ACADEMIC REGULATIONS
&
COURSES OF STUDY (FULL TIME) **From July 2014**

Applicable to
Master of Industrial Hygiene & Safety

in
Faculty of Engineering & Technology
Of
SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR – 388 120, GUJARAT, INDIA

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July 2014

SARDAR PATEL UNIVERSITY

VALLABH VIDYANAGAR – 388 120, GUJARAT

FACULTY OF ENGINEERING AND TECHNOLOGY

POST-GRADUATE PROGRAMME FOR MASTER OF INDUSTRIAL HYGIENE & SAFETY

ACADEMIC

REGULATIONS AND COURSES OF STUDY

R.PG.TE. 1 ADMISSION

1. **A candidate for admission to the Post-Graduate degree Programme for MASTER OF INDUSTRIAL HYGIENE & SAFETY must have passed the Bachelor of Science Degree Examination or Bachelor of engineering from a recognized university. Two years of industrial experience is preferred.**
2. Student who has passed qualifying examination from any other University or examining body and is seeking admission to this Programme must produce an eligibility certificate from this University.

R.PG.TE. 2 PROGRAMME OF STUDY

1. A student shall follow at a time any one of the prescribed courses set out in the Programme of study enclosed at Annexure – I.

R.PG.TE. 3 REGISTRATION

1. To earn course credits in a semester a student must register for the courses at the commencement of the semester.

2. A student shall not be permitted to any classes without completing his registration formalities.

3. The registration formalities must be completed by the student in person.

R.PG.TE. 4 REQUIREMENTS FOR REGISTRATION

1. A student can register for a course provided following conditions are satisfied:

    (i) The course is being offered in the semester.

2. If a student is required to repeat one or more courses due to inadequate performance (Ref. R.PG.TE. 9 and R.PG.TE. 10) it is essential that he must register for these courses in the earliest following semester in which the courses are offered.

3. Any registration, which violates above requirements, will automatically be cancelled and grades obtained, if any, shall be withdrawn.

R.PG.TE. 5 ADDING AND DROPPING OF COURSES

1. In exceptional circumstances, a student may be permitted to withdraw from one or more courses at any time before the end of the end-semester theory examinations.

2. Withdrawal from one or more courses will not entitle the student to the refund of fees.

R.PG.TE. 6 ASSESSMENT OF STUDENT PERFORMANCE IN A COURSE

1. Aggregate marks for each course are assigned on the basis of 25 marks per credit.

2. The performance of a student in a course is judged through (i) continuous internal assessment of theory and (ii) end-semester theory examinations.

3. The end-semester theory examination in a course has a weightage of 50 percent of theory marks. Continuous internal assessment carries the remaining 50 percent distributed in minimum two internal written tests and quizzes, carry-home exercise etc. to be conducted by the college.

4. Viva-voce for Seminar and Project Work will be conducted only at the end of the semester.

R.PG.TE. 7 EXAMINATIONS

1. The University will conduct the end-semester examinations for all courses offered in each semester of an academic year.

2. No student shall be admitted to the end semester examination of a course unless he has attended the course to the satisfaction of the Principal/Head of the college/institute. If this requirement is not fulfilled the student shall automatically be awarded the letter grade F in the course.

R.PG.TE. 8 LETTER GRADES

1. The overall performance of a student in a course is represented by a letter grade from A to F with the following meaning and equivalent grade points:

LETTER GRADE	QUALITATIVE MEANING	EQUIVALENT GRADE POINTS
Excellent	10	A
Good	8	B

Average	6	C
Pass	4	D
Conditional Pass	2	E
Fail	0	F

2. A course is completed successfully, i.e., credit is earned for a course, when a letter grade E or better is obtained in the course.
3. The scheme of awarding letter grades and the letter grades awarded in each course are subject to scrutiny and approval by the University.

R.PG.TE. 9 CONDITIONAL PASS

1. The letter grade E is qualified as 'Conditional Pass', and is in the nature of a condonation. The letter grade E is awarded to a student only if he fails to meet the minimum requirements of letter grade D by a small margin.

2. A conditional pass is sufficient to meet course pre-requisite requirements.

3. A student is allowed to have a maximum of one conditional pass at each level of courses. If he obtains more than one conditional pass at any one level, he must repeat courses until he is left with not more than one conditional pass at each level.

4. To improve his performance, a student may voluntarily repeat any course in which he has a conditional pass.

R.PG.TE. 10 FAILURE IN A COURSE

1. A student does not earn any credit for a course when he gets letter grade F in the course.

2. The letter grade F obtained in a course will be shown in the final transcript issued to the student (**Ref. R.PG.TE. 17**) whether or not he subsequently obtains another letter grade in a repeat attempt.

R.PG.TE. 11 SEMESTER PERFORMANCE INDEX (SPI)

1. The performance of a student in a semester is expressed in terms of the Semester Performance Index (SPI).

2. The Semester Performance Index is the weighted average of course grade points obtained by the student in the courses taken in the semester. The weights assigned to course grade points are the credits carried by the respective courses.

That is,

$$SPI = \frac{g_1c_1 + g_2c_2 + ...}{c_1 + c_2 + ...}$$

where g_1, g_2 ..... are the grade points obtained by the student in the semester for course carrying credits c_1, c_2 ..... respectively.

R.PG.TE. 12 CUMULATIVE PERFORMANCE INDEX (CPI)

1. The cumulative performance of a student is expressed in terms of the Cumulative Performance Index (CPI). This index is defined as the weighted average of course grade points obtained by the student for all courses taken since his admission to the programme, where the weights are defined in the same way as in **R.PG.TE. 11** above.
2. If a student repeats a course, only the grade points obtained in the latest attempt are counted towards the Cumulative Performance Index.

R.PG.TE. 13 DISCONTINUANCE FROM THE PROGRAMME

1. A Semester Performance Index of less than 4.00 in two consecutive semesters shall disqualify a student from continuing his studies. Such a student will be referred to the University. After considering the extenuating circumstances, if any, the University will decide whether the student should be allowed to continue his studies. The decision of the University shall be final.

R.PG.TE. 14 REPEAT COURSES

1. Course, which usually account for a higher rate of failure may be offered again as repeat course or courses as the case may be in the following semester.

2. Repeat courses are not offered to students as a matter of right. These courses are offered subject to the availability of manpower and other facilities.

R.PG.TE. 15 REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF INDUSTRIAL HYGIENE & SAFETY

1. To be eligible for award of the Master's Degree in INDUSTRIAL HYGIENE & SAFETY a student must earn :

Total of at least 100 credits for respectively as prescribed under the programme of studies with (subject to exemption granted for credits) :

(i) a minimum Cumulative Performance Index of 4.00

(ii) not more than one course with letter grade E at each level

2. The total credit requirements for the Master's Degree be completed in not more than 8 semesters from the date of admission of the student.

3. If the University is satisfied that there are extenuating circumstances, the student may be allowed a maximum of two additional semesters to complete his degree requirements.

R.PG.TE. 16 AWARD OF CLASS

1. The class awarded to a student with his Master of Industrial Hygiene & Safety degree is decided by final CPI as per the following table :

DISTINCTION	-	CPI	not less than 8.00
FIRST CLASS	-	CPI	less than 8.00 but not less than 6.75
SECOND CLASS	-	CPI	less than 6.00 but not less than 4.50
PASS CLASS	-	CPI	less than 4.50 but not less than 4.00

R.PG.TE. 17 TRANSCRIPT

1. The Transcript issued to the student at the time of leaving the University will contain a consolidated record of all the courses taken by him, grades obtained, SPI, CPI etc.

R.PG.TE. 18

The syllabi of the MASTER OF INDUSTRIAL HYGIENE & SAFETY programme is given at Annexure–I.

ANNEXURE - I

TABLE – 1

PROGRAMME OF STUDIES LEADING TO THE MASTER OF INDUSTRIAL HYGIENE & SAFETY

Sr. No	Course No.	Course Name	Contact Hours			Credits
			L	P	Total	
Semester: 1						
1	IH671	Introduction to Industrial Hygiene, Occupational Health & Environmental Toxicology	5	2	7	6
2	IH672	Introduction to Human Physiology	3	-	3	3
3	IH673	Introduction to Biostatistics and Epidemiology	3	-	3	3
4	IH674	Safety Management	6	-	6	6
5	IH675	Air Sampling Analysis	4	4	8	6
		TOTAL CREDITS				**24**
Semester: 2						
6	IH676	Industrial Ventilation	3	2	5	4
7	IH677	Hazard Identification, Assessment and Control Techniques	6	-	6	6
8	IH678	Physical Aspects of the Environment	4	2	6	5
9	IH679	Safety Engineering- I	5	-	5	5
10	IH680	Safety in Chemical Industry	6	-	6	6
		TOTAL CREDITS				**26**
Semester: 3						
11	IH681	Medical Surveillance and Biological Monitoring	3	-	3	3
12	IH682	Hazardous Waste Management	4	-	4	4
13	IH683	Principles of Ergonomics	4	2	6	5
14	IH684	Safety Engineering- II	6	-	6	6
15	IH685	Legislation on Safety & Health	6	-	6	6
		TOTAL CREDITS				**24**
Semester: 4						
16	IH686	Advanced Safety Management and Engineering Techniques	5	-	5	5
17	IH687	Industrial Visits and Seminars	3	6	9	6
18	IH688	Dissertation/Project Work	_	30	30	15
		TOTAL CREDITS				**26**

*L = Theory Contact Hours * P = Practical Contact Hours which include seminars, field trips, laboratory works, survey etc.

IH 671 INTRODUCTION TO INDUSTRIAL HYGIENE, OCCUPATIONAL HEALTH AND ENVIRONMENTAL TOXICOLOGY

CREDITS 6 (L = 5, P = 2)

SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Introduction of Industrial Hygiene & Occupational Health	12	7
2	Practical aspects in chemical hazard communication	5	3
3	Occupational diseases	40	21
4	Occupational health services at the work place	5	3
5	Introduction of Toxicology	5	3
6	Effects by the Organ	10	10
7	Toxic effects of heavy metals	20	15
8	Toxic effects of Solvents	10	5
9	Toxic effects of Gases	10	5
10	Toxic effects of Pesticides (Any Two)	8	3
	Total	125	75

TOPICS & SUB TOPICS

Introduction of Industrial Hygiene **7**

1.1Historical aspects of Industrial Hygiene, Definition, Units, mathematics and measurements concerning to it

1.2 Role of Industrial Hygienist and scope

1.3 Difference between industrial hygiene and occupational health

1.4 Work co-ordination between industrial hygienist, safety officer and factory medical officer for the purpose of safety, hygiene & health.

1.5 Introduction of ACGIH, OSHA, NIOSH

1.6 Hierarchy of Control

1.7 Benefits of Industrial Hygiene

1.8 Personal Protective Equipment: Need of PPE, Selection and applicable standards, on Respiratory Protection: Head, Ear, Face, Hand, Foot and Body Protection, Respiratory Protection: classification, Training, maintenance, testing procedures

SAMA /IS coding for PPES

1.9 Introduction of Occupational Health

Aim and Definition as per word health organization

History of OH in India & foreign countries

Discipline of occupational health and interlink with other subjects

Role of occupational doctor in industries

Importance of occupational history & key elements of industrial hygiene, safety and medical program.

2.0 Practical aspects in hazard Communication **3**

2.1Occupational hazards: chemical agents, physical agents, biological agents, psychological agents, physiological agents, etc.

2.2 Effects of the occupational hazards on human health.

3.0 Occupational Diseases **21**

3.1 Notifable diseases under schedule III of the factories act 1948

3.2 Silicosis: Property, Use & Application of compound in various industries, Common silica Types, Definition, Health related problems and other diseases, Mesothelioma, Pathology, sign & symptoms, Diagnoses Tests, Treatment, and Exposure Limits. Some of the case studies done by national and international research agencies

3.3 Asbestosis: Property, Use & application of compound in various industries, Common Asbestos Types, Definition, Health related problems and other diseases, Mesothelioma, Pathology, sign & symptoms, Diagnoses Tests, Treatment, and Exposure Limits. Some of the case studies done by national and international research agencies.

3.4 Bysinosis: Property, Use & application of compound in various industries, Health related problems, Pathology, sign & symptoms, Diagnoses Tests, Treatment, and Exposure Limits. Some of the case studies done by national and international research agencies.

3.5 Coal miners' pneumoconiosis

3.6Occupational Asthma: Definition, List and characteristic of related compounds, causes, types, Pathophysiology, symptoms, diagnoses, symptoms.

3.7 Occupational Stress: Definition, Common stressor, Established model & Studies

3.8 Occupational Health related other diseases: Introduction, Definition, causes, symptoms, health impairment for following terminology

1) Anorexia 2) Hemoptysis3) Rales 4) Sarcoidosis 5) Emphysema 6) Bronchitis 7) Scleroderma

3.9 Occupational health related problems due to the cold and heat

3.10 Occupational Dermatitis: types, compounds, characteristics, sign and symptoms, tests etc.

3.11 Musculoskeletal Injuries in various industries: Definition & explanation of Strain, Sprain, Tendonitis, Tenosynovitis, Bursitis, Myositis, Arthritis and it's treatment/Control

3.12 Occupational health problems in Hospitals/Agriculture/general cottage type of Industries

4.0Occupational health services at the work place **3**

Occupational health center

Ambulance van.

Factory medical officer, staff and equipment

5.0 Introduction of Toxicology **3**

5.1 Aim, What is the toxicology?

5.2 Routes of entry into the body

5.3 Absorption, distribution, and excretion of toxic substances

5.4 Site of action - local or systemic effects

5.5 By the organ they effect

6.0 Effects by the Organ **10**

6.1 Hematotoxicity, Hepatotoxicity

6.2 Nephrotoxicity, Neurotoxicity

6.3 Dermatotoxicity,Pulmonotoxicity

7.0 Toxic effects of heavy metals **15**

Pb, Cd, As, Mn, Hg, Cr, Be, Ni

8.0 Toxic effects of Solvents **05**

Benzene, Carbon Disulphide, Formaldehyde

9.0 Toxic effects of Gases **05**

Chlorene, Ammonia, Carbon monoxide, SOX, NOX

10.0 Toxic effects of Pesticides (Any Two) **03**

PRACTICAL / SEMINAR/ WORKSHOP

Sr.No.	Practicles/Seminar/Exercise/Workshop	Hrs (Time)	Marks
1	Lung function test by using Spirometer or equivalent instrument practical includes Demostration, Measurement of all parameters and conclusion	4	5
2	Ear testing on audiometer and demonstration of various models on audiometer.	4	5
3	Demonstration of medical laboratory equipment such as tetamus vision tester, blood analyzer, electrocardiography etc.	4	5
4	Seminars on any subject of Introduction of Occupational Health (30 mins four seminars)	2	2
5	Practical aspects in chemical hazard communication (30 mins four seminars)	2	1
6	Occupational health services at the work place (30 mins four seminars)	2	1
7	Introduction of Toxicology (30 mins four seminars)	2	1
8	Effects by the Organ (30 mins four seminars)	2	1
9	Toxic effects of heavy metals (30 mins four seminars)	2	1
10	Toxic effects of Solvents (30 mins four seminars)	2	1
11	Toxic effects of Gases (30 mins four seminars)	2	1
12	Toxic effects of Pesticides (30 mins four seminars)	2	1
	Total	30 hrs	25

Reference Book

1. Toxicology Fundamentals, Target organs, and Risk Assessment, 2nd edition, Hemisphere Publishing Corps, 1991Lu, Frank C, Basic,
2. The Basic Science of Poisons Amdur M. Doull, J and Klassen, C.D.
3. Handbook of Occupational Safety & Health Lawrance Slote,
4. U S Department of Labor, Occupational Outlook Handbook
5. Industrial toxicology Philip L. Williams and James L. Burson,
6. Inhalation Toxicology Research Methods, Applications and Evaluationm, Harry Salem
7. Industrial hygiene & Toxicology, Volume –2, Frank a. Petty
8. Environmental Occupational Medicine, Third Edition, William N.Rom
9. Occupational Lung Diseases by Hans Weill and Ter
10. Pulmonary Function Tests In Clinical and Occupational Lung Diseases by Albert Miller
11. Occupational Health Recognizing and Preventing Work-Related Diseases Edition 2 by Barry S Levy, David H Wegman
12. Occupational Cancer in Developing Countries by N Pearce, E. Matos, H. Vainio
13. Lead versus Health: Sources and effects of Low Level Exposure by Micheal Rutter and Robin Russell Jones
14. Asbestos Abatement : Risks and Responsibilities by The Bureau of National Affairs, Inc.
15. Asbestos : Medical and Legal Aspects Edition 3 by Barry I Castleman
16. Occupational Health & Hygiene : Guidebook for the WHSO by David Grantham

17. Copper : Medical and Biologic Effects of Environmental Pollutants by The National Research council
18. Control of silicosis in Vermont Granite Industry : Progress Report by US Department of Health, Education and Welfare
19. Mercury Contamination : A Human Tragedy by Patricia A D'itri and Frank M D'itri
20. Physiology of Respiration by Julius H Comroe
21. ILO Encyclopedia Volume I
22. ILO Encyclopedia Volume II
23. Guide to Occupational Exposure Values by ACGIH
24. Coppers Pocket Environmental Compliance Dictionary by Copper Sr.
25. The VNR Dictonary
26. Hundred (100) Problems in Environmental Health by Jack E Mckee
27. Environmental Health : New Directions by J Shields
28. Asbestos Sampling and Analysis by Gyan S Rajhans and John L Sullivan
29. Control of silicosis in Vermont Granite Industry : Progress Report by US Department of Health, Education and Welfare
30. Occupational Lung Diseases Edition 2 by Morgan and Seaton
31. Effects of Exposure to Toxic Gases : First Aid & Medical Treatment Edition 3 by Matheson Gas Products
32. Toxicology by Mickel A Kamrin
33. Effects of Exposure to Toxic Gases Edition 2, by William Braker and Allen L Mossaman
34. Occupational Carcinogenesis by Umberto Saffiotti, Joseph K Wagoner
35. Toxicology Principal and Practice Volume 2, by Fredierick Sperling

IH 672 INTRODUCTIONS TO HUMAN PHYSIOLOGY
CREDITS 3 (L = 3,P = 0)
SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Scope of human physiology	4	1
2	Structure of cell, functions of its component	3	1
3	Structure & function of skeleton, joints, classification functions & their movements.	4	2
4	Blood-Composition & functions of blood elements, blood groups, coagulation of blood, blood transfusion	6	3
5	CNS- structure and function of nervous system, reflex, arc and its types, spinal cord and tracks its relation to higher parts of CNS, brain and its parts	8	4
6	Cardiovascular system- Heart: Functional Anatomy, Properties of the heart, The heart as a pump, Heart rate, Blood Pressure	5	***5***
7	Respiratory System-Anatomy of different parts, mechanisms of respiration, regulation of respiration, gas transport between lungs and tissue, respiratory volume, Natural Defenses, pulmonary circulation, respiration insufficiency- Pathophysiology, diagnosis and oxygen therapy	9	5
8	Digestive system-Gross anatomy of alimentary canal, functions of different parts including liver & pancreas, G.I.T. motility and secretion	5	3
9	General aspects of Neurology, Elementary Neuroanatomy, The receptors	5	4
10	Physiology of special senses (ear, eye, smell & taste), structure and function of skin	6	4

11	Endocrine system: Physiological considerations of pituitary, thyroid, parathyroid, pancreas and suprarenal glands.	9	7
12	Reproductive system: Anatomy and physiology of male and female reproductive system- spermatogenesis, ovulation, menstrual cycle, pregnancy, milk secretion, and menopause.	7	***3***
13	Excretory System: Various parts, Structure and functions of kidney, physiology of urine formation.	4	3
	Total	75	45

Reference Books

1. Guyton, Arthur C., Physiology of the Human Body, 6th Ed. Saunders College Pub. Philadelphia
2. Review of medical physiology by ganong
3. Grants methods of Anatomy
4. Human Physiology by C.C. Chattergee
5. ***Elements of Human Anatomy- Physiology and Health education- by Derasari and Goyal Twenty Third Edition 2012-2013 BS Shah Prakhashan Ahmedabad***
6. Best and Taylor- Physiological basis of medical physiology
7. Human Physiology and Anatomy by Tortora

IH 673 INTRODUCTION TO BIOSTATISTICS AND EPIDEMIOLOG Y
CREDITS 4 (L = 3, P = 0)
SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Introduction of Biostatistics	3	3
2	Sources and Presentation of Data	5	5
3	Descriptive statistics: Measures of location Averages and percentiles	10	7
4	Sampling Variability and Significance	16	8
5	Introduction to epidemiology	7	4
6	Routine sources of Epidemiological Data	6	3
7	Analytical and experimental methods used in studies of disease in human	6	3
8	Descriptions of source of data, methods of collection, causation, interpretation of observations in case-com-comparison and cohort studies	22	12
	Total	75	45

1. Introduction of Biostatistics

Overview and Introduction

Data

Application, uses, scope of Biostatistics in Occupational Hygiene & Health

Common statistical Terms: Variable, Sigma, Constant, Observation, Observation uniit, Data, Population, Sampling unit, Sampe, Paramer, Notation for a population and sample value

2. **Sources and Presentation of Data**

2.1 Sources for collection of Occupational Hygiene, Safety, Health statistics (Experiments, Surveyes and Records)

2.2 Qualitative and Quantitative Data

2.3 Methods of Presentation 1. Tabulation 2. Drawing

2.4 Sampling distributions: Frequency distribution table, Rules for making a frequency distribution table, Frequency Distribution drawing, Histogram

2.5 Sampling Representative sample, Sample size, Sample bias, Sampling technique, simple random sampling, systematic, stratified, multistage, cluster, multiphase

3. **Descriptive statistics: Measures of location Averages and percentiles**

3.1 Measures of central tendency- Averages: Mean, median, mode, calculations of mean

3.2 Ungrouped series and grouped series with examples.

3.3 Measures of location- percentiles

3.4 Variability and its Measure: Types of Variability

3.4.1 Measures of variability of individual observations: Range, Mean Deviation, Standard Deviation, Coefficient of variation, Standard error of mean, standard error of difference between two means, standard error of proportion

3.5 Normal Distribution and Normal Curve: Demonstration of a Normal Distribution, Normal Curve, Standard normal deviate, asymmetrical Distributions

4.0 Sampling Variability and Significance:

4.1 Sampling distribution, significance, estimation of population parameter, testing Statistical hypothesis, Type1 and type 2 errors, tests of significance, Z test, one tailed and two tailed tests.

4.2 Significance of difference in means: standard error means, application and uses, standard error of differences between two means of large samples, small samples, t- test, unpaired, paired, variance ratio test, analysis of variances test.

4.3 significance of difference in proportion of large samples: standard error of proportion, application and uses, standard error of difference between two proportions, SE.

4.4 The Chi-Square test: Alternate test to find the significance of difference in two or more than two proportions, as a test of association between two events in binomial or multinomial samples, as a test of goodness of fit, Calculation of Chi square value, restriction in application of Chi squares test

5. **Introduction to epidemiology**

5.1 Overview of epidemiology, definition, role of epidemiology, aims and goals epidemiology, measuring health and diseases: Case, Incidence and Prevalence Prevalence and Prevalence point, Examples, Cumulative Incidence (Risk), Odd of disease, Incidence Rate, Risk ratio, Rate ratio, Odd ratio, Case Fatality, Attribute Risk

6. R**outine sources of Epidemiological Data**

6.1 Definition, Types and it's value and limitation

6.2 Screening and validity of test

7. **Analytical and experimental methods used in studies of disease in human populations**

7.1 measures of exposure effect, Estimating exposures, chronic disease, infectious disease, occupational exposures, environmental and life style factors.

7.2 Epidemiological studies: Experimental and Non experimental: Case study and study design

8. **Descriptions of source of data, methods of collection, causation, interpretation of observations in case-com-comparison and cohort studies**

8.1 Cohort Study, Elements of cohort study, Advantage and disadvantage of cohort study

8.2 Cross sectional study: Definition, Types of cross sectional studies, Comparision with cohort studies

8.3 Case Control Studies: Definition, Types of Case Control studies, Methods

8.4 Intervention study

Reference Book

1. Hennekens, Epidemiology in Medicine, 1st Edition

2. Rosner: Fundamentals of Biostatistics – 3rd Edition
3. Introduction to Biostatistics by P,S.Sundar rao J Richard 3rd edition
4. Methods in Biostatistics by Dr. B.K.Mahajan
5. C.D. on Indo-US Workshop on Environmental & Occupational Epidemiology by National Institute of Occupational Health
6. Statistical Methods for Environmental Pollution Monitoring By Richard O.Gilbert

IH 674 SAFETY MANAGEMENT

CREDITS 6 (L = 6, P = 0)

SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Introduction of Safety	15	9
2	Philosophy of safety	15	9
3	Safety psychology	20	12
4	General Management	20	10
5	SHE Management & Planning for Safety	10	4
6	Organizing for Safety	05	5
7	Directing for safety	05	3
8	Controlling for safety	10	6
9	Safety education and training	15	9
10	Employee participation in safety	15	10
11	Economics of safety	10	7
12	Management in information system	10	6
	Total	150	90

TOPICS & SUB TOPICS

1. Introduction **9**

1.1 The concept of safety

1.1.1 Need, Nature & Importance

1.1.2 Focus on "Human Resource". Safety of "Man" at the center

1.1.3 The concept development as accident prevention, occupational health and Environmental protection

1.1.4 The modern concept of SHE or HSE

1.2 Problems of industrial safety

1.2.1 Occupational health and environmental pollution.

1.2.2 Nature and size of the problem

1.2.3 Factors and size of the problem

1.2.4 Factors impeding safety

1.2.5 Reasons of accident prevention

1.2.6 As the place of industry in society has become inevitable, safety in industry is also inevitable

1.2.7 Importance of Safety Technology and Engineering for minimizing the accidents.

2. Philosophy of safety **9**

2.1 Meaning of Philosophy and Safety Philosophy. Its Scope Explanation of basic definitions and safety terminology

Incident, accident, major accident hazard (MAH), oversight, error, mistake, near miss, injury, unsafe act, unsafe condition, hazard, risk etc.

2.2 Accident Causation Theories

2.2.1 H.W. Heinrich's Ten Axioms of industrial safety

2.2.2 Heinrich's Domino Theory and his "ratio".

2.2.3 William Hadden's Energy Theory.

2.2.4 V L Groses Multiple Causation Theory

2.3 Accident Prevention

2.3.1 Five Fundamentals of Accident Prevention – Organisation, Fact. Finding, Analyses of the facts, selection of remedy and application of Remedy.

2.3.2 Models of Accident Prevention ;Kepner-Tregoe Model ,Performance Cycle model,Updated safety management model.

2.3.3 Five "E"s of accident prevention – engineering control, Education and training, Enforcement, Enthusiasm and Example setting.

2.3.4 ***Approaches to preventive Action: Proactive Approach, Reactive Approach***

3. Safety Psychology **12**

3.1 Meaning of psychology, safety psychology and its importance

3.2 Psychological factors affecting work and accidents.

3.2.1 Attitudes, Aptitudes, Frustration, Conflict, Morale, Fatigue, Boredom & Monotony.

3.2.2 Role of these factors in accident causation and techniques to remove ill effects due to them.

3.3 Human Behavior

3.3.1 Knowledge and responsibility vis-à-vis safety performance.

3.3.2 Old concept of "Accident Proneness" and its debate

3.4 Motivation for Safety:

3.4.1 Need and Nature of Motivation

3.4.2 Theories of motivation and their application to safety

3.4.3 Role of management, supervisors and safety department in motivation.

3.5 Behavior based safety (BBS) Management Program:

3.5.1 Criteria for estimation and strategies

3.5.2 Management techniques of accident control

4. General management **10**

4.1 Origin and Evolution of Management Thoughts

4.2 Definitions, nature and importance of Management

4.3 Elements of management functions – planning, organizing, staffing, directing, controlling and co-coordinating

4.4 General Principles of Management

4.1.1 Managerial Role, Authority, Responsibility and power

4.1.2 Span of Management

4.1.3 Delegation and decentralization of authority.

5. SHE management & planning for safety **04**

5.1 Planning: Definition, purpose, nature, scope and procedure.

5.2 Range of planning and variety of plans

5.3 Strategic planning and tools of implementation

5.4 MBO i.e. management by objectives and its role in safety, health and environment (SHE)

5.5 Safety Policy – Formulation and implementation. Statutory provisions

6. Organizing for safety **05**

6.1 Organising : Definition, need, nature and principles

6.2 Organising for safety of SHE Department

6.2.1 Types, structure functions and responsibilities

6.2.2 Line and Staff Functions and responsibilities

6.2.3 Role of supervisors, Workers and Trade Unions

7. Directing for safety **03**

7.1 Direction : Definition, process, principles and techniques,

7.2 Leadership:

7.2.1 Role, functions and attributes of a leader

7.2.2 Leadership styles in safety management

7.3 Communication

7.3.1 Purpose, process, types and channels

7.3.2 Essential rules of communication

7.3.3 Two way communication

7.3.4 Barriers in communication

7.3.5 Essential of effective communication.

7.3.6 Communication and group dynamics. Team building

8. Controlling for safety **06**

8.1 Controlling: Definition, need, benefits, types, areas, elements and control technique

8.2 MBE i.e. management by exception

8.3 Monitoring by Safety Standards

8.3.1 Application and use of Indian Standards on Safety and Health IS:14489 and IS:15001, OHSAS 18001.

8.3.2 ILO and EPA Standards

9. Safety Education and Training **09**

9.1 Safety Department

9.2 Need of Safety Officer

9.3 Safety Officers Rule and their role

9.4 Assessment of Training

9.5 Elements of training cycle

9.6 Assessment of training needs

9.7 Objectives of training program

9.7.1 Techniques of training

9.7.2 Design and development of training programs

9.7.3 Training methods and strategies

9.7.4 Types of safety training

9.8 Evaluation and review of training programs

9.9 Modern methods of training

9.10 Modern teaching aids

9.11 Competence building technique (CBT)

9.12 Concept for training. Safety as on line function

9.13 Role of multimedia and communication

9.13.1 Applications of computers

9.13.2 Relevance of WTO regarding SHE.

10. Employee and various Organizations participation in safety **10**

10.1 Employee Participation

Purpose, Areas and methods of participation

10.2 Workers and Union's participation

Role of Supervisor

Role of Safety specialists (Consultants and Professionals)

10.3 Safety Promotion and Publicity

10.4 Safety suggestion schemes

10.5 Safety competetions

10.6 Safety incentives schemes

10.7 Audio visual publicity and other promotional methods

10.8 Safety performance awards and recognition

10.9 Safety Committee:

Structure, functions, meetings, minutes and implementation of its own remarks.

Statutory provisions

10.10 Approaches to compliance and violations

11. Economics of safety: 07

Cost of accidents

Direct and indirect costs and their ratio

Usefulness to convince management

Financial Costs

Financial costs to individual, his family, organisation and society.

Cost compilation procedure

Utility and limitations of cost data

Budgeting for safety

Purpose and procedure of safety budgeting

Consideration of performance rates

12. Management information system 06

12.1 Sources of information on safety, health and environment protection

12.2 Compilation and collation of information, its analysis and use.

12.3"Benchmarking" for safety performance

12.4 Modern methods of programming

12.5 Storing and retrieval of MIS for SHE

Computer software application and limitations. Causes of MIS failure. Advantages and disadvantages of computerized information system.

Status and future goals of computer utilization in SHE services in industries.

Integration between departmental MIS.

REFERENCES

1. Accident prevention manual for industrial operations, national safety council, 425 North Michigan Ave, Chicago, Illinois, USA.

2. Encyclopedia of Occupational Health and Safety, Fourth Edition, ILO, Geneva,
3. Safety and Health for Engineers, by Roger L Brauer, Van Nostrain Reinhold, New York.
4. Occupational Safety Management & Engineering by Willi Hammer.
5. Safety at work by John Ridley.
6. Industrial accident prevention by H.W. Heinrich, McGraw Hill Book Co.
7. Techniques of Safety Management by Dan Pederson.
8. Effective safety and health training by Jack W.Boley.
9. Safety Training Methods (Practical solutions for the Next Millennium) by Jack B.Revelle
10. Safety by Objectives (second edition) by Dan Petersen
11. Safety Training for the Supervisor by James E.Gardner
12. Safety Management in Construction and Industry, Brauer, Safety & Health for Engineers
13. What Went Wrong ; Edition III Kletz, Trevor A,
14. ***Fundamentals Of Industrial Safety and Health ; Dr.KU Mistry Third Edition 2012***

IHS675 AIR SAMPLING ANALYSIS

CREDITS 6 (L = 4, P = 4)

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Introduction to air sampling and analysis	35	23
2	Air monitoring instruments	20	11
3	Direct reading air monitoring instruments	8	5
4	Gas detector tubes	4	2
5	Preparation of known concentration of air contaminants (Solid, Liquid, Gas)	4	2
6	Environmental (Personal & Workplace area) Air Sample Analysis	20	12
7	Passive Sampling	4	2
8	Sampling Airborne Microorganisms and Aeroallergens	5	3
	Total	100	60

1) Introduction to air sampling and analysis 23

1.1 Types of sampling

1.1.1 Importance of personal, Workplace and Area/ambient Sampling/monitoring (Passive, Grab, Active, Integrated)

1.1.2 Definitions TLV, PEL, REL, IDLH, STEL Ceiling limits

1.1.3 Various organizations & Limits: ACGIH, OSHA, NIOSH,Factory Act 1948

1.1.4 Sampling Duration and Rate

1.2 Respiratory system & correlation with respirable, inhalable and total dust

1.2.1 BMRC, ACGIH curve, size selective sampling

1.3 **Types of contaminants**

1.3.0 Nature of Air Contaminants (Gases & Vapor, Particulate Matter, Odors and sampling consideration)

Dust

1.3.1 What Is Dust?

1.3.2 How Is Dust Generated?

1.3.3 Types Of Dust

1.3.4Why Is Dust Control Necessary?

1.3.5 Introduction of Equipment, accessories like media, calibrator etc. for Personal/workplace/area dust monitoring

1.3.5 Calculation of Dust concentration

1.3.7 Preventing & Control Dust Formation

1.3.8 Dust Control Systems

Solvent, Aerosol & Gaseous

1.3.9 How is solvent & gaseous exposure generated?

1.3.10 Introduction of Equipment, accessories & filters for

Personal/workplace/area dust monitoring

1.3.11 Solvent and gas exposure monitoring techniques

1.4 **Area/ambient Sampling**

1.4.1 Type of Plumes

1.4.2 Plume Behavior

1.4.3 Methods for measurement of Plumes

1.4.4 Stack Sampling Methods for Extractive Sampling: Particulate Matter, Methods for measurement of Gases Like Oxides of Nitrogen, Oxides of Sulfur, Ammonia and Chlorine

2) Air monitoring instruments

11

2.1 **Instruments for Dust sampling: Principle and theory**

2.1.1 Personal sampler, high volume sampler

2.1.2 Calibrator

2.1.3 Accessories like Cassettes, cyclone, and IOM sampler

2.1.4 Filters, Types and size of filters, Efficiency, requirement of Analytical Procedure and characteristics, Availability

2.2 **Instruments for solvent and gas sampling**

2.2.1 Low flow sampler

2.2.2 Calibrator

2.2.3 Accessories like Charcoal & silica gel tube, impinger etc.

2.3 **Monitoring Method**

2.3.1 Sampling train: How to do/Requirement etc.

2.3.2 Sampling strategy: Pattern of exposure, Sampling for Estimation of Average Exposure, Sampling high exposure periods, Sampling for peak exposures

Sampling form

Sample shipment

Calibration of Air Sampling Instruments

Flow Rate Metering Instruments

Procedures of Calibration flow and volume meters

Methods for calibration and the determination of collection efficiency

Gas and Vapor Calibration

3) Direct reading air monitoring instruments 5

3.1 Types, principles, application, advantages & disadvantages (At least 5 equipments)

3.2 Grab Sampling, Advantages and limitation

4) Gas detector tubes: Application and use of dragger tubes in Factory 2

5) **Preparation of known concentration of air contaminants** 2

1.1 Knowledge of standards

1.2 Standard curve for

1.2.1 Solid

1.2.2 Liquid

1.2.3 Gases

6) Environmental Air Sample Analysis 12

1. Analytical Instruments and it's Principle, Analysis of compound, working and required accessories

1.1 Atomic absorption Spectrophotometer/ICP

1.2 FTIR

1.3 Gas Chromatography/HPLC

1.4 PCM

2. Manual chemical methods of analysis

2.1 Introduction, reagent, standard preparation

2.2 Advantages and Disadvantages

7) Passive Sampling: Principles, Operating Procedure, Passive Badges and Dosimeter Tubes 2

8) Sampling Airborne Microorganisms and Aeroallergens 3

1.1 Factors to be considered in the selection of samplers for collecting airborne microorganisms

1.2 Characteristics of Aeroallergens

1.3 Sampler Selection

1.4 Sampling plan and analysis

PRACTICLES

Sr.No.	**Name of the Practicles**		**Name of Equipments**	**Marks**	**Hrs.**
1		Weighing the filters including Blank	