Estd. 1962
"A++" Accredited by
NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA

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शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र

दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४

Ref./SU/BOS/Science/531 **Date : 08/09/2025**

To,

The Director,
School of Engineering and Technology,
Shivaji University, Kolhapur.

Subject : Regarding Minor Change in Syllabi of P.G. Diploma in Process Safety Management under the Faculty of Science and Technology.

Ref : SU/BOS/Science/532 Date : 03/10/2024 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the changes in syllabi, nature of question paper and rules and regulation of P.G. Diploma in Process Safety Management programme under the Faculty of Science and Technology.

This syllabus to be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020 (Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

(Dr. S. M. Kubal)
Dy. Registrar

Encl: As above

for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

SHIVAJI UNIVERSITY, KOLHAPUR.

Established: 1962

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Structure, Curriculum, Rules and Regulations

For

P.G. Diploma in Process Safety Management

Under Faculty of Science and Technology

To be implemented from June, 2024 onwards.

Shivaji University, Kolhapur,

Post Graduate Diploma in Process Safety Management

Curriculum Structure

Semester I

Sr. No.	Course Code	Course Title	Total Contact Hours	Credits Assigned per week	Evaluation Scheme				
					CIE	IOE	SEE	EOE	Total
1.	PGD-PSM 1.1	Fundamentals of Process Safety Management	60	04	30	-	70	-	100
2.	PGD-PSM 1.2	Process Safety Technology and Innovation	60	04	30	-	70	-	100
3.	PGD-PSM 1.3	Elective-I	60	04	30	-	70	-	100
4.	PGD-PSM 1.4	Research Methodology for Process Safety Management	60	04	30	-	70	-	100
5.	PGD-PSM 1.5	In Plant Training –I (OJT)	180*	06	-	75	-	75	150
Total			420	22	195		355		550

* As regards the in plant training, the students will have liberty to carry out training activity at their respective workplaces.

Semester II

Sr. No.	Course Code	Course Title	Total Contact Hours	Credits Assigned Per Week	Evaluation Scheme				
					CIE	IOE	SEE	EOE	Total
1.	PGD-PSM 2.1	Advanced Process Safety Management	60	04	30	-	70	-	100
2.	PGD-PSM 2.2	Process Safety Implementation and Compliance	60	04	30	-	70	-	100
3.	PGD-PSM 2.3	Elective II	60	04	30	-	70	-	100
4.	PGD-PSM 2.4	In Plant Training –II (OJT)	120*	04	-	50	-	50	100
5.	PGD-PSM 2.5	Capstone Project	180*	06	-	75	-	75	150
Total			480	22	215		335		550

* As regards the in plant training II & Capstone Project, the students will have liberty to carry out training activity at their respective workplaces.

Program: Vision, Mission Objectives & Outcome Statements

Vision Statement

"To be the premier educational program in process safety management, dedicated to advancing knowledge and expertise in ensuring safe and efficient industrial processes globally."

Mission Statement

- Deliver a robust curriculum focused on process safety management.
- Equip graduates with advanced skills in risk identification, assessment, and mitigation.
- Integrate the latest industry practices and technological advancements.
- Foster a culture of safety and continuous improvement in industrial environments.
- Promote environmental stewardship and sustainable practices in process safety management.

Program Educational Objectives

- Equip graduates with advanced knowledge and skills in process safety management.
- Develop a deep understanding of safety protocols, risk assessment, and emergency response.
- Foster leadership qualities for effective safety culture implementation.
- Provide hands-on experience through a capstone project, simulating real-world industrial scenarios.

Program Outcomes

Upon completion of the PGD-PSM program, graduates will demonstrate the following outcomes:

1. Proficient understanding of process safety principles and regulations.
2. Competence in hazard identification, risk assessment, and safety system design.
3. Leadership skills for promoting a culture of safety in industrial settings.
4. Ability to analyze and investigate incidents, implementing corrective measures.
5. Practical experience gained through an industry-relevant capstone project.

SEMESTER I

Course 1: PGD-PSM 1.1: Fundamentals of Process Safety Management

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale: This course provides an in-depth exploration of fundamental concepts in process safety management, emphasizing the integration of risk management, regulatory compliance, and best practices to ensure safe and efficient industrial operations.

Course Objective:

- To enhance understanding of risk assessment and management techniques.
- To explore the latest developments in process safety regulations and standards.
- To develop strategies for implementing and improving process safety management systems in complex industrial environments.

Course Outcomes:

CO1: Apply risk assessment methodologies to identify and mitigate potential hazards in industrial processes.

CO2: Demonstrate knowledge of current process safety regulations and standards and their application in real-world scenarios.

CO3: Develop and implement comprehensive process safety management systems tailored to specific industrial needs.

CO4: Evaluate and improve existing process safety practices through continuous monitoring and feedback.

CO5: Analyze case studies to extract valuable lessons and best practices in process safety management.

Course Content

Unit No.	Unit Description	Hours
01.	**Process Safety Metrics and Performance Indicators** • Basics of Process Safety. • Importance of process safety metrics • Types of safety performance indicators • Leading vs. lagging indicators • Developing and implementing effective safety metrics	10
02.	**Process Safety in Design and Engineering** • Principles of inherently safer design	10

	• Safety considerations in process design • Integration of safety into engineering practices • Case studies of design-related safety improvements	
03.	**Advanced Risk Assessment Techniques** • Layer of Protection Analysis (LOPA) • Bow-tie analysis • Dynamic risk assessment methodologies • Risk assessment in complex and high-hazard processes	**10**
04.	**Process Safety in Operations and Maintenance** • Safety protocols for routine and non-routine operations • Maintenance practices and safety • Operational safety audits and inspections • Human factors in operations and maintenance	**10**
05.	**Safety Management Systems and Standards** • Overview of major process safety management systems (PSM, OSHA, etc.) • ISO 45001 and other relevant standards • Implementing and auditing safety management systems • Continuous improvement in safety management	**10**
06.	**Safety Culture and Behavioral Safety** • Building and sustaining a safety culture • Leadership and employee engagement in safety • Behavior-based safety programs • Measuring and improving safety culture	**10**
Reference Books		
1.	Mannan, S. (2012). Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control (4th ed.). Butterworth-Heinemann.	
2.	Center for Chemical Process Safety (CCPS). (2016). Introduction to Process Safety for Undergraduates and Engineers. Wiley-AIChE.	
3.	Kletz, T. (2006). HAZOP and HAZAN: Identifying and Assessing Process Industry Hazards. CRC Press.	

