M.E. (Industrial Safety Engineering)

2021 Regulations, Curriculum & Syllabi

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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CONTENTS

	Page No.
Regulations 2021	i
Vision of the Department	xvii
Mission of the Department	xviii
PEOs	xix
POs	xx
Mapping of PEOs and POs	xxi
Curriculum 2021	1
Syllabi	3
Electives	26

BANNARI AMMAN INSTITUTE OF TECHNOLOGY
REGULATIONS 2021
(CHOICE BASED CREDIT SYSTEM)

Common to all M.E. / M.Tech. Degree Programmes

NOTE: *The regulations given hereunder are subject to amendments as may be decided by the Academic Council of the Institute from time to time. Any or all such amendments will be effective from such date and to such batches of students, including those already in the middle of the programme as may be decided by the Academic Council.*

1. ELIGIBILITY FOR ADMISSION

(i) Candidates seeking admission to the First Semester of M.E./M.Tech. degree programmes will be required to satisfy the eligibility criteria for admission thereto prescribed by the Directorate of Technical Education, Chennai and Anna University, Chennai.

(ii) Students admitted under 'Full-Time' should be available in the departments during the entire duration of working hours (from morning to evening on a full-time basis) for the curricular, co-curricular and extra-curricular activities.

The full-time students should not attend any other full-time programme(s) / course(s) or take up any full-time job / part-time job during working hours in any institution or company during the period of the full-time programme. Violation of the above rules will result in the cancellation of admission to the PG programme.

2. DURATION OF THE PROGRAMME

(i) **Minimum Duration:** Master of Engineering (M.E.) / Master of Technology (M.Tech.) extends over a period of two years. The two academic years will be divided into four semesters, with two semesters per year.

(ii) **Maximum Duration**: A candidate shall complete all the passing requirements of M.E./M.Tech. programmes within a maximum period of 4 years / 8 semesters, these periods being reckoned from the commencement of the first semester to which the candidate was first admitted, regardless of the break-of-study availed.

3. BRANCHES OF STUDY

Following M.E./M.Tech. programmes are offered by the institute

M.E. Programmes

1. Communication Systems
2. Computer Science and Engineering

3. Embedded Systems
4. Industrial Automation and Robotics
5. Industrial Safety Engineering
6. Power Electronics and Drives
7. Software Engineering
8. Structural Engineering

M. Tech. Programme

9. Biotechnology

4. STRUCTURE OF PROGRAMMES

(i) **Curriculum:** Every post- graduate programme will have a curriculum with syllabi consisting of theory and practical courses that include

Program Core Courses (PCC) include the core courses relevant to the chosen specialisation.

Program Elective Courses (PEC) include the elective courses relevant to the chosen specialisation.

Research Methodology and IPR Course to understand the importance and the process of creation of patents through research.

Employability Enhancement Courses (EEC) include project work, practical courses, internship, mini project and industrial/practical training.

Audit Courses (AC) expose the students to Disaster Management, Yoga, English for Research Paper Writing, Value education, Pedagogy Studies, Stress Management, and Personality Development through Life Enlightenment Skills. Registration for any of these courses is optional to students.

(ii) **Project Work:** Every student, individually, shall undertake Dissertation Phase I during the third semester and Dissertation Phase II during the fourth semester under the supervision of a qualified faculty. The project work can be undertaken in an industrial / research organisation or institute in consultation with the faculty guide and the Head of the Department. In the case of project work at an industrial / research organisation, the same shall be jointly supervised by a faculty guide and an expert from the organisation. The student shall be instructed to meet the supervisor periodically and attend the review committee meetings to evaluate the progress.

(iii) **Elective Courses: Fi v e Elective** courses are offered to the students admitted in various disciplines as prescribed in the curriculum to widen their knowledge in their specialisation area.

(iv) **Online Courses:** A Student may be permitted to credit online courses with the approval of a Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of six credits. Such students may be exempted

from attending the classes if such course(s) are offered in the semester. Summary of such online courses, taken by the students, along with the offering agency shall be presented to the Academic Council for information and further suggestions. However, the student needs to obtain certification from the agency offering the course to become eligible for writing or seeking exemption from the End Semester Examinations. In case of credits earned through online mode from the Institute / University, the credits may also be transferred directly after due approval from the Departmental Consultative Committee and the Controller of Examinations.

(v) **Industrial Training:** Every full-time student shall take up training in industry/research laboratories, under the supervision of a faculty guide during summer/winter vacation till the pre-final semester of the programme subject to the evaluation prescribed in Clause 15.

If industrial training/internship is not prescribed in the curriculum, the student may undergo industrial training/internship optionally, and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in industrial training/internship, the student may drop one Program Elective in the III semester. In such cases, industrial training/internships need to be undergone continuously from one organisation only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for the classification of the degree. The student is only allowed to undergo a maximum of 6 weeks of industrial training/internship during the entire duration of the study.

Duration of Training / Internship	**Credits**
2 Weeks	1
4 Weeks	2
6 Weeks	3

(vi) **Mini Project**: The students shall undertake a mini project individually in consultation with the respective faculty and Head of the Department, as specified in the curriculum. A student is expected to make a presentation about the mini-project during the final evaluation as given in Clause 15.

(vii) **Value Added / Certificate Courses:** Students can opt for any one of the value-added courses in II and III semesters, approved by the Academic Council. A separate certificate will be issued on successful completion of the course by the Controller of Examinations.

(viii) **Credit Assignment:** Each course is normally assigned a certain number of credits with 1 credit per lecture hour per week, 1 credit for 2 hours of practical per week, 1 credit for 1 hour of tutorial per week. The exact numbers of credits assigned to the different courses of various programmes are decided by the respective Board of Studies.

(ix) **Minimum Credits:** For the award of the degree, the student shall earn a minimum number of total credits as prescribed by the respective Board of Studies as given below:

S.No.	M.E./M. Tech. Programmes	Total Credits
1.	M.E. Communication Systems	68
2.	M.E. Computer Science and Engineering	68
3.	M.E. Embedded Systems	68
4.	M.E. Industrial Automation and Robotics	68
5.	M.E. Industrial Safety Engineering	68
6.	M.E. Power Electronics and Drives	68
7.	M.E. Software Engineering	68
8.	M.E. Structural Engineering	68
9.	M.Tech. Biotechnology	68

5. COURSE ENROLLMENT AND REGISTRATION

5.1 Each student, on admission, shall be assigned to a Faculty Advisor (vide Clause 7) who shall advise/counsel the student about the details of the academic programme and the choice of courses considering the student's academic background and career objectives.

5.2 Every student shall enrol for the courses of the succeeding semester in the current semester. However, the student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of the semester concerned.

5.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

5.3.1 Each student on admission to the programme shall register for all the **courses prescribed in the curriculum** in the **first semester of study**.

5.3.2 The enrolment for all the courses of semester II will commence 10 working days prior to the last working day of the semester I. The student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of semester II.

5.3.3 If a student wishes, the student may drop or add courses (vide Clause 5.5)

within **five** working days after the commencement of the semester concerned and complete the registration process duly authorised by the PG coordinator of the programme. In this case, if a student fails in a course, he/she may be permitted to register for the course in the subsequent semester or when it is offered.

5.3.4 A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enrol to improve the student's marks in a course or the aggregate marks / CGPA.

5.4 Minimum Credits to Register for Project work

The Project work for M.E./M.Tech. consists of dissertation phase I and dissertation phase II. Dissertation phase I is to be undertaken during the III semester, and dissertation phase II, which is a continuation of phase I, is to be undertaken during the IV semester. Minimum 24 credits are required to be earned to enrol on dissertation phase I.

If a student fails to earn the requisite minimum credits, the student cannot enrol for dissertation phase I. In such a case, the student can enrol for the project work in a subsequent semester after earning the minimum credits specified.

5.5 Flexibility to Add or Drop courses

5.5.1 A student has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum of the student's programme by opting for additional courses.

5.5.2 From the II to final semesters, the student has the option to register for additional courses or drop existing courses. The total number of credits that a student can add or drop is limited to 6, subject to a maximum of 2 courses. In such cases, the attendance requirement as stated in Clause 6 is mandatory.

The courses that a student registers in a particular semester may include:

i. Courses of the current semester and

ii. Courses dropped in the lower semesters.

The maximum number of credits that can be registered in a semester is 36. However, this does not include the number of Re-appearance (RA) and Withdrawal (W) courses registered by the student for the appearance of Examination.

5.6 Reappearance Registration

5.6.1 If a student fails in a theory course, the student shall do reappearance registration for that course in the subsequent semester or when it is offered next.

5.6.2 On registration, a student may attend the classes for the reappearance registration courses if the student wishes. However, the attendance requirement (vide Clause 6) is not compulsory for such courses.

5.6.3 The student who fails in any practical/mini project or any other EEC courses shall register for the same in the subsequent semester or when offered next and **repeat** the course. In this case, the student shall attend the classes, satisfy the attendance requirements (vide Clause 6) and earn continuous assessment marks.

5.6.4 The student who fails in dissertation phase I / II shall register for the same in the subsequent semester or when offered next and **repeat** the course. In this case, the student shall attend the classes, satisfy the attendance requirements (vide Clause 6), earn continuous assessment marks and appear for the end semester examinations. Reappearance registration is not available for such courses.

5.6.5 If a student is prevented from writing the end semester examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfil the attendance requirements as per Clause 6.

6. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide clause 6.1 and 6.2) shall be deemed to have satisfied the attendance requirements for appearing for the End Semester Examination of a particular course.

Each semester shall normally consist of 75 working days or 540 periods of each 50 minutes duration for the full-time mode of study.

6.1 Ideally, every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

6.2 If a student secures attendance between 70% and 79% in any course in the current semester due to medical reasons (prolonged hospitalisation/accident / specific illness) or participation in Institution/University/State/National/International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate/participation certificate attested by the Head of the Department. Such certificates shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations.

63 A student shall normally be permitted to appear for the end semester examination of a course if the student has satisfied the attendance requirements (vide Clause 6.1-6.2) and has registered for the examination in those courses of that semester by paying the prescribed fee.

64 A student who does not satisfy clauses 6.1 and 6.2 and secures less than 70% attendance in a course will not be permitted to write the end semester examination. The student has to register and repeat this course in the subsequent semester or when it is offered next (vide clause 5.6.4).

65 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course to improve grades/marks.

7. FACULTY ADVISOR

To help students plan their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a teacher of the department, who shall function as a faculty advisor for those students throughout their period of study. The faculty advisor shall advise the students in registration and reappearance (Arrear) registration of courses, authorise the process, monitor their attendance and progress and counsel them periodically. If necessary, the faculty advisor may also discuss with or inform the parents about the progress/performance of the students concerned.

The responsibilities of the faculty advisor shall be:

i. To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.

ii. To guide student enrolment and registration of the courses

iii. To authorise the final registration of the courses at the beginning of each semester.

iv. To monitor the academic and general performance of the students, including attendance, and to counsel them accordingly.

v. To collect and maintain the academic and co-curricular records of the students

8. COMMITTEES

8.1 Class Committee Meeting

i. For all the courses taught, prescribed in the curriculum, a class committee meeting shall be convened twice a semester, comprising faculty members handling all the courses and two student representatives from the class.

ii. One of the faculty members (not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of

this Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

9. ASSESSMENT AND PASSING REQUIREMENTS

9.1 Assessment

The assessment will comprise continuous assessment and end semester examination, carrying marks as specified in the scheme (Clause 15). All assessments will be done on absolute marks basis. However, to report the performance of a student, letter grades and grade points will be awarded as per Clause 9.4.

9.2 End Semester Examinations

End semester examinations will normally be conducted as per the timetable circulated by the CoE's Office. A student will be permitted to appear for the end semester examination of a semester only if he/she completes the study of that semester satisfying the requirements given in Clause 5 and 6, and registers simultaneously for the examinations of the highest semester eligible and the courses, pertaining to that semester, that needs reappearance.

9.3 Employability Enhancement Courses

Every candidate shall submit reports on industrial training / mini-project, dissertation phase I and dissertation phase II on dates announced by the institute/department through the faculty guide to the head of the department. If a candidate fails to submit the reports of any of these courses not later than the specified date, he/she is deemed to have failed in it. The reports /papers shall be orally presented by the student before a team of experts consisting of an internal examiner, usually the supervisor, and an external examiner, appointed by the Controller of the Examination.

A candidate is permitted to register for dissertation phase II only after passing dissertation phase I. A candidate who fails in industrial training / mini-project, dissertation phase I or dissertation phase II shall register for redoing the same at the beginning of a subsequent semester.

9.4 Letter Grade and Grade Point

The letter grade and the grade point are awarded based on the percentage of total marks secured by a candidate in an individual course as detailed below:

Letter Grade	**Grade Points**
O (Outstanding)	10
A + (Excellent)	9
A (Very Good)	8
B + (Good)	7
B (Above average)	6
C (Satisfactory)	5
RA (Reappearance Registration)	0
I (Incomplete)	0
W (Withdrawal)	0
AB (Absent)	0
SA(Shortage of Attendance)	0

'RA' - Reappearance registration is required for that particular course

'I' - Continuous evaluation is required for that particular course in the subsequent examinations.

