

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF AGRICULTURAL ENGINEERING

QUESTION BANK

V SEMESTER - (VERTICAL 1)



PAG102-Food Equipment and Design

Regulation – 2023

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QUESTION BANK

SUBJECT: PAG102-Food Equipment and Design

SEM / YEAR: III/V

UNIT I - PROCESS EQUIPMENT DESIGN

Introduction on process equipment design, principles and selection of food processing equipment
Application of design engineering for processing equipment.

<u>PART - A</u>			
Q.No	Questions	BT Level	Competence
1.	Define process equipment design.	BT-1	Remember
2.	What are the objectives of food process equipment design?	BT-1	Remember
3.	List two examples of food processing equipment.	BT-1	Understand
4.	What factors influence the selection of processing equipment?	BT-1	Remember
5.	Mention any two properties of food that influence equipment design.	BT-1	Evaluate
6.	What is the role of ergonomics in food process equipment design?	BT-1	Remember
7.	Define the term “food-grade material”.	BT-1	Remember
8.	State any two reasons for failure of food processing equipment.	BT-1	Remember
9.	What is meant by ‘scale-up’ in equipment design?	BT-1	Remember
10.	What is the importance of hygiene in equipment design?	BT-1	Remember
11.	What do you mean by modular design in food processing equipment?	BT-1	Remember
12.	Mention two materials commonly used for food contact surfaces.	BT-2	Understand
13.	List any two criteria for selecting food processing machinery.	BT-2	Understand
14.	Write any two applications of stainless steel in food equipment.	BT-2	Understand
15.	What is the importance of cleaning-in-place (CIP) in equipment design?	BT-2	Understand
16.	Mention two examples of thermal food processing equipment.	BT-2	Understand
17.	What is the difference between batch and continuous equipment?	BT-1	Remember
18.	Define overdesign and its drawback.	BT-2	Understand
19.	What is a process flow diagram?	BT-2	Understand
20.	What is meant by equipment standardization?	BT-1	Remember

21.	Name two important mechanical properties considered in equipment selection.	BT-2	Understand
22.	What is the relevance of product rheology in equipment design?	BT-1	Remember
23.	Mention two international standards related to food equipment design.	BT-1	Understand
24.	What are sanitary fittings in food processing equipment?	BT-2	Understand

PART - B

1.	Explain in detail the steps involved in process equipment design with examples.	BT-3	Application
2.	Describe the influence of food properties on equipment design with suitable illustrations.	BT-3	Application
3.	Elaborate on the selection criteria for food-grade materials in processing equipment.	BT-4	Analyses
4.	Discuss the significance of modular design in the development of modern food equipment.	BT-3	Application
5.	Describe the standardization and regulatory aspects of equipment design.	BT-3	Application
6.	Compare batch and continuous food processing systems and their equipment design features.	BT-5	Evaluate
7.	Explain the importance and methods of cleaning-in-place (CIP) systems in equipment.	BT-4	Analyses
8.	What is the significance of process flow diagrams in designing food equipment?	BT-5	Evaluate
9.	Describe the engineering considerations for ensuring mechanical strength in food equipment.	BT-3	Application
10.	Explain how ergonomics influences the safety and efficiency of food processing equipment.	BT-3	Application
11.	Illustrate the process of equipment scale-up from lab-scale to industrial scale.	BT-4	Analyses
12.	Discuss the advantages and limitations of stainless steel in food equipment design.	BT-3	Application
13.	Design a simple equipment layout for a pasteurization plant and justify equipment selection.	BT-3	Application
14.	Explain the integration of automation and control in process equipment design.	BT-5	Evaluate

15.	Describe the typical lifecycle of a food processing equipment from design to decommissioning.	BT-3	Application
16.	Discuss the various factors affecting the selection of equipment in food industries.	BT-3	Application
17.	Explain the role of hygiene and sanitation in food process equipment design.	BT-4	Analyses

UNIT II - DESIGN PROCEDURE

Design parameters and general design procedure, Material specification, Types of material for process equipment, Design codes, Pressure vessel design, Design of cleaners