Course 2: PGD-PSM 1.2: Process Safety Technology and Innovation

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale: This course focuses on the role of technological advancements and innovative practices in enhancing process safety. It covers emerging technologies, safety instrumented systems, and innovative approaches to managing and improving safety in industrial operations.

Course Objective:

- To understand the impact of emerging technologies on process safety.
- To explore innovative approaches and tools for enhancing safety performance.
- To develop skills in applying technological solutions to address safety challenges in industrial settings.

Course Outcomes:

CO1: Identify and evaluate emerging technologies and their implications for process safety.
CO2: Utilize innovative tools and methods to enhance safety performance in industrial operations.
CO3: Integrate advanced safety instrumented systems into process safety management frameworks.
CO4: Develop strategies for leveraging technology to proactively address safety challenges.
CO5: Assess the effectiveness of technological solutions through real-world applications and case studies.

Course Content

Unit No.	Unit Description	Hours
01.	**Safety Instrumented Systems (SIS)** • Overview of SIS and functional safety standards (IEC 61511) • Design and implementation of SIS • Safety Integrity Levels (SIL) determination • SIS lifecycle management	10
02.	**Advanced Process Control and Safety** • Role of process control in safety • Integration of safety and control systems • Advanced control strategies for safety enhancement • Alarm management and safety	08
03.	**Hazardous Materials and Chemical Safety** • Classification and properties of hazardous materials • Safe handling and storage practices	10

	• Chemical compatibility and reactivity • Case studies on hazardous material incidents	
04.	**Explosion Protection and Mitigation** • Principles of explosion protection • Venting, suppression, and containment techniques • Dust explosion hazards and prevention • Standards and regulations for explosion protection	**10**
05.	**Safety in Equipment and Facility Design** • Designing equipment and facilities for safety. • Compliance with safety standards in design. • Concept of Electrical Hazard Classification. **Fire Safety in Process Industries** • Fire hazards and risk assessment • Fire detection and suppression systems • Emergency response planning for fire incidents • Fire safety regulations and standards	**12**
06.	**Emerging Technologies in Process Safety** • Use of IoT and AI in process safety • Digital twins and predictive maintenance • Advanced materials for safety improvement • Future trends and innovations in process safety	**10**
Reference Books		
1.	Crowl, D. A., & Louvar, J. F. (2011). Chemical Process Safety: Fundamentals with Applications (3rd ed.). Prentice Hall.	
2.	Mannan, S. (2012). Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control (4th ed.). Butterworth-Heinemann.	
3.	Geller, E. S. (2001). The Psychology of Safety Handbook. CRC Press.	

Course 3: PGD-PSM 1.3: Elective I
Environmental Impact of Process Industries

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale: This course focuses on the design, implementation, and management of Safety Instrumented Systems (SIS), critical components in preventing and mitigating process-related incidents.

Course Objective:

- To understand the environmental consequences of various industrial processes.
- To assess and manage the environmental impacts of industrial operations.
- To develop strategies for sustainable industrial practices and compliance with environmental regulations.

Course Outcomes:

CO1: Identify and analyze the environmental impacts of different industrial processes.
CO2: Apply environmental assessment tools and techniques to evaluate industrial activities.
CO3: Develop and implement strategies to mitigate adverse environmental effects.
CO4: Demonstrate knowledge of environmental regulations and standards relevant to industrial operations.
CO5: Promote sustainable practices within industrial settings to reduce environmental footprint.

Course Content

Unit No.	Unit Description	Hours
01.	**Introduction to Environmental Impact Assessment (EIA)** • Overview of EIA processes and methodologies • Legal and regulatory framework • Public participation in EIA • Case studies of successful EIA implementations	10
02.	**Air Quality Management** • Sources of air pollution in process industries • Air quality monitoring and control techniques • Regulatory standards for air emissions Mitigation strategies for reducing air pollution	10
03.	**Water and Wastewater Management** • Water usage in process industries • Wastewater treatment technologies • Regulatory standards for water discharge • Water conservation and recycling practices	10

04.	**Solid and Hazardous Waste Management** • Classification and management of industrial waste • Treatment and disposal methods for hazardous waste • Waste minimization and recycling • Regulatory compliance and documentation	**10**
05.	**Environmental Risk Assessment and Management** • Principles of environmental risk assessment • Tools and techniques for risk assessment • Risk management strategies • Case studies of environmental risk management	**10**
06.	**Sustainable Development in Process Industries** • Principles of sustainable development • Green chemistry and engineering • Life cycle assessment • Strategies for sustainability in process industries	**10**
Reference Books		
1.	Nathanson, J. A. (2007). Basic Environmental Technology: Water Supply, Waste Management and Pollution Control. Prentice Hall.	
2.	CCPS (Center for Chemical Process Safety). (1998). Guidelines for Safe Storage and Handling of High Toxic Hazard Materials. Wiley-AIChE.	
3.	Hawkins, T., & Sutton, P. (2009). Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products. Wiley.	

