



**Uva Wellassa University, Sri Lanka**  
**End Semester Examination – June/July 2010**



**ENG 434-2 Food Equipment Design and Fabrication**

Time: Two (02) hours

Total 05 questions.

Answer Four (04) Questions Only.

**Question 01:**

- A) Food safety is an important aspect in the food processing industry. What are the five (05) pillars of food safety and quality requirements? Give two examples under each pillar. (30 marks)
- B) Explain the following terms and their importance in food safety.
- I) HACCP
  - II) MRL
  - III) Traceability
  - IV) Labeling Requirements
  - V) Quarantine (70 marks)

**Question 02:**

Food contaminations can be categorized as physical, chemical and biological. Sanitary design of food equipments ensures minimum level of contamination to the product.

- A) Give three (03) examples for each type of food contaminations. (18 marks)
- B) Briefly explain how the fabrication material and the surface finish of the equipment will affect the level of contamination. (40 marks)
- C) I) Name two (02) materials that can be used for food contact surfaces in a fruit juice processing plant. Justify your selection. (22 marks)
- II) Briefly explain the properties and applications of one of the materials you mentioned. (20 marks)

**Question 03:**

- A) List three types of vessels used in the food industry and give examples for their major applications. (30 marks)
- B) Give five (05) basic requirements for designing of the piping system for your food plant. (30 marks)
- C) Site selection for a food processing plant is as important as the design of the equipments. Discuss the importance of the immediate environment on the safety and quality of food products. (20 marks)
- D) Write down five (05) safety and hygienic requirements that should be considered when installing food processing equipments. (20 marks)

**Question 04:**

A food processing vessel with outer diameter of 1.5m and operating at a maximum pressure of 1MN/m<sup>2</sup> by gauge requires a torispherical head for its closure. The material for fabrication is SS 316. If the allowable stress for SS316 at the operating temperature is 160 MN/m<sup>2</sup> and a single blank has to be used for the fabrication of the head, calculate the thickness and the diameter of the blank that has to be used for the fabrication. (100marks)

Note: closeness of t/D<sub>o</sub> values around 0.001 is accepted.

**Data:**

For torispherical heads:  $R_{\text{crown}} = D_{\text{outer}}$        $r_{\text{knucle}} = 6\%D_{\text{outer}}$        $h_{\text{flange}} = 40 \text{ mm}$

$h_1E = D_o^2/4R$        $h_2E = (D_o r/2)^{1/2}$        $h_3E = R - [(R - D_o/2)(R + D_o/2 - 2r)]^{1/2}$

Blank  $\phi = D_o + D_o/42 + 2r/3 + 2h_{\text{flange}}$

h <sub>Effective</sub> /D <sub>outer</sub>	t/D <sub>outer</sub>				
	0.002	0.005	0.01	0.02	0.04
0.15	4.55	2.66	2.15	1.95	1.75
0.20	2.30	1.70	1.45	1.37	1.32
0.25	1.38	1.14	1.00	1.00	1.00

**Question 05:**

A vertical vessel with a thickness of 2 mm and height of 10 m has a 1.2 m inner diameter. The vessel will be installed inside a building and the vessel contains no internal fittings or accessories. If the vessel is to be operated under a maximum pressure of 1 MN/m<sup>2</sup> with a load of 2000 N (total of the materials and the vessel itself), calculate the following.

- A) The axial stresses on the vessel due to the operating pressure, dead weight and wind. (60 marks)
- B) The resultant axial stress and the hoop stress (20 marks)
- C) What are the uses of the above calculations in equipment design? (20 marks)

**Data:**

$T = 6.35 \times 10^{-5} (H/D_o)^{3/2} (W_{\text{dead}}/t)^{1/2}$

$P_{\text{wind}} = k_1 \cdot k_2 \cdot P_1 \cdot h_1 \cdot D_o$

Region	P <sub>1</sub> (kN/m <sup>2</sup> )	
	H <sub>vessel</sub> < 20m	H <sub>vessel</sub> > 20m
Coastal area	1.0	1.5
Moderate wind area	0.4	1.0

Shape factor (k<sub>1</sub>) for the vessel = 1.0

For T < 0.5 s; k<sub>2</sub> = 1 and For T > 0.5 s; k<sub>2</sub> = 2