

ANNAMALAI UNIVERSITY



(Accredited With 'A' Grade by NAAC)

Faculty of Engineering and Technology  
Department of Chemical Engineering

M.Tech., Industrial Safety Engineering  
(Choice Based Credit System)



HAND BOOK REGULATIONS AND  
SYLLABUS

REGULATIONS 2023



**ANNAMALAI UNIVERSITY**  
**FACULTY OF ENGINEERING AND TECHNOLOGY**  
**DEPARTMENT OF CHEMICAL ENGINEERING**

**M.E. / M. Tech (Two-Year Full Time & Three-year Part Time)**

**DEGREE PROGRAMME(CBCS)**

**REGULATIONS -2023**

**1. Conditions for Admission**

Candidates for admission to the first year of the four-semester **M.E / M.Tech Degree programme in Engineering** shall be required to have passed B.E / B.Tech degree of Annamalai University or any other authority accepted by the syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time. The admission for M.E Part Time programme is restricted to those working or residing within a radius of **90 km** from Annamalainagar. The application should be sent through their employers.

**2. Branches of Study in M.E /M.Tech**

The Branch and Eligibility criteria of programmes are given in Annexure I

**3. Courses of study**

The courses of study along with the respective syllabi and the scheme of Examinations for each of the M.E / M. Tech programmes offered by the different Departments of study in the Faculty of Engineering and Technology are given separately.

**4. Choice Based Credit System(CBCS)**

The curriculum includes three components namely Program Core, Program Electives and Open Electives, Mandatory Learning Courses and Audit Courses in addition to Thesis. Each semester curriculum shall normally have a blend of theory and practical courses.

**5. Assignment of Credits for Courses**

Each course is normally assigned one credit per hour of lecture / tutorial per week and 0.5 credit for one hour of laboratory or project or industrial training or seminar per week. The total credits for the programme will be **68**.

**6. Duration of the programme**

A student of M.E / M.Tech programme is normally expected to complete in four semesters for full-time / six semesters for part-time but in any case not more than four years for full-time / six years for part-time from the date of admission.

**7. Registration for courses**

A newly admitted student will automatically be registered for all the courses prescribed for the first semester, without any option. Every other student shall submit a completed registration form indicating the list of courses intended to be credited during the next semester. This registration will be done a week before the last working day of the current semester. Late registration with the

approval of the Dean on the recommendation of the Head of the Department along with a late fee will be done up to the last working day. Registration for the Thesis Phase - I and Phase-II shall be done at the appropriate semesters.

## **8. Electives**

### **8.1 Program Electives**

The student has to select two electives in first semester, another two electives in the second semester and one more in the third semester from the list of Program Electives.

### **8.2 Open Electives**

The student has to select two electives in third semester from the list of Open Electives offered by the Department and / or other departments in the Faculty of Engineering and Technology.

### **8.3 MOOC (SWAYAM) Courses**

Further, the student can be permitted to earn credits by studying the Massive Open Online Courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent to open elective courses. Thus the credit earned through MOOC courses can be transferred and considered for awarding Degree to the student concerned.

### **8.4 Value added courses (Inter Faculty Electives)**

Of the two open elective courses, a student must study one value added course that is offered by other Faculties in our University either in second or third semester of the M.E programme.

## **9. Industrial Project**

A student may be allowed to take up the one program elective and two open elective courses of third semester (Full Time program) in the first and second semester, to enable him/her to carry out Project Phase-I and Phase-II in an industry during the entire second year of study. The condition is that the student must register those courses in the first semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

## **10. Assessment**

### **10.1 Theory Courses**

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	: 08 marks
Second assessment (Mid-Semester Test-II)	:12 marks
Third Assessment	: 05marks
End Semester Examination	: 75marks

### **10.2 Practical Courses**

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	:15marks
Second assessment (Test-II)	:15marks
Maintenance of record book	: 10marks
End Semester Examination	: 60marks

### **10.3 Thesis work**

The thesis Phase I will be assessed for 40 marks by a committee consisting of the Head of the

Department, the guide and a minimum of two members nominated by the Head of the Department. The Head of the Department will be the chairman. The number of reviews must be a minimum of three per semester. 60 marks are allotted for the thesis work and viva voce examination at the end of the third semester. The same procedure will be adopted for thesis Phase II in the fourth semester.

#### **10.4 Seminar / Industrial Training**

The continuous assessment marks for the seminar / industrial training will be 40 and to be assessed by a seminar committee consisting of the Seminar Coordinator and a minimum of two members nominated by the Head of the Department. The continuous assessment marks will be awarded at the end of the seminar session. 60 marks are allotted for the seminar / industrial training and viva voce examination conducted based on the seminar / industrial training report at the end of the semester.

### **11. Student Counselors(Mentors)**

To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counselor (mentor) for those students throughout their period of study. Such student counselors shall advise the students in selecting open elective courses from, give preliminary approval for the courses to be taken by the students during each semester, and obtain the final approval of the Head of the Department monitor their progress in SWAYAM courses / open elective courses.

### **12. Class Committee**

For each of the semesters of M.E / M.Tech programmes, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from first to fourth semesters for Full time and first to sixth semesters for Part-time will be as follows:

- Teachers of the individual courses.
- A Thesis coordinator (for Thesis Phase I and II) shall be appointed by the Head of the Department from among the Thesis supervisors.
- A thesis review committee chairman shall be appointed by the Head of the Department
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.
- All counselors of the class and the Head of the Department (if not already a member) or any staff member nominated by the Head of the Department may opt to be special invitees.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory courses / 40 marks for practical courses, for Industrial Training and for Thesis work (Phase-I and

Phase-II) will be finalized for every student and tabulated and submitted to the Head of the Department for approval and transmission to the Controller of Examinations.

### **13. Temporary Break of Study**

A student can take a one-time temporary break of study covering the current semester and / or the next semester with the approval of the Dean on the recommendation of the Head of the Department, not later than seven days after the completion of themed-semester test. However, the student must complete the entire programme within the maximum period of **four years for Full time / six years for Part time.**

### **14. Substitute Assessments**

A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the end of semester examination may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

### **15. Attendance Requirements**

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

A student who withdraws from or does not meet the minimum attendance requirement in a semester must re-register and repeat the same semester in the subsequent academic years.

### **16. Passing and declaration of Examination Results**

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the grade point average (GPA) and cumulative grade point average (CGPA) and prepare the mark sheets.

90 to 100 marks	Grade 'S'
80 to 89 marks	Grade 'A'
70 to 79 marks	Grade 'B'
60 to 69 marks	Grade 'C'
55 to 59 marks	Grade 'D'
50 to 54 marks	Grade 'E'
Less than 50 marks	Grade 'RA'
Withdrawn from the Examination	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course and earned the credits for that course. Such a course cannot be repeated by the student.

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

**S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0**

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totalling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

## **17. Awarding Degree**

After successful completion of the programme, the degree will be awarded with the following classifications based on CGPA.

For First Class with Distinction the student must earn a minimum of 68 credits within four semesters for full-time / six semesters for Part time from the time of admission, pass all the courses in the first attempt and obtain a CGPA of 8.25 or above.

For First Class, the student must earn a minimum of 68 credits within two years and six months for full-time / three years and six months for Part time from the time of admission and obtain a CGPA of 6.75 or above.

For Second class, the student must earn a minimum of 68 credits within four years for full-time / six years for Part time from the time of admission.

The conversion of OGPA/CGPA (from I semester to IV Semester) to the corresponding Percentage of marks may be calculated as per the following formula:

$$\text{Percentage of marks} = (\text{OGPA/CGPA} - 0.25) \times 10$$

$$\text{Where } \text{OGPA/CGPA} = \frac{\sum C_i GP_i}{\sum C_i}$$

$C_i$  - Credit hours of a course

$GP_i$  - Grade Point of that course

## **18. Ranking of Candidates**

The candidates who are eligible to get the M.E /M.Tech degree in First Class with Distinction will be ranked on the basis of CGPA for all the courses of study from I to IV semester for M.E / M.Tech full-time / I to VI semester for M.E / M.Tech part-time.

The candidates passing with First Class and without failing in any subject from the time of admission

will be ranked next to those with distinction on the basis of CGPA for all the courses of study from I to IV semester for full-time / I to VI semester for M.E / M.Tech part-time.

**19. Transitory Regulations**

If a candidate studying under the old regulations M.E. / M.Tech could not attend any of the courses in his/her courses, shall be permitted to attend equal number of courses, under the new regulation and will be examined on those subjects. The choice of courses will be decided by the concerned Head of the department. However he/she will be permitted to submit the thesis as per the old regulations. The results of such candidates will be passed as per old regulations.

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

**ANNEXURE 1**

S.No.	Department		Programme (Full Time & Part time)	Eligible B.E./B.Tech Programme
1	Chemical Engineering	i.	Chemical Engineering	B.E. / B.Tech – Chemical Engg, Petroleum Engg, Petrochemical Technology
		ii.	Food Processing Technology	B.E. / B.Tech - Chemical Engg, Food Technology, Biotechnology, Biochemical Engg, Agricultural Engg.
		iii.	Industrial Bio Technology	B.E. / B.Tech - Chemical Engg, Food Technology, Biotechnology, Leather Technology
		iv.	Industrial Safety Engineering	B.E. / B.Tech – Any Branch of Engineering
2	Civil Engineering	i.	Environmental Engineering	B.E. / B.Tech – Civil Engg, Civil & Structural Engg, Environmental Engg, Mechanical Engg, Industrial Engg, Chemical Engg, BioChemical Engg, Biotechnology, Industrial Biotechnology, Chemical and Environmental Engg.
		ii.	Environmental Engineering & Management	
		iii.	Water Resources Engineering & Management	B.E. / B.Tech – Civil Engg, Civil & Structural Engg, Environmental Engg, Mechanical Engg, Agricultural and irrigation Engg, Geo informatics, Energy and Environmental Engg.
3	Civil & Structural Engineering	i.	Structural Engineering	B.E. / B.Tech – Civil Engg, Civil & Structural Engg.
		ii.	Construction Engg. and Management	
		iii.	Geotechnical Engineering	
		iv.	Disaster Management & Engg.	
4	Computer Science & Engineering	i.	Computer Science & Engineering	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
5	Electrical Engineering	i.	Embedded Systems	B.E. / B.Tech – Electrical and Electronics Engg, Control and Instrumentation Engg, Information technology, Electronics and communication Engg, Computer Science and Engg
		ii.	Smart Energy Systems	
		iii.	Power System	B.E. / B.Tech – Electrical and Electronics Engg, Control and Instrumentation Engg, Electronics and communication Engg,
6	Electronics & Communication Engineering	i.	Communication Systems	B.E. / B.Tech - Electronics and Communication Engg, Electronics Engg.