Course 3: PGD-PSM 1.3: Elective I
Human Factors and Ergonomics in Process Safety

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale: This course delves into the critical role of human factors and ergonomics in ensuring process safety. It focuses on understanding how human behavior, system design, and workplace ergonomics influence safety outcomes in industrial environments.

Course Objectives:

- To understand the principles of human factors and ergonomics and their impact on process safety.
- To identify and mitigate human error in industrial operations.
- To design ergonomic workplaces those enhance safety and productivity.

Course Outcomes:

CO1: Explain the principles of human factors and ergonomics in the context of process safety.
CO2: Analyze the impact of human error on process safety and develop strategies to mitigate it.
CO3: Design ergonomic workplaces that promote safety and efficiency.
CO4: Evaluate human-machine interfaces and their role in enhancing process safety.
CO5: Implement human factors and ergonomic principles to improve safety culture and performance in industrial settings.

Course Content

Unit No.	Unit Description	Hours
01.	**Introduction to Human Factors and Ergonomics** • Definition and importance of human factors in process safety • Historical perspective and evolution of ergonomics • Key concepts and principles of ergonomics • The relationship between human factors, ergonomics, and safety	10
02.	**Human Error and Accident Causation** • Types and causes of human error • Models of accident causation (e.g., Swiss Cheese Model, Human Factors Analysis and Classification System - HFACS) • Identifying and mitigating human error in process industries • Case studies of accidents caused by human error	10
03.	**Ergonomic Assessment Methods** • Techniques for assessing ergonomic risks (e.g., RULA, REBA, NIOSH Lifting Equation) • Workstation design and layout for optimal ergonomics • Evaluation of physical, cognitive, and organizational ergonomics • Application of ergonomic principles to process safety	10

04.	**Human-Machine Interface (HMI) and Control Room Design** • Principles of HMI design for process safety • Designing effective control rooms and operator interfaces • Impact of HMI design on operator performance and safety • Case studies of HMI improvements in process industries	**10**
05.	**Safety Culture and Behavioral Safety** • Understanding safety culture and its impact on behavior • Strategies for promoting a positive safety culture • Behavior-based safety (BBS) programs and interventions Measuring and improving safety culture	**10**
06.	**Training and Competence in Process Safety** • Designing effective training programs for process safety • Methods for assessing and improving worker competence • Role of simulation and virtual reality in safety training • Continuous learning and development in process safety	**10**
Reference Books		
1.	Wickens, C. D., Lee, J. D., Liu, Y., & Gordon-Becker, S. E. (2004). An Introduction to Human Factors Engineering. Prentice Hall.	
2.	Sanders, M. S., & McCormick, E. J. (1993). Human Factors in Engineering and Design. McGraw-Hill.	
3.	Wilson, J. R., & Corlett, E. N. (2005). Evaluation of Human Work. CRC Press.	

Course 4: PGD-PSM 1.4: Research Methodology for Process Safety Management

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale: This course equips students with essential research skills and methodologies necessary for conducting systematic inquiries in process safety management. It focuses on developing proficiency in research design, data collection, analysis techniques, and ethical considerations relevant to advancing knowledge in the field of process safety.

Course Objectives:

- To familiarize students with research methodologies applicable to process safety management.
- To develop skills in formulating research questions and hypotheses in the context of safety.
- To provide an understanding of ethical principles and regulatory requirements in safety-related research.

Course Outcomes:

CO1: Apply various research methodologies to investigate issues related to process safety management.
CO2: Formulate and justify research questions and hypotheses in the field of process safety.
CO3: Demonstrate proficiency in data collection, analysis, and interpretation techniques.
CO4: Evaluate and critique safety-related research literature effectively.
CO5: Adhere to ethical standards and regulatory guidelines in conducting safety-related research.

Course Content

Unit No.	Unit Description	Hours
01.	**Introduction to Research in Process Safety Management** • Definition and importance of research in process safety • Types of research methodologies • Formulating research questions and hypotheses • Literature review and its significance	10
02.	**Research Design and Methods** • Qualitative and quantitative research methods • Experimental and non-experimental research designs • Data collection techniques (surveys, interviews, observations) Sampling methods and sample size determination	10
03.	**Data Analysis and Interpretation** • Statistical tools and techniques for data analysis • Qualitative data analysis methods • Software tools for data analysis (e.g., SPSS, R) Interpreting and presenting research findings	10

04.	**Safety Data and Information Management** • Collection and management of safety data • Use of databases and information systems in research • Data integrity and quality control • Ethical considerations in data management	**10**
05.	**Writing and Publishing Research** • Structuring research papers and reports • Writing for academic and professional audiences • Guidelines for publishing in journals and conferences • Peer review process and responding to reviewers	**10**
06.	**Case Studies and Applied Research in Process Safety** • Conducting case study research in process safety • Application of research findings to real-world problems • Collaborative research with industry partners • Future directions and trends in process safety research	**10**
Reference Books		
1.	Kothari, C. R. (2004). Research Methodology: Methods and Techniques. New Age International.	
2.	Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage Publications.	
3.	Yin, R. K. (2017). Case Study Research and Applications: Design and Methods. Sage Publications.	

Course 5: PGD-PSM 1.5: In Plant Training-I (OJT)

IOE: 75 Marks **EOE: 75 Marks** **Contact Hours: 180**

Course Rationale: The In-Plant Training course is designed to provide working professionals with hands-on experience in applying process safety management principles within their workplace. This course allows students to directly implement and observe process safety practices, enabling them to identify hazards, assess risks, and develop effective safety management strategies in a real-world industrial environment.

Course Objectives:

- To apply theoretical knowledge of process safety management in a practical industrial context.
- To enhance the ability to identify, assess, and mitigate risks in the workplace.
- To develop skills in conducting safety audits, incident investigations, and emergency response planning.
- To foster continuous improvement and professional development in process safety management practices.