After completion of the evaluation process, S e m e s t e r Grade Point Average (SGPA) and Cumulative Grade Point Average is calculated using the formula:

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

where

C_i Credit allotted to the course.

g_i Grade Point secured corresponding to the course.

n number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

9.5 A student can apply for revaluation of his/her semester examination answer paper in a theory course, within 3 working days from the declaration of results, along with prescribed application to the Controller of Examinations through the Head of Department. Revaluation is not permitted for laboratory courses, industrial training, and project works.

9.6 Passing a Course

A candidate who secures Grade Point 6 or more in any course of study will be declared to have passed that course, provided he/she secures a minimum of 50% of the total mark in the end semester examination of that course.

If a student fails to secure a pass in theory courses and laboratory courses in the current semester examination, he/she is allowed to write arrear examinations for the next three consecutive semesters, and their internal marks shall be carried over for the above mentioned period of three consecutive semesters.

In case if he/she has not completed all the courses of the semester I at the end of semester IV, he/she shall redo the semester I courses along with regular students. The same procedure shall be followed for the subsequent semesters of II, II I and IV, subject to the maximum permissible period for this programme.

9.7 If a candidate fails in the end semester examinations of Phase I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the end semester examination of Phase II of M.E. / M.Tech., he/she shall resubmit the project report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva voce examination will be considered as reappearance with payment of the exam fee. If a student fails to resubmit the project report within the stipulated period and fails in the subsequent viva-voce examination, the student shall register for the course again in the subsequent semester.

10. REJOINING THE PROGRAMME

A candidate who has not completed the study of any of the semesters as per Clause 6 or who is allowed to rejoin the programme after the period of discontinuance or who on his/her own request is permitted to repeat the study of any semester (break of study), may join the semester which he/she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of candidates and after obtaining the approval from the Director of Technical Education and Anna University, Chennai. In such a case, earlier continuous assessment in the repeated courses will be disregarded. However, no candidate will be allowed to enrol in more than one semester at any point of time.

11. QUALIFYING FOR THE AWARD OF THE DEGREE

A candidate will be declared to have qualified for the award of the M.E. / M.Tech. Degree provided:

i. He/she has completed the course requirements and has passed all the prescribed courses of study of the respective programme listed in Clause 3 within the duration specified in Clause 2.

ii. No disciplinary action is pending against the candidate.

12. CLASSIFICATION OF THE DEGREE AWARDED

12.1 First Class with Distinction:

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within two years (Three years in case of authorised break of study of one year (if availed)). Withdrawal from examination (vide Clause 13) will not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50.
- Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses.

12.2 First Class:

A student who satisfies the following conditions shall be declared to have passed the examination in first-class:

- Should have passed the examination in all the courses of all four semesters within three years, including one year of authorised break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of not less than 6.50

12.3 Second Class:

All other students (not covered in clauses 12.1 and 12.2) who qualify for the award of the degree shall be declared to have passed the examination in the second class.

12.4 A student who is absent in the End Semester Examination in a course/project work after having registered for the same shall be considered to have appeared in that examination (except approved withdrawal from end semester examinations as per clause 13) for the purpose of classification.

13. WITHDRAWAL FROM EXAMINATION

13.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

13.2 Withdrawal application shall be valid only if the student is eligible to write the examination as per Clause 6 and if such withdrawal request is made prior to the submission of marks of the continuous assessment of the course(s) with the recommendations from the Head of the Department.

13.3 If a student withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examination(s)

13.4 Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for first class with distinction or first class.

13.5 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 3 years for M.E. / M.Tech. as per clauses 12.1 and 12.2.

14. AUTHORISED BREAK OF STUDY FROM A PROGRAMME

14.1 A student is permitted to go on a break of study for a fixed period of one year as a single break in the entire course of study.

14.2 A student who would like to avail the break of study, on account of short term employment / medical treatment / personal reasons) shall apply to the Head of the Institution through the concerned Head of the Department (application available with the Controller of Examinations), in any case, not later than the last date for registering for the semester.

14.3 The students permitted to re-join the programme after a break of study/prevention

due to lack of attendance shall be governed by the curriculum and regulations in force at the time of re-joining. A committee constituted by the Head of the Institution shall prescribe additional/equivalent courses, if any, from the regulation in force to bridge the requirement between the curriculum in force and the old curriculum.

14.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 2, irrespective of the period of break of study in order that he/ she may be eligible, for the award of the degree (vide Clause 11 and 12).

14.5 In case of any valid reasons for the extension of break-of-study, such extended break-of-study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorised break of study. Such extended break-of-study shall be counted for the purpose of classification of degree (vide clause 12).

14.6 If a student does not report back to the institute, even after the extended break of study, the name of the student shall be deleted permanently from the college enrolment. Such candidates are not entitled to seek readmission under any circumstances.

15. SCHEME OF ASSESSMENT

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (15)	
	Periodical Test II (15)	
	Term Paper Report (10) & Presentation (10)	
	End Semester Examination	**50**
	Total Marks	**100**
II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (15)	
	Periodical Test II (15)	
	Lab Examination (10)	
	Viva-voce (10)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**
III	**PRACTICAL COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (10)	
	ii. Experiment and Analysis of Results (20)	
	iii. Record (5)	
	Self-Learning Experiment (15)	
	Test - Cycle I (15)	
	Test - Cycle II (15)	
	Final Viva-voce (20)	
	Total Marks	**100**
IV	**DISSERTATION PHASE I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Identification of topic and Justification (5)	
	Literature Survey (5)	
	Review II	
	Work plan & Approach (10)	
	Progress, Results and Discussion (10)	
	Review III	
	Conclusion (10)	
	Implementation & Applications (10)	

	End Semester Examination	
	Presentation (20)	**50**
	Report (10)	
	Viva Voce (20)	
	Total Marks	**100**

V	**DISSERTATION PHASE II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Work plan & Approach (10)	
	Review II	
	Progress (10)	
	Results and Discussion (10)	
	Review II	
	Conclusion (10)	
	Implementation & Applications *(10)*	
	End Semester Examination	
	Presentation (20)	**50**
	Report (10)	
	Viva Voce (20)	
	Total Marks	**100**

VI	**MINI PROJECT**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Review I	**25**
	Review II	**25**
	Presentation & Viva voce	**50**
	Total Marks	**100**

VII	**INDUSTRIAL TRAINING / INTERNSHIP**	**Marks**
	Continuous Assessment	**100**
	Presentation	**30**
	Viva-voce	**30**
	Case study / Report	**40**
	Total Marks	**100**

VIII	**VALUE ADDED COURSES / CERTIFICATE COURSES (Continuous Assessment Only)**	**Marks**
	Test I	50
	Test II	50
	Grades: Excellent (>80) / Good (61≤Marks ≤ 80) / Satisfactory (50≤Marks ≤ 60))	

Optional Test: *A student becomes eligible to appear for the one optional test conducted after the Periodical Test II, only under the following circumstances, if absent for Test I or Test II or both, on account of (i) medical reasons (hospitalisation / accident / specific illness) (ii) participation in the college/university/state / national/international level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned faculty member who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII and VIII listed above.*

16. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the end semester / continuous assessments, he/she shall be liable for punitive action as prescribed by the institution / university from time to time.

M.E. – INDUSTRIAL SAFETY ENGINEERING

Vision of the Department

Seek excellence in the field of Mechanical Engineering education through knowledge and skills to cater to the requirements of the society.

Mission of the Department

I. To continuously improving the teaching and learning process to enable students to meet the global needs.

II. To upgrading the knowledge and skills of students, members of faculty and supporting staff through regular training.

III. To produce the best minds of engineers capable of meeting expectations of Industry, Society and Entrepreneurship development.

M.E. – INDUSTRIAL SAFETY ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. Attain mastery in the knowledge of industrial safety engineering and safety management skills to reach higher professional levels.

II. Become a competent safety engineer rendering professional expertise to industrial and societal needs at national and global levels, subject to legal requirements.

III. Effectively communicate information on health, safety and environment, facilitating collaboration with experts across various disciplines to create and execute safe methodologies in complex engineering activities.

PROGRAMME OUTCOMES (POs)

The Graduate will be able to

a. Apply knowledge of engineering specialization for hazard identification and risk assessment, analyze the cause of an incident, and control occupational health safety and environmental problems.

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.

c. Conduct investigation, analyze the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.

e. Recognize and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.

f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

MAPPING OF PEOs AND POs

PEO(s)	PROGRAMME OUTCOME(s)					
	(a)	(b)	(c)	(d)	(e)	(f)
I	X	X				X
II		X		X	X	X
III				X	X	X

M.E. INDUSTRIAL SAFETY ENGINEERING
Minimum Credits to be Earned 68.0

First Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
21IS11	Research Methodology and IPR	I	a,c	2	0	0	2
21IS12	Safety Management	II,III	b,d,f	3	0	0	3
21IS13	Occupational Health and Hygiene	II, III	b,d,e,f	3	0	0	3
21IS14	Regulation for Health, Safety and Environment	I,II,III	b,c,d,f	4	0	0	4
	Elective I		-	-	-	-	3
21IS16	Environmental Analysis Laboratory	I	a,c	0	0	4	2
21IS17	Industrial Hygiene and Ergonomics Laboratory	I	a,c	0	0	4	2
	Audit course I	-	-	-	-	-	0
			Total	12	0	8	19

Second Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
21IS21	Safety in Engineering Industry	I,II,III	a,b,c,d,f	3	0	0	3
21IS22	Fire Engineering and Explosion Control	II,III	b,d,f	3	0	0	3
21IS23	Electrical Safety	II,III	b,d,e,f	3	0	0	3
	Elective II	-	-	-	-	-	3
	Elective III	-	-	-	-	-	3
21IS26	Industrial Fire and Electrical Safety Laboratory	I	a,c	0	0	4	2
21IS27	Mini Project	I,II,III	a,b,c,d,e,f	0	0	4	2
	Audit Course II	-	-	-	-	-	0
			Total	9	0	8	19

Third Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
	Elective IV	-	-	-	-	-	3
	Elective V	-	-	-	-	-	3
21IS33	Dissertation Phase I	I,II,III	a,b,c,d,e,f	0	0	20	10
			Total	0	0	20	16

Fourth Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
21IS41	Dissertation Phase II	I,II,III	a,b,c,d,e,f	0	0	28	14
			Total	0	0	28	14

1 Audit Course is optional

LIST OF CORE ELECTIVES							
Code No.	Course	Objectives &		L	T	P	C
		PEOs	POs				
21IS51	Plant Layout and Material Handling	I,II,III	a,b,c,d,f	3	0	0	3
21IS52	Applied Probabilities and Statistics	I	a c	3	0	0	3
21IS53	Nuclear Engineering and Safety	I	a,c	3	0	0	3
21IS54	Industrial Noise and Vibration Control	I	a,c	3	0	0	3
21IS55	Safety in Chemical Industries	I,II,III	a,b,c,d,f	3	0	0	3
21IS56	Environmental Pollution Control	I,II,III	a,c,d,e,f	3	0	0	3
21IS57	Safety in Powder Handling	II,III	b,d,f	3	0	0	3
21IS58	Environmental Impact Assessment	I,II,III	b,c,e,f	3	0	0	3
21IS59	Safety in Petrochemical Industries	I	b,f	3	0	0	3
21IS60	Transport Safety	I,I	b,c,d,f	3	0	0	3
21IS61	Safety in On-Shore and Off- Shore Drilling	I	b,c,d,f	3	0	0	3
21IS62	Safety in Mines	II,III	a,b,c,e,f	3	0	0	3
21IS63	Work Study and Ergonomics	I	a, c	3	0	0	3
21IS64	Maintenance Engineering	I	b,d,f	3	0	0	3
21IS65	Risk Analysis	I,II,III	b,c,d,f	3	0	0	3
21IS66	Safety in Wastewater Management	II	b,d,f	3	0	0	3
21IS67	Safety in Construction	I,III	a,c,d,f	3	0	0	3
21IS68	Reliability Engineering	I	a,c	3	0	0	3
21IS69	Management System Standards	II,III	b,d,f	3	0	0	3
21IS70	Safety in Textile Industry	I,II	a,c,d,e,f	3	0	0	3

LIST OF AUDIT COURSES							
Code	Course	PEOs	POs	L	T	P	C
21XE01	English For Research Paper Writing	II, III	b,d	2	0	0	0
21XE02	Cost Management of Engineering Projects	I,II	b,c,	2	0	0	0
21XE03	Stress Management	III	c,e,	2	0	0	0
21XE04	Disaster Management	II,III	c,e,	2	0	0	0
21XE05	Value Education	III	d,e,	2	0	0	0
21XE06	Pedagogy Studies	III	a,b,d,e	2	0	0	0
21XE07	Business Analytics	I,II,III	d,e,f	2	0	0	0

2 0 0 2

21IS11 RESEARCH METHODOLOGY AND IPR

Course Objectives

- To introduce the basics of research methodology.
- To know the sampling methods used in research methodology.
- To study the method of hypothesis testing.
- To learn the procedures for carrying out design of experiments.
- To educate on optimization and report writing.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Analyze the research problem formulation.
2. Analyze research related information
3. Apply the IPR in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property
4. Right to be promoted among students in general & engineering in particular.
5. Analyze 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.

UNIT I **6 Hours**

MEANING OF RESEARCH PROBLEM

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.

UNIT II **6 Hours**

EFFECTIVE LITERATURE

Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT III **6 Hours**

EFFECTIVE TECHNICAL WRITING

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

UNIT IV **6 Hours**

NATURE OF INTELLECTUAL PROPERTY

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 grants of patents, Patenting under PCT.

