GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING & TECHNOLOGY (14)
FOOD PLANT UTILITIES & SANITATION
SUBJECT CODE: 2161407
B.E. 6th SEMESTER

Type of course: Food Processing Technology

Prerequisite: Nil

Rationale:
Every food processing plant needs basic utilities like steam, water, air, electricity, waste water treatment and refrigeration systems to service its main line production activities. A thorough understanding of these plant utilities is required would be highly desirable for a graduating food engineer and technologists. The course is designed lead to a learner into acquiring the functional knowledge and technical familiarity required to work in the industry with an understanding of types of different utilities, their duty requirements, components, costs involved, safety and maintenance issues, selection, installation and commissioning.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Steam generation and performance:** Boiler operation and design considerations, forced and induced draught. Flue gas composition and performance analysis.	8	13
2	**Process water treatment:** Water treatment for prevention against boil corrosion and scale formation on heat exchange equipment. Water treatment against microbial contamination. Process plant sanitation - chemistry and CIP cleaning systems.	14	17
3	**Cleaning & corrosion:** Detergent types, properties and corrosion inhibition.	4	8
4	**Waste water treatment:** BOD and its reduction, fundamentals of batch and continuous type effluent treatment system.	7	12
5	**Biochemical engineering:** Principles for biochemical reaction engineering.	2	6
6	**Process air generation and applications:** Process air requirement & supply system. Air Moving and vacuum equipment.	4	10
7	**Power supply system:** Power supply system for food process plants. Equipment and Plant earthing.	3	9

8	**Water supply system:** Water supply system for food process plants: Layout and distribution. Industrial and potable water.	**3**	10
9	**Cleaning, sanitizing and Sterilization:** Basic principles and problems, cleaning and sterilizing agents, methods of sterilization, methods of cleaning, choice of cleaning methods, introduction to special cleaning methods.	**10**	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
19	23	17	20	21	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Food Plant Design**:** Antonio López-Gómez Gustavo V. Barbosa-Cánovas, Published in 2005 byCRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, International Standard Book Number-10: 1-57444-602-9.
2. Food Plant Sanitation, edited by Y. H. Hui, Bernard L. Bruinsma, J. Richard Gorham, Wai-Kit Nip, Phillip S. Tong, and Phil Ventresca.
3. Food Plant Sanitation: design, maintenance, and good manufacturing practices by Michael M. Cramer, CRC Press, 2006, ISBN: 0849341973, 9780849341977.
4. Handbook of Food Processing Equipment, *Food engineering series* by George D Saravacos, A. E. Kostaropoulos, Springer, 2002 ISBN: 0306472767, 9780306472763
5. Food Engineering and Dairy Technology, by Professor Dr.-Ing. H.G. Kessler, 1981, Published by VERLAG. A. KESSLER, Germany

Course Outcome:

At the end of this module, the student will be able to:

1. By the end of the course, the students will acquire knowledge on theoretical and practical aspects of steam generation and boilers, design a process water system, air supply system and power supply system to meet the needs of a food processing plant.
2. The student would be equipped to make decisions on site selection, layout selection and design considerations for a food plant housing all the utilities. The students are expected to develop skills and acquaint in project preparations, estimations and cost estimates of different utilities of various food industries.
3. The learner would be fairly acquainted with cleaning, sanitizing and sterilization needs of a food industry vis-a-vis product safety and regulatory requirements.
4. In-depth knowledge of food waste water generation, its properties, regulatory requirements, design, selection, operation and maintenance of customized treatments systems.
5. An idea about the contributing costs involved in usage of various utilities

List of Experiments:

1. To examine the installed boiler in the laboratory and carry out the following:

(i) Write down capacity and nominal pressure.

(ii) Identify various components of the system and mention their specifications.

(iii) Draw a process flow diagram indicating water, air, fuel, power and steam lines.
(iv) Calculate the BHP of the installed boiler operating at 6 bar and full load for a blow-down fraction of 6%. Take feed water temperature at 25 ^{o}C

2. Draw neat and labeled diagrams of the following and write at least 50 words for each:
(i) Sectional view of a vertical fire-tube boiler exposed tube type and submerged tube type.
(ii) Arrangement of a safety valve on a steam drum showing steam discharge piping and drains.
(iii) Gate Valve and Feed Pump.

3. To operate the installed boiler in the laboratory and carry out the following:

(i) State the logical sequence of operation of different components and explain their functions.

(ii) To list the safety precautions for operation and possible consequences thereof if not followed.

4. To examine the installed Air Compressor and carry out the following exercise:
(i) Draw its plan, elevation and a pictorial view. Choose approximate proportionate scales.

(ii) Mention its nominal capacity (Motor HP, Pressure, and Storage Tank Capacity)

(i) Make a part list of various components of the compressor and state their functions.
(ii) Mention all the installation steps sequentially.

5. To operate the installed Air Compressor and carry out the following exercise:
(i) Mention steps for its start up.
(ii) Safety precautions.
(iii) Servicing instructions.
(iv) Trouble shooting practice in a tabular form indicating "Problems, Causes and Remedial action".
(v) Calculate the volumetric efficiency and the swept volume.

6. To calculate the oxygen absorbed by a given waste water sample by chemical analysis.
7. To determine the ultimate 1st stage BOD and rate constant of a waste stream using Thomas Method.
8. To determine the total alkalinity in a waste water stream due to carbonates, bicarbonates and hydroxides.
9. To devise water supply system for a medium scale food processing plant and identify potential hazardous events related to the system.
10. To work out a power supply system for medium scale food processing plant and identify potential hazardous events related to the system like earthing, neutral grounding, MCB's etc..
11. To calculate power requirements for water pumping.

Design based Problems (DP)/Open Ended Problem:

1. Design a composite waste water treatment plant to handle the waste generated from a multi product food processing set up.
2. Design a solid waste treatment and disposal system from a food grain processing establishment.
3. Suggest **hygienic design construction materials for a food processing plants.**
4. **Develop a C**ommunity Water supply, treatment and Sanitation Program (CWSP) for your locality having a population of 1000 people .
5. Develop a renewable energy based power supply system to meet the needs of a small scale food processing plant.
6. Develop an anaerobic waste water treatment plant for generation of bio-gas

Major Equipments & Instruments:

1. Package steam boiler, pipes and fittings.
2. Boiler house accessories and mountings.
3. Boiler tool kit.
4. Reciprocating air compressor.
5. Compression tester.

6. Electrical panel board and power transformers.
7. Chemicals and reagents for water testing in lab.
8. Multi port water softener.
9. Laboratory for material analysis.
10. BOD Bottles and Incubation chamber.
11. Centrifugal pump

List of Open Source Software/learning website: http://foodscience.uark.edu/
www.foodquality.com/
www.sanitarydesign.com/principles.cfm
www.gpcb.gov.in/
www.cpcb.nic.in/ [**Central Pollution Control Board]**
www.unicef.org/india/wes.html
indiasanitationportal.org/
www.wesnetindia.org/
www.indiaboiler.com/ibr.htm [Indian Boilers Regulations - 1950]

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.