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Apply process safety management principles in a real-world industrial setting.
2. Identify and evaluate safety hazards and risks specific to their workplace.
3. Implement effective risk mitigation measures and safety management strategies.
4. Conduct thorough safety audits and inspections within their plant.
5. Develop and execute emergency response plans tailored to their workplace.
6. Perform incident investigations and identify root causes and corrective actions.
7. Promote a culture of safety and continuous improvement within their organization.

Course Content

Note: The candidates will spare time equivalent to 180 hours in order to complete the in plant training related exercise. This time will be uniformly distributed throughout the semester so as to undergo the completion of this in plant training. In case of the students who are not the working professionals; they are required to join an industry for a period of minimum 3 weeks to complete this in plant training.

Activity No.	Description	Hours
01.	**Orientation and Goal Setting** • **Initial Meeting**: Meet with the course supervisor to outline the training objectives, expectations, and deliverables. • **Goal Setting**: Identify specific, measurable objectives for the in-plant training based on the student's workplace safety needs.	**25**
02.	**Workplace Hazard Identification and Risk Assessment** • **Comprehensive Safety Assessment**: Conduct a thorough assessment of the workplace to identify critical hazards and high-risk areas. • **Risk Analysis**: Use risk assessment techniques to evaluate identified hazards and prioritize them based on severity and likelihood.	**100**
03.	**Implementation of Safety Management Systems** • **Review and Update Policies**: Review existing safety policies and procedures. Update or develop new procedures to address identified risks. • **Safety Training Sessions**: Conduct safety training sessions for employees to enhance awareness and adherence to safety practices.	**55**

Reference Books

1.	Mannan, S. (Ed.). (2012). Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment, and Control (4th ed.). Butterworth-Heinemann.
2.	Hopkins, A. (2008). Failure to Learn: The BP Texas City Refinery Disaster. CCH Australia Limited.
3.	CCPS (Center for Chemical Process Safety). (2005). Guidelines for Integrating Management Systems and Metrics to Improve Process Safety Performance. Wiley-AIChE.
4.	Kletz, T. A. (2009). What Went Wrong? Case Histories of Process Plant Disasters and How They Could Have Been Avoided. Butterworth-Heinemann.
5.	Geller, E. S. (2001). The Psychology of Safety Handbook. CRC Press.

SEMESTER II

Course 6: PGD-PSM 2.1: Advanced Process Safety Management

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale: This course integrates leadership, culture, audits, inspections, and management in designing safe operations, emphasizing advanced principles for maintaining process safety excellence.

Course Objectives:

- To analyze and implement effective leadership strategies in process safety management.
- To evaluate safety culture and its impact on organizational safety performance.
- To conduct comprehensive process safety audits and inspections.
- To integrate process safety management principles into design and operational phases.

Course Outcomes:

CO1: Evaluate leadership roles in promoting a safety-conscious culture within organizations.
CO2: Implement strategies to enhance safety culture and leadership effectiveness.
CO3: Conduct process safety audits and inspections to ensure compliance and effectiveness.
CO4: Integrate process safety management principles into design processes to mitigate risks.
CO5: Analyze case studies to illustrate successful implementations of advanced process safety techniques.

Course Content

Unit No.	Unit Description	Hours
01.	**Leadership and Safety Culture** • Understanding leadership styles and their impact on safety culture. • Strategies for fostering a safety-conscious work environment.	10
02.	**Process Safety Audits and Inspections** • Planning and conducting effective process safety audits. • Techniques for comprehensive safety inspections and compliance checks.	10
03.	**Designing for Process Safety** • Integrating process safety principles into engineering design. • Evaluating safety considerations throughout the design lifecycle.	10
04.	**Operational Safety Management** • Implementing operational safety procedures and protocols. • Continuous improvement in operational safety practices.	10

05.	**Case Studies in Process Safety Management** • Analyzing real-world incidents and their implications. • Extracting lessons learned for enhancing process safety performance.	**10**
06.	**Advanced Topics in Process Safety** • Emerging trends and innovations in process safety management. • Future directions and challenges in maintaining process safety excellence.	**10**
Reference Books		
1.	Cooper, M. D. (2000). Towards a Model of Safety Culture. Safety Science. 36(2). 111-136.	
2.	Krause, T. R., Hidley, J. H., & Hodson, S. J. (1999). The Behavior-Based Safety Process: Managing Involvement for an Injury-Free Culture. Wiley.	
3.	Wild, C., Weinstein, S. (2016). Smith and Keenan's Company Law: UK Edition. Pearson UK.	

Course 7: PGD-PSM 2.2: Process Safety Implementation and Compliance

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale: This course focuses on practical implementation strategies and regulatory compliance in process safety management, emphasizing operational excellence and adherence to industry standards.

Course Objectives:

- To implement process safety management principles effectively in industrial operations.
- To ensure compliance with regulatory requirements and standards.
- To develop strategies for continuous improvement and sustainable safety practices.

Course Outcomes:

CO1: Implement process safety management systems in industrial operations.
CO2: Ensure compliance with regulatory standards and legal requirements.
CO3: Develop and implement strategies for continuous improvement in safety performance.
CO4: Evaluate the effectiveness of safety programs through performance metrics.
CO5: Promote a culture of safety and accountability within the organization.