<u>PART – A</u>			
Q.No	Questions	BT Level	Competence
1.	Define design procedure.	BT-2	Understand
2.	What are design parameters?	BT-1	Remember
3.	Mention two types of design stresses.	BT-1	Remember
4.	List two types of loads considered in design.	BT-1	Remember
5.	What is the purpose of using design codes?	BT-2	Understand
6.	Define factor of safety.	BT-1	Remember
7.	Write any two important design codes for pressure vessels.	BT-1	Remember
8.	List any two properties of materials used in food processing equipment.	BT-1	Remember
9.	Define wall thickness in pressure vessels.	BT-1	Remember
10.	What is a corrosion allowance?	BT-1	Remember
11.	State two advantages of using stainless steel in pressure vessels.	BT-1	Remember
12.	What is the use of ASME code in equipment design?	BT-2	Understand
13.	Define working pressure.	BT-2	Understand
14.	Differentiate between ductility and toughness.	BT-2	Understand
15.	Mention two types of failures in pressure vessels.	BT-2	Understand
16.	Define weld joint efficiency.	BT-1	Remember
17.	List any two non-destructive testing methods.	BT-1	Remember
18.	What are joints in fabrication?	BT-2	Understand
19.	Mention any two functions of flanges.	BT-2	Understand
20.	What is a nozzle in pressure vessel design?	BT-1	Remember
21.	State the use of gussets in design.	BT-2	Understand

22	What is stress concentration?	BT-1	Remember
23	Define shell and head in pressure vessels.	BT-2	Understand
24	List any two design considerations for food equipment cleaners.	BT-2	Understand

PART- B

1.	Explain the general design procedure for food process equipment with a flowchart.	BT-3	Application
2.	Discuss the significance of design parameters with examples from food industry.	BT-3	Application
3.	Describe the selection criteria for materials in the design of food equipment.	BT-4	Analysis
4.	Explain different types of loads acting on food processing equipment.	BT-3	Application
5.	Write a detailed note on pressure vessel codes and standards (e.g., ASME).	BT-3	Evaluate
6.	Explain the design procedure of a cylindrical pressure vessel with example.	BT-4	Analysis
7.	Discuss the importance and types of joints used in pressure vessel fabrication.	BT-4	Analysis
8.	Explain the concept and calculation of corrosion allowance and wall thickness.	BT-3	Application
9.	Describe the effect of temperature and pressure on material selection in design.	BT-4	Analysis
10.	Illustrate the steps in designing a pressure vessel with neat diagrams.	BT-4	Analysis
11.	Discuss material testing and its importance in ensuring equipment safety.	BT-4	Analysis
12.	Explain different types of failures in food processing vessels and their causes.	BT-4	Analysis
13.	Describe the use of weld joint efficiency in pressure vessel design.	BT-4	Analysis
14.	Design a basic shell-type food equipment cleaner and explain the key assumptions.	BT-3	Application

15.	Discuss how cleaning and sanitation considerations are factored into the design.	BT-3	Application
16.	Explain the importance of design codes and standards in food equipment manufacturing.	BT-3	Application
17.	Describe the procedure for selecting material specifications for a dairy tank.	BT-3	Application

UNIT III - HEAT EXCHANGER

Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger
Problems on tubular heat exchanger, shell and tube type heat exchanger and plate heat exchanger.

<u>PART – A</u>			
Q.No	Questions	BT Level	Competence
1.	What is a heat exchanger?	BT-1	Remember
2.	Name two types of heat exchangers used in food industries.	BT-2	Understand
3.	Define LMTD.	BT-2	Understand
4.	State one advantage of plate heat exchanger.	BT-2	Understand
5.	Write the use of shell and tube heat exchangers.	BT-1	Remember
6.	What is fouling factor?	BT-1	Remember
7.	Define NTU method.	BT-1	Remember
8.	Write the formula for calculating LMTD.	BT-2	Remember
9.	What is a baffle in shell and tube heat exchanger?	BT-1	Remember
10.	Mention one application of tubular heat exchanger.	BT-1	Remember
11.	Differentiate between co-current and counter-current flow.	BT-1	Remember
12.	What are the main components of a plate heat exchanger?	BT-2	Understand
13.	Define heat transfer coefficient.	BT-2	Understand
14.	State any two assumptions made in heat exchanger design.	BT-2	Understand
15.	What is the role of insulation in heat exchangers?	BT-2	Understand
16.	Mention one reason for efficiency loss in heat exchangers.	BT-2	Understand
17.	Define effectiveness in the context of heat exchanger.	BT-1	Remember
18.	What is the use of gaskets in plate heat exchangers?	BT-1	Remember
19.	Name the fluids used in a typical milk pasteurization process.	BT-2	Understand
20.	What is a regenerative heat exchanger?	BT-1	Remember