S.No.	Department		Programme (Full Time & Part time)	Eligible B.E./B.Tech Programme
7	Electronics & Instrumentation Engineering	i.	Process Control & Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and Electronics Engg, Control and Instrumentation Engg, Instrumentation Engg, Electronics and Communication Engg,
		ii.	Rehabilitative Instrumentation	B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and Electronics Engg, Electronics and Communication Engg, Control and Instrumentation Engg, Instrumentation Engg, Bio Medical Engg, Mechatronics.
		iii.	Micro Electronics and MEMS	B.E. / B.Tech – B.E. / B.Tech – Electronics and Instrumentation Engg, Electrical and Electronics Engg, Electronics and communication Engg, Control and Instrumentation Engg, Instrumentation Engg, Bio Medical Engg, Mechatronics, Telecommunication Engg
8	Information Technology	i	Information Technology	B.E. / B.Tech - Computer Science and Engineering, Information Technology, Electronics and Communication Engg, Software Engineering
9	Mechanical Engineering	iv.	Thermal Power	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical Engg (Manufacturing).
		v.	Energy Engineering & Management	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Mechanical (Manufacturing) Engg, Chemical Engg
10	Manufacturing Engineering	i.	Manufacturing Engineering	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Manufacturing Engg, Production Engg, Marine Materials science Engg, Metallurgy Engg, Mechatronics Engg and Industrial Engg.
		ii.	Welding Engineering	
		iii.	Nano Materials and Surface Engineering	B.E. / B.Tech – Mechanical Engg, Automobile Engg, Manufacturing Engg, Production Engg, Marine Materials science Engg, Metallurgy Engg, Chemical Engg

## COURSES OF STUDY AND SCHEME OF EXAMINATIONS

### Full-Time

#### FACULTY OF ENGINEERING AND TECHNOLOGY DEPARTMENT OF CHEMICAL ENGINEERING

Program: M.Tech Specialization: Industrial Safety Engineering CURRICULUM-2019

SEMESTER I									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
23CHISPC11	PC	Safety Management	3	-	-	25	75	100	3
23CHISPC12	PC	Occupational Health and Hygiene	3	-	-	25	75	100	3
23CHISPE13	PE	Program Elective-I	3	-	-	25	75	100	3
23CHISPE14	PE	Program Elective-II	3	-	-	25	75	100	3
23CHISMC15	MC	Research Methodology and IPR	2	-	-	25	75	100	2
23CHISCP16	CP	Environmental Hazard Analysis Laboratory	-	-	3	40	60	100	2
23CHISCP17	CP	Air Pollutants Analysis Laboratory	-	-	3	40	60	100	2
23CHISAC18	AC	Audit Course-I	2	-	-	-	-	-	0
								Total	<b>18</b>

SEMESTER II									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
23CHISPC21	PC	Computer Aided Risk Analysis	3	-	-	25	75	100	3
23CHISPC22	PC	Fire Engineering and Explosion Control	3	-	-	25	75	100	3
23CHISPE23	PE	Program Elective-III	3	-	-	25	75	100	3
23CHISPE24	PE	Program Elective-IV	3	-	-	25	75	100	3
23CHISCP25	OE	Open Elective(Interfaculty)	3	-	1	25	75	100	3
23CHISOE26	CP	Fire Control, PPE & QRA Studies Laboratory	-	-	3	40	60	100	2
23CHISTS27	TS	Industrial Training and Seminar/ Miniproject		Tr 2	S 2	40	60	100	2
23CHISAC28	AC	Audit Course-II	2	-	-	-	-	-	0
								Total	<b>19</b>

**DEPARTMENT OF CHEMICAL ENGINEERING**

**Program: M.Tech.**

**Specialization: Industrial Safety**

**Engineering CURRICULUM-2019**

<b>SEMESTER III</b>									
<b>Course Code</b>	<b>Category</b>	<b>Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>CA</b>	<b>FE</b>	<b>Total</b>	<b>Credits</b>
23CHISPE31	<b>PE</b>	Program Elective-V	3	-	-	25	75	100	3
23CHISOE32	<b>OE</b>	Open Elective (interfaculty)	3	-	-	25	75	100	3
23CHISPV33	<b>PV-I</b>	Project work & Viva-voce Phase-I	-	Pr 16	S 4	40	60	100	10
							<b>Total</b>		<b>16</b>

<b>SEMESTER IV</b>									
<b>Course Code</b>	<b>Category</b>	<b>Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>CA</b>	<b>FE</b>	<b>Total</b>	<b>Credits</b>
23CHISPV41	<b>PV-II</b>	Project work & Viva-voce Phase-II	-	Pr 24	S 6	40	60	100	15
							<b>Total</b>		<b>15</b>

### **LIST OF PROGRAM ELECTIVES**

1. Safety in Chemical Industries
2. Environmental Pollution Control
3. Safety in On and Off shore Drilling
4. Safety in Material Handling
5. Safety in Engineering Industry
6. Safety in Mines
7. Regulations for Health, Safety and Environment
8. Nuclear Engineering and Safety
9. Dock Safety
10. Safety in Construction
11. Environmental Impact Assessment
12. Occupational Health Safety Management System ISO 45001:2018
13. Human Factors Engineering
14. Safety in Textile Industry
15. Air Pollution Control

### **LIST OF OPEN ELECTIVES**

1. Maintainability Engineering
2. Electrical Safety
3. Work Study and Ergonomics
4. Transport Safety

**DEPARTMENT OF CHEMICAL ENGINEERING**

**M.E. (Industrial safety Engineering) PART TIME - DEGREE**

**PROGRAMME REGULATION-2019**

**Courses of Study and Scheme of Examination**

Sl. No.	Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
<b>SEMESTER- I</b>											
1	23PSCNYYPC11	PC	Safety Management	3	-	-	25	75	100	3	23PCHISPC11
2	23PSCNYYPC12	PC	Occupational Health and Hygiene	3	-	-	25	75	100	3	23PCHISPC12
3	23PSCNYYMC13	MC	Research Methodology And IPR	2	-	-	25	75	100	2	23PCHISMC15
4	23PSCNYYCP14	CP	Environmental Hazard Analysis Laboratory	-	-	3	40	60	100	2	23PCHISCP16
<b>Total</b>							<b>115</b>	<b>285</b>	<b>400</b>	<b>10</b>	

Sl. No.	Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
<b>SEMESTER- II</b>											
1	23PSCNYYPC21	PC	Computer Aided Risk Analysis	3	-	-	25	75	100	3	23PCHISPC21
2	23PSCNYYPC22	PC	Fire Engineering and Explosion Control	3	-	-	25	75	100	3	23PCHISPC22
3	23PSCNYYOE23	OE	Open Elective-I (From the Dept)	3	-	-	25	75	100	3	23PCHISOE25
4	23PSCNYYCP24	CP	Fire Control, PPE & QRA Studies Laboratory	-	-	3	40	60	100	2	23PCHISCP26
<b>Total</b>							<b>115</b>	<b>285</b>	<b>400</b>	<b>11</b>	

Sl. No.	Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
<b>SEMESTER- III</b>											
1	23PSCNYYPE31	PE	Program Elective-I	3	-	-	25	75	100	3	23PCHISPE13
2	23PSCNYYPE32	PE	Program Elective-II	3	-	-	25	75	100	3	23PCHISPE14
3	23PSCNYYCP33	CP	Air Pollutants Analysis Laboratory	-	-	3	40	60	100	2	23PCHISCP17
<b>Total</b>							<b>90</b>	<b>210</b>	<b>300</b>	<b>8</b>	

Sl. No.	Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E.FullTime
<b>S E M E S T E R - I V</b>											
1	23PSCNYYPE41	PE	Program Elective-III	3	-	-	25	75	100	3	23PCHISPE23
2	23PSCNYYPE42	PE	Program Elective-IV	3	-	-	25	75	100	3	23PCHISPE24
3	23PSCNYYTS43	TS	Industrial Training and Seminar /Mini project		Tr	S	40	60	100	2	23PCHISTS27
					2	2					
<b>Total</b>							<b>90</b>	<b>210</b>	<b>300</b>	<b>8</b>	

Sl. No.	Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E.FullTime
<b>S E M E S T E R – V</b>											
1	23PSCNYYPE51	PE	Program Elective-V	3	-	-	25	75	100	3	23PCHISPE31
2	23PSCNYYOE52	OE	Open Elective - II (From the Dept)	3	-	-	25	75	100	3	23PCHISOE32
3	23PSCNYYPV53	PV-I	Project work & Viva-voce Phase-I	-	Pr	S	40	60	100	10	23PCHISPV33
					16	4					
<b>Total</b>							<b>90</b>	<b>210</b>	<b>300</b>	<b>16</b>	

Sl. No.	Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E.FullTime
<b>S E M E S T E R – VI</b>											
1	23PSCNYYPV61	PV-II	Project work & Viva-voce Phase-II	-	Pr	S	40	60	100	15	23PCHISPV41
					24	6					
<b>Total</b>							<b>40</b>	<b>60</b>	<b>100</b>	<b>15</b>	

**ANNAMALAI UNIVERSITY**  
**DEPARTMENT OF CHEMICAL ENGINEERING**  
**M.Tech. Industrial Safety Engineering**

**VISION**

Our vision is to be a leading Chemical Engineering Department in the Nation, to create and  
Develop technocrats, entrepreneurs and business leaders.

