GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170403

BIOPROCESS PLANT DESIGN
7thSEMESTER

Type of course: Professional elective course

Prerequisite: The student should have basic understanding of Unit Operations of Process Engineering.

Rationale: Plant design involves modifications and additions to existing plants or creating design layouts of plant / equipments. With rapid rate of increase in the advancement of knowledge, it is important that the students should know the relevant application for equipment design. It has been observed conclusively that practice inusing thereference literature and software has helped the students to secure jobs and also to perform better in profession.

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)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	• Basics of Stress, Strain and Mechanical Properties of Materials. • Development of the flow sheets and its description. • Piping and instrumentation diagrams.	9
2	Detailed process design of the following equipments(numericals included) • Shell and tube heat exchanger • Evaporators • Distillation columns	15
3	Detailed mechanical designs of following vessels(numericals included) • Pressure vessels • Heads and closures • Reactor (With Coil & Jacket) • Storage tank (Only theory)	16
4	• Nozzles, supports, non-standard flanges: Sketch, uses. • Design of tall vertical vessels.	12

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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	**21**	**21**	**7**	**14**	-

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.

Text Books:

1) Process Equipment Design, M.V.Joshi, second edition.
2) Bioprocess Engineering- Systems, Equipment and Facilities, Bjorn K.L., Nancy A.D., Wiley Intersciences, First Edition

Reference Books:

1. Perry's Chemical Engineers Handbook
2. Pharmaceutical Engineering, Sambamurthy
3. Chemical Engineering – Vol. 6 – Richardson & Coulson.
4. Process Equipments Design – Vessel Design – L. E. Brownell, D. H. Young.
5. ISI Codes / ASME section 8-B
6. Plant Design and Economics for Chemical Engineers – Peters &Timmerhaus.
7. Bioseparations Science and Engineering by Roger Harrison, Paul Todd, Scott Rudge and Demetri Petrides, 1st Edition, published by Oxford University Press

Course Outcomes:

After learning the course the students should be able to:

CO1	Define various mechanical properties associated with the material.
CO2	Explain the importance of piping & instrumentation diagram, fabrication techniques, corrosion allowance and weld joint efficiency factor in industry.
CO3	Calculate the thickness of pressure vessel, vessel head and tall vertical vessel.
CO4	Examine various parameter related with the designing of shell & tube heat exchanger, distillation column and evaporators.
CO5	Explain the importance of support, nozzle & flange in industries.

Suggested Assignments:

1) Drawings of technical sketches of various equipments, diagrams etc from the text books (one from each topic)

2) Assignments on topics designed to clear the concepts of the subjects (one from each topic)

3) LABORATORY WORK / TERM WORK:

Task 1: Drawings/ Technical Sketches**:**
Students are asked to make important sketches from the book " Principles of Fermentation technology,2/e, Stanbury" [Students are asked to draw all sketches in A4 size both side blank paper

and attach to term work file; Use **HB** or **2H** pencil; Drawings have to be proportaionate/ or as per the scale of the drawings]

Task 2: Selection and design of fluid moving machinery. (types of pumps, valves etc and their total design and selection features, comparisons, advantages, disadvantages) **Task 3**: Students are asked to collect the procedures for 'Bioprocess validation" taking an example from pharmaceutical industries.

4) Additionally, students may refer for tasks 1-3 : "Bioprocess Engineering- Systems, Equipment and Facilities, Bjorn K.L., Nancy A.D., Wiley Intersciences, First Edition"

Design based Problems (DP)/Open Ended Problem:

Students are free to select any area for designing of equipment based on Chemical engineering applications to define Projects. Some suggested projectsarelisted below:

- Carry out design of pressure vessel / heads & clousers / reactor etc….
- Calculation related to the designing of distillation & evaporator.
- Design Calculation related to heat exchange equipment and their performance criteria.

List of Open Source Software/learning website:

- Students can refer to video lectures available on the platforms including NPTEL lecture series.
- Students can refer to the CDs available with some reference books for the solution of problems using software/spreadsheets. Students can develop their own programs/spreadsheets for the solution of problems.
- MIT Open course lecture on Equipment design.
- Open Literature available for design of equipment in plant / industry.