21	Define pressure drop in heat exchanger systems.	BT-2	Understand
22	What is the difference between direct and indirect heating?	BT-1	Remember
23	What is meant by surface area in heat exchangers?	BT-1	Remember
24	What are temperature profiles in heat exchanger systems?	BT-2	Understand

PART – B

1.	Describe the working principle and construction of a shell and tube heat exchanger.	BT-3	Application
2.	Explain with equations how to design a tubular heat exchanger.	BT-4	Analysis
3.	Design a plate heat exchanger for a milk pasteurization process.	BT-3	Application
4	Compare the advantages and limitations of different types of heat exchangers.	BT-4	Analysis
5.	Solve a numerical problem involving LMTD for a counter-flow heat exchanger.	BT-3	Application
6.	Discuss the factors affecting heat transfer coefficient in food heat exchangers.	BT-3	Application
7.	Explain the NTU method of heat exchanger design with a worked example.	BT-3	Application
8.	Describe the fouling effect in food heat exchangers and mitigation methods.	BT-3	Application
9.	Explain the significance of surface area and pressure drop in heat exchanger design.	BT-5	Evaluate
10.	Discuss the design of a double-pipe heat exchanger with assumptions and diagrams.	BT-4	Analyse
11.	Compare co-current and counter-current flow in heat exchangers with diagrams.	BT-4	Analyse
12.	Discuss the criteria for selecting heat exchanger type for viscous foods.	BT-3	Application
13.	Describe regenerative heating with suitable examples in food processing.	BT-5	Evaluate
14.	Explain gasket design and material considerations in plate heat exchangers.	BT-4	Analyse
15.	Evaluate the performance of heat exchangers using effectiveness-NTU method.	BT-5	Evaluate
16.	Design a simple heat exchanger layout for fruit juice heating with calculations.	BT-3	Application
17.	Discuss thermal and mechanical design aspects of a shell and tube exchanger	BT-3	Application

UNIT IV - CONVEYING SYSTEM

Design of belt conveyer, screw conveyer and bucket elevator, Design of dryers
Design of milling equipment

<u>PART – A</u>			
Q.No	Questions	BT Level	Competence
1.	What is a conveyor?	BT-2	Understand
2.	Name any two types of conveying systems.	BT-2	Understand
3.	Define screw conveyer.	BT-1	Remember
4.	Mention two components of a belt conveyor.	BT-1	Remember
5.	What is a bucket elevator used for?	BT-1	Remember
6.	Write one application of pneumatic conveyor.	BT-1	Remember
7.	Define angle of repose.	BT-1	Remember
8.	List two design parameters of a screw conveyor.	BT-1	Remember
9.	What is a belt speed?	BT-1	Remember
10.	Mention two advantages of belt conveyors.	BT-1	Remember
11.	Define volumetric capacity in conveying systems.	BT-1	Remember
12.	State the function of idlers.	BT-2	Understand
13.	What is meant by inclined conveying?	BT-1	Remember
14.	Name any two materials conveyed in food processing.	BT-2	Understand
15.	What is a drag chain conveyor?	BT-2	Understand
16.	Define lift height in bucket elevators.	BT-2	Understand
17.	What is a dryer in food processing?	BT-2	Understand
18.	Mention two types of dryers.	BT-1	Remember
19.	Define residence time in drying systems.	BT-2	Understand
20.	List two energy sources for dryers.	BT-1	Remember
21.	What is the function of milling equipment?	BT-2	Understand
22.	Mention one advantage of hammer mill.	BT-2	Understand
23.	What is screen efficiency?	BT-1	Remember
24.	Write one difference between roller and attrition mills.	BT-2	Understand

PART - B

1.	Design a screw conveyor for conveying wheat grains with given capacity.	BT-3	Application
2.	Explain the design considerations for a belt conveyor system in a food plant.	BT-4	Analyse