Course Content

Unit No.	Unit Description	Hours
01.	**Implementation of Process Safety Management Systems** • Designing and implementing effective process safety management systems. • Integrating safety into daily operational practices.	10
02.	**Regulatory Compliance in Process Safety** • Understanding global and regional regulatory frameworks. • Developing strategies for compliance with process safety regulations.	10
03.	**Continuous Improvement in Safety** • Utilizing performance metrics to assess safety performance. • Implementing feedback mechanisms for continuous improvement.	10
04.	**Safety Performance Metrics and Reporting** • Developing key performance indicators (KPIs) for safety. • Reporting on safety performance and benchmarking against industry standards.	10
05.	**Emergency Preparedness and Response** • Developing emergency response plans and procedures. • Conducting drills and simulations for emergency preparedness.	10
06.	**Safety Leadership and Organizational Culture**	10

	• Promoting safety leadership and accountability. • Building a culture of safety and employee engagement.	
Reference Books		
1.	Wild, C., Weinstein, S. (2016). Smith and Keenan's Company Law: UK Edition. Pearson UK.	
2.	Center for Chemical Process Safety (CCPS). (2011). Guidelines for Auditing Process Safety Management Systems. Wiley-AIChE.	
3.	Crowl, D. A., & Louvar, J. F. (2001). Chemical Process Safety: Fundamentals with Applications. Pearson Education.	
4.	Bausbacher, Ed. & Hunt, R. (1993). Process Plant Layout and Piping Design. Prentice Hall Inc.	

Course 8: PGD-PSM2.3: Elective II
Process Safety in Chemical and Petrochemical Industries

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale

The chemical and petrochemical industries involve handling hazardous materials and complex processes, necessitating a deep understanding of process safety to prevent accidents and ensure compliance with regulations.

Course Objectives

- To understand the principles of process safety management in chemical and petrochemical industries.
- To identify and analyze potential hazards associated with chemical processes.
- To learn about risk assessment techniques and safety systems.
- To familiarize with regulatory requirements and standards in the chemical and petrochemical industries.
- To develop skills to design and implement safety management systems.

Course Outcomes

CO1. Demonstrate knowledge of process safety principles and their application in chemical and petrochemical industries.

CO2. Identify and evaluate potential hazards in chemical processes.

CO3. Apply risk assessment techniques to ensure safe operations.

CO4. Understand and comply with regulatory standards and requirements.

CO5. Design and implement effective safety management systems.

Course Content

Unit No.	Unit Description	Hours
01.	**Introduction to Process Safety in Chemical and Petrochemical Industries** • Overview of chemical and petrochemical industries • Importance of process safety • Historical incidents and lessons learned	10
02.	**Hazard Identification and Risk Assessment** • Hazard identification techniques (HAZID, HAZOP) • Risk assessment methods (QRA, LOPA) • Safety Integrity Level (SIL) assessment	10
03.	**Safety Systems and Controls** • Process control systems and instrumentation • Safety Instrumented Systems (SIS)	10

	• Alarm management	
04.	**Regulatory Requirements and Standards** • Regulatory frameworks (OSHA, EPA, EU regulations) • Industry standards (API, NFPA, IEC) • Compliance and auditing	**10**
05.	**Process Safety Management Systems** • Elements of Process Safety Management (PSM) • Safety culture and leadership • Incident investigation and root cause analysis	**10**
06.	**Case Studies and Applications** • Analysis of major accidents in the chemical and petrochemical industries • Best practices and lessons learned • Future trends in process safety	**10**
Reference Books		
1.	Crowl, D. A., & Louvar, J. F. (2001). Chemical Process Safety: Fundamentals with Applications. Pearson Education.	
2.	Bausbacher, Ed. & Hunt, R. (1993). Process Plant Layout and Piping Design. Prentice Hall Inc.	
3.	Center for Chemical Process Safety (CCPS). (2008). *Guidelines for Hazard Evaluation Procedures* (3rd ed.). Wiley-AIChE.	
4.	Center for Chemical Process Safety (CCPS). (2019). *Process Safety for Engineers: An Introduction*. Wiley-AIChE.	

Course 8: PGD-PSM2.3: Elective II
Process Safety in Pharmaceutical and Biotech Industries

CIE: 30 Marks **SEE: 70 Marks** **Contact Hours: 60**

Course Rationale

The pharmaceutical and biotech industries deal with unique hazards related to chemical handling, biological agents, and complex processes. Understanding process safety in these industries is crucial for protecting workers, the environment, and ensuring regulatory compliance.

Course Objectives

- To understand the specific process safety challenges in pharmaceutical and biotech industries.
- To learn about hazard identification and risk management in these sectors.
- To study regulatory requirements and standards specific to pharmaceutical and biotech industries.
- To develop skills to implement safety management systems in pharmaceutical and biotech settings.
- To analyze case studies and learn from past incidents in these industries.

Course Outcomes

CO1. Demonstrate knowledge of process safety principles in pharmaceutical and biotech industries.

CO2. Identify and evaluate potential hazards specific to these industries.

CO3. Apply risk management techniques to ensure safe operations.

CO4. Understand and comply with industry-specific regulatory standards.

CO5. Implement effective safety management systems in pharmaceutical and biotech settings.

Course Content

Unit No.	Unit Description	Hours
01.	**Introduction to Process Safety in Pharmaceutical and Biotech Industries** • Overview of pharmaceutical and biotech industries • Importance of process safety • Historical incidents and lessons learned	10
02.	**Hazard Identification and Risk Management** • Hazard identification techniques (PHA, FMEA) • Risk management frameworks (QRM) • Containment strategies for hazardous materials	10
03.	**Biological and Chemical Safety**	10

	• Handling and containment of biological agents • Chemical safety in pharmaceutical processes • Cross-contamination prevention • Alarm management	
04.	**Regulatory Requirements and Standards** • Regulatory frameworks (FDA, EMA, OSHA) • Industry standards (ISPE, GAMP) • Compliance and auditing in pharmaceutical and biotech industries	**10**
05.	**Process Safety Management Systems** • Elements of Process Safety Management (PSM) • Safety culture and leadership in pharmaceutical and biotech industries • Incident investigation and root cause analysis	**10**
06.	**Case Studies and Applications** • Analysis of major accidents in pharmaceutical and biotech industries • Best practices and lessons learned • Future trends in process safety	**10**
Reference Books		
1.	Blacker, A. J., & Williams, M. T. (2011). *Pharmaceutical Process Development: Current Chemical and Engineering Challenges*. Royal Society of Chemistry.	
2.	Center for Chemical Process Safety (CCPS). (2010). *Guidelines for Process Safety in Bioprocess Manufacturing Facilities*. Wiley-AIChE.	
3.	Center for Chemical Process Safety (CCPS). (1999). *Guidelines for Process Safety in Batch Reaction Systems*. Wiley-AIChE.	
4.	Center for Chemical Process Safety (CCPS). (2019). *Process Safety for Engineers: An Introduction*. Wiley-AIChE.	

