

Greenhouse Technology (ME-1034)

Time-3 hours

Full Marks: 70

Attempt any four. All questions carry equal marks. Use of property tables and charts allowed. Usual property values may be assumed suitably, if required.

1. (a) What is PAR? Briefly describe how photosynthesis and plant growth are influenced by different artificial sources of light.
(b) What factors affect the CO₂ uptake by plants? Mention different CO₂ enrichment methods that are employed in greenhouse cultivation.
2. (a) What criteria are considered in deciding the orientation for a greenhouse? Using neat sketches show the different structural forms that are used for free-standing greenhouses.
(b) Name different covering materials that are used in commercial greenhouses and give a brief comparative study of the materials in terms of light transmissivity, longevity and cost.
3. (a) What factors affect the natural ventilation in a greenhouse? Deduce the expression for ventilation rate taking into consideration the stack and wind effects for a greenhouse having side and top vents.
(b) At a given instant, the temperature difference between the greenhouse air and the ambient is found to be 4°C, the ambient being lower and at 22°C. The effective height for the calculation of stack effect is 4 m. If the vent openings for side and roof vents are 10 sq. m. each, estimate the mass flow rate of natural ventilation. Assume air density suitably and consider a C_d value of 0.6.
4. (a) How does cooling pads work? Give the expression for its saturation efficiency. How the water requirement for a cooling pad is estimated?
(b) A floriculture greenhouse is equipped with fan-pad system for cooling and ventilation. The greenhouse ground area is 20 m in length and 6 m in width, its effective height being 3 m. Outside design condition is 32°C and 50% RH. Assume that intensity of solar radiation penetrating the covering material and shade nets is 240 W/sq.m and that the combined ground-plant absorptivity is 0.5. Assuming a saturation efficiency of 85% for the pads and assuming the entire covered ground area as the effective area for solar radiation calculation, estimate the minimum and maximum temperature inside the greenhouse, if the ventilation rate is 1.2 ACM. Assume overall heat transfer coefficient of 4.5 W/m²-K. Air density and specific heat may be assumed suitably.
5. (a) Briefly discuss the desirable properties of root media.
(b) Mention and explain the different irrigation methods employed in greenhouse cultivation
6. Write short notes on any three:
 - (a) Earth Air Heat Exchanger.
 - (b) Greenhouse Floriculture potential of India
 - (c) Roof evaporative cooling
 - (b) Soilless cultivation