UNIT V **6 Hours**

PATENT RIGHTS

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

Total: 30 Hours

Reference(s)

1. Stuart Melville and Wayne Goddard, Research methodology: an introduction for science & engineering students,1996.
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. Asimov, Introduction to Design, Prentice Hall, 1962.

21IS12 SAFETY MANAGEMENT 3 0 0 3

Course Objectives

- To introduce the evaluation of safety concepts.
- To impart hazardous identification techniques.
- To understand the procedure for accident investigation.
- To study the methods of safety performance monitoring.
- To impart knowledge on safety education and training.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Derive the concepts of Safety management relevant to the industry and the society.
2. Implement the techniques resolving the safety problems related to industries.
3. Execute the accident investigation to find out the root cause to prevent the re occurrence of accidents.
4. Determine the accident indices to indicate the safety performance of an industry.
5. Demonstrate organizing and handling safety training classes to different level of employees.

UNIT I **9 Hours**

INTRODUCTION

Evolution of modern safety concept- Safety policy-Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNIT II **9 Hours**

TECHNIQUES

Incident Recall Technique(IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III **9 Hours**

ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition - principles of accident prevention - Heinrich theory, Supervisory role- Role of safety committee - Accident causation models - Cost of accident. Overall accident investigation process -Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports -Class exercise with case study.

UNIT IV **9 Hours**

SAFETY PERFORMANCE MONITORING

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.

UNIT V **9 Hours**

SAFETY EDUCATION AND TRAINING

Importance of training-identification of training needs -Training methods - programme, seminars, conferences, competitions - method of promoting safe practice- motivation - communication - role of government and private consulting agencies in safety training creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign - Home safety training - 5S concepts.

Total: 45 Hours

Reference(s)

1. Chales D. Reese (2017) Occupational Health and Safety management.
2. Frank Lees (2012) Lees Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
3. Philip Hagan, Accident Prevention Manual for Business and Industry, N.S.C.Chicago, 13th Edition, 2009
4. V. Subramanian, The Factories Act 1948 with Tamilnadu factories rules 1950, Madras Book Agency,Chennai, 2000.
5. C.Ray Asfahl, Industrial Safety and Health management, Pearson Prentice Hall,2003.
6. National Safety Council, Accident Prevention Manual for Industrial Operations, N. S. C. Chicago, 1988.

21IS13 OCCUPATIONAL HEALTH AND HYGIENE 3 0 0 3

Course Objectives

- To provide knowledge on physical hazards of an industrial unit.
- To provide knowledge on chemical hazards of an industrial unit.
- To expose the biological and ergonomic hazards present in an industrial unit.
- To impart knowledge on occupational health and toxicology.
- To introduce the topic of occupational physiology.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Identify the physical hazards present in the occupation of an industrial unit.
2. State the chemical hazards present in the occupation an industrial unit.
3. Indicate the biological and ergonomic hazards present in an industrial unit.
4. Find out the toxic effects on heath while handling different chemicals.
5. Use the elements of occupational physiology of an industrial unit

UNIT I **10 Hours**

PHYSICAL HAZARDS

Noise, compensation aspects, noise exposure regulation 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, TLV- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.

UNIT II **10 Hours**

CHEMICAL HAZARDS

Recognition of chemical hazards- types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS 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.

UNIT III **9 Hours**

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.

UNIT IV **9 Hours**

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, notifiable occupational diseases such as Silicosis, Asbestosis, Pneumoconiosis, Siderosis, Anthracosis, Aluminosis and Anthrax, Lead-nickel, Chromium and Manganese toxicity, Gas poisoning 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.

UNIT V **7 Hours**

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 - shift work - personal hygiene.

Total: 45 Hours

Reference(s)

1. Louis J. Di Berardinis, Handbook of occupational safety and health, Wiley, 1999
2. Danuta Koradecka, Handbook of Occupational Health and Safety, CRC, 2010.
3. Lawrence Slote , Handbook of occupational safety and health, Wiley, 2001.
4. John W. Cherrie, Reducing occupational exposure to chemical carcinogens, Oxford journal of occupational medicine (2009).
5. Barbara A.Plog, Patricia J.Quinlan, MPH, CIH and Jennifer Villareal Fundamentals of Industrial Hygiene, 6th edition 2012, National Safety Council, 2012.
6. Encyclopaedia of Occupational Health and Safety, Vol.I and II, International Labour Office, Geneva, 2011.

21IS14 REGULATION FOR HEALTH, SAFETY AND ENVIRONMENT

4 0 0 4

Course Objectives

- To introduce the statutory provisions of The Factory Act and Rules.
- To familiarize Tamil Nadu Factories Rules.
- To introduce Environment Act.
- To highlight the important provisions in Air Act.
- To study the provisions of Water Act.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Find the relevant references in The Factory Act, related to the industry involved.
2. Implement the provisions of Environment Act of an industrial unit.
3. Implement the provisions of Hazardous Chemical Rules applicable to an industrial unit.
4. Predict the provisions of Boiler Act, SMPV Rules, Petroleum Act and Gas Cylinder Rules.
5. Classify the provisions of Occupational Safety and Health act of USA and Health and safety work act (HASAWA 1974, UK)

UNIT I **12 Hours**

OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE

Statutory authorities - inspecting staff, health, safety, provisions relating to hazardous processes, welfare - special provisions - penalties and procedures- Tamilnadu Factories Code under Safety and health chapters of OSHWC Code, Tamilnadu safety officer rules 2005.

UNIT II **12 Hours**

ENVIRONMENT ACT - 1986

General Powers of the central government, prevention, control and abatement of environmental Pollution-Biomedical waste(Management and handling Rules), 1989-The noise pollution(Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974.

UNIT III **12 Hours**

MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989

Definitions- duties of authorities - responsibilities of occupier - notification of major accidents - information to be furnished -preparation of offsite and onsite plans - list of hazardous and toxic chemicals - safety reports - safety data sheets.

UNIT IV **12 Hours**

OTHER ACTS AND RULES

Indian Boiler Act 2007, Static and mobile pressure vessel rules (SMPV), Motor vehicle rules, The Mines and Minerals (Development and Regulation) Act, 2010, Employees compensation code, rules - Electricity act and rules - Hazardous wastes (management and handling) rules, 1989, with amendments in 2000 - The building and other construction workers act 1996, Petroleum rules, Gas cylinder rules-Explosives Act 1983-Pesticides Act - Tamilnadu lifts act 1997, .Boiler operating Engineers - rules -2011

UNIT V **12 Hours**

INTERNATIONAL ACTS AND STANDARDS

Occupational Safety and Health act of USA - Health and safety work act (HASAWA 1974, UK), OSHAS 21000, ISO 45000, ISO 14000 - benefits and elements.

Total: 60 Hours

Reference(s)

1. Bakshi P M , The Constitution of India , Lexis Nexis, 17th Edition ,2020
2. Srinivasan S,The Factories Act 1948 with Tamil Nadu Factories Rules 1950 Madras Book Agency, Chennai, 28th Edition, 2017.
3. The Factories Act 1948 with Tamilnadu factories rules 1950, Madras Book Agency,21st ed., Chennai, 2000.
4. The Environment Act(Protection) 1986 with allied rules, Law Publishers (India) Pvt Ltd., Allahabad,2014
5. Water(Prevention and control of pollution) act 1974, Law publishers (India) Pvt. Ltd., Allahabad,2016
6. Air (Prevention and control of pollution) act 1981, Law Publishers (India) Pvt. Ltd., Allahabad,2021

21IS16 ENVIRONMENTAL ANALYSIS LABORATORY 0 0 4 2

Course Objectives

- To provide basic knowledge on the various methods of analysis of water and wastewater
- To emphasize the students to know how to carryout different experiments related to safety.
- To introduce determination of chemicals.
- To highlight the important in estimation of BOD, COD.
- To provide basic knowledge on the various methods of exhaust gas, particulate matter measurement.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Demonstrate the various characteristics of water and wastewater sample
2. Analyze a given water sample to find out the properties.
3. Determine the properties of chemicals used in an industrial unit.
4. Compute the estimation of BOD, COD for the samples taken from the unit.
5. Apply the measurement of dust and fumes available in the working environment.

1 **5 Hours**

EXPERIMENT 1
Estimation of Hardness

2 **5 Hours**

EXPERIMENT 2
Determination of pH for a given sample

3 **5 Hours**

EXPERIMENT 3
Estimation of Alkalinity in Waste water

4 **5 Hours**

EXPERIMENT 4
Determination of chlorides

5 **5 Hours**

EXPERIMENT 5
Determination of Total solids, Suspended solids and Dissolved solids

6 **5 Hours**

EXPERIMENT 6
Estimation of Sulphates in the given sample

7 **5 Hours**

EXPERIMENT 7
Determination of Iron

8 **5 Hours**

EXPERIMENT 8
Estimation of Dissolved oxygen

9 **5 Hours**

EXPERIMENT 9
Determination of bio chemical oxygen demand in the given sample (titration method)

10 **5 Hours**

EXPERIMENT 10
Indian standards of drinking water- A Study

11 **5 Hours**

EXPERIMENT 11
Exhaust Gas analysis using ORSAT Apparatus

12
EXPERIMENT 12
Analysis of flue gas using portable Flue Gas Analyzer **5 Hours**

Total: 60 Hours

21IS17 INDUSTRIAL HYGIENE AND ERGONOMICS LABORATORY

0 0 4 2

Course Objectives

- To provide knowledge in measurement of dust and fumes.
- To emphasize the students to know how to carryout heat stress index, relative humidity measurement
- To provide knowledge on illumination and sound pressure level measurement
- To carry out ergonomic assessment using RULA and REBA
- To provide basic knowledge on various methods of vibration measurement.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Analyze the various characteristics of exposure measurement to dust fumes and gaseous pollutants
2. Analyze heat stress index, moisture, temperature for a given working condition
3. Analyze luminance level, emissivity measurement
4. Analyze sound level measurement of an industrial unit
5. Analyze Ergonomic impacts of working population in an industrial unit

1 **5 Hours**

EXPERIMENT 1

Personal Exposure measurement to Dust and Fumes using Personal Air Sampler

2 **5 Hours**

EXPERIMENT 2

Measurement of Particulate and Gaseous Pollutants in the ambient air using High Volume Sampler

3 **5 Hours**

EXPERIMENT 3

Measurement of Heat stress index using WBGT instrument

4 **5 Hours**

EXPERIMENT 4

Measurement of moisture and temperature using Relative Humidity Meter

5 **5 Hours**

EXPERIMENT 5

Measurement and monitoring of Temperature using Infrared Thermometer and Thermal imaging camera

6 **5 Hours**

EXPERIMENT 6
Emissivity measurement

7 **5 Hours**

EXPERIMENT 7
Measurement of luminance of light using lux meter

8 **5 Hours**

EXPERIMENT 8
Sound Pressure level measurement

9 **5 Hours**

EXPERIMENT 9
Assessment of Ergonomic impact using RULA

10 **5 Hours**

EXPERIMENT 10
Assessment of Ergonomic impact using REBA

11 **5 Hours**

EXPERIMENT 11
Air Conditioning Test

12 **5 Hours**

EXPERIMENT 12
Vibration measurement

Total: 60 Hours

21IS21 SAFETY IN ENGINEERING INDUSTRY 3 0 0 3

Course Objectives

- To provide knowledge on safe operation of metal and wood working machineries.
- To introduce the principles of machine guarding
- To learn the safety methods in welding and gas cutting.
- To provide knowledge safety in cold and hot working of metals.
- To study safe methods in finishing, inspection and testing.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Identify the safe operation of metal and wood working machineries.
2. Demonstrate the principles of machine guarding for relevant machines.
3. Apply the safe methods in welding and gas cutting to prevent the hazards.
4. Elaborate the safe methods of cold and hot working of metals to minimize injury.
5. Apply the safe methods in finishing, inspection and testing to prevent accidents.

UNIT I **9 Hours**

SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES

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

UNIT II **9 Hours**

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. benefits of good guarding systems flywheels-shafts- couplings- gears-sprockets wheels and chains-pulleys and belts-Lifting tackles.

UNIT III **9 Hours**

SAFETY IN WELDING AND GAS CUTTING

Gas welding and oxygen cutting, resistances 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-color coding - flashback arrestor - leak detection - pipe line safety-storage and handling of gas cylinders.

UNIT IV **9 Hours**

SAFETY IN COLD FORMING AND HOT WORKING OF METALS

Cold working, power presses, point of operation safeguarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes - Hot-working safety in forging, hot rolling mill operation, safeguards 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, Foundry Production Cleaning and Finishing Foundry Processes. Mechanical Material Handling, material handling equipments,

UNIT V **9 Hours**

SAFETY IN FINISHING, INSPECTION AND TESTING

Heat treatment operations, Electro Plating, 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.