Course 9: PGD-PSM 2.4: In Plant Training II (OJT)

IOE: 50 Marks **EOE: 50 Marks** **Contact Hours: 120**

Course Rationale: The In-Plant Training course is designed to provide working professionals with hands-on experience in applying process safety management principles within their workplace. This course allows students to directly implement and observe process safety practices, enabling them to identify hazards, assess risks, and develop effective safety management strategies in a real-world industrial environment.

Course Objectives:

- To apply theoretical knowledge of process safety management in a practical industrial context.
- To enhance the ability to identify, assess, and mitigate risks in the workplace.
- To develop skills in conducting safety audits, incident investigations, and emergency response planning.
- To foster continuous improvement and professional development in process safety management practices.

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Apply process safety management principles in a real-world industrial setting.
2. Identify and evaluate safety hazards and risks specific to their workplace.
3. Implement effective risk mitigation measures and safety management strategies.
4. Conduct thorough safety audits and inspections within their plant.
5. Develop and execute emergency response plans tailored to their workplace.
6. Perform incident investigations and identify root causes and corrective actions.
7. Promote a culture of safety and continuous improvement within their organization.

Course Content

Note: This course is the continuation of the In Plant Training activity I wherein Activities No. 1 to 3 are completed. The candidates will now spare time equivalent to 120 hours in order to complete the In Plant training II related exercise through completion of Activities No.4 to 7. This time will be uniformly distributed throughout the semester so as to undergo the completion of this training. In case of the students who are not the working professionals; they are required to join an industry for a period of minimum 3 weeks to complete this in plant training.

Activity No.	Description	Hours
04.	**Conducting Safety Audits and Inspections** • **Audit Planning**: Prepare audit checklists and schedules. Identify key areas for detailed inspection. • **On-Site Audits**: Perform safety audits and inspections. Document findings and non-compliance issues. Provide recommendations for improvement.	**30**
05.	**Emergency Response Planning and Drills** • **Develop Emergency Plans**: Develop or update the emergency response plan to ensure it aligns with regulatory requirements and best practices. • **Conduct Drills**: Organize and conduct emergency response drills. Evaluate drill performance and identify areas for improvement.	**30**
06.	**Incident Reporting and Investigation** • **Implement Reporting Protocols**: Set up protocols for reporting safety incidents and near-misses. • **Root Cause Analysis**: Conduct root cause analysis for reported incidents. Develop corrective actions to prevent recurrence.	**30**
07.	**Continuous Improvement and Final Report** • **Develop Action Plans**: Based on incident investigations and audit findings, develop action plans for continuous safety improvement. • **Final Report and Presentation**: Prepare a comprehensive report detailing the activities performed, findings, and improvements made during the in-plant training. Present the report to the course supervisor and workplace management.	**30**

Reference Books

1.	Mannan, S. (Ed.). (2012). Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment, and Control (4th ed.). Butterworth-Heinemann.
2.	Hopkins, A. (2008). Failure to Learn: The BP Texas City Refinery Disaster. CCH Australia Limited.
3.	CCPS (Center for Chemical Process Safety). (2005). Guidelines for Integrating Management Systems and Metrics to Improve Process Safety Performance. Wiley-AIChE.
4.	Kletz, T. A. (2009). What Went Wrong? Case Histories of Process Plant Disasters and How They Could Have Been Avoided. Butterworth-Heinemann.
5.	Geller, E. S. (2001). The Psychology of Safety Handbook. CRC Press.

Course 10: PGD-PSM 2.5: Capstone Project

IOE: 75 Marks **EOE: 75 Marks** **Contact Hours: 180**

Course Rationale: The Capstone Project serves as the culmination of the PGD-PSM program, providing students with an opportunity to apply their acquired knowledge and skills to address a real-world process safety management challenge.

Course Objective: To provide students with practical experience in solving process safety management challenges through a hands-on industrial project.

Course Outcomes:

1. Apply process safety management principles to a real-world industrial scenario.
2. Demonstrate the ability to analyse, synthesize, and present solutions to complex process safety challenges.

Course Content

Note: The candidates will spare time equivalent to 180 hours in order to complete the project work. The working professionals will utilize this time at their work site itself. This time for both In Plant Training II and that for Capstone Project will be uniformly distributed throughout this semester. In case of the students who are not the working professionals; they are required to join an industry for a period of minimum 4 weeks to complete this Project Work.

Activity No.	Description	Hours
01.	**Project Proposal and Approval** • Developing a proposal for the capstone project. • Gaining approval and feedback from faculty. • Defining the scope, objectives, and deliverables of the project.	10
02.	**Literature Review and Background Analysis** • Conducting a comprehensive literature review on the chosen topic. • Analysing the background and context of the project. Identifying gaps in existing knowledge and practice.	30
03.	**Project Planning and Execution** • Developing a detailed project plan and timeline. • Executing the project in accordance with the plan. • Managing resources and potential challenges during execution.	70
04.	**Data Collection and Analysis** • Gathering relevant data for analysis. • Utilizing appropriate tools and techniques for data analysis. • Ensuring the accuracy and reliability of collected data.	50
05.	**Solution Design and Implementation** • Designing effective solutions based on project findings.	10

	• Implementing and testing proposed solutions. • Addressing any unforeseen challenges during implementation.	
06.	**Project Presentation and Documentation** • Creating a comprehensive project report. • Presenting the project findings and solutions to faculty and external examiners. • Preparing clear and concise documentation for future reference.	**10**
Reference Books		
1.	Center for Chemical Process Safety (CCPS). (1995). Guidelines for Process Safety Documentation. Wiley-AIChE.	
2.	Center for Chemical Process Safety (CCPS). (2012). Guidelines for Engineering Design for Process Safety. Wiley-AIChE.	