**MISSION**

The department fosters chemical engineering as a profession that interfaces engineering and  
all aspects of basic sciences to disseminate knowledge in order to prepare the students to be successful  
leaders and practitioners and to meet the present and future needs of the society by highest degree  
of standards and ethics.

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

The objectives of the programme are to train and make known to the students to achieve the following:

1. Prevent accidents in the industries by eradicating the hazard
2. Eliminate accident caused work stoppage and lost production
3. Achieve lower workmen's compensation, insurance rates and reduce all other direct and indirect costs of accidents
4. Prevent loss of life, permanent disability and the loss of income of worker by eliminating causes of accidents
5. Evaluate employee's morale by promoting safe work place and good working condition



**PROGRAMME OUTCOMES (PO):**

<b>For PG Programme</b>	
<b>PO1</b>	<b>Scholarship of Knowledge</b> Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesise existing and new knowledge, and integration of the same for enhancement of knowledge.
<b>PO2</b>	<b>Critical Thinking</b> Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
<b>PO3</b>	<b>Problem Solving</b> Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
<b>PO4</b>	<b>Research Skill</b> Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
<b>PO5</b>	<b>Usage of modern tools</b> Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.
<b>PO6</b>	<b>Collaborative and Multidisciplinary work</b> Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
<b>PO7</b>	<b>Project Management and Finance</b> Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
<b>PO8</b>	<b>Communication</b> Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
<b>PO9</b>	<b>Life-long Learning</b> Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
<b>PO10</b>	<b>Ethical Practices and Social Responsibility</b> Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
<b>PO11</b>	<b>Independent and Reflective Learning</b> Observe and examine critically the outcomes of one's actions and make corrective measures

subsequently, and learn from mistakes without depending on external feedback.

PEO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PEO1	3	2		2	2	2	1		3	2	1
PEO2	3	2	2	2	2	2	2		3	2	1
PEO3	2	2	2	3	2	2	2		3	3	2
PEO4	3	2	2	3	2	2	2		3	3	2
PEO5	3	2		3		2	2		3	2	2

1–Slight, 2–Moderate, 3–Substantial

### PROGRAM SPECIFIC OUTCOMES (PSOs)

**PSO1:** Ability to contribute in the development and maintenance of a healthy and safe work environment.

**PSO2:** Ability to interpret and apply legislative requirements, industry standards, risk management principles and best practices in a variety of workplaces.

**PSO3:** Ability to design, support, and evaluate health and safety programs and implement procedures using project management principles and processes appropriate to the task.

## SEMESTER –I

<b>23CHISPC11</b>	<b>SAFETYMANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

- ☐ To know the history of safety movement and modern concepts in safety
- ☐ To learn the various techniques involved in identifying the hazards
- ☐ To know the methods of accident investigating and reporting
- ☐ To assess the performance of safety in industries

**Concepts:** History of Safety movement – Evolution of modern safety concept – general concepts of management – planning for safety for optimization of productivity – line and staff functions for safety – budgeting for safety – safety policy.

**Techniques:** Incident Recall Technique (IRT), disaster management, job safety analysis, safety survey, safety inspection, safety sampling, Safety Audit, Onsite and off site emergency plans.

**Accident investigation and reporting:** Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee – cost of accident.

**Safety performance monitoring:** ANSI (Z16.1) Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities – Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

**Safety education and training:** Importance of training – identification of training needs – training methods – programmes, seminars, conferences, competitions – method of promoting safe practice – motivation – communication – role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training. Importance of First aid and training

### **REFERENCES:**

1. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
2. John Ridley, “Safety at Work”, Butterworth & Co., London, 1983.
3. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1982
4. Accident Prevention Manual for Industrial Operations”, N.S.C. Chicago, 1982
5. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973

**COURSE OUTCOMES:**

After completing the course, the students will be able to

1. Explain the modern concepts in safety
2. Techniques to identify the hazards and risks in the organization
3. Investigate accidents and identify the causes of the accidents and take necessary preventive measures
4. Calculate the performance indices of safety which helps improving safety
5. Organize safety seminar and training programmes in motivating the workers

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1		1				1		3		1
CO2	3	2	2	2		2						3		2
CO3	3	3	3	1		2		3	2		2	3	3	
CO4	3	1	1		2						2	3	1	1
CO5	3	1	1			1		3		1	2	3	2	2

23CHISPC12	OCCUPATIONAL HEALTH AND HYGIENE	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To know the importance of health and hygiene at work place
- To understand the concept of Physical, Chemical, Biological and ergonomical hazards
- To know the various threshold limit values and its significance

**Physical hazards**

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs- vibration, types, effects, instruments, surveying procedure, permissible exposure limit.

Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard-non-ionizing radiations, effects, types, radar hazards, microwaves and radio waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control

**Chemical hazards**

Recognition of chemical hazards- dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV- Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHA Standard.

Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapor monitors, dust sample collection devices, personal sampling Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods-training and education

**Biological and ergonomical hazards**

Classification of Biohazardous agents - bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases -

Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets- building design. Work Related Musculoskeletal Disorders-carpal tunnel syndrome CTS-Tendon pain disorders of the neck-back injuries.

### Occupational health and toxicology

Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, modifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracnose, aluminosis and anthrax, lead, nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention- cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests.

Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems

### Occupational physiology

Man as a system component - allocation of functions - efficiency - occupational work capacity aerobic and anaerobic work - evaluation of physiological requirements of jobs - parameters of measurements - categorization of job heaviness - work organization - stress - strain-fatigue-rest pauses-shiftwork - personal hygiene.

### REFERENCES:

1. McCornick, E.J. and Sanders, M.S., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.
2. Handbook of Occupational Health and Safety, NSC Chicago, 1982.
3. Encyclopedia of Occupational Health and Safety, Vol. I & II, International Labour Organization, Geneva, 1985.

### COURSE OUTCOMES:

After completing the course, the students will be able to

1. Get a clear idea about occupational health and hygiene
2. Know about the hazards such as Physical hazards, chemical hazards, Biological and ergonomic hazards
3. Will be able to take control measures from occupational diseases
4. Understand the functions and activities of Occupational health services
5. Identifying noticeable occupational diseases arising out of occupation and suggestion for preventing methods

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3							1	1		1	3		
CO2	2	2				2		1		2				2
CO3	1		2									2	1	
CO4	2			1					1		2			
CO5	2	1	1			2	1			2		2	1	

23CHCEMC15	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Effective literature studies approaches, analysis Plagiarism, Research ethics,

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development : technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grant of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

#### REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**COURSE OUTCOMES:**

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information and follow research ethics.
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such an important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping with PO & PSO														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2				3		3	3	3	3
CO2	3	3	3	3	2				3		2	3	3	3
CO3	3		2			2	2		3	3	3	3	3	3
CO4	3	3	2	2	3	2			3	3	3	3	3	3
CO5	3	3	2	3		3	2	3	3	3	3	3	3	3

23CHISCP16	ENVIRONMENTAL HAZARD ANALYSIS LABORATORY	L	T	P	C
				3	2

**COURSE OBJECTIVES:**

- To provide basic knowledge to carry out field investigations
- To demonstrate the operational features of fire extinguishers
- To understand the usage and importance of Personal Protective Equipment

**List of Experiments**

- 1) Measurement of Sound level
- 2) Measurement of illumination level
- 3) Measurement of humidity
- 4) Estimation of COD
- 5) Estimation of BOD

**COURSE OUTCOMES:**

After completing the course, the students will be able to

1. Carry out field investigations such as measurement of noise, illumination and humidity
2. Carry out field investigation on illumination level
3. Carry out field investigation on humidity level
4. Compare the measured level with standards
5. Suggest measures for minimizing abnormalities

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	1		1			1	1	2	3	2	3	
CO2	3	1	1		1			1	1	2	3	2	3	
CO3	3	1	1		1			1	1	2	3	2	3	
CO4	3	1	1		1			1	1	2	3	2	3	
CO5	3	1	1	2	1			1	1	2	3	2	3	1

23CHISCP17	AIR POLLUTANTS ANALYSIS LABORATORY	L	T	P	C
				3	2

#### COURSE OBJECTIVES:

- To learn procedures to estimate the air pollutants
- To demonstrate the operational features of fire alarm and detecting mechanisms
- To understand and use the software tool to estimate the level of concerns in the leakage gases/fires/explosions

#### List of Experiments

- 1) Estimation of dust in atmosphere by gravimetric method
- 2) Estimation of sulphur dioxide in the atmosphere
- 3) Estimate the amount of ammonia in the atmosphere
- 4) Estimation of carbon disulphide in atmosphere
- 5) Estimation of Nitrogen dioxide in atmosphere
- 6) Determination of particulate matter in air

#### COURSE OUTCOMES:

After learning the course, the students should be able to

1. Estimate the pollutant level in atmosphere
2. Test and instruct the mechanism of fire/smoke detectors
3. Use the software tool and calculate the level of concerns in the case of leakage of gases/fires/explosions
4. Take preventive measures during emergency situations such as toxic release, fire, etc.,
5. Compare the measured level with standards

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1		1					2	1	2	
CO2	2	2	2	1		1		2			2	1	2	
CO3	2	2	2	2	3	1			1		2	1	2	3
CO4	2	2	2			1					2	1	2	
CO5	2	2				1					2	1	2	1



## SEMESTER –II

23CHISPC21	COMPUTER AIDED RISK ANALYSIS	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES:

- To develop and understand the significance of risk analysis and its types
- To know the procedures involved in the usage of software
- To learn about the pool fire/jet fire/explosion and the method of calculating safe zones

Introduction, hazard, hazard monitoring-risk issue- Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), hazard operability studies (HAZOP)

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, Applications, advantages. Explosive testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test (BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

Fault Tree Analysis & Event Tree Analysis, Logics symbols, methodology, minimal cut set ranking - fire explosion and toxicity index (FETI), various indices –

Hazard analysis (HAZAN)- Failure Mode and Effect Analysis (FMEA)- Basic concepts of Software on Risk analysis, CISCON, FETI, ALOHA

Logics of consequences analysis- Estimation- Hazard identification based on the properties of chemicals- Chemical inventory analysis- identification of hazardous processes- Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout.

