GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30)

PROCESS SAFETY MANAGEMENT

SUBJECT CODE: 2723013

SEMESTER: II

Type of course: Chemical Engineering (Major Elective-III)

Prerequisite: None

Rationale:

The Course focus on engineering principles and management required for process safety in Industries. This course would educate students to identify and assess hazards in any stage of operation, to quantify and manage them as well. Process Safety Management systems are comprehensive sets of policies, procedures and practices designed to ensure that barriers to major incidents are in place, in use and effective.

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)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Hrs	% Weightage
1	**Introduction** Introduction to safety, health and environmental management- toxicology, industrial hygiene, flammability, reactivity, Importance of safety- safety assurance and assessment- safety in design and operation- organizing for safety, MSDS	4	7
2	**Process Hazard Analysis** Checklist, What-if/checklist, Hazard and Operability Study (HAZOP) Failure Modes and Effects Analysis (FMEA), Fault Tree Analysis	6	11
3	**Government Regulations/Process Safety Management** Case Studies/Accident Investigation, safe operating procedures. Safety rules & regulations for transportation , storage and handling of hazardous materials	7	13
4	**Modeling in Safety** Accidents modeling- release modeling- fire and explosion modeling- toxic release and dispersion modeling- accident investigation and reporting- concepts of HAZOP and PHA. Safety measures in design and process operations- inerting, explosion, fire prevention, sprinkler systems	8	15
5	**Economic Aspects of Safety** Operational safety-commissioning, safe start-up and safe shut-down of equipment such as, distillation column, furnace, reactor, pumps and compressors	6	11
6	**Process Risk Management**	7	13

	Risk assessment and management- Risk picture- definition and characteristics- risk acceptance criteria- quantified risk assessment- hazard assessment- fatality risk assessment.		
7	**Elements of Process Safety Management** Accountability, Process Knowledge and Documentation, Process Safety Review Procedures for Capital Projects, Process Risk Management, Management of Change, Process and Equipment Integrity, Human Factors, Training and Performance, Incident Investigation, Company Standards, Codes and Regulations, Audits and Corrective Actions, Enhancement of Process Safety Knowledge	7	13
7	**Design of Safety Systems** Interlock / tripping System, Safety devices, Control of Major Chemical Hazards, Revealed and unrevealed faults. Ventilation calculations, control of worker exposure, Designs to Prevent Fires and Explosions.	9	17

Reference Books:

1. "Chemical Process Safety, Fundamentals with Applications", Second Edition by Daniel A. Crowl & Joseph F. Louvar Published by Prentice Hall, Inc. ISBN 0-13-018176-5
2. Frank P Lees, "Loss Prevention in Process Industries" Volume 1, 2 & 3
3. Richard Turton, Richard C Bailie, Wallace B Whiting, Analysis Synthesis and Design of Chemical Processes, Pearson, New Delhi, 4th Edition
4. Health, Safety and Accident Management in the Chemical Process Industries Ed. by H. Heinmann, M. Dekker
5. "Safety, Health, and Loss Prevention in Chemical Processes: Problems For Undergraduate Engineering Curriculum", 1990, AIChE Center for Chemical Process Safety (CCPS).
6. Plant Guidelines for Technical Management of Chemical Process Safety", by the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers ISBN 0-8169-0499-5
7. "Fundamentals of Process Safety", by the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers ISBN 0-85295-431-X

Course Outcome:

After learning the course the students will be able to:

1. Be aware of the factors that can lead to an accident.
2. Discuss toxicology, industrial hygiene, source models, dispersion models, , fires and fire prevention, explosions and explosion prevention, electrostatics, pressure relief systems, runaway reactions, and risk analysis as they apply to chemical process safety, and be able to solve corresponding problems.
3. Discuss the nature of the accident process and methods used in accident investigation, inherently safer design strategies, and the various strategies and governmental regulations relevant to process safety management.
4. Collect and analyze data for designing pressure relief systems, and for characterizing dust explosions and electrostatic charge accumulation and discharge.
5. Be aware of societal issues concerning technology and the impact of the practice of chemical engineering on the surrounding and larger community.
6. Be aware of ethical issues and principles in chemical engineering practice.

List of Tutorials:

Each group is expected to analyze the process of manufacturing of the specific chemical assigned to his group, with a special emphasis on safety issues. In addition, each group will be expected to give a

powerpoint presentation during last week of semester. The presenter will be selected randomly just prior to the presentation.

List of Major Equipments: None

List of Open Source Software/learning website:

- **Softwares:** Safety Management Software, MSDS Software, CSafe, DR software's ChemGes, Periscope software, MAUS OHS Planning software (Occupational, Health & Safety Planner), CINTELLATE
- Students can refer to video lectures available on the websites including NPTEL.
- Students can refer to the CDs which are available with some reference books for the solution of problems using softwares. Students can develop their own programs for the solutions of problems.
- Websites: www.safetyforlife.com.au, SmartOHS.com.au

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website