3.	Discuss the working and construction of bucket elevators used in food industries.	BT-3	Application
4.	Describe the selection criteria for a conveying system for powdered materials.	BT-4	Analyse
5.	Explain the principles and design of pneumatic conveying systems.	BT-3	Application
6.	Design a belt conveyor layout for a rice milling plant and justify each component.	BT-5	Evaluate
7.	Compare screw conveyor and bucket elevator in terms of construction and operation.	BT-4	Analyse
8.	Discuss the working and design of fluidized bed dryer.	BT-3	Application
9.	Explain the design of tray dryers with temperature and airflow considerations.	BT-3	Application
10.	Classify different types of dryers and describe any one in detail.	BT-5	Evaluate
11.	Describe the milling process and design of hammer mill with diagram.	BT-4	Analyse
12.	Discuss the factors affecting energy efficiency in dryers.	BT-4	Analyse
13.	Design a simple drying system for dehydration of fruits and vegetables.	BT-3	Application
14.	Explain the significance of conveying angle and friction in screw conveyors.	BT-4	Analyse
15.	Compare the merits and demerits of roller and attrition mills.	BT-3	Application
16.	Explain the relationship between residence time and drying rate.	BT-5	Evaluate
17.	Design a bucket elevator for vertical lifting of grain and estimate its capacity.	BT-3	Application

UNIT V – CAD

Optimization of design with respect to process efficiency, energy and cost,
Computer Aided Design.

<u>PART – A</u>			
Q.No	Questions	BT Level	Competence
1.	What is CAD?	BT-2	Understand
2.	Name any two CAD software.	BT-2	Understand
3.	Mention one benefit of CAD in food equipment design.	BT-1	Remember
4.	What is design optimization?	BT-1	Remember
5.	Define 3D modeling.	BT-1	Remember
6.	What is the function of CAD in plant layout?	BT-1	Remember
7.	Write one example of energy optimization using CAD.	BT-1	Remember

8.	What is FEA (Finite Element Analysis)?	BT-1	Remember
9.	State any two features of AutoCAD.	BT-1	Remember
10.	What is simulation in CAD?	BT-1	Remember
11.	Define process efficiency.	BT-1	Remember
12.	What is meant by parametric design?	BT-2	Understand
13.	Mention one application of CAD in dryer design.	BT-2	Understand
14.	Define computer-aided manufacturing (CAM).	BT-2	Understand
15.	What is virtual prototyping?	BT-2	Understand
16.	What is meant by assembly modeling?	BT-1	Remember
17.	List two advantages of using CAD in cost reduction.	BT-2	Understand
18.	What is rendering in CAD?	BT-1	Remember
19.	What is the role of CAD in safety analysis?	BT-1	Remember
20.	Mention two common CAD file formats.	BT-2	Understand
21.	What is rapid prototyping?	BT-1	Remember
22.	Define tolerance in CAD design.	BT-2	Understand
23.	Write one difference between 2D and 3D CAD.	BT-1	Remember
24.	Mention any one limitation of CAD tools.	BT-1	Remember

PART-B

1.	Explain the role of CAD in the design and development of food processing equipment.	BT-5	Evaluate
2.	Describe how CAD is used in optimizing process layouts in food industries.	BT-3	Application
3.	Discuss cost, energy, and efficiency optimization through CAD modeling.	BT-3	Application
4.	Explain with steps the design of a simple processing vessel using CAD tools.	BT-3	Application
5.	Compare manual and computer-aided design processes in terms of accuracy and time.	BT-4	Analyse
6.	Describe the role of simulation and prototyping in food equipment CAD.	BT-3	Application
7.	Illustrate the use of CAD in designing a heat exchanger for milk pasteurization.	BT-4	Analyse
8.	Discuss the integration of CAD and CAM in equipment manufacturing.	BT-5	Evaluate

9.	Explain the significance of finite element analysis (FEA) in food equipment design.	BT-4	Analyse
10.	Describe how CAD improves safety, hygiene, and maintenance features.	BT-3	Application
11.	Develop a CAD model of a simple bucket elevator and explain each step.	BT-5	Evaluate
12.	Explain the challenges in using CAD tools for modeling food rheology.	BT-3	Application
13.	Compare various CAD software used in food process equipment design.	BT-3	Application
14.	Describe 3D modeling and its relevance in the food machinery industry.	BT-5	Evaluate
15.	Explain the role of CAD in minimizing design errors and material waste.	BT-4	Analyse
16.	Discuss the contribution of CAD in sustainability and eco-design of equipment.	BT-5	Evaluate
17.	Describe the application of CAD in the customization of processing lines.	BT-4	Analyse