### REFERENCES:

1. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK.
2. Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.
3. Quantitative Risk Assessment in Chemical Industries, Institute of Chemical Industries,
4. Centre for Chemical Process Safety.
5. Loss Prevention in Process Industries- Frank P. Lees Butterworth- Hein UK 1990 (Vol. I, II & III)
6. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process Safety, AIChE 1992.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Understand the fundamentals of hazard analysis, concepts of hazard evaluation procedure.
2. Able to apply software's for hazard analysis procedure.
3. Understand the principles of risk analysis quantification methods.
4. Understand the use of various instruments and testing methods.
5. Understand the consequences of risks and hazards

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3					1		2				2		
CO2	3	3	2	2	2			2	2		2	2		2
CO3	3											2	2	2
CO4	3		1		1				2		2	2		1
CO5	3	1	1			1	1	2		2		2		

23CHISPC22	FIRE ENGINEERING AND EXPLOSION CONTROL	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To provide necessary knowledge about the fire and fuels; mechanism of fire and impart information about different fire extinguishing mechanisms and systems.
- Help to familiarize about the explosion and its control.
- Provide knowledge about the evaluation and design of buildings for fire safety.
- To give information about the rules and regulations regarding fire and explosions safety at national level.

**Fire dynamics**

Fire chemistry-Dynamics of fire behavior-Fire properties of solid, liquid and gas-

Fire spread-Toxicity of products of combustion

**Fire protection systems**

Industrial fire protection systems-Sprinkler-Hydrants-Standpipe-

Special fire suppression system like deluge and emulsifier.

**Buildings safety**

Building evaluation for fire safety-Fire load-Fire resistance materials and fire testing-

Structural Fire protection-Exits and egress.

**Explosion & control**

Explosion protection systems-Explosion parameters-

Explosion suppression system based on CO<sub>2</sub> and Halon -Hazards in L.P.G handling.

**Fire safety- rules & regulations**

Statutory Rules and Techniques of firefighting-Indian Explosive acts and rules-

Techniques of firefighting and demonstration.

**REFERENCES:**

1. James, D., Fire Prevention Handbook, Butterworths, London, 1986.
2. Gupta R.S., Handbook of Fire Technology, Orient Longman, Bombay, 1997.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Know the chemistry and mechanism of fire and explosion and the methods to prevent and control them.
2. Evaluate the fire safety of buildings and design the measures to ensure the safety of buildings.
3. Implement the rules and regulations of fire safety for specific sites
4. Know the different source of ignition and their prevention techniques
5. Understand the causes and prevention of explosion

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		3			2		2	1			3		
CO2	3	3			3				1		2	2		2
CO3	3							2		3		1	3	
CO4	3			1		2								
CO5	3		2					2				1		2

23CHISCP26	FIRE CONTROL, PPE & QRA STUDIES LABORATORY	L	T	P	C
				3	2

#### COURSE OBJECTIVES:

- To learn procedures to estimate the air pollutants
- To demonstrate the operational features of fire alarm and detecting mechanisms
- To understand and use the software tool to estimate the level of concerns in the leakage of gases/fires/explosions

#### List of Experiments

1. Study of Fire Alarms
2. QRA study using ALOHA
3. A study on Fire Fighting Equipment
4. A study on Personal Protective Equipment

#### COURSE OUTCOMES:

After learning the course, the students will be able to

1. Test and instruct the mechanism of fire/smoke detectors
2. Use the software tool and calculate the level of concerns in the case of leakage of gases/fires/explosions
3. Take preventive measures during emergency situations such as toxic release, fire, etc.,
4. Test the air quality standards
5. Compare the environmental standards

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		1		1			1			2	2	1	
CO2	3	3	3	3	3	2					2	2	1	3
CO3	3					2	1		1		2	2	1	
CO4	3	1				2				1	2	2	3	
CO5	3								1		2	2	3	

23CHISTS27	INDUSTRIAL TRAINING AND SEMINAR/ MINI PROJECT	Tr	T	P	C
		2	0	2	2

**COURSE OBJECTIVES:**

- To train the students in the field work related to industrial safety engineering and to have a practical knowledge in carrying out work at industrial safety engineering
- To train and develop skills in solving problems during execution of certain works related to industrial safety engineering

The students individually undergo a training program in reputed concerns in the field of chemical engineering during the summer vacation (at the end of second semester for full-time/ IV semester for part time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training they had, within ten days from the commencement of third semester for full time/fifth semester for part time. The student will be evaluated by a team of staff members nominated by head of the department through a viva voce examination

**COURSE OUTCOME:**

After completion of the course, the students will be able to

1. Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
2. Develop awareness about general workplace behavior and build interpersonal and team skills.
3. Prepare professional work reports and presentations.
4. Manage the situation arises during the execution of work related to chemical process industries.
5. Generate ideas for the startup and new business opportunities.

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3			1		2		1				1	1	2
CO2	3	2	2					1				2	1	2
CO3	3	2	2		3	1		2	1	2		2	1	2
CO4	3	3	3	3			1				2	2	1	2
CO5	3		1	1		1	3				1	2	3	2

### SEMESTER –III

<b>23CHCEPV33</b>	<b>PROJECT WORK VIVA VOCE PHASE– I</b>	<b>L</b>	<b>P</b>	<b>S</b>	<b>C</b>
		<b>0</b>	<b>16</b>	<b>4</b>	<b>10</b>

<b>23CHCEPV41</b>	<b>PROJECT WORK VIVA VOCE PHASE– II</b>	<b>L</b>	<b>P</b>	<b>S</b>	<b>C</b>
		<b>0</b>	<b>24</b>	<b>6</b>	<b>15</b>

#### **DissertationPhase–IandPhase–II**

TeachingSchemeLabwork: 20and30 hrs/weekforphaselandIIrespectively

#### **COURSEOBJECTIVES:**

Attheend ofthiscourse,studentswillbe ableto

- Abilitytosynthesizeknowledgeandskillspreviouslygainedandappliedtoanin-depthstudyandexecution ofnew technicalproblem.
- Capabletoselectfromdifferentmethodologies,methodsandformsofanalysisistoproduceasuitableresearch design, and justifytheir design.
- Abilityto presentthefindings oftheir technicalsolution in awritten report.
- PresentingtheworkinInternational/Nationalconferenceorreputedjournals.

#### **SyllabusContents:**

The dissertation / project topic should be selected / chosen to ensure the satisfaction of theurgentneedtoestablishadirectlinkbetweeneducation,nationaldevelopmentandproductivityandthusreducethegapbetweentheworldofworkandtheworldofstudy.The dissertationshouldhavethefollowing

- Relevancetosocial needsofsociety
- Relevancetovalueadditionto existingfacilitiesintheinstitute
- Relevancetoindustryneed
- Problemsofnationalimportance
- Research anddevelopmentinvariousdomain

Thestudentshouldcompletethefollowing:

- Literature surveyPr oblemDe finition
- MotivationforstudyandObjectives
- Preliminarydesign /feasibility/modularapproaches
- ImplementationandVerification
- Reportandpresentation

The dissertationstagellisbasedonareportpreparedbythestudentsondissertationallottedto them.

Itmaybebased on:

- Experimentalverification /Proofofconcept.
- Design,fabrication,testingofCommunicationSystem.
- Theviva-voceexaminationwill bebased on theabovereportand work.

#### Guidelines for Dissertation Phase – I and II

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include Springer/Science Direct. In case of Industry sponsored projects, the relevant application notes, white papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the phase-I work.
- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

#### **COURSE OUTCOMES:**

After completion of the course, the students will be able to

1. Come across different literatures relevant to his study
2. Reflect on, evaluate, and critically assess one's own and others' scientific results
3. Apply the relevant knowledge and skills, which are acquired within the technical area, to solve a given problem
4. Present the findings of the technical solution in a written report
5. Publishing the novelty of the work in conferences of journals

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	2	2	3	2	3	3	3	3
CO2	3	3	3	3	2	3	2	2	3	2	3	3	3	3
CO3	3	3	3	2	2	3	2	3	3	2	3	3	3	3
CO4	3	3	3	2	2	3	2	3	3	2	3	3	3	3
CO5	3	3	3	2	1	3	2	3	3	2	3	3	3	3

### PROGRAM ELECTIVE

23CHISPESCN	SAFETY IN CHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

#### COURSE OBJECTIVES:

- To develop and evaluate appropriate strategies designed to mitigate risk;
- To take all reasonably practicable measures to prevent accidents in nuclear installations and to mitigate their consequences.
- To identify the hazards in erection, commissioning, storage, handling, etc, of chemical industries

Safety in the design process of chemical plants-  
safety in erection and commissioning of chemical plants- safety in material handling – Pressure and leak testing.

Safety in operational and maintenance –  
Exposure of personnel, Operational activities and hazards – Work permit systems entry into confined space where toxic contaminants are present.

Safety in storage and Handling of chemical and gases –  
Hazards during transportation – pipeline transport –  
safety in chemical laboratories.

Toxic release and control methodologies – toxic effects- threshold limit values – Awareness and preparedness for energy at local level Specific safety consideration

for Cement, paper, pharmaceutical, petroleum, petrochemical, rubber, fertilizer and distilleries.

Safety in nuclear plants - Objectives and concepts, technical requirements, safety functions, accident prevention and plants safety characteristics, radiation protection,

Safety analysis, safety requirements for reactor core and associated features, reactor coolants system, containment system, Waste treatment and control systems, fuel handling and storage systems.