Total: 45 Hours

Reference(s)

1. Philip E. Hagan, John Franklin Montgomery, James T. O"Reilly, Accident Prevention Manual NSC, Chicago, 2009.
2. Charles D. Reese, Occupational Health and Safety Management, CRC Press, 2003.
3. John V. Grimaldi and Rollin H. Simonds Safety Management by All India Travelers Book seller, New Delhi, 1989.
4. John Davies, Alastair Ross, Brendan Wallace, Safety Management: A Qualitative Systems Approach, CRC Press, 2003.
5. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London,2002
6. Anil Mital Advances in Industrial Ergonomics and Safety Taylor and Francis Ltd, London, 1989

21IS22 FIRE ENGINEERING AND EXPLOSION CONTROL

3 0 0 3

Course Objectives

- To introduce the topic of physics and chemistry of fire.
- To impart knowledge on fire prevention and protection.
- To study the industrial fire protection system.
- To develop knowledge on building fire safety.
- To provide knowledge on explosion protection systems.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Introduce the topic of physics and chemistry of fire for relevant to the industry.
2. Impart knowledge on fire prevention and protection of an industrial unit.
3. Study the industrial fire protection system for implementation.
4. Develop knowledge on building fire safety for better practice.
5. Provide knowledge on explosion protection systems of an industrial unit.

UNIT I **9 Hours**

PHYSICS AND CHEMISTRY OF FIRE

Fire properties of solid, liquid and gases - fire spread - toxicity of products of combustion - theory of combustion and explosion - vapour clouds - flash fire - jet fires - pool fires - unconfined vapour cloud explosion, shock waves - auto-ignition - boiling liquid expanding vapour explosion - case studies - Flixborough, Mexico disaster, Pasedena Texas, Piper Alpha, Bombay Victoria dock ship explosions, Mahul refinery explosion, Nagothane vapour cloud explosion and Vizag refinery disaster.

UNIT II **9 Hours**

FIRE PREVENTION AND PROTECTION

Sources of ignition - fire triangle-IS 2190 - principles of fire extinguishing - active and passive fire protection systems - various classes of fires Fire extinguishing agents Water, Foam, Dry chemical powder, Carbon-dioxide- Halon alternatives Halocarbon compounds Inert gases, dry powders - types of fire extinguishers - fire stoppers -hydrant pipes hoses monitors fire watchers - layout of stand pipes - fire station fire alarms and sirens maintenance of fire trucks foam generators escape from fire rescue operations - fire drills notice-first aid for burns.

UNIT III **9 Hours**

INDUSTRIAL FIRE PROTECTION SYSTEMS

Sprinkler –hydrants -stand pipes - special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards - alarm and detection systems. Other suppression systems -CO2 system, foam system, Dry chemical powder (DCP) system, halon system - need for halon replacement - smoke venting. Portable extinguishers - flammable liquids - tank farms - indices of inflammability-firefighting systems.IS-15105 (guidelines for installation of sprinklers)

UNIT IV **9 Hours**

BUILDING FIRE SAFETY

Objectives of fire safe building design, Fire load, fire resistant material and fire testing -structural fire protection - structural integrity -concept of egress design - exit - width calculations - fire certificates - fire safety requirements for high rise buildings - Snookers-Tamil Nadu fire and rescue services act-1985

UNIT V **9 Hours**

EXPLOSION PROTECTING SYSTEMS

Principles of explosion-detonation and blast waves-explosion parameters - Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO2) and halons - hazards in LPG, ammonia (NH3), Sulphur dioxide (SO2), chlorine (Cl) etc. -Installation of fire protection system.

Total: 45 Hours

Reference(s)

1. R.S.Gupta., Hand Book of Fire Technology, Orient Blackswan, 2010
2. Arthur E Cote Fire protection Handbook NFPA 2008.
3. Jain V K, Fire Safety in Buildings, New Age International (P) Limited Publishers,New Delhi, 2nd Edition, 2015.
4. Nolan, Handbook of Fire and protection principles, Elseiver ,2014.
5. Charles J. Baker, Fire Fighter"s Handbook of Hazardous Materials, Van No strand Rein Hold, Jones and Bartlett Learning, New York, 2006.
6. Danial E.Della Giustina, Fire safety management,3rd edition, 2014

21IS23 ELECTRICAL SAFETY 3 0 0 3

Course Objectives

- To introduce the concepts and statutory requirements of electrical safety
- To impart knowledge on electrical hazards.
- To understand electrical protection systems for avoiding accidents.
- To study the selection, installation, operation and maintenance of electrical devices.
- To introduce the classification of electrical hazardous zones.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Indicate the concepts and statutory requirements of electrical safety.
2. Estimate the hazards in handling electrical system to prevent accidents.
3. Derive the importance of electrical protection systems for preventing accidents.
4. Formulate the method of selection, installation, operation and maintenance of electrical devices.
5. Explain the importance of classifying electrical hazardous zones.

UNIT I **9 Hours**

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-cardio pulmonary resuscitation(CPR).

UNIT II **9 Hours**

ELECTRICAL HAZARDS

Primary and secondary hazards - shocks, burns, scalds, falls - human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications excess energy-current surges-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity - definition, sources, hazardous conditions, control, electrical causes of fire and explosion ionization, spark and arc-ignition energy-national electrical safety codes - IS codes - Lightning hazards, lightning arrestor, installation - specifications, earth resistance, earth pit maintenance.

UNIT III **9 Hours**

PROTECTION SYSTEMS

Fuse, circuit breakers and overload relays - protection against over-voltage and under-voltage - safe limits of amperage - voltage - safe distance from lines-capacity and protection of conductor- Joints and connections, overload and short circuit protection - no load protection - earth fault protection. FRLS insulation-insulation and continuity test-system grounding equipment grounding earth leakage circuit breaker (ELCB) - cable wires-maintenance of ground - ground fault circuit interrupter - use of low voltage - electrical guards - Personal protective equipment - safety in handling hand held electrical appliances tools and medical equipment.

UNIT IV **9 Hours**

SELECTION, INSTALLATION, OPERATION AND MAINTENANCE

Role of environment in selection-safety aspects in application - protection and interlock self-diagnostic features and fail safe concept-lock out and work permit system discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints-preventive maintenance.

UNIT V **9 Hours**

HAZARDOUS ZONES

Classification of hazardous zones - intrinsically safe and explosion proof electrical apparatus - increase safe equipment - their selection for different zones-temperature classification - grouping of gases-use of barriers and isolators-equipment certifying agencies.

Total: 45 Hours

Reference(s)

1. John Cadick Mary Capelli-Schellofeffer, Dennis K Neitzel and Al Winfield, Electrical Safety Handbook, Mc Graw Hill Education, 4 th Edition, 2012.
2. Rao S, Saluja H L, Electrical Safety, Fire Safety Engineering and Safety Management, Khanna Publishers, New Delhi, 2009.
3. W. Fordham Cooper, Electrical Safety Engineering, Butterworth and -Heinemann Ltd, London, Third edition, 1998.
4. Dr .Massim A.G .Mitolo, Electrical safety of Low voltage systems, Mc Graw Hill, 2009
5. Accident prevention manual for industrial operations, N.S.C. Chicago, 1982.
6. Indian Electricity Act and Rules Government of India, 2003.

21IS26 INDUSTRIAL FIRE AND ELECTRICAL SAFETY LABORATORY

0 0 4 2

Course Objectives

- To study the selection of Personal protective equipment.
- To study active and passive fire protection system.
- To provide knowledge on of earth resistance and ground resistivity measurement.
- To provide knowledge on first aid firefighting equipment and to apply fire mock drill in industries.
- To apply software for dispersion modeling of dangerous chemicals.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Demonstrate the usage different Personal Protective Equipment (PPE) relevant to the industry.
2. Determine earth resistance and ground resistivity and static electricity hazards within the industries
3. Identify suitable fire extinguisher for firefighting of an industrial unit and demonstrate fire mock drill in industries
4. Demonstrate frictional sensitivity of an energetic material
5. Compute dispersion modelling using software of an industrial unit.

1 **5 Hours**

EXPERIMENT 1
Study of Fire Extinguishers

2 **5 Hours**

EXPERIMENT 2
Study and Demonstration of Fire Mock Drill.

3 **5 Hours**

EXPERIMENT 3
Study on Active and Passive Fire protection system

4 **5 Hours**

EXPERIMENT 4
Study of Personal Protective Equipments

5 **5 Hours**

EXPERIMENT 5

Study on Static Electricity hazards, discharging of the same and use of antistatic materials in vulnerable areas

6 **5 Hours**

EXPERIMENT 6

Determination of frictional sensitivity of an energetic material using Friction tester

7 **5 Hours**

EXPERIMENT 7

Whirling of Shaft-Determination of Critical Speed of Shaft with Concentrated Loads

8 **5 Hours**

EXPERIMENT 8

Measurement of Earth Resistance and Ground Resistivity

9 **5 Hours**

EXPERIMENT 9

Fire and explosion modelling using ALOHA Software

10 **5 Hours**

EXPERIMENT 10

Toxic release dispersion modelling using ALOHA Software

11 **5 Hours**

EXPERIMENT 11

Self-Learning - Safety Audit

12 **5 Hours**

EXPERIMENT 12

Self-Learning - Energy Audit

Total: 60 Hours

21IS27 MINI PROJECT 0 0 4 2

Course Objectives

- To develop skills to identify and convert a real world problem into a technical problem.
- To teach use of new tools and techniques required to carry out the project.
- To teach use of new tools and techniques required to carry out the project.
- To make familiar in developing the proof of concept.
- To provide guidelines to prepare standard project report.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Develop the solutions for the real world problem.
2. Identify the suitable strategies and methodologies to carry out the project.
3. Use of required new tools and techniques to carry out the project
4. Test and validate the developed proof of concept.
5. Prepare a standard project report with demonstration.

Total: 60 Hours

21IS33 DISSERTATION PHASE I **0 0 20 10**

Course Objectives

- To develop skills to identify and convert a real world problem into a technical problem.
- To provide knowledge on methodology of carrying out project in phases.
- To teach use of new tools and techniques required to carry out the project.
- To make familiar in developing the proof of concept.
- To provide guidelines to prepare standard project report.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Develop the solutions for the real world problem.
2. Identify the suitable strategies and methodologies to carry out the project.
3. Use of required new tools and techniques to carry out the project
4. Test and validate the developed proof of concept.
5. Prepare a standard project report with demonstration.

Total: 240 Hours

21IS41 DISSERTATION PHASE II 0 0 28 14

Course Objectives

- To develop skills to identify and convert a real world problem into a technical problem.
- To provide knowledge on methodology of carrying out project in phases.
- To teach use of new tools and techniques required to carry out the project.
- To make familiar in developing the proof of concept.
- To provide guidelines to prepare standard project report.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Develop the solutions for the real world problem
2. Identify the suitable strategies and methodologies to carry out the project.
3. Use of required new tools and techniques to carry out the project
4. Test and validate the developed proof of concept.
5. Prepare a standard project report with demonstration.

Total: 240 Hours

21IS51 PLANT LAYOUT AND MATERIAL HANDLING 3 0 0 3

Course Objectives

- To provide knowledge in Selection of plant locations.
- To enhance knowledge in developing layout for various industries incorporating the safety aspects.
- To develop knowledge on creating and maintaining safe working environment.
- To impart knowledge in Manual Material Handling and Lifting Tackles.
- To educate on Manual Material Handling equipment.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Select plant locations suitable to the process requirements of an industrial unit.
2. Develop layout for various industries incorporating the safety aspects considering the society.
3. Create and maintain safe working environment without any harm to employee and society.
4. Select suitable Manual Material Handling and Lifting Tackles and proper
5. Explain Manual Material Handling equipment and testing requirement.

UNIT I **9 Hours**

PLANT LOCATION

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions Safe location of chemical storages in the form of bullets, spheres, cylinders for LPG, LNG, CNG, acetylene, ammonia, chlorine - explosives and propellants.

UNIT II **9 Hours**

PLANT LAYOUT

Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works.

UNIT III **9 Hours**

WORKING CONDITIONS

Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S.

UNIT IV **9 Hours**

MANUAL MATERIAL HANDLING AND LIFTING TACKLES

Preventing common injuries, lifting by hand, team lifting and carrying - accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows - storage of specific materials - problems with hazardous materials, liquids, solids - storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading - personal protection ergonomic considerations. Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement - slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection.

UNIT V **9 Hours**

MECHANICAL MATERIAL HANDLING

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist - conveyors, precautions, types, applications. Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks - power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks - man lifts, construction, brakes, inspection.

Total: 45 Hours

Reference(s)

1. Encyclopedia of occupational safety and health, ILO Publication, 2009.
2. Accident prevention manual for industrial operations N.S.C., Chicago, 2012.
3. M.P. Alexandrov. Material handling equipment Mir Publishers, Moscow,1981
4. Apple M. James Plant layout and material handling, 3rd edition, John Wiley and sons.1978
5. Spivakosky, Conveyors and related Equipment, Vol.I and II Peace Pub. Moscow, 1985.
6. Industrial ventilation (A manual for recommended practice), American conference of Governmental Industrial Hygiene, USA, 1984.

21IS52 APPLIED PROBABILITIES AND STATISTICS 3 0 0 3

Course Objectives

- Exemplify the different approaches of Probability theory, which will enable them in the decision making in the face of uncertainty.
- Summarize and apply the concepts of Statistics in solving safety engineering problems.
- Understand the concept of joint, marginal and conditional probability distribution.
- Provide knowledge on root causes of the failure events using the concepts of testing of hypothesis.
- Understand the design of experiments can help in optimizing the industrial processes.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Construct probabilistic models for observed phenomena in risk analysis for the safety of industries.
2. Apply the knowledge of probability distributions for designing safety criteria of national and international grounding standards.
3. Demonstrate the concept of joint, marginal and conditional probability distribution involving two random variables for assessing the radioactive waste disposal in industries.
4. Analyze the root causes of the failure events using the concepts of testing of hypothesis.
5. Illustrate how design of experiments can help in optimizing the industrial processes operated under open-loop control systems.

