE2-CC–07

(ADVANCED FOOD PROCESS ENGINEERING—II)

1. A silo of 10 m diameter and length of 30 m is filled with grain of 1500 kg/m^3. The angle of internal and external friction was given as 35° and 33°, respectively. Determine the vertical and lateral pressures using Airy's theory and Janssen's theory. 10

2. Air of 1000 m^3/min recirculated at 45 °C dry bulb temperature and 20 °C dew-point temperature is to be mixed with 700 m^3/min of fresh air at 65 °C dew-point temperature and 65% relative humidity. Determine the following properties of the mixture using psychrometric chart :

(a) Dew-point temperature

(b) Enthalpy

(c) Specific volume

(d) Humidity ratio

(e) Wet bulb temperature

(f) Dry bulb temperature

(g) Relative humidity

Support your answer with a representative figure of the processes. 10

3. *(a)* With a neat figure, describe the velocity profile of fluid flowing in a pipe. 5

(b) A pipe of 0·15 m diameter and 20 m long deliver diluted fruit juice at a rate of 1000 lit/min at 25 °C. The density and absolute viscosity can be taken as 1015 kg/m^3 and 993×10 ^{6} Pa.S respectively. What fraction of the pipe represents the entrance region? 5

4. *(a)* Describe the working principle of fluidization and pneumatic conveying with neat figure. Discuss in brief their applications in food processing. 5

(b) Differentiate between deep bin and shallow bin. How temperature and moisture change in storage structure? 5

5. Describe the working principle and applications of radio frequency and microwave heating of food materials. 10

6. Describe the methods of freezing of food products. 10

7. What do you mean by filtration? Discuss the basic theory of filtration. Establish a relationship between volume of filtrate and time of filtration at constant pressure. 10

8. With neat sketch diagram, discuss the following : 10

(a) Plate and frame filter

(b) Centrifugal filter

Course No. : MAE3-CC–07

(DESIGN AND TESTING OF FARM POWER SYSTEMS—II)

1. *(a)* Distinguish between *(i)* 2 WD tractor and 4 WD tractor, and *(ii)* 4 WD tractor and crawler tractor. 3

(b) A mechanical front-wheel drive tractor weighing 91597 N has its static weight divided so that 41672 N is on the two front wheels and 49925 N is on the four rear wheels. The front tires are 14·9–30 bias-ply tires (overall unloaded diameter d 1410 mm with a static loaded radius of 650 mm).

The rear tires are 18·4–42 bias-ply tires (overall unloaded diameter d 1864 mm with a static loaded radius of 846 mm).

(i) Estimate the force and power required to tow the tractor at a speed of 8 km/h on a soil with a cone index of 800 kN/m^2.

(ii) What would be the force required if the cone index was 400 kN/m^2? 7

2. Determine the steady-state drawbar pull, $P\cos$, required to just lift the front wheels of a tractor off the ground (R_f 0) when the tractor is operating on level ground. The drawbar force P applied to the tractor is inclined downward from the horizontal at an angle of 15°.

Assume TF_r/R_r = 0·0325 in the relation e_r $(TF_r/R_r)r_r$. The drawbar force is applied 907 mm behind and 337 mm below the rear axle center.

If the gross tractive coefficient has the form

$$(F/R)\quad 0\ 88(1\quad e^{\ 0\ 1Bn})(1\quad e^{\ 9\ 5S})\quad 0{\cdot}0325$$

show that the tractor cannot develop the tractive force required for developing this drawbar pull. 10

3. The weighing method is used to determine the center of gravity location of a tractor. Because of tractor symmetry, the center of gravity is known to lie in the vertical plane perpendicular to the axles and passing midway between the wheels.

(a) With the tractor level, the weights supported by the rear (R_r) and front (R_f) axles are measured. The following values are recorded : R_r 55·2177 kN, R_f 44·6858 kN. The wheel base of the tractor, L, is 2675·0 mm. Find the longitudinal location of the center of gravity of the tractor.

(b) With the center of the front wheels raised to H 1600 mm above the level surface used in *(a)*, the weight supported by the rear axle, R_r, is measured as 59·1881 kN. Find the height of the center of gravity of the tractor above the rear axle center. 10

4. A tractor is put into a steady-state turn such that the center of gravity of the tractor traverses a circle of radius 7 m. Assume the tractor is of the tricycle-type and has a front wheel tread setting of 0·5 m and a rear wheel tread setting of 2 m.

(a) If the forward speed of the tractor is 6·2 m/s, is the tractor in danger of

turning over sideways? Assume the tractor is travelling on a firm surface on which the tires can develop the lateral forces required by the specified turn.

(b) A front-end loader weighing 4000 N is attached to the tractor. A 5000 N load is to be carried in the loader bucket while the bucket is raised to its maximum height. In this position, the center of gravity of the loader plus the bucket load is estimated to be 2 m ahead of and 1·75 m above the rear axle. Is the loader-equipped tractor in danger of overturning in the turn described in *(a)*? 10

5. *(a)* Explain the effect of vibration on the tractor operator. 3

(b) What is transmissibility in the design of a tractor seat? Design a seat suspension for seat and operator mass of 90 kg, transmissibility of 0·315, vehicle chassis frequency of 4 Hz, and static spring deflection of seat and operator of 10 cm.

(i) Determine the spring rate, k, in N/m for the seat suspension.

(ii) Determine the undamped natural frequency of the seat.

(iii) Determine the damping (shock absorber), c, in N/m-s for seat suspension.

(iv) Determine the decibel reduction in RMS acceleration that the seat suspension provides.

(v) Using ISO 2631 criteria, how long should an off-road vehicle operator be exposed to a vehicle chassis input of 1 RMS m/s^2 for the seat suspension you designed?

(vi) If the vehicle chassis frequency decreases, will the seat suspension be more or less effective? Why? 7

6. *(a)* Explain the effect of exposure to noise on human operators. 3

(b) *(i)* A test engineer has isolated a pure tone noise in a tractor and determined its frequency to be 8000 Hz and peal-to-peak amplitude to be 0·01 Pa. Determine the period, RMS sound pressure and resulting sound pressure level. Should the engineer be concerned about eliminating or reducing this source of noise? Why?

(ii) Show through calculations that doubling the sound pressure results in 6 dB increase. 7

7. Discuss the different types of drawbar dynamometer. Draw the strain gauge bridge configurations and suggest the type of dynamometers for the measurement of forces and moments in the following : 10

(a) Horizontal force, vertical force and their resulting moment

(b) PTO torque

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