#### REFERENCES:

1. Lees, F.P., Loss Prevention in Process Industries, Butterworths, New Delhi, 1986
2. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Recommends safety parameters required for the design process of equipment
2. Develops safety precautions to be followed in the erection and commissioning of plants
3. Develop emergency preparedness plans for various industries at toxic release scenario
4. Able to prepare the emergency planning for chemical industry problem
5. Able to create a safe storage system

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	2	1	3	2	3	3
CO2	3	2	1	2	2	2	2	2	2	1	3	2	3	2
CO3	3	2	3	3	2	2	2	2	1	1	2	2	3	2
CO4	3	3	3	2	2	2	2	3	1	1	2	2	3	2
CO5	3	1	1	1	1	2	2	2	1	1	2	2	2	2

23CHISPESCN	ENVIRONMENTAL POLLUTION CONTROL	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand about pollution control methods
- To understand the principles of air pollution and water pollution control methods.
- To understand the concept of wastewater treatment methods
- To understand the solid waste management methods

Air pollution– Classification and properties of Air pollutants–Pollution sources–Control of air pollution– Gravitational settling chambers–Cyclone separators, ESP, Wet scrubber.

Dispersion of Air pollutants–Plume behaviour–Control of gaseous pollutants, sulphur dioxide, nitrogen oxides, Carbon monoxide and hydrocarbons. Air pollution laws and standards.

Water pollution– Classification of water pollutant and their effects on receiving bodies. Advanced wastewater treatments by physical, chemical, biological and thermal methods–Effluent quality standards.

Solid waste management– methods of collection – Disposal of solid waste, landfilling, Handling of toxic and radioactive wastes–Incineration and vitrification.

Pollution control in process industries–Cement, paper, petroleum, fertilizer and petrochemical.

**REFERENCES:**

1. Rao, CS, "Environmental pollution engineering", Wiley Eastern Limited, New Delhi, 1992.
2. S.P. Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 1993.
3. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

**COURSE OUTCOMES:**

After learning the course, the students shall be able to



1. Advise pollution control methods to industries
2. Overcome the issues related to air and water pollution
3. Advise for zero discharge
4. Understand the standards that are published by the professional bodies
5. Explain the environmental health issues problem arises due to air and water pollution

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	2	3	2	2	1	2	1	1	2	2	2
CO2	2	1	2	2	2	2	2	1	2	1	1	2	1	2
CO3	2	1	2	2	3	2	2	1	2	1	1	2	2	2
CO4	2	1	1	1	2	1	1	1	1	1	1	1	2	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	1	1

23CHISPESCN	SAFETY IN ON AND OFFSHORE DRILLING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the origin of petroleum
- To identify the hazards and risks in the drilling operation
- To know the safety procedures involved in the operation and maintenance of oil field

Petroleum and Petroleum products – Fuels – Petroleum solvents –

Lubricating oils – Petroleum wax, greases – Miscellaneous product

On and offshore oil operation – Construction of Installation – Pipeline Construction –

Maintenance and repair activities – Safety and associated hazards

Drilling oil – Technique and equipment – Work position – Working condition –

safety and associated hazards – lighting and its effects

Petroleum Extraction and transport by sea – Oilfield products – Operation –

Transport of crude by sea – Crude oil hazards.

Petroleum product storage and transport – Storage equipment – Precaution – Tank cleaning

**REFERENCES:**

1. Offshore Safety Management, Ian Sutton, Elsevier, 2<sup>nd</sup> edition, 2013
2. Petroleum Refining Engineering, Nelson W.L., McGraw Hill, 4<sup>th</sup> edition, 1985
3. Encyclopedia of Occupational Health and Safety, Vol. II, International Labour Organisation, Geneva, 1985 & I.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Understand the fundamentals of drilling techniques
2. Develop safe operating procedures required for an oil field
3. Identify the hazards and take preventive measures in the oilfield
4. Know the necessary personal protective equipments required for drilling operations
5. Understanding the need of safe storage and transportation of petroleum products

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	1	2	1	2	1	1	2	2	3
CO2	2	2	2	2	2	2	2	1	2	1	1	2	2	2
CO3	2	2	2	2	2	2	2	1	1	1	2	2	2	2
CO4	2	2	2	2	2	2	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	2	2	1	1	1	2	2	2	2

23CHISPESCN	SAFETY IN MATERIAL HANDLING	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES:

- To learn the various types of material handling techniques and its hazards
- To know the ergonomics of various conveying mechanisms
- To identify the hazards involved in the material handling and to suggest precautions in the operation of heavy equipment

### Material handling

General safety consideration in material handling- Ropes, Chains, Sling, Hoops, Clamps, Arresting gears- Primemovers.

### Ergonomics of conveying mechanisms

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, travelling and slewing mechanisms.

### Ergonomics of hoisting mechanisms

Ergonomic consideration in material handling, design, installation, operation and maintenance of driving gear for hoisting mechanism- Travelling mechanism

### Handling of heavy equipments

Selection, operation and maintenance of Industrial Trucks- Mobile Cranes- Tower crane- Checklist- Competent persons.

### Storage of goods and equipments

Storage and Retrieval of common goods of various shapes and sizes in a general store of an industry.

### REFERENCES:

1. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
2. Alexandrov, M.P., Material Handling Equipment, Mir Publishers, Moscow, 1981.
3. Rudenko N., Material Handling Equipments, Mir Publishers, Moscow, 1981.

### COURSE OUTCOMES:

After learning the course, the students will be able to

1. Understand the Basic principles of safety in Material handling
2. Know the safe operation and maintenance of Trucks and cranes
3. Understanding the difficulties during the application of ergonomics in work environment

onment

4. Identifying the proper equipment requirement for a specific process to avoid accidents
5. Know the effective material handling system

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	1	1	2	1	2	2	1	1
CO2	2	2	2	2	2	2	1	1	2	1	2	2	2	1
CO3	2	2	2	2	2	2	2	1	2	1	2	2	1	1
CO4	3	2	2	2	2	2	2	1	2	1	1	2	2	1
CO5	3	2	2	2	2	2	2	1	2	1	1	2	1	1

23CHISPESCN	SAFETY IN ENGINEERING INDUSTRY	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the safe practice of woodworking machines
- To know about the principle of machine guarding
- To know about welding, gas cutting, cold forming and hot working of metals

**Safety in metal working machinery and woodworking Machines**

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planing machine and grinding machines, CNC machines, Woodworking machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

**Principles of machine guarding**

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing-guard construction-guard opening.

Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing presses-forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains pulleys and belts-authorized entry to hazardous installations-benefit of good guarding systems.

**Safety in welding and gas cutting**

Gas welding and oxyacetylene cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases- colour coding – flashback arrestor – leak detection-pipe line safety-

storage and handling of gas cylinders.

### **Safety in cold forming and hot working of metals**

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press setup and die removal, inspection and maintenance - metal shears - press brakes.

Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

### **Safety in finishing, inspection and testing**

Heat treatment operations, electroplating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry - pollution control in engineering industry - industrial waste disposal.

### **REFERENCES:**

1. Safety in Industry by N.V. Krishnan Jaico Publishers House, 1996
2. Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Bookseller, Delhi, 1989.
3. Accident Prevention Manual – NSC, Chicago, 1982.
4. Occupational safety Manual - BHEL, Trichy, 1988.
5. Indian Boiler acts and Regulations, Government of India.
6. Safety in the use of wood working machines, HMSO, UK 1992.
7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech Publishing Ltd., London, 1989.

### **COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Understand the safety principles of machine guarding
2. Know about the working of wood, welding, gas cutting, cold forming and hot working of metals
3. Understand the safety rules and standards in various mechanical engineering processes
4. Knowledge in testing and inspecting as per rules of boiler, heat treatment operations etc.
5. Clear about the preventive measures in health and welfare of workers aspects in industries.

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1	2	1	1	1	1	1	1	1	1	2
CO2	2	2	2	1	2	2	1	1	2	1	2	2	2	2
CO3	1	1	2	1	1	1	2	1	2	1	1	2	2	2
CO4	2	1	2	2	1	2	2	1	2	1	1	2	2	1
CO5	2	1	2	1	2	2	2	1	1	1	2	1	1	1

23CHISPESCN	SAFETY IN MINES	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES:

- To know the hazards of mines and the common causes of accidents in mines
- To learn the safe operations in tunneling and carry out risk assessments

### Open Cast Mines

Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatics systems, pumping, water, dust, electrical stems, fire prevention. Garage safety-accident reporting system- working condition- safe transportation-handling of explosives.

### Underground Mines

Fall of roof and sides- effect of gases-fire and explosions-water flooding-warningsensors-gas detectors-occupational hazards-working conditions-winding and transportation.

### Tunnelling

Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts) -trapping-transport-noise-electrical hazards-noise and vibration from: pneumatic tools and other machines-ventilation and lighting-personal protective equipment.

### Risk Assessment

Basic concepts of risk-reliability and hazard potential-elements of risk assessment-statistical methods-control charts-appraisal of advanced techniques-fault tree analysis-failure mode and effect analysis-quantitative structure-activity relationship analysis-fuzzy model for risk assessment.

### Accident analysis and management

Accident classification and analysis-fatal, serious, minor and reportable accidents-safety audits-recent development of safety engineering approaches for mines-frequency rates-accident occurrence-investigation-measures for improving safety in mines-cost of accident-emergency preparedness-disaster management

### REFERENCES:

1. Mine Health & Safety Management, Michael Karmised., SME, Littleton, Co., 2001.
2. Kejriwal, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Know the hazards in the mines and control of those hazards
2. Learn how to overcome the issues such as ground collapse, atmospheric pollution, etc., occurs in the mines
3. Understand the mining activities of opencast, underground and tunneling mining
4. Able to implement disaster management, emergency preparedness and risk assessment
5. Effectively employ the knowledge on prevention of accident

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	2	1	1	1	1	2	1	1
CO2	3	2	2	2	2	2	2	1	1	1	1	2	2	1
CO3	2	2	2	2	2	2	2	1	1	1	1	2	2	1
CO4	2	2	2	2	2	3	2	1	1	1	1	2	2	1
CO5	2	2	2	2	2	2	2	1	1	1	1	2	1	1

23CHISPESCN	REGULATIONS FOR HEALTH, SAFETY AND ENVIRONMENT	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To study various Safety legislations
- To know about Health Regulations
- To know about Environmental Safety Acts

Factories Act and Rules - Employee's Compensation Act 1923 - Building and Other Construction Workers Act 1996

Indian Explosive Act - Gas Cylinder Rules - SMPV Act - Indian Boiler Act 1923 - Indian Petroleum Act - Indian Electricity Act.