PGD-PSM Assessment Method

A. Continuous Assessment (CIE):

- Assignments, quizzes, and class participation contribute to a total of 30 marks per theory course. Per Course, there will be a separate faculty coordinator [from B. Tech (Chemical Engineering) Program, Department of Technology] who will be assigned the task of Continuous Assessment (CIE).

B. Semester-End Examinations (SEE):

- 70 marks for theory courses, evaluating theoretical knowledge. This will be the semester end examination conducted by the University.

C. In plant Training & Capstone Project Evaluation:

- For in plant Training I which is also known as On Job Training, there are 75 marks for internal evaluation (IOE) and 75 marks for external evaluation (EOE).
- For in Plant Training II which is also known as On Job Training, there are 50 marks for internal evaluation (IOE) and 50 marks for external evaluation (EOE).
- For Capstone Project, there are 75 marks for internal evaluation (IOE) and 75 marks for external evaluation (EOE).
- IOE stands for Internal Oral Evaluation and EOE stands for External Oral Evaluation for the in plant training and capstone project work.

D. Nature of Question paper for SEE: (All four questions will be compulsory)

Question 1: Total of 16 marks.

- **6 MCQs:** 1 mark each (6 marks total).
- **2 Short Answer Questions:** 5 marks each (10 marks total).

Question 2: Total of 18 marks.

- **4 Sub Bits:** Each worth 6 marks. Students need to attempt any 3.

Question 3: Total of 18 marks.

- **3 Sub Bits:** Each worth 9 marks. Students need to attempt any 2.

Question 4: Total of 18 marks.

- **2 Sub Bits:** Each worth 10 marks. Students need to attempt any 1.
- **2 Sub Bits:** Each worth 8 marks. Students need to attempt any 1.

E. Passing Criterion: The minimum marks required for passing in SEE is 40 %

PGD-PSM Enrolment Guidelines

1. Student Intake – 40 (Extra Seats if any will be as per University Rules and regulations.)
2. Program Fees per student: Total INR 44,000 for the year. (Detailed Fee structure depicting tuition fees, other fees will be as per University Rules and Regulations.)
3. The enrolment to this PG Diploma will be as per the merit list of the interested candidates, provided they get fit as per the eligibility criteria. (The seat matrix will be as per the University Rules and Regulations.)
4. The minimum qualification or criteria for the candidates will be as follows:

   4.1 The fresh or pass out graduates from BSc. in any Science Stream or BSc. in Engineering and or Technology from any specialization.

   4.2 The fresh or pass out graduates in B.E or B. Tech in any stream or specialization of Engineering & Technology.

PG Diploma in Process Safety Management
Examination Rules & Regulations

I. **Medium of Instruction and Program Pattern:** Medium of instruction for the entire Program is English. It is semester patter with 1-year duration comprising of two semesters. The curriculum is well aligned with NEP2020. It follows the guidelines of National Credit as well as curriculum framework. It also follows the guidelines of National Higher Education Qualification Framework.

II. **Examination and Evaluation Terminologies with description of the nature of assessment:**

F. Continuous Assessment (CIE):

- Assignments, quizzes, and class participation contribute to a total of 30 marks per theory course. Per Course, there will be a separate faculty coordinator [from B. Tech (Chemical Engineering) Program, Department of Technology] who will be assigned the task of Continuous Assessment (CIE).

G. Semester-End Examinations (SEE):

- 70 marks for theory courses, evaluating theoretical knowledge. This will be the semester end examination conducted by the University.

H. In plant Training & Capstone Project Evaluation:

- For in plant Training I which is also known as On Job Training, there are 75 marks for internal evaluation (IOE) and 75 marks for external evaluation (EOE).
- For in Plant Training II which is also known as On Job Training, there are 50 marks for internal evaluation (IOE) and 50 marks for external evaluation (EOE).
- For Capstone Project, there are 75 marks for internal evaluation (IOE) and 75 marks for external evaluation (EOE).
- IOE stands for Internal Oral Evaluation and EOE stands for External Oral Evaluation for the in plant training and capstone project work.

I. SGPA means Semester Grade Point Average which is elaborated further

J. CGPA means Cumulative Grade Point Average which is elaborated further

K. **ATKT (Allowed to Keep Terms) and the rule for the same:** If a candidate fails in any number of courses (subject heads) of Semester I, will be allowed to proceed to Semester II.

III. **Standard of Passing:** In case of CIE viz continuous internal evaluation, it is equivalent to term work for which the completion is mandatory. However, CIE marks to be essentially submitted by the course in charge to the University. As regards the Semester End Examination, the minimum marks required for passing are 40 %.

Similarly, the IOE viz Internal Oral Evaluation is essentially to be carried out by the course in charge who will carry out the same based on submission of the training/project report. In case of EOE (External Oral Evaluation), there will be external referee appointed by the University. Both the course in charge and the external referee will conduct the evaluation for which there will be University passing head. The minimum marks required for the passing in EOE will also be 40%.

IV. **Conduct of the terms:** There will be two semesters namely odd and even. The Department of Technology will prepare a separate academic calendar for the same. Each of the term will be about 15 weeks' duration and the classes will be conducted online in the evening time on 5 working days as well as the weekend. The weekend classes will be either Saturday or Sunday to have at least 6 online classes on the day. The last week of each of the term will be for the face to face sessions. During these face to face sessions, the internal evaluation also will be carried out by the course in charges.