UNIT I **9 Hours**

PROBABILITY

Axioms of probability - Addition and multiplication theorems on probability - Conditional probability - Bayes theorem (problems only) - Random variable: Continuous and discrete random variables - Distribution function - Expectation with properties - Moments, mean, Variance and standard deviation of a random variable.

UNIT II **9 Hours**

STANDARD DISTRIBUTIONS

Discrete distributions: Binomial, Poisson and Geometric - Continuous distributions: Normal, Exponential and Gamma - Simple problems and properties.

UNIT III **9 Hours**

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and Regression: properties and problems - Rank correlation - Multiple and Partial Correlations.

UNIT IV **9 Hours**

TESTING OF HYPOTHESIS

Concepts of sampling - Methods of sampling - Sampling distributions and classifications - Standard Error - Tests of hypothesis: Tests of hypothesis about proportion, mean and their differences - Chi-square distributions: Test of goodness of fit and test of independence of attributes

UNIT V **9 Hours**

DESIGN OF EXPERIMENTS

Basic principles of experimental designs - Analysis of variance: one-way, Two-way classifications - Latin square design - 22 Factorial Design.

Total: 45 Hours

Reference(s)

1. R.A.Johnson, Miller and Freunds: Probability and Statistics for Engineers, Pearson Education, 8th Edition, 2015.
2. Veerarajan T, Probability, Statistics and Random Process, 3rd Edition, Tata Mc-Graw Hill Publications, New Delhi, 2008
3. Arora P N, Arora , Statistics for Management, S. Chand & Company Ltd, 1st Edition, 2003.
4. R.E.Walpole, R.H. Myers, R.S.L.Myers and K.Ye, Probability and Statistics for Engineers and Scientists , Pearsons Education, Delhi , 2003.
5. S. Ross , A first Course in Probability , 8th Edition, Pearson Education , New Jersey, 2010.
6. S.C. Gupta and V.K. Kapoor., Fundamentals of Mathematical Statistics, 5th Edition, Sultan Chand and Sons, India, 2014.

21IS53 NUCLEAR ENGINEERING AND SAFETY 3 0 0 3

Course Objectives

- To know about the radioactive material and its effects
- To know about the reactor, design consideration in controls and operational problems.
- To learn the role of reactors in power generation and the nuclear power plants in India
- To learn the Safety of Nuclear Reactors with case studies.
- To learn about the radiation control.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Demonstrate the radioactive material and its effects on human being.
2. Explain the reactor, design consideration in controls and operational problems.
3. Indicate the role of reactors in power generation and the nuclear power plants in India
4. Explain the Safety of Nuclear Reactors with case studies of an industrial unit.
5. Interpret about the radiation control of an industrial unit.

UNIT I **9 Hours**

INTRODUCTION

Binding energy - fission process - radio activity - 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.

UNIT II **9 Hours**

REACTOR CONTROL

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

UNIT III **9 Hours**

REACTORS

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 its role in power generation in the Indian context conversion and breeding -doubling time-liquid metal coolants-nuclear power plants in India.

UNIT IV **9 Hours**

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.

UNIT V **9 Hours**

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.

Total: 45 Hours

Reference(s)

1. Robert E Masterson, Nuclear Engineering Fundamentals-A Practical Perspective, CRC Press, 1st Edition, 2017.
2. Micheal R Greenberg, Nuclear Waste, Management, Nuclear Power and Energy Choices, Springer, 2013.
3. Sam Mannan, Lees Loss Prevention in Process Industries, Vol1, Vol2, Vol3, Butterworth-Heinemann,, London, 4th Edition 2012.
4. John R Marsh, Introduction to Nuclear Engineering, Prentice Hall, 2001
5. Frank P. Lees Butterworth- Hein-UK, Loss prevention in the process Industries, 2004.
6. R.L Loffness, Nuclear Power Plant Vann strand Publications, 2008.

21IS54 INDUSTRIAL NOISE AND VIBRATION CONTROL

3 0 0 3

Course Objectives

- To introduce the topic of industrial noise and vibration control.
- To provide knowledge on instrumentation and auditory effects of noise.
- To study the source of noise and procedure for carrying out rating.
- To develop knowledge on noise control.
- To learn the methods of noise abatement.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Derive the basics concept of noise and vibration analysis and monitoring.
2. Use the instruments and perceive the noise effects.
3. Identify the source of noise find out standards of rating for reference.
4. Find out the methods of noise control analyze for implement it.
5. Indicate the methods of noise abatement of an industrial unit.

UNIT I **9 Hours**

INTRODUCTION

Basic definitions used in Vibrations and acoustics - Mathematical concepts and degrees of freedom in vibratory systems - Natural frequencies and vibration modes - continuous systems and wave theory concept - wave equation and relation to acoustics - theory of sound propagation and terminology involved - Plane wave and spherical waves - Concepts of free field and diffuse field, near field and far field - frequency analysis and vibration and noise spectrum - Signature analysis and condition monitoring.

UNIT II **9 Hours**

INSTRUMENTATION AND AUDITORY

Sensors used in vibration and measurements - Frequency and spectrum analyzers - Weighting networks - Hearing mechanism - relation between subjective and objective sounds -Auditory effects of noise and audiometric testing - Speech interference levels and its importance.

UNIT III **9 Hours**

SOURCES OF NOISE AND RATINGS

Mechanism of noise generation and propagation in various machinery and machine components, vehicles etc. - Directivity index - Concept of Leq and estimation - Noise ratings and standards for various sources like industrial, construction, traffic, aircraft community etc. - industrial safety and OSHA regulations - Noise legislations and management

UNIT IV **9 Hours**

NOISE CONTROL

Energy transferring and dissipating devices Source: Structure borne and flow excited. Vibration isolation and absorption. Spring and damping materials, Dynamic absorbers, Mufflers and silencers, Path: Close filter and loosely covered enclosures - Acoustic treatment and materials - Transmission loss and absorption coefficient of materials and structures and their estimation - Reverberation time and room constant - Design for minimum noise. Receiver: Measure to control at the receiver end- use of enclosures, ear muffs and other protective devices.

UNIT V **9 Hours**

ABATEMENT OF NOISE

Active noise attenuators and scope for abatement of industrial noise - Methods of control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers-spectrum analysis, Anechoic chamber

Total: 45 Hours

Reference(s)

1. V,Rao. Dukkipati and J.Srinivas, Text book of Mechanical Vibrations, Prentice-Hall of India P Ltd, New Delhi.2004.
2. David A.Bies, Colin Hansen, Carl Howard, Engineering Noise Control - 2017
3. Frank Fahy, David Thompson, Fundamentals of Sound and Vibration-2015
4. John Fenton, Handbook of Automotive body Construction and Design Analysis, Professional Engineering Publishing,
5. R.G White, J.G Walker, Noise and Vibration, John Wiley and sons New York, 2008.
6. Irwing Crandall, Theory of Vibrating Systems and Sound, D. Vannostrand Company, New Jercy, 2006

21IS55 SAFETY IN CHEMICAL INDUSTRIES 3 0 0 3

Course Objectives

- To study the safety in process design and pressure system design.
- To provide knowledge on plant commissioning and inspection procedures.
- To learn the activities involved in plant maintenance, modification and emergency planning.
- To introduce the various methods of storage and safe transportation of hazardous chemicals.
- To infer the operational methods of various industries.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Formulate the steps of process design and pressure system design.
2. Identify the safety features while commissioning and follow inspection procedures.
3. Use the safe methods of plant maintenance and modifications and carryout emergency planning.
4. Identify the methods of storage and safe transportation of hazardous chemicals.
5. Execute the operational methods of various industries.

UNIT I **9 Hours**

SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN

Design process, conceptual design and detail design, assessment, inherently safer design-chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipments, utilities. Pressure system, pressure vessel design, standards and codes-pipe works and valves- heat exchangers- pressure relief devices and design, fire relief, vacuum and thermal relief, disposal- flare and vent systems-failures in pressure system.

UNIT II **9 Hours**

PLANT COMMISSIONING AND INSPECTION

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation. Plant inspection, pressure vessel, pressure piping system, non-destructive testing, pressure testing, leak testing and monitoring-plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

UNIT III **9 Hours**

PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING

Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs-maintenance of protective devices- modification of plant, problems- controls of modifications. Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL.

UNIT IV **9 Hours**

STORAGES AND TRANSPORTATION

General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection-LPG storages, pressure storages, layout, instrumentation, vaporizer, refrigerated storages-LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG Hazards during transportation - pipeline transport.

UNIT V **9 Hours**

PLANT OPERATIONS

Operating discipline, operating procedure and inspection, format, emergency procedures-hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel. Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petro-chemical, rubber, fertilizer and distilleries.

Total: 45 Hours

Reference(s)

1. Lees, F.P. Loss Prevention in Process Industries Butterworths and Company, 2012.
2. Green, A.E., High Risk Safety Technology, John Wiley and Sons, 2003.
3. Fawcett, H.H. and Wood, Safety and Accident Prevention in Chemical Operations Wiley inters, Second Edition.2008
4. Guidelines for Chemical Process Quantitative Risk Analysis, American Institute of Chemical Industries, Centre for Chemical Process safety, Wiley Publications,1999.
5. Accident Prevention Manual for Industrial Operations NSC, Chicago, 1982.

21IS56 ENVIRONMENTAL POLLUTION CONTROL 3 0 0 3

Course Objectives

- To introduce the elements of Air pollution and equipments.
- To study the control measures of gaseous pollutants.
- To learn the effects of water pollution.
- To impart knowledge on solid waste management.
- To provide knowledge on pollution control measures adopted in various hazardous industries.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Gain knowledge on Air Pollution and the constructional details of equipments.
2. Predict the effect of gaseous pollutants of an industrial unit.
3. Find out the effects of water pollution on the receiving body.
4. Identify the methods for solid waste management of an industrial unit.
5. Evaluate the pollution control measures adopted in various industries.

UNIT I **9 Hours**

AIR POLLUTION

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

UNIT II **9 Hours**

CONTROL OF GASEOUS POLLUTANTS

Dispersion of Air pollutants -Plume behavior -Control of gaseous pollutants, Sulphur dioxides, nitrogen oxides, Carbon monoxide and Hydrocarbons. Air pollution laws and Standards.

UNIT III **9 Hours**

WATER POLLUTION

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.

UNIT IV **9 Hours**

SOLID WASTE MANAGEMENT

Solid waste management - methods of collection - Disposal of solid waste, land filling, Handling of toxic and radioactive wastes - Incineration and Verification.

UNIT V **9 Hours**

POLLUTION CONTROL IN INDUSTRIES

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

Total: 45 Hours

Reference(s)

1. Rao C S, Environmental Pollution Control Engineering, New Age International, 2007.
2. Guidelines for EIA of Industrial and other Projects Ministry of Environment and Forests, Government of India, 2009.
3. P, R Trivedi, Environmental Pollution and Control, Paragon-Nivin Shahdara, New Delhi, 2008
4. G.T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006
5. Planet, Wadsworth Publishing Co., Belmont, CA 2006
6. M.J Hammer, and M.J Hammer, Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006

21IS57 SAFETY IN POWDER HANDLING 3 0 0 3

Course Objectives

- To introduce the safe handling of powders.
- To understand the characteristics of handling powders.
- To study the process of dust explosions.
- To develop knowledge of dust handling plants and electrostatic hazards.
- To learn the method of dust evaluation and control.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Indicate the safe methods of handling powders of an industrial unit.
2. Analyze the hazards involved in unsafe handling of powders in the relevant Industry.
3. Identify Industrial dust and explosions accidents and its control
4. Explain the working of dust handling plants and the nature of electrostatic hazards.
5. Resolve dust evaluation methods and suggest control measures.

UNIT I **9 Hours**

INTRODUCTION

Powder classification-physical, chemical and other properties-metal powders-other non- metallic powders-handling methods-manual, mechanical - Synthesis of nano powders - automatic-charges on powders-charge distribution-charging of powders.

UNIT II **9 Hours**

METAL POWDERS AND CHARACTERIZATION

Atomization, types - milling - electro deposition - spray drying, Production of iron powder, Aluminum powder, Titanium - screening and cleaning of metals - Explosivity and pyrophoricity - toxicity Particle size and size distribution-measurement, types and significance-particle shape analysis-SEM, AFM, particle size analyzer, surface area, density, porosity, flow rate - testing.

UNIT III **9 Hours**

DUST EXPLOSION

Industrial dust, dust explosion accidents - explosibility characteristics, minimum explosive concentration, minimum ignition energy, explosion pressure characteristics, maximum permissible oxygen concentration - explosibility tests, Hartmann vertical tube apparatus, horizontal tube apparatus, inflammatory apparatus, Godbert and Greenward furnace.