Environment Act (Protection) 1986 - Air Act 1981 - Water Act 1974 - The Noise Pollution (Regulation and Control) Rules, 2000 - National Green Tribunal Act 2010

Manufacture, Storage and Import of Hazardous Chemical Rules 1989 - Hazardous Wastes (Management and Handling) Rules 1989 - Biomedical Waste (Management and Handling) Rules 1998 - Municipal Solid Wastes (Management and Handling) Rules 2000

Overview of ISO Series - ISO 45001 - ISO 14001

**REFERENCES:**

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. Water (Prevention and Control of Pollution) Act 1974, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
4. Air (Prevention and Control of Pollution) Act 1981, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
5. Explosive Act, 1884 and Explosive Rules, 1883 (India), (2002), Eastern Book Company, Lucknow, 10th Edition
6. The Manufacture, Storage and Import of Hazardous Chemical Rules 1989, Madras B

ookAgency, Chennai.

7. TheIndianboilersact1923,CommercialLawPublishers(India)Pvt.Ltd.,Allahabad.

**COURSEOUTCOMES:**

Afterlearningthe course,the studentswill beable to

1. Understandthe fundamentalsofFactoriesAct.
2. KnowledgeaboutHealth Regulations.
3. KnowaboutEnvironmentLegislations.
4. KnowledgeaboutEmployeesCompensation
5. Understandingthe benefits of followingregulations forhealth safetyand environment

MappingwithPOs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	1	1	2	1	1	1	3	1
CO2	2	1	2	1	1	1	1	1	2	1	1	1	3	1
CO3	2	1	2	1	1	1	1	1	2	1	1	1	3	1
CO4	2	1	2	1	1	1	1	1	2	1	1	1	3	1
CO5	2	1	1	1	1	1	1	1	2	1	1	1	3	1

23CHISPESCN	NUCLEAR ENGINEERING AND SAFETY	L	T	P	C
		3	0	0	3

**COURSEOBJECTIVES:**

- To impart knowledge and skills in the safety of Nuclear Engineering
- Know the various design considerations required for a nuclear reactor
- To provide knowledge on the radiation hazards and its prevention techniques
- Introduction

Binding energy – fission process – radioactivity – alpha, beta and gamma rays radioactive decay – decay schemes – effects of radiation – neutron interaction – cross section – reaction rate – neutron moderation – multiplication – scattering – collision – fast fission – resonance escape – thermal utilization – criticality.

**Reactor control**

Control requirements in design considerations – means of control – control and shutdown rods – their operation and operational problems – control rod worth – control instrumentation and monitoring – online central data processing system.

**Reactor types**

Boiling water reactors – radioactivity of steam system – direct cycle and dual cycle power plants – pressurized water reactors and pressurized heavy water reactors – fast breeder reactors and their role in power generation in the Indian context – conversion and breeding – doubling time – liquid metal coolants – nuclear power plants in India.

**Safety of nuclear reactors**

Safety design principles – engineered safety features – site related factors – safety related systems – heat transport systems – reactor control and protection system – fire protection system – quality assurance in plant components – operational safety – safety regulation process – public awareness and emergency preparedness. Accident Case studies – Three Mile Island and Chernobyl accident.

## Radiation control

Radiation shielding – radiation dose – dose measurements– units of exposure –exposure limits –barriers for control of radioactivity release – control of radiation exposure to plant personnel – health physics surveillance – waste management and disposal practices –environmental releases.

### REFERENCES:

1. M.M.E.L.Wakil, "Nuclear Power Engineering", International Text Book Co.
2. Serman U.S. "Thermal and Nuclear Power Stations", MIR Publications, Moscow, 1986.
3. "Loss prevention in the process Industries" Frank P. Lees Butterworth-Hein-UK, 1990.
4. M.M.E.L.Wakil, "Nuclear Energy Conversion", International Text Book Co.
5. R.L.Murray, "Introduction to Nuclear Engineering", Prentice Hall.
6. Sri Ram K, "Basic Nuclear Engineering" Wiley Eastern Ltd., New Delhi, 1990.
7. Loffness, R.L., "Nuclear Power Plant" Van Nostrand Publications, 1979. USA

### COURSE OUTCOMES:

After learning the course, the students will be able to

1. Understand the concepts of safety of Nuclear reactors.
2. Design the safety relief systems required for nuclear reactors
3. Manage emergency situations
4. Control radiation hazards and advise on disposal techniques, etc.,
5. Explain the safety design principles and regulation process

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	2	1	1	1	2	2	2	2
CO2	2	2	2	2	3	2	3	1	1	1	2	2	2	2
CO3	2	2	2	2	3	2	2	1	1	1	2	2	2	2
CO4	2	2	2	2	2	2	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	2	3	1	1	1	2	2	3	2

23CHISPESCN	DOCK SAFETY	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES:

- To know the statues associated with the dock safety
- To know the hazards in the dock
- To learn the safe operation of handling cargo equipment and emergency action plan in the dock

### History of Safety Legislation

History of dock safety statues in India-background of present dock safety statues-dock workers (safety, health and welfare) act 1986 and the rules and regulations framed thereunder, other statues like marking of heavy packages act 1951 and the rules framed thereunder-manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989–few cases laws to interpret the terms used in the dock safety statues. Responsibility of different agencies for safety, health and



welfare involved in dock work—responsibilities of port authorities—dock labour board—owner of ship master, agent of ship – owner of lifting appliances and loose gear etc. – employers of dock workers like stevedores—clearing and forwarding agents—competent persons and dock worker. Forums for promoting safety and health in ports—Safe Committees and Advisory Committees. Their functions, training of dock workers.

### **Working on Board the Ship**

Types of cargo ships—working on board ships—Safety in handling of hatch beams—hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features—safety in chipping and painting operations on board ships—safe means of accesses—safety in storage etc.—illumination of decks and in holds—hazards in working inside the hold of the ship and on decks – safety precautions needed – safety in use of transport equipment—internal combustible engines like forklift trucks—payloaders etc. Working with electricity and electrical management—Storage—types, hazardous cargo.

### **Lifting Appliances**

Different types of lifting appliances—construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances—portainers—transtainers—top lift trucks—derricks in different rigging etc. Use and care of synthetic and natural fiber ropes—wire open chains, different types of slings and loose gears.

### **Transport Equipment**

The different types of equipment for transporting containers and safety in their use—safety in the use of self loading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes. Safe use of special lift trucks inside containers—Testing, examination and in section of containers—carriage of dangerous goods in containers and maintenance and certification of containers for safe operation Handling of different types of cargo—stacking and unstacking both on board the ship and ashore—loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa—restriction of loading and unloading operations.

### **Emergency Action Plan and Dock Workers Regulations**

Emergency action Plans for fire and explosions collapse of lifting appliances and buildings, shed etc., as leakages and precautions concerning spillage of dangerous goods etc., Preparation of on site emergency plan and safety report. Dock workers (SHW) rules and regulations 1990 related to lifting appliances, Container handling, loading & unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.

### **REFERENCES:**

1. Safety and Health in Dockwork, II Edition, ILO, 1992.

2. Dock Safety, Thane Belapur Industries Association, Mumbai.
3. Taylor D.A., Introduction to Marine Engineering
4. Srinivasan, Harbour, Dock and Tunnel Engineering
5. Bindra SR, Course in Dock & Harbour Engineering

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. The Students will know the statutes relating to dock activities
2. Students can identify the various hazards in different dock activities and take measures to eradicate them.
3. Students shall be able to manage emergency situations in the dock due to fire/explosion.
4. Understand the operation of various types of material handling equipments
5. Students, recognize various problems associated with the use of lifting equipments in storage yard.

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	1	1	1	1	1	1	2	1	1
CO2	2	1	2	1	2	1	1	1	1	1	1	2	1	1
CO3	2	1	2	1	2	1	1	1	1	1	1	2	1	1
CO4	2	2	2	1	2	1	1	1	1	1	1	2	1	1
CO5	2	2	2	1	1	1	1	1	1	1	1	1	1	1

<b>23CHISPESCN</b>	<b>SAFETY IN CONSTRUCTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- ☐ To know the factors associated with contract document and safety
- ☐ To know the hazards in excavation, foundation, cordoning, demolition and other construction activities
- ☐ To learn preventive measures such as Lockout/Tagout systems

General Safety Consideration – Analyzing construction jobs for Safety – Contract Document

Hazards in Excavation – Working at Height – Foundation and utilities – Cordoning – Demolition – Dismantling – Clearing Debris

Types of Foundations – Footings

Safety in Erection – Construction Materials – Specifications – Suitability –

Limitations Steel structures – Concrete structures –

Safety in the Construction of Dams – Bridges –

Water Tanks – Retaining Walls – Critical factors for failure – Inspection and Monitoring

Maintenance – Training – Scheduling – Preventive Maintenance –

Lockout of Mechanical and Electrical systems – Ground maintenance – Hand tools –

Gasoline operating equipment.

**REFERENCES:**

1. Fulman, J.B., Construction Safety, Security and Loss Prevention, John Wiley & Sons, 1979.
2. Hudson, R. Construction Hazard and Safety Handbook, Butterworth-Heinemann, 1985

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Able to understand the importance of contracts and agreements in the construction with respect to workers safety and health.
2. Identify the various hazards in different construction activities and take measures to eradicate them.
3. Knowledge on the critical factors that can cause damages in the dams, bridges, water tanks and retaining walls which would help them in the design to prevent accidents.
4. Identifying types and causes of accidents and designing aids for safe construction
5. Understanding the safety procedures for work at height.

