GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Bio-Technology (04)
SUBJECT NAME: Bioprocess Plant Design
SUBJECT CODE: 2170403
B.E. 7th SEMESTER

Type of course: Bio Technology (Core subject)

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 in using the reference 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
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	1. Basics of Stress, Strain and Mechanical Properties of Materials. 2. Development of the flow sheets and its description. 3. Piping and instrumentation diagrams.	9	18
2	Detailed process design of the following equipments (numericals included) 1) shell and tube heat exchanger, 2) evaporators, 3) distillation columns	16	31
3	Detailed mechanical designs of following vessels (numericals included) 1) Pressure vessels 2) Heads and closures 3) reactor 4) storage tank (theory only)	14	27
4	1) Nozzles, supports, non-standard flanges: Sketch, uses. 2) Design of tall vertical vessels.	12	24

TEXT BOOK:

Process Equipment Design, M.V.Joshi, second 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

Suggested Specification table with Marks (Theory):

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

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
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Course Outcome:

After learning the course the students should be able to:

1) Understand the concepts of designing various chemical and biochemical equipments and devices
2) They will be able to select the right ancillaries or equipments for the industrial units
3) Calculate the required parameters for different vessels and parts theirof.

List of Tutorials [Tasks]:

1) Assignments on topics designed to clear the concepts of the subjects (one from each topic)
2) LABORATORY WORK / TERM WORK:
    - **Task 1**: Drawings/ Technical Sketches**:**
      Students are asked to make technical sketches relevant to topics 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**:
      Theory and numericals related to Pipeline design (concept of piping, design features, numericals)
    - **Task 3**:
      Selection and design of fluid moving machinery. (Types of pumps, valves etc and their total design and selection features, comparisons, advantages, disadvantages)
    - **Task 4**:
      Students are asked to collect the procedures for 'Bioprocess validation" taking an example from pharmaceutical industries.
    - **Task 5**:
      Students are asked to make notes of Bioprocess and plant economics with comparison of downstream processes
    - Additionally, students may refer for tasks 1-5 : "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 projects are listed 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 websites 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.

ACTIVE LEARNING ASSIGNMENTS: The tutorials will be given to students which will cover entire content of the subject. The students will be required to solve all problems given in the tutorials.