UNIT IV **9 Hours**

DUST HANDLING PLANTS AND ELECTRO STATIC HAZARDS

Grinding mills, conveyors, bucket elevators, dust separators, dust filters, cyclones, driers, spray driers, silos, grain elevators, typical applications, hazards. Electrostatic charges-energy released- type of discharge-spark-carona-insulating powders-propagating brush discharge-discharge in bulk lightning hazards in powder coating-electroplating - handling of Nano powders in the presence of flammable gases and vapour

UNIT V **9 Hours**

DUST EVALUATION AND CONTROL

Evaluation, methodology, Quantitative, sampling, measurements - control of dust sources, dust transmission - role of workers, PPE and work practice - Housekeeping - storage -labeling - warning sign - restricted areas - Environmental protections. Evaluation procedures and control measures for particulates (Respirable), Asbestos and other fibers, silica in coal mine - NIOSH guide to the selection and use of particulate respirators - case studies.

Total: 45 Hours

Reference(s)

1. SRMC, Hazard recognition and prevention in the work place-airborne dust, Vol. I and II, Chennai, 2000.
2. A.S. Edelstein and R.C. Cammarata, Nano materials: Synthesis, Properties and Applications, Taylor and Francis, New York, 1996.
3. Martin Glor, Electro Static Hazard in Powder Handling, Research studies Press Ltd., England, 1988.
4. International Labour Organization, Major hazard control, Geneva, 1991.
5. Safety considerations when handling metal powders, Journal of the Southern African Institute of Mining and Metallurgy. Johannesburg Jan.2012. Vol.112 suppl.1
6. http://www.chilworth.co.uk/

21IS58 ENVIRONMENTAL IMPACT ASSESSMENT 3 0 0 3

Course Objectives

- To introduce the safe handling of powders.
- To understand the characteristics of handling powders.
- To study the process of dust explosions.
- To develop knowledge of dust handling plants and electrostatic hazards.
- To learn the method of dust evaluation and control.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Demonstrate the Environmental Impact Assessment(EIA), Impact Statement(EIS) and Environmental Risk Assessment (ERA.)
2. Compute the environmental assessment techniques for Environmental Analysis.
3. Determine the Environmental Impact Assessment and the evaluation criteria.
4. Execute the Environmental Management Plan and document it.
5. Justify previous environmental cases and their causes.

UNIT I **9 Hours**

INTRODUCTION

Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS)-Environmental Risk Assessment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - Terms of Reference in EIA- Issues in EIA - national - cross sectorial - social and cultural.

UNIT II **9 Hours**

ENVIRONMENTAL ANALYSIS AND ASSESSMENT TECHNIQUES

Components - screening - setting - analysis - prediction of impacts - mitigation. Matrices Networks - Checklists - Importance assessment techniques - cost benefit analysis - analysis of alternatives - methods for Prediction and assessment of impacts. Standards and guidelines for evaluation. Public Participation in environmental decision- making.

UNIT III **9 Hours**

ENVIRONMENTAL IMPACT ASSESSMENT EVALUATION

Trends in EIA practice and evaluation criteria - capacity building for quality assurance. Expert System in EIA - use of regulations and AQM.

UNIT IV **9 Hours**

ENVIRONMENTAL MANAGEMENT PLAN

Document planning - collection and organization of relevant information - use of visual display materials - team writing - reminder checklists. Environmental monitoring - guidelines - policies - planning of monitoring programmes. Environmental Management Plan. Post project audit.

UNIT V **9 Hours**

CASE STUDIES

Case studies of EIA of developmental projects.

Total: 45 Hours

Reference(s)

1. L W Canter, Environmental Impact Assessment, McGraw Hill, New York, 1996.
2. J Petts, Handbook of Environmental Impact Assessment, Vol. I and II, Blackwell Science, London, 1999.
3. The World Bank Group, Environmental Assessment Sourcebook, Vol. I, II and III, World Bank, Washington, 1991.
4. G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley and Sons, 2000
5. C. H. Eccleston, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley and Sons, 2000.
6. www.cpcb.nic.in

21IS59 SAFETY IN PETROCHEMICAL INDUSTRIES 3 0 0 3

Course Objectives

- To recognize the various risks and hazards involved in petrochemical industries - and its control Measures
- To impart knowledge on risk analysis, toxic effect and planning for onsite and-offsite emergency planning in petrol chemical industries
- To acquire knowledge on Controlling of safety systems and Relief systems and to acquire knowledge on design activities of safety and relief systems.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Familiarize with the terminologies involved in the safety of petrochemical industries.
2. Understand Risk analysis, hazard assessment and toxicity in petrol chemical industries.
3. Control the risk factors by applying the various safety techniques in mitigating the hazards in petrochemical industries

UNIT I **9 Hours**

INTRODUCTION

Environmental Impact Assessment(EIA - Environmental Impact Statement (EIS)-Environmental Risk Assessment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - Terms of Reference in EIA- Issues in EIA - national - cross sectorial - social and cultural.

UNIT II **9 Hours**

CONTROL OF SAFETY SYSTEMS

Concept of risk, selection of design bases for safety systems, guidelines for risk tolerability, potential process safety systems and design solutions. Control of safety systems, safety system characteristic and design - Safety system computer control - Control of trip, interlock and emergency shut-down systems - Programmable logic and electronic system - Layered control systems for safety

UNIT III **9 Hours**

CONTROL OF RELIEF SYSTEM

Relief Systems: Preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation, and sprinkling, proofing, relief systems- relief valves, flares, scrubbers. Design of flares, scrubbers and condensers for toxic release from chemical process industries; Design of tank farms for liquid/gaseous fuel storage.

UNIT IV **9 Hours**

TOXICOLOGY OF PETRO CHEMICAL INDUSTRIES

Toxicology: Hazards identification-toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

UNIT V **9 Hours**

CONTROLLING OF LEAKAGES AND ASSOCIATED HAZARDS

Leaks and Leakages: Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases. Hazards Associated with Hydrocarbon and Other Chemical Products: Crude oil, natural gas, LPG, CNG, LNG, oxygenated hydrocarbons, chlorine, ammonia, hydrogen fluoride

Total: 45 Hours

Reference(s)

1. L W Canter, Environmental Impact Assessment, McGraw Hill, New York, 1996
2. J Petts, Handbook of Environmental Impact Assessment, Vol. I and II, Blackwell Science, London, 1999.
3. The World Bank Group, Environmental Assessment Sourcebook, Vol. I, II and III, World Bank, Washington, 1991.
4. G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley and Sons, 2000
5. C. H. Eccleston, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley and Sons, 2000.
6. http://envfor.nic.in/

21IS60 TRANSPORT SAFETY 3 0 0 3

Course Objectives

- To provide the steps to be followed for safe handling of hazardous goods during transportation
- To illustrate the road accident and the roles and responsibilities of a driver and the Safety training needed for the drivers.
- To inculcate the need for safe driving and give an over view of the motor vehicle act and rules.
- To develop knowledge on road safety including the laying of road and traffic control lines.
- To educate safety aspects in handling material and the material handling equipment in the shop floor.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Apply the safety measures in handling of hazardous goods during transportation
2. Formulate the causes for accident and the roles and responsibilities of a driver and the Safety training needed for the drivers.
3. Identify the need for safe driving and understand an over view of the motor vehicle act and rules.
4. Demonstrate the rules on road safety including the laying of road and traffic control lines.
5. Indicate the safety aspects in handling material and the material handling equipment in the shop floor.

UNIT I **9 Hours**

TRANSPORTATION OF HAZARDOUS GOODS

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.

UNIT II **9 Hours**

ROAD TRANSPORT

Introduction - factors for improving safety on roads- signage and mandatory signs - causes of accidents due to drivers and pedestrians-design, selection, operation and maintenance of motor trucks preventive maintenance-check lists-motor vehicles act - motor vehicle insurance and surveys.

UNIT III **9 Hours**

DRIVER AND SAFETY

Driver safety programme - selection of drivers - driver training – tacho – graph - driving test driver 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.

UNIT IV **9 Hours**

ROAD SAFETY

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. Plant railway: Clearance-track-warning methods-loading and unloading-moving cars safety practices.

UNIT V **9 Hours**

SHOP FLOOR SAFETY

Transport precautions-safety on manual, mechanical handling equipment operations safe driving movement of cranes-conveyors etc., equipment

Total: 45 Hours

Reference(s)

1. Kadiyali, Traffic Engineering and Transport Planning Khanna Publishers, New Delhi, 1983.
2. Motor Vehicles Act, 1988, Government of India, Universal Law Publishing,2016
3. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
4. Pasricha, Road Safety guide for drivers of heavy vehicle Nasha Publications, Mumbai, 1999.
5. C.A Popkes, Traffic Control and Road Accident Prevention Chapman and Hall Limited, 1986
6. V.F Babkov, Road Conditions and Traffic Safety MIR Publications, Moscow, 1986

21IS61 SAFETY IN ON-SHORE AND OFF-SHORE DRILLING

3 0 0 3

Course Objectives

- To provide knowledge on various petroleum products, the hazards involved, the control and preventive measures.
- To impart knowledge on shore and off shore operations, the hazards associated with it and the safety requirements.
- To develop knowledge on oil drilling, the hazards associated with it and the safety requirements.
- To provide knowledge on petroleum extraction and transportation, the hazards associated with it and the protective measures.
- To impart knowledge on storage of petroleum products and the storage equipment and the hazards associate with it.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Identify various petroleum products, the hazards involved, and suggest the control and preventive measures.
2. Compare with on shore and off shore operations, the hazards associated with it and the safety requirements.
3. Indicate about oil drilling, the hazards associated with it and the safety requirements.
4. Explain the petroleum extraction and transportation, the hazards associated with it and the protective measures.
5. Determine the method of storage of petroleum products and the storage equipment and the hazards associate with it.

UNIT I **9 Hours**

PETROLEUM PRODUCTS

Petroleum and Petroleum products - Fuels- Petroleum solvents - Lubricating oils - Petroleum wax, greases - Miscellaneous product

UNIT II **9 Hours**

ON AND OFF SHORE OPERATIONS

On and off shore oil operation - Construction of Installation - Pipe Line Construction - Maintenance and repair activities - Safety and associated hazards.

UNIT III **9 Hours**

DRILLING

Drilling oil- Technique and equipment- Work position - Working condition - safety and associated hazards- lightning and its effects.

UNIT IV **9 Hours**

EXTRACTION AND TRANSPORTATION

Petroleum Extraction and transport by sea - Oil field products - Operation - Transport of crude by sea - Crude oil hazards.

UNIT V **9 Hours**

STORAGE AND CLEANING

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

Total: 45 Hours

Reference(s)

1. Encyclopedia of Occupational Health and Safety, Vol. II, International Labour Organisation, Geneva, 1985 and I.
2. Dr. Paul Bommer A Primer of Oilwell Drilling A Basic Text of Oil and Gas Drilling Seventh Edition published by The University of Texas Continuing Education petroleum extension service.2008
3. S. Tanaka, Y. Okada, Y. Ichikawa, Offshore Drilling And Production Equipment, in Civil Engineering, in Encyclopedia of Life Support Systems, Developed under the Auspices of the UNESCO, Eolss Publishers, Oxford, UK, 2005
4. Management and Engineering of Fire Safety and Loss Prevention: Onshore and offshore, BHR group and Taylor and francis,1991.
5. Ian Sutton, Off shore safety Management, Elseiver,2013.
6. Huacan Fang, Menglan Duan, Offshore Oil and Gas Drilling Engineering and Equipment, Offshore Operation Facilities-2014, Pages 141-340

21IS62 SAFETY IN MINES 3 0 0 3

Course Objectives

- To create knowledge on various types of mines and the hazards associated with it.
- To develop knowledge on underground mines, occupational hazards and the safety aspects.
- To impart knowledge on tunneling and the personal protection.
- To identify the risk, potential hazards and do the risk assessment.
- To give an exposure to various accidents happened in mines and the way to manage situation during accidents.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Identify various types of mines and the hazards associated with it.
2. Demonstrate underground mining, the occupational hazards and the safety aspects.
3. Explain on tunneling and the personal protection.
4. Identify the risk, potential hazards and do the risk assessment.
5. Classify the accidents, investigate and analyze the accidents.

UNIT I **9 Hours**

OPENCAST MINES

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

UNIT II **9 Hours**

UNDERGROUND MINES

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

UNIT III **9 Hours**

TUNNELING

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.

UNIT IV **9 Hours**

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

UNIT V **9 Hours**

ACCIDENT ANALYSIS AND MANAGEMENT

Accidents 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.

Total: 45 Hours

Reference(s)

1. Michael Karmis, Mine Health and Safety Management, SME, Littleton, Co. 2001.
2. B.K Kejiriwal, Safety in Mines, Publisher Gyan Prakashan, Dhanbad, 2002.
3. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan-DHANBAD, 2002.
4. Dhillon, S Balbir Mine safety- A modern Approach, Springer Publication,2010
5. Hartmann, Introduction to mining engineering, Wiley Publications, 2007.
6. Fred G. Bell, J. Laurance, Mining and its impact on environment, Taylor and Francis, 2006.

21IS63 WORK STUDY AND ERGONOMICS 3 0 0 3

Course Objectives

- To learn about the concepts of work study
- To develop knowledge on application of ergonomic principles and physiology of workers.
- To study the concept of personal protective equipment, section and usage.
- To understand process and equipment design incorporating safety.
- To understand the man machine system

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Compare the work and indicate methods for safe operation
2. Implement ergonomic principles in an Industrial Unit.
3. Identify different Personal protective equipment for usage based on the hazard
4. Explain built in safety for different process and equipment
5. Indicate the human risk factors in the man machine system.