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	2	1	1	2	1	2	2	1
CO2	2	2	2	2	2	1	2	1	1	2	1	2	2	1
CO3	2	2	2	2	2	2	2	1	1	1	2	2	2	1
CO4	2	2	2	2	2	2	2	1	1	1	1	2	2	1
CO5	2	2	2	2	2	2	2	1	1	1	1	1	2	1

23CHISPESCN	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- ☐ To understand the concept of EIA
- ☐ To prepare EIA reports
- ☐ To know the components of EIA
- ☐ To know about various Prediction tools of EIA
- ☐ To know legislation requirement of EIA

Evolution of EIA-Concepts-Methodologies-Screening-Scoping-Mitigation-Matrices-Checklist

Rapid and Comprehensive EIA-Legislative and Environmental Clearance Procedure in India -Prediction tools for EIA

Assessment of Impact-Air-Water-Soil-Noise-Biological-Sociocultural Environment-Public Participation-Resettlement and Rehabilitation

Documentation of EIA - Environmental Management Plan - Post Project

## Monitoring Environmental Audit - Life Cycle Assessment-EMS-Case Studies

in EIA

### REFERENCES:

1. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.
2. Shukla, S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
3. John G. Rau and David C. Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.
4. "Environmental Assessment Sourcebook", Vol. I, II & III. The World Bank, Washington, D.C., 1991.
5. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Science, 1999.

### COURSE OUTCOMES:

After learning the course, the students will be able to

1. Carry out scoping and screening of developmental projects for environmental and social assessments
2. Explain different methodologies for environmental impact prediction and assessment
3. Plan environmental impact assessments and environmental management plans
4. Evaluate environmental impact assessment reports
5. Students able to document environmental impact assessment

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	1	2	1	1	2	1	2	3	2
CO2	2	2	1	2	2	1	2	1	1	2	1	2	3	2
CO3	2	2	1	2	2	1	2	1	1	2	1	2	3	2
CO4	2	2	1	2	2	1	2	1	1	2	1	2	3	2
CO5	2	2	1	2	2	1	2	1	1	2	1	2	3	2

23CHISPESCN	OCCUPATIONAL HEALTH SAFETY MANAGEMENT SYSTEM ISO 45001:2018	L	T	P	C
		3	0	0	3

### COURSE OBJECTIVES:

- To have familiarities with OHSAS standards and its policy and implementation procedures
- To provide an idea to the ISO 45001

Introduction to ISO 45001 - purpose of developing the standard, major difference between the OHSAS 18001 and ISO 45001, benefits of using and adapt the standard. ISO 45001 related to other standards, terms and definitions, requirements of ISO 45001 OH&SMS.

Clause 4: Context of the organization - understanding the organization and its context, input-process-output for contextual issues. Factors affecting the OH&S activities - internal issues, external issues. Plan-Do-Check-Act for gathering the need and expectation of input-process-

output for ISO 45001 occupational health and safety. Implementation guidelines.

Clause 5: Leadership OH&S policy, consultation and participation of workers

Clause 6: Planning action to address risk and opportunity-general hazard identification and assessment of risk and opportunity, assessment of OHS risk and other risk, OHS objective and planning, input-process-output for addressing the risk, OH&S legal requirements.

Clause 7: Support input-process-output for clause requirements “people” OH&S competency matrix, implementation guidelines, plan-do-check-act for communication – internal, external communication charts, control of documented information-clause requirement, block diagram, documentation structure.

Clause 8: operational planning and control eliminating hazard and reducing OH&S risk, situation where the operation controls are required, management of change, outsourcing, procurement, emergency preparedness and response (EPR), EPR flow chart, Mock Drill and procedure and carried out for following emergency.

Clause 9: performance evaluation, internal audit - terms and terminologies block diagram, input-process-output, purpose, procedure. Management review.

Clause 10: improvement - input-process-output, use of incident, input-process-output for non-conformity and corrective, Pareto diagram for causes of accident, occurrence of accidents and its analysis.

**REFERENCES:**

1. K.C.Arora, *ISO 9000 to OHSAS 18001*, S.K.Kataria & Sons, New Delhi
2. R.K.Jain & Sunil Rao, (2006) *Industrial Safety, Health and Environment Management Systems*, 1<sup>st</sup> Ed. Khanna Publishers, New Delhi.
3. ISO 45001:2018 occupational health and safety management system, Ramesh Lakhe, Krantidharkar
4. The ISO 45001:2018 Implementation Handbook: Guidance on Building an Occupational Health and Safety Management System. Milton P. Dentch

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. The Students will know the current standards of OH&S and implementing procedure
2. Students understand the guidelines of ISO 45001 and its necessity and the principles of occupational health audits
3. Students could be able to understand the updating of standards
4. Knowledge on various clauses and preparation of documentation
5. Provide the skill in analyzing the applicability on the nature of organization

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	1	1	1	1	1	1	1	2	1
CO2	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO3	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO4	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO5	2	2	2	1	1	1	1	1	1	1	1	1	2	1

23CHISPESCN	HUMAN FACTORS ENGINEERING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the man-machine concept
- To know the relation between human behavior and its causes for accidents
- To know the principles of ergonomics and motion economy
- To understand the importance of PPE

Concept of Man-Machine system – Application of human factors engineering –  
 Man as Sensor – Man as Information Processor – Man as Controller  
 Human behavior – Individual difference – Unsafe Action Factors – Personal Factors –  
 Psychological and Psychosocial Factors – Motivation  
 Frustration and Conflicts – Attitudes – Learning concepts  
 Principles of Ergonomics – Application of ergonomics in a work system –  
 Principle of Motion Economy – Effects of Environment  
 Personal Protective Equipment – types – specifications – standards –  
 testing procedures – maintenance

**REFERENCES:**

1. McCornick, E. J. Human Factors in Engineering and Design, Tata McGraw Hill, 1982
2. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
3. Introduction to Ergonomics, R.S. Bridger, Taylor & Francis.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. The students will be able to understand the concept of man-machine system and hence design the various parameters which would be user friendly and hazard free.
2. Students will learn how the human factors are contributing for accidents and the various ways to overcome those factors. Students can understand the necessity of ergonomic design of work places and thus the musculo skeletal disorders can be prevented.
3. The students will learn the necessity of PPE in the work place and its types and standards
4. Students will be able to reduce the accident possibilities by creating the new device.
5. Able to incorporate PPE to reduce the human error.

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	1	1

23CHISPESCN	SAFETY IN TEXTILE INDUSTRY	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the textile industrial process
- To identify the hazards and risks associated to textile industry
- To develop health and safety measures

**Introduction**

Introduction to process flow chart of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture- accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.

**Textile hazards I**

Accident hazards i) sizing processes - cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttleless looms iii) knitting machines iv) non-wovens.

**Textile hazards II**

Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluent treatment textile processes.

**Health and welfare**

Health hazards in textile industry related to dust, fly and noise generated- control measures- relevant occupational diseases, personal protective equipment - health and welfare measures specific to textile industry, Special precautions for specific hazardous work environments.

**Safety status**

Relevant provision of factories act and rules and other statutes applicable to textile industry – effluent treatment and waste disposal in textile industry.

**REFERENCES:**

1. "Safety in Textile Industry" Thane Belapur Industries Association, Mumbai.
2. Textile fires – analysis, findings and recommendations LPA
3. Groover and Henry DS, "Hand book of textile testing and quality control"
4. "Quality tolerances for water for textile industry", BIS
5. Shenai, V.A. "A technology of textile processing", Vol. I, Textile Fibres
6. Little, A.H., "Water supplies and the treatment and disposal of effluent"

**COURSE OUTCOMES:**

After learning the course, the students shall be able to

1. Identify the hazards and risks and suggest safety procedures for textile industries
2. Develop health and safety measures.
3. Use special precautions for specific hazardous work environments.
4. Advise statutory norms to be followed for a textile industry.

5. Create the method of various design arrangements to avoid risk.

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	2	1	1	1	1	2	2	1
CO2	2	2	1	1	1	1	2	1	1	1	1	2	2	1
CO3	2	2	1	1	1	1	2	1	1	1	1	2	2	1
CO4	2	2	1	1	1	1	1	1	1	1	1	2	2	1
CO5	2	2	1	1	1	1	1	1	1	1	1	2	2	1

23CHISPESCN	AIR POLLUTION CONTROL	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- ☐ To impart knowledge on air pollutants and measurement.
- ☐ To understand the control of gas and particulate contaminants by using control equipments.
- ☐ To develop the knowledge of automobile emissions, indoor air pollution and odour control.
- ☐ To analyse the industrial applications and its control measures.

Scope-nature of air pollutants-air pollution measurement-principles underlying the design of pollution control equipment. Pollutant distributions and collection efficiencies: properties and collection of particles-particle distributions-collection of fumes-multiple collectors

Design of industrial ventilation systems; Control of particulate contaminants: Settling chambers- Inertial separators- Cyclones- Filters- Scrubbers or wet collectors- Electrostatic Precipitators and collection efficiency.

Control of gaseous contaminants: Methods of control and designs- absorption, Adsorption, condensation, Incineration; Design of biological systems- Bio filters, Bio trickling filter, Bio scrubbers; Odours and their control

Types and control of automobile emissions- Exhaust emissions, evaporative emissions, crank-case emissions; Indoor air pollution

Control Measures for Industrial Applications: Mineral products- asphaltic concrete, glass manufacturing, asbestos processing; Cement Industry- Thermal Power plants- Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry

**REFERENCES:**

1. Martin Crawford, Air Pollution Control Theory 2nd Edn., Tata McGraw-Hill Publications
2. Noel De Nevers, Air Pollution Control Engineering, McGraw Hill, New York, 1995.
3. M.N. Rao et al, "Air Pollution" Tata McGraw Hill, 1989.
4. Pollution Prevention and Abatement Handbook, 1998: Toward Cleaner Production,



**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Understand the effect of air pollution and fundamentals.
2. Understand the selection of control measures for air and particulate pollutions.
3. Understand the impact of air pollution on automobile emission, Odours and indoor emission
4. Understand the importance of control measures on industrial Pollutants
5. Understand recycling of air pollutants

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	1	1	1	1	1	1	2	2	1
CO2	2	2	1	1	2	1	1	1	1	1	1	2	2	1
CO3	2	2	1	1	2	1	1	1	1	1	1	2	2	1
CO4	2	2	1	1	2	1	1	1	1	1	1	2	2	1
CO5	2	2	1	1	2	1	1	1	1	1	1	2	2	1

**OPEN ELECTIVE**

23CHISOESCN	MAINTAINABILITY ENGINEERING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- ☐ To enable the students know about the basic concept of maintainability engineering.
- ☐ To impart knowledge on various maintenance models, maintenance policies and replacement of various equipment.
- ☐ To provide knowledge on logistics for the effective utilization of existing resources and facilities availability of spares parts.

Maintenance definition – Need for maintenance – Maintenance objectives and challenges – Technology – Maintenance costs – Scope of maintenance department.

Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – PM schedule and product characteristics – Inspection models – Optimizing profit/downtime – Replacement decisions.

Human factors – Maintenance staffing: Learning curves – Simulation –

Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning and scheduling – Spare parts planning.

Maintenance excellence – Five Zero concept – FMECA – Root cause analysis – System effectiveness – Design for maintainability – reliability Centered Maintenance.

TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars – Autonomous maintenance –

TPM implementation

**REFERENCES:**

- i. Andrew K.S. Jardine & Albert H.C. Tsang, "Maintenance, Replacement and Reliability", Taylor and Francis, 2006.
2. Bikas Badhury & S.K. Basu, "Tero Technology: Reliability Engineering

- and Maintenance Management”, Asian Books, 2003.
3. Seichi Nakajima, “Total Productive Maintenance”, Productivity Press, 1993.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Understand the various terms and terminologies about the maintenance concept.
2. Understand the various maintenance modes and logistics meant for the execution of various services.
3. Apply their knowledge in areas where the downtime, over replacement are existing and could lead to improve the productivity and quality.
4. Understanding the effectiveness of equipment
5. Students able to know about optimizing profit and replacing decisions

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	2	1	1	1	1	1	2	2	1
CO2	2	2	1	1	2	2	1	1	1	1	1	2	2	1
CO3	2	2	1	1	2	2	1	1	1	1	1	2	2	1
CO4	2	2	1	1	2	2	1	1	1	1	1	2	2	1
CO5	2	2	1	1	2	2	1	1	1	1	1	2	2	1

23CHISOESCN	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To explain how electrical current adversely affects the human body.
- Applicable Statutory requirements on safety standards regarding electrical works, equipment and installations
- To educate workers on safety tips in an electrical environment
- To identify and access the electrical hazard

**Concepts and statutory requirements:** Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid- cardiopulmonary resuscitation (CPR).

**Electrical Hazards:** Primary and secondary hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion-ionization, spark and arc-ignition energy – National electrical Safety code-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity – definition, sources, hazardous conditions, control Protection systems- fuse, circuit breakers, FRLS insulations, and Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth

resistance,earthpit maintenance.

**Selection,installation, operationandmaintenance:**Roleofenvironmentinselection-safety aspects in application - protection and interlock self diagnostic features and fail safeconcepts-lock out and work permit system-discharge rod and earthing devices-safety in theuseof portable tools-cablingandcable joints- Preventivemaintenance.

**Hazardous zones:** Classification of hazardous zones -intrinsically safe and explosion profelectrical apparatus (IS, API and OSHA standard) -increase safe equipment-their selection fordifferent zones- temperature classification-grouping of gases-use of barriers and isolators-equipmentcertifyingagencies.

**REFERENCES:**

1. FordhamCooper,W.,“ElectricalSafety Engineering”ButterworthandCompany,London,1986.
2. Accidentpreventionmanualforindustrialoperations”,N.S.C.,Chicago,1982.
3. Indian ElectricityActandRules,GovernmentofIndia.
4. PowerEngineers–HandbookofTNEB,Chennai,1989.

**COURSEOUTCOMES:**

Afterthe completion ofthecourse, theStudentswill beableto

1. understandthetypesofelectricalhazards
2. developsafeoperatingprocedurestovarious electricalinstallations
3. classifythevarious hazardous zones as per theStandards
4. Understandtheoperationofvariousprotectionsystemsfromelectricalhazards
5. Studentsabletoknowabouttheinterlockselfdiagnosticfeatures

MappingwithPOs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	2	1	1	1	1	1	2	2	1
CO2	3	2	1	2	2	2	1	1	1	1	1	2	2	1
CO3	3	2	1	2	2	1	1	1	1	1	1	2	2	1
CO4	3	2	1	2	2	1	1	1	1	1	1	2	2	1
CO5	2	2	1	2	2	1	1	1	1	1	1	2	2	1

23CHISOESCN	WORK STUDY AND ERGONOMICS	L	T	P	C
		3	0	0	3

**COURSEOBJECTIVES:**

- To studyabout workplacehazards
- Tounderstandtheconceptofergonomics
- Toknowtheimportanceofpersonalprotectiveequipment
- Tolearnprocessand equipmentdesignandman machinesystems

**Workstudy:**

Study of operations – work content – work procedure – breakdown – human factors – safetyand method study –methods and movements at the workplace – substitution with latestdevices – robotic concepts – applications in hazardous workplaces – productivity, qualityand safety(PQS).

**Ergonomics**

Definition– applications of ergonomic principles in the shop floor – work benches –

seating arrangements – layout of electrical panels – switch gears – principles of motion economy – location of controls – display locations – machine foundations – work platforms, fatigue, physical and mental strain – incidents of accident – physiology of workers.

**Personal protection**

Concepts of personal protective equipment – types – selection of PPE – invisible protective barriers – procurement, storage, inspection and testing – quality – standards – ergonomic considerations in personal protective equipment design.

**Process and equipment design**

Process design – equipment – instrument – selection – concept modules – various machine tools - inbuilt safety – machine layout - machine guarding- safety devices and methods – selection, inspection, maintenance and safe usage – statutory provisions, operator training and supervision – hazards and prevention.

**Man-machine systems**

Job and personal risk factors – standards – selection and training – body size and posture – body dimension (static/dynamic) – adjustment range – penalties – guidelines for safe design and postures – evaluation and methods of reducing posture strain. Man-machine interface – controls – types of control – identification and selection – types of displays – compatibility and stereotypes of important operations – fatigue and vigilance – measurement characteristics and strategies for enhanced performance.

**REFERENCES:**

1. Introduction to Work Study”, ILO, Oxford and IBH Publishing company, Bombay, 1991”.
2. “Work Study”, National Productivity Council, New Delhi, 1995.
3. E.J. McCormick and M.S. Sanders “Human Factors in Engineering and Design”, TMH, New Delhi, 1982.
4. W. Benjamin Neibal Motion and Time Study, 7th Edition.
5. Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989.
6. “Accident Prevention Manual for Industrial Operations”, NSC Chicago, 1982.
7. Hunter, Gomas, “Engineering Design for Safety”, McGraw Hill Inc., 1992.

**COURSE OUTCOMES:**

After learning the course, the students will be able to

1. Understand the fundamentals of ergonomics.
2. Know about workplace hazards.
3. Use personal protective equipments for specific hazardous work environments.
4. Able to incorporate human factors in design of PPE

5. Know the safe design of man-machine systems

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	1	2	1	1	1	1	2	2	1
CO2	2	2	2	1	1	1	2	1	1	1	1	2	2	1
CO3	2	2	2	1	1	1	2	1	1	1	1	2	2	1
CO4	2	2	2	1	1	1	2	1	1	1	1	2	2	1
CO5	2	2	2	1	1	1	2	1	1	1	1	2	2	1

23CHISOESCN	TRANSPORT SAFETY	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To provide the students about the various activities/step to be followed in a safe handling the hazardous goods transportation from one location to another location.
- To educate the reasons for the road accident and the roles and responsibilities of a safe Driver and the training needs of the driver.
- To inculcate the culture of safe driving and fuel conservation along with knowing of basic traffic symbols followed throughout the highways.

Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries - static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures– communication.

Introduction – factors for improving safety on roads – causes of accidents due to drivers and pedestrians- design, selection, operation and maintenance of motor trucks- preventive maintenance-checklists-motor vehicle insurance and surveys.

Driver safety programme – selection of drivers – driver training-tacho-graph-driving test-driver's responsibility-accident reporting and investigation procedures-fleet accident frequency-safe driving incentives-slogans in driver cabin-motor vehicle transport workers act- driver relaxation and rest pauses– speed and fuel conservation– emergency planning and Hazmat codes

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per km.-factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers-street lighting and illumination overloading-concentration of driver. Plan railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices.

Transport precautions-safety on manual, mechanical handling equipment operations-safe driving-movement of cranes-conveyors etc., servicing and maintenance equipment-greaserack operation-wash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

**REFERENCES**

1. "Accident Prevention Manual for Industrial Operations", NSC, Chicago, 1982.
2. Babkov, V.F., "Road Conditions and Traffic Safety" MIR Publications, Moscow, 1986.
3. K.W.Ogden, "Safer Roads – A Guide to Road Safety Engineering"
4. Kadiyali, "Traffic Engineering and Transport Planning" Khanna Publishers, New Delhi, 1983.
5. Motor Vehicles Act, 1988, Government of India.
6. Pasricha, "Road Safety guide for drivers of heavy vehicle" Nasha Publications, Mumbai, 1999.

7. Popkes, C.A. "Traffic Control and Road Accident Prevention" Chapman and Hall Limited, 1986.

**COURSE OUTCOMES:**

After learning the course, the students should be able to

1. Recognize various safety activities undertaken in transporting of hazardous goods
2. Understand the various symbols which are specific to the roads safety and able to reduce the accidents occurred in the roads.
3. Apply for the safe transportation of hazardous goods, creating TREM card and safe loading and unloading procedure.
4. Able to know about the procedures on accident investigating and reporting
5. Know the importance in design of tanker lorries, responsibility of driver, inspection and maintenance of vehicle.

Mapping with POs and PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	1	2	1	1	1	1	2	2	1
CO2	2	2	2	1	2	1	2	1	1	1	1	2	2	1
CO3	2	2	2	2	2	1	2	1	1	1	1	2	2	1
CO4	2	2	2	2	2	1	2	1	1	1	1	2	2	1
CO5	2	2	2	2	2	1	2	1	1	1	1	2	2	1