V. **Nature of In Plant Training (On Job Training) and the Capstone Project:** This particular Program is well designed to suit to the working professionals who will be in a position to pursue the same without resigning from their services. As regards in plant Training (OJT) I, II & Capstone Project; they will have liberty to complete these courses at their workplace itself.

In case of the students who are not the working professionals; they are required to join an industry for a period of minimum 4 weeks to complete 'in plant training I', minimum 3 weeks to complete 'in plant training II' while minimum 4 weeks' equivalent time against the 'Capstone Project Work'.

VI. **Credits and Grades:** Course Credit are the weighted sum of the number of Lecture hours (L), Tutorial hours (T), and Practical hours (P) associated with the course. Credits Earned are the sum of course credits for credit courses in which a student has passed. Assessment of the student's performance as grades in various courses are indicated by the letters, "AA", "AB", "BB", "BC", "CC", "CD", "DD", "FF", "XX", "ABSENT" which in turns indicate the number equivalents as 10, 9, 8, 7, 6, 5, 4 respectively. "FF" and "XX" carry zero grade points. "FF" is the grade for the failure in a course. "XX" is the grade for term detained case on account of non-compliance/completion of the CIE. "ABSENT" is the remark for the candidate who remains absent for the SEE.

VII. Evaluation System:

1. **Semester Grade Point Average (SGPA)**

$$= \frac{\sum(\textbf{Grade Points earned in a course} \times \textbf{Earned Credits})}{\sum(\textbf{Course credits in registered courses})}$$

2. **Cumulative Grade Point Average (CGPA)**

$$= \frac{\sum(\textbf{Course credits in passed courses} \times \textbf{Earned Credits})\textbf{of all Semesters}}{\sum(\textbf{Course credits in registered courses})}$$

As the program has only two semesters, the CGPA will be calculated cumulatively for Sem I and Sem II.

3. At the end of the Program, student will be placed in any one of the divisions as detailed below:

Ist Division with distinction	: CGPA $\geq$ 7.5 and above
Ist Division	: CGPA $\geq$ 6.0 and < 7.5
IInd Division	: CGPA $\geq$ 5.5 and < 6.0
Pass Class	: CGPA $\geq$ 4.5 and < 5.5

Gradation suggested is as follows.

Table 1

Grade Points	Equivalent Range
4.5	45%
5.5	55%
6.0	60%
6.5	65%
7.0	70%
7.5	75%

Conversion of CGPA to percentage marks for CGPA can be obtained using the equation **Percentage marks = (CGPA x 10)**

Its mandatory for all the examinees to maintain CGPA $\geq$ 4.5 failing to which the defaulter has to go for class improvement by appearing to one or more courses and to finally attain the minimum pass class (Division)

The grades points are linked to the percentage of marks as per the below table.

Table 2: System of Evaluation

Grade	Grade Points	Marks obtained (%)			Description of Performance
		Regular Semester	Repeated examination	Re-Repeated Examination	
AA	10	90-100	--	--	Outstanding
AB	09	80-89	90-100	--	Excellent
BB	08	70-79	80-89	90-100	Very Good
BC	07	60-69	70-79	80-89	Good
CC	06	50-59	60-69	70-79	Fair
CD	05	45-49	50-59	60-69	Average
DD	04	40-44	40-49	40-59	Poor
DD$	04	Below 40	Below 40	Below 40	Poor (Subject to Application of Ordinance 96)
FF	00	Below 40	Below 40	Below 40	Fail
XX	--	--	--	--	Detained
ABSENT	--	--	--	--	Absent

An example of these calculations is given below (It's a sample calculation):

Table 3: Typical academic performance calculations - I semester

Course no.	Course credits	Grade awarded	Earned credits	Grade points	Points secured
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6 (col4 *col5)
MALXXX	4	CC	4	6	24
CSLXXX	4	CD	4	5	20
PHLXXX	4	AA	4	10	40
PHPXXX	4	BB	4	8	32
MELXXX	6	BC	6	7	42
Total	22		22	38	158

1. Total Points earned for this semester = 158

$$\text{Semester Point Grade Average} = \frac{\text{(Total Points Secured)}}{\text{(Total Credits of the Semester)}} = 158/22 = 7.18$$

2. **Cumulative Grade Point Average (CGPA)** =

   Cumulative points earned in all passed courses = 158 (The First semester) + Say 148 (The Second Semester) = 306

   Cumulative earned credits = 22 (past semester) + 22 (this sem.) = 44

   Cumulative Grade Point Average (CGPA) = ∑ (158+148)/ ∑ (22+22) =6.95

3. **Appearance to the repeated examination:** The student who will be with failure grade in a course/s will have chance to appear for the additional maximum two times. Means for every course the additional maximum attempts would be 2. These two attempts would be said as repeated examination and re-repeated examination respectively. However, there will be one grade point penalty as mentioned in the **table no. 2.**

4. **Delay in completion of the Program:** In case a candidate has completed the CIE, IOE & EOE but the candidate has not succeeded in completing the entire Program within the chances as mentioned above, the candidate will have to register for the Program newly by paying the proportionate tuition fees as applicable to the number of courses which the candidate is yet to pass. However, there is no need for him to attend the classes. The grade point penalty in this case would be as per the re-repeated examination.

VIII. Nature of Question paper for SEE (70 marks distribution):

(All four questions will be compulsory)

Question 1: Total of 16 marks.

- **6 MCQs:** 1 mark each (6 marks total).
- **2 Short Answer Questions:** 5 marks each (10 marks total).

Question 2: Total of 18 marks.

- **4 Sub Bits:** Each worth 6 marks. Students need to attempt any 3.

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