UNIT I **9 Hours**

WORK STUDY

Selection of plant locations, Safe layout, equipment layout, Study of operations - work content - work procedure - breakdown - human factors - safety and method study - methods and movements at the workplace - substitution with latest devices - robotic concepts - applications in hazardous workplaces - productivity, quality and safety (PQS).

UNIT II **9 Hours**

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.

UNIT III **9 Hours**

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.

UNIT IV **9 Hours**

PROCESS AND EQUIPMENT DESIGN

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

UNIT V **9 Hours**

MAN MACHINE SYSTEMS

Job and personal risk factors - standards-selection and training-body size and posture body dimension (static/dynamic) - adjustment range - penalties - guide lines for safe design and postures - evaluation and methods of reducing posture strain.

Total: 45 Hours

Reference(s)

1. Introduction to Work Study, ILO, Oxford and IBH Publishing company, 3rd edition, 2008.
2. Work Study, National Productivity Council, New Delhi, 1995.
3. E J Mc Cormick. and M.S Sanders Human Factors in Engineering and Design, TMH, New Delhi, 1993.
4. W Benjamin Neibal., Motion and Time Study, 7th Edition.
5. Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989.
6. McElroy, E Frank., Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1980.

21IS64 MAINTENANCE ENGINEERING 3 0 0 3

Course Objectives

- To learn the basic concept of maintainability engineering.
- To gain knowledge on various maintenance methods, maintenance policies and replacement models.
- To obtain information on maintenance logistics.
- To develop knowledge on maintenance quality by various analysis.
- To learn about Total Productive Maintenance.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Explain the basic concept of maintainability engineering of an Industrial Unit.
2. Implement various maintenance methods, maintenance policies and replacement models.
3. Demonstrate maintenance logistics of an Industrial Unit.
4. Compute maintenance quality by various analysis.
5. Indicate Total Productive Maintenance of an Industrial Unit.

UNIT I **9 Hours**

MAINTENANCE CONCEPT

Need for maintenance - Maintenance definition - Maintenance objectives - Challenges of Maintenance management - Tero technology - Scope of maintenance department - Maintenance costs.

UNIT II **9 Hours**

MAINTENANCE MODELS

Proactive/Reactive maintenance - Imperfect maintenance - Maintenance policies - PM versus b/d maintenance - Optimal PM schedule and product characteristics - Optimal Inspection frequency: Maximizing profit Minimizing downtime - Replacement models.

UNIT III **9 Hours**

MAINTENANCE LOGISTICS

Human factors - Crew size decisions: Learning curves - Simulation - Maintenance resource requirements: Optimal size of service facility - Optimal repair effort - Maintenance planning - Maintenance scheduling - Spare parts control - Capital spare.

UNIT IV **9 Hours**

MAINTENANCE QUALITY

Maintenance excellence - Five Zero concept - FMECA - Root cause analysis - System effectiveness - Design for maintainability - Maintainability allocation - CMMS - Reliability Centered Maintenance.

UNIT V **9 Hours**

TOTAL PRODUCTIVE MAINTENANCE

TPM features - Chronic and sporadic losses - Equipment defects - Six major losses - Overall Equipment Effectiveness - TPM pillars - TPM implementation Autonomous maintenance.

Total: 45 Hours

Reference(s)

1. Higgins & Morrow , Maintenance Engineering Handbook,Eighth Edition,2008
2. K.S Andrew, Jardine and Albert H.C.Tsang, Maintenance, Replacement and Reliability, Taylor and Francis, 2006.
3. Bikas Badhury and S.K.Basu, Tero Technology: Reliability Engineering and Maintenance Management, Asian Books, 2003.
4. Kelly and M J. Harris, Management of Industrial Maintenance, Butter worth and Company Limited, 2001
5. R. C.Mishra and K.Pathak , Maintenance Engineering and Management, PHI, 2005.
6. Sushil Kumar Srivatsava, Industrial Maintenance Management, S Chand and Company, 2005.

21IS65 RISK ANALYSIS 3 0 0 3

Course Objectives

- To introduce hazard, risk issues and hazard assessment.
- To learn about the basics of instrumentation.
- To study the method of risk analysis quantification and software.
- To get exposed to the method of consequence analysis.
- To educate on the credibility of risk assessment techniques.

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Indicate the hazard, risk issues and hazard assessment for the betterment of an industry.
2. Select the appropriate instrument for measuring parameters to find out the healthiness.
3. Analyze the method of risk analysis quantification and use the software in relevant area
4. Formulate the method of applying consequence analysis of an industrial unit.
5. Explain the strength of risk assessment techniques for better utilization.

UNIT I **9 Hours**

HAZARD, RISK ISSUES AND HAZARD ASSESSMENT

Introduction, 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)

UNIT II **9 Hours**

INSTRUMENTATION

Applications of Advanced Equipments and Instruments, Thermocalorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer(TGA), Accelerated Rate Calorimeter(ARC). Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitive Test, Impact Sensitive Test (BAM) and Friction Sensitive Test (BAM), Shock Sensitive Test, Card Gap Test.

UNIT III **9 Hours**

RISK ANALYSIS QUANTIFICATION AND SOFTWARES

Fault Tree Analysis and Event Tree Analysis, Logic 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, FETI, ALOHA

UNIT IV **9 Hours**

CONSEQUENCES ANALYSIS

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 Flashfire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout.

UNIT V **9 Hours**

CREDIBILITY OF RISK ASSESSMENT TECHNIQUES

Past accident analysis as information sources for Hazard analysis and consequences analysis of chemical accident, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster(1966), Port Hudson disaster- convey report, hazard assessment of nonnuclear installation- Rijnmond report, risk analysis of size potentially Hazardous Industrial objects- Rasmussen masses report, Reactor safety study of Nuclear power Plant.

Total: 45 Hours

Reference(s)

1. Methods in Chemical Process Safety, Volume 1 (1st Edition) - 7th April 2017.
2. Risk Analysis,Wiley; 2nd edition (2 October 2015)
3. P. Frank. Less Butterworth-Hein, Loss Prevention in Process Industries (Vol.I, II and III), Butterworth-Hein UK 1990.
4. F.I. Khan, S.A. Abbasi, Advanced Risk Assessment In Chemical Process Industries, Discovery Publishing House, 2000.
5. Center for Chemical Process Safety (CCPS), Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety. second Edition, 2000.
6. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AICHE 2008.

21IS66 SAFETY IN WASTE WATER MANAGEMENT 3 0 0 3

Course Objectives

- To develop knowledge on characteristic of water the sources of water pollutants and wastewater treatment.
- To impart knowledge on physical treatments processes such as sedimentation, reverse osmosis, Nano filtration, electro dialysis etc.
- To provide knowledge on chemical treatment processes such as coagulation flocculation, precipitation, flotation, ion exchange, electrolytic etc.
- To develop skill in Design of Conventional Water Treatment Plants.
- To afford knowledge on Design of Industrial Water Treatment and Reclamation

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Explain the characteristic of water, the sources of water pollutants and wastewater treatment.
2. Indicate the physical treatments processes such as sedimentation, reverse osmosis, Nano filtration, electro dialysis etc.
3. Identify and explain the chemical treatment processes such as coagulation flocculation, precipitation, flotation, ion exchange, electrolytic etc.
4. Assess the Design of Conventional Water Treatment Plants.
5. Execute the Industrial Water Treatment and Reclamation

UNIT I **9 Hours**

INTRODUCTION

Characteristics of waste water - Aerobic Treatment of Wastewater - Suspended growth processes, Activated sludge process, Aerated lagoons Anaerobic Treatment of Wastewater - Sludge digesters, Suspended growth Processes, Attached growth Processes Standards for performance - Significance and need for physico-chemical treatment.

UNIT II **9 Hours**

PHYSICAL TREATMENT PRINCIPLES

Principles of Screening - Mixing, equalization- Sedimentation - Filtration - Modelling - Back washing - Evaporation - Incineration - Gas transfer - Mass transfer coefficients - Adsorption - Isotherms Principles, equilibrium and kinetics, reactors, regeneration, membrane separation, Reverse Osmosis, Nano filtration ultra-filtration and hyper filtration - Electro dialysis, distillation - Stripping and crystallization - Recent Advances.

UNIT III **9 Hours**

CHEMICAL TREATMENT PRINCIPLES

Principles of Chemical treatment - Coagulation flocculation - Precipitation - flotation, solidification and stabilization - Disinfection - Ion exchange, Electrolytic methods, Solvent extraction - advance oxidation reduction - Recent Advances.

UNIT IV **9 Hours**

DESIGN OF CONVENTIONAL TREATMENT PLANTS

Aerators chemical, feeding-Flocculation-clarifier filters Rapids and filter, slow sand filter, pressure filter Chlorinators Displacement and gaseous type. Layouts - flow charts- Hydraulic Profile O and M aspects Case studies Residue management- Up gradation of existing plants Recent Advances.

UNIT V **9 Hours**

DESIGN OF INDUSTRIAL WATER TREATMENT AND RECLAMATION

Selection of process - Design of softeners- Demineralizers - Wastewater reclamation - Reverse osmosis plants - Residue management - O and M aspects - Recent Advances - Case studies.

Total: 45 Hours

Reference(s)

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw-Hill, Fourth Edition, 2009
2. Lee, and Shundar Lin, Handbook of Environmental Engineering Calculations, McGraw- Hill, 1999.
3. S.R Qasim, E M Motley, and G Zhu, Water works Engineering Planning, Design and Operation, Prentice Hall, 2002.
4. T J.Casey, Unit Treatment Processes in Water and Wastewater Engineering, John Wiley and Sons, 1993.
5. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, 1999.
6. www.gpcb.gov.in

21IS67 SAFETY IN CONSTRUCTION 3 0 0 3

Course Objectives

- To study the accident causes and management systems in construction.
- To understand the hazards of construction and prevention.
- To provide knowledge on safety while working at heights.
- To educate on the safe operation and maintenance of construction machineries.
- To expose to the conditions of safety in demolition works.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Identify the accident causes and management systems in construction.
2. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
3. Demonstrate the safety provisions while working at heights.
4. Classify the safety operation and maintenance of construction machineries.
5. Identify safe operation of demolition works.

UNIT I **9 Hours**

ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident-construction regulations, contractual clauses-Pre contract activates, preconstruction meeting-design aids for safe construction -permits to work-quality assurance in construction - compensation - Recording of accidents and safety measures -Education and training.

UNIT II **9 Hours**

HAZARDS OF CONSTRUCTION AND PREVENTION

Excavations, basement and wide excavation, trenches, shafts - scaffolding, types, causes of accidents, scaffold inspection checklist - false work - erection of structural frame work, dismantling -tunneling - blasting, pre blast and post-blast inspection-confined spaces-working on contaminated sites- work over water-road works-power plant constructions-construction of high rise buildings.

UNIT III **9 Hours**

WORKING AT HEIGHTS

Fall protection in construction OSHA3146-OSHA requirement for working at heights, Safe access and egress - safe use of ladders- Scaffoldings, requirement for safe work platforms, stairways, gang ways and ramps-fall prevention and fall protection, safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems - working on fragile roofs, work permit systems, height pass- accident case studies.

UNIT IV **9 Hours**

CONSTRUCTION MACHINERY

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist -builders hoist, winches, chain pulley blocks- use of conveyors - concrete mixers, concrete vibrators - safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes-use of conveyors and mobile cranes- manual handling.

UNIT V **9 Hours**

SAFETY IN DEMOLITION WORK

Safety in demolition work, manual, mechanical, using explosive-keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard-trusses, girders and beams - first aid - fire hazards and preventing methods - interesting experiences at the construction site against the fire accidents.

Total: 45 Hours

Reference(s)

1. Safety Handbook for the Building and Construction, Incolink (Australian construction association),2013
2. Sharma S C and Vineet kumar, Safety, Occupational Health and Environmental Management in Construction, Khanna Publishers, 1 st Edition,2013.
3. Construction Safety Paperback, 1 May 2013 by R.K. Mishra
4. Bhattacharajee S K, Safety Management in Construction, Khanna Publishers,2013.
5. V.J.Davies and K.Tomasin Construction Safety Hand Book Thomas Telford Ltd., London,2008
6. Charles D.Reese and James V.Edison Handbook of OSHA Construction safety and health, CRC Press Taylor and Francis group, 2006.

21IS68 RELIABILITY ENGINEERING 3 0 0 3

Course Objectives

- To develop knowledge on the reliability concept.
- To impart knowledge on Failure data analysis.
- To provide knowledge on various reliability prediction modelling..
- To create knowledge on Reliability Management.
- To inculcate knowledge on risk assessment

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.

Course Outcomes (COs)

1. Understand the reliability concept.for system effectiveness.
2. Do Failure data analysis and plotting techniques.
3. Gain knowledge on various reliability prediction modelling.
4. Familiarise with Reliability Management.
5. Do risk assessment in industry

UNIT I **9 Hours**

RELIABILITY CONCEPT

Reliability function -failure rate - mean time between failures (MTBF) - mean time to failure (MTTF) - A priori and a posteriori concept - mortality curve - useful life - availability -maintainability - system effectiveness.

UNIT II **9 Hours**

FAILURE DATA ANALYSIS

Time to failure distributions-Exponential, normal, Gamma, Weibull, ranking of data probability plotting techniques- Hazard plotting.

UNIT III **9 Hours**

RELIABILITY PREDICTION MODELS

Series and parallel systems -RBD approach -Standby systems - m/n configuration-Application of Bayestheorem - cut and tie set method - Markov analysis - Fault Tree Analysis - limitations.

UNIT IV **9 Hours**

RELIABILITY MANAGEMENT

Reliability testing - Reliability growth monitoring - Non-parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model.

UNIT V **9 Hours**

RISK ASSESSMENT

Definition and measurement of risk- risk analysis techniques -risk reduction resources-industrial safety and risk assessment.

Total: 45 Hours

Reference(s)

1. L.S Srinath, Reliability Engineering, Affiliated East-West Press Pvt Ltd, New Delhi,1988 Modarres, Reliability and Risk analysis, Maral Dekker Inc.1993.
2. John Davidson, The Reliability of Mechanical system published by the Institution of Mechanical Engineers, London, 1988.

21IS69 MANAGEMENT SYSTEM STANDARDS 3 0 0 3

Course Objectives

- To provide knowledge on OHSMS, standard, its development and structure.
- To impart knowledge on OHSMS policy and planning, implementation and documentation.
- To develop for checking and reviewing as per guidelines.
- To familiarize with the ISO 14000 and ISO 9000 requirements.
- To create knowledge to carry out Environment impact assessment

Programme Outcomes (POs)

b. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Explain the importance of OHSMS, standard, its development and structure.
2. Demonstrate OHSMS policy and planning, implementation and documentation.
3. Formulate for checking and reviewing as per OHSMS guidelines.
4. Indicate the ISO 14000 and ISO 9000 requirements for an Industrial unit.
5. Identify the activity to carry out Environment impact assessment

UNIT I **9 Hours**

OHS MANAGEMENT SYSTEM STANDARD

Introduction ISO 45001- Development of OHSMS standard Structure and features of OSHMS Benefits of certification-certification procedure OH and S management system element, specification and scope, success factors, plan do check act cycle- contents and scope of ISO 45001, terms and definitions

UNIT II **9 Hours**

POLICY AND PLANNING, IMPLEMENTATION AND OPERATION

General requirements, OH and S policy, Planning- Hazard identification, risk assessment and determining controls -Legal and other requirements-Objectives and program (s), Implementation and operation-Resources, roles responsibility, accountability and authority- Competence, training and awareness - Communication, participation and consultation Documentation - Control of documents - Operational control-Emergency preparedness and response.

UNIT III **9 Hours**

CHECKING AND REVIEW GUIDELINES

Checking- Performance measurement and monitoring-Evaluation of compliance-Incident investigation, nonconformity, corrective action and preventive action- Control of records-Internal audit-Management review - guidelines for implementation of ISO 45001 -Examples of items for hazard identification checklist Comparison of risk assessment tool and methodologies

UNIT IV **9 Hours**

ISO 14001 AND ISO 9000

ISO 14001 -Environmental management systems Requirements with guidance for use - Environmental policy- Environmental aspects - Legal and other requirements - Objectives, targets and programme(s)- Implementation and operation - Checking - Management review- Guidance for use - Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for ISO 14000 based EMS, steps in ISO 14001 -Implementation plan, Registration, Importance of ISO 14000 to the Management. Guidelines for environmental management systems auditing -General principles, Managing audit programme - Audit activities, steps in audit, Audit plan. Competence of auditors.

UNIT V **9 Hours**

ENVIRONMENT IMPACT ASSESSMENT

ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco-labeling) - History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco-labeling before company attempts for it. Advantages - EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits. Audit-methodology, Auditors Audit results management review- Continual improvement.

Total: 45 Hours

Reference(s)

1. Occupational Health and Safety Assessment Series BS (OHSAS) 21001:2007 BSI, UK, 2007.
2. OHSAS 21002, Occupational Health and Safety Management Systems - Guidelines for the implementation of OHSAS 21001, OHSAS project group, 2008.
3. ISO 14001:2004, Environmental Management Systems - Requirements with guidance for use ISO, 2004.
4. Dr K.C. Arora. ISO 9000 to OHSAS 21001, S. K. Katariaand Sons, 2012.
5. Guidelines on Occupational Health and Safety Management Systems (OSH-MS) International Labour Organization: 2001.
6. http://pozhproekt.ru/nsis/bs/management/BS-8800-2004.pdf

21IS70 SAFETY IN TEXTILE INDUSTRY 3 0 0 3

Course Objectives

- To provide the knowledge on textile Machineries, products and the hazards involved.
- To learn the hazards in textile processing such as looms, knitting and non-ovens.
- To study various hazards in textile processing such as bleaching, dyeing, punting, finishing and effluents.
- To enhance the knowledge on Health hazards in textile industry and welfare measures specific to textile industry
- To develop knowledge on statues applicable to textile industry, including effluent treatment and waste disposal in textile industry.

Programme Outcomes (POs)

a. Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.
c. Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.
d. Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.
e. Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.
f. Comply with legal and contractual requirements, professional ethics, responsibilities, and general norms of engineering practice to control risk.

Course Outcomes (COs)

1. Analyze the overview of the textile Machineries, products and the hazards involved.
2. Identify the hazards in textile processing such as looms, knitting and non-ovens.
3. Explain various hazards in textile processing such as bleaching, dyeing, punting, finishing and effluents.
4. Infer knowledge on Health hazards in textile industry and welfare measures specific to textile industry
5. Implement the statues applicable to textile industry, including effluent treatment and waste disposal in textile industry.

UNIT I **9 Hours**

INTRODUCTION

Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fiber, 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.

UNIT II **9 Hours**

TEXTILE HAZARDS I

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

UNIT III **9 Hours**

TEXTILE HAZARDS II

Scouring, bleaching, punting, mechanical finishing operations and effluents in textile processes.

UNIT IV **9 Hours**

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.

UNIT V **9 Hours**

SAFETY STATUS

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

Total: 45 Hours

Reference(s)

1. Safety in Textile Industry, Thane Belapur Industries Association, Mumbai,2007.
2. 100 Textile fires analysis, findings and recommendations LPA,2008.
3. E.B.Groover and D.S.Hamby, Hand book of textile testing and quality control, New York: Textile Book Publishers, 1960.
4. Quality tolerances for water for textile industry,BIS,1992.
5. V,A.Shenai, A technology of textile processing, Vol. I, Textile Fibres, Sevak, 1975.
6. Little, A.H., Water supplies and the treatment and disposal of effluent, Manchester: Textile Institute, 1975.

21XE01 ENGLISH FOR RESEARCH PAPER WRITING 2 0 0 0

Course Objectives

- Illustrate that how to improve your writing skills and level of readability.
- Learn about what to write in each section.
- Recognize the skills needed when writing a Title.
- Ensure the good quality of paper at very first-time submission.

Programme Outcomes (POs)

Course Outcomes (COs)

1. Illustrate the research ideas and writing journal papers
2. Creating research paper writing

UNIT I **6 Hours**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT II **6 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III **6 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV **6 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V **6 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Total: 30 Hours

Reference(s)

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

21XE02 COST MANAGEMENT OF ENGINEERING PROJECTS

2 0 0 0

Course Objectives

- To understand the cost concepts and different stages of project execution and its activities.
- To understand cost behavior, management and its quantitative techniques.

Programme Outcomes (POs)

Course Outcomes (COs)

1. Apply the cost concepts in decision making.
2. Analyze the various stages of project execution and its activities.
3. Analyze the cost behavior and various types of costing.
4. Analyze the cost management and budget related decisions.
5. Analyze the quantitative techniques for cost management.

UNIT I **6 Hours**

COST CONCEPTS IN DECISION-MAKING

Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II **6 Hours**

PROJECT

Meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance.

UNIT III **6 Hours**

COST BEHAVIOR AND PROFIT PLANNING MARGINAL COSTING

Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning.

UNIT IV **6 Hours**

TOTAL QUALITY MANAGEMENT AND THEORY OF CONSTRAINTS

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V **6 Hours**

QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total: 30 Hours

Reference(s)

1. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

21XE03 STRESS MANAGEMENT 2 0 0 0

Course Objectives

- To achieve overall health of body and mind.
- To overcome stress by practicing yoga.

Programme Outcomes (POs)

Course Outcomes (COs)

1. Develop healthy mind in a healthy body thus improving social health also.
2. Improve Efficiency of the body by practicing breathing exercises and yoga.

UNIT I **10 Hours**

Definitions of Eight parts of yoga. (Ashtanga)

UNIT II **10 Hours**

Yam and Niyam. Dos and Donts in life.i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT III **10 Hours**

Asan and Pranayam, i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam.

Total: 30 Hours

Reference(s)

1. Yogic Asanas for Group Training-Part-I Janardan Swami Yogabhyasi Mandal, Nagpur. Model Curriculum of Engineering & Technology PG Courses [Volume-I][47].
2. Rajayoga or conquering the Internal Nature by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

21XE04 DISASTER MANAGEMENT 2 0 0 0

Course Objectives

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Programme Outcomes (POs)

Course Outcomes (COs)

1. Illustrate the key concepts in disaster risk reduction and humanitarian response
2. Interpret the strengths and weaknesses of disaster management approaches, planning and programming

UNIT I **5 Hours**

INTRODUCTION

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II **5 Hours**

REPERCUSSIONS OF DISASTERS AND HAZARDS

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms and Cyclones, Tsunamis and Floods, Droughts and Famines, Landslides and Avalanches Man-made disaster Nuclear Reactor Meltdown, Industrial Accidents and Oil Slicks and Spills Outbreaks of Disease and Epidemics War and Conflicts.

UNIT III **5 Hours**

DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT IV **5 Hours**

DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V **5 Hours**

RISK ASSESSMENT

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People"s Participation In Risk Assessment. Strategies for Survival.

UNIT VI **5 Hours**

DISASTER MITIGATION

Disaster mitigation meaning, concept and strategies of disaster mitigation, emerging trends in mitigation. Structural mitigation and non-structural mitigation, programs of disaster mitigation in India.

Total: 30 Hours

Reference(s)

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies " , New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi
3. Goel S. L. "Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

21XE05 VALUE EDUCATION 2 0 0 0

Course Objectives

- Interpret value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Programme Outcomes (POs)

Course Outcomes (COs)

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

UNIT I **8 Hours**

Values and self-development- Social values and individual attitudes-Work ethics- Indian vision of humanism- Moral and non- moral valuation-Standards and principles-Value judgements.

UNIT II **7 Hours**

Importance of cultivation of values- Sense of duty Devotion- Self-reliance- Confidence-Concentration-Truthfulness- Cleanliness-Honesty- Humanity- Power of faith- National Unity- Patriotism- Love for nature-Discipline.

UNIT III **8 Hours**

Personality and Behavior Development - Soul and Scientific attitude- Positive Thinking- Integrity and discipline-Punctuality- Love and Kindness- Avoid fault Thinking- Free from anger- Dignity of labour-Universal brotherhood and religious tolerance-True friendship-Happiness Vs suffering- love for truth-Aware of self-destructive habits-Association and Cooperation-Doing best for saving nature.

UNIT IV **7 Hours**

Character and Competence -Holy books vs Blind faith, Self-management and Good health. Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women. All religions and same message, Mind your Mind, Self-control. Honesty, Studying effectively.

Total: 30 Hours

Reference(s)

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.

21XE06 PEDAGOGY STUDIES 2 0 0 0

Course Objectives

- Review existing evidence on the review topic to inform programmer design and policy making undertaken by the DfID, other agencies and researchers
- Identify critical evidence gaps to guide the development.

Programme Outcomes (POs)

Course Outcomes (COs)

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? verall personality

UNIT I **8 Hours**

INTRODUCTION AND METHODOLOGY

Aims and rationale- Policy background- Conceptual framework and terminology-Theories of learning-Curriculum- Teacher education-Conceptual framework- Research questions-Overview of methodology and Searching

UNIT II **7 Hours**

THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

UNIT III **8 Hours**

EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy. Theory of change, Strength and nature of the body of evidence for effective pedagogical, practices, Pedagogic theory and pedagogical approaches, Teachers" attitudes and beliefs and Pedagogic strategies

UNIT IV **7 Hours**

PROFESSIONAL DEVELOPMENT

Alignment with classroom practices and follow up, Support Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Total: 30 Hours

Reference(s)

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379
3. Akyeampong K (2003) Teacher training in Ghana - does it count. Multi-site teacher education research project (MUSTER) country report 1. London: DFID
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, "learning to read" campaign

21XE07 BUSINESS ANALYTICS 2 0 0 0

Course Objectives

- Illustrate the role of business analytics within an organization
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making
- To become familiar with processes needed to develop, report, and analyze business data
- Use decision-making tools/Operations research techniques and Manage business process using analytical and management tools

Programme Outcomes (POs)

Course Outcomes (COs)

1. Implement the knowledge of data analytics
2. Apply the ability of think critically in making decisions based on data and deep analytics.
3. Analyze the ability to use technical skills in predicative and prescriptive modeling to support business decision-making
4. Determine the ability to translate data into clear, actionable insights
5. Analyze the decision problems in business analytics

UNIT I **6 Hours**

BUSINESS ANALYTICS AND STATISTICAL TOOLS

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics-Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview

UNIT II **6 Hours**

TRENDINESS AND REGRESSION ANALYSIS

Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology

UNIT III **6 Hours**

ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS

Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization

UNIT IV **6 Hours**

FORECATING TECHNIQUES

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models

UNIT V **6 Hours**

DECISION ANALYSIS

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making

Total: 30 Hours

Reference(s)

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics by James Evans, persons Education