

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

AEH 305

Department Of Engineering and Physics
Bachelor of Science (Honours) in Agricultural Engineering
Agricultural Structures

3 HOURS (100 MARKS)

INSTRUCTIONS

06/2024

Answer any **FOUR** questions. Each question carries 25 marks.

Question 1

- a. Explain briefly four aims of planning strategies in rural/farming areas. [8 marks]
- b. A wall is to retain loose gravel to a depth of 3.2 m. The angle of shearing resistance (angle of repose) for gravel was found to be θ . If the gravel has a specific weight of 35 kN/m^3 and the total force per metre length of the wall face was found to be 52.5 kN, determine the angle of repose of gravel. [7 marks]
- c. Explain five factors that are taken into account when sketching the functional design of a building. [10 marks]

Question 2

- a. Give two reasons for placing a polythene sheet on a foundation of farm. [2 marks]
- b. Determine the critical height of a square storage bin of size 6 m, if the bin is to retain shelled maize with an angle of internal resistance of 22° . If the maize is retained up to 5 m height and its specific weight is 7.4 kN/m^3 , calculate the maximum pressure at the base of the wall. [5 marks]
- c. Explain four design strategies that can be employed to prevent fire spreads mainly by windborne embers and by radiation. [8 marks]
- d. Determine the suitable dimensions for a slurry manure pit with an access ramp, given the following:
Animals: 5 dairy cows 500 kg
Storage period: 30 days
Maximum slope of access ramp: 15%
Total manure storage capacity/cow: 0.055 [10 marks]

Question 3

- a. Mention four disadvantages of using steel materials for construction of farm structures. [4 marks]
- b. Describe briefly two categories of building walls. [4 marks]
- c. Explain four factors that determine the depth and size of foundation in a farm building [8 marks]
- d. A circular water tank has a radius of 5.2 m. If it is to hold water up-to its 1.8 m level, compute the:
 - i. design load at the base of the tank [3 marks]
 - ii. value and the point of action of the total force on the base, and [3 marks]
 - iii. total force on the side per meter of perimeter wall. [3 marks]

Question 4

- a. Outline the procedure of impregnation of thatch. [5 marks]
- b. Highlight four ways of controlling fish predators in a fish pond. [4 marks]
- c. Describe four factors considered when citing a fish pond. [8 marks]
- d. Explain the maintenance practices of a fish pond. [8 marks]

Question 5

- a. Outline the procedure of erecting wooden rail fence. [7 marks]
- b. Explain four essential features of a good calf pen. [8 marks]
- c. Calculate the amount of materials needed to construct a rectangular concrete floor measuring 12 m by 6 m and 10 cm thick. Use a nominal mix of 1:3:6. Fifty kilograms of cement is equal to 35 litres. [10 marks]

Question 6

- a. You have recently qualified as an agricultural engineer. A dairy farmer wishing to construct a silage silo for 400 dairy cows approaches you for design advice. The cows have an average body weight of 450 kg and are to be fed with stored silage from 1st of August to 31st of October. You are told that 1 m³ of silage has an average weight of 700 kg. In order to prevent spoilage, the thickness of silage fed each day is assumed to be 10cm. It is also assumed that each cow is fed 3.8 kg of silage per 100 kg of its body weight. By making an allowance of 15% for the losses, calculate:
 - i. The economic diameter of a silo to store sufficient quantity of silage for the herd, and [10 marks]
 - ii. The economical depth of the silo. [3 marks]
- b. Calculate the size of foundation that is required for a building that is 16 metres long and 8 metres wide. It is given that the roof framing plus the expected wind load totals 130 kN. The wall above the foundation is 0.9 kN/m. The floor will be used for grain storage and will support as much as 7.3 kPa and the floor structure is an additional 0.5 kPa. The foundation wall and piers are each 1 metre high above the footing. The wall is 200 mm thick and the piers are 300 mm square. The soil on the site is judged to be compact clay in a well-drained area. Assume that the weight of the mass 1 kg equals approximately 10 N. The mass of concrete is 2 400 kg/m³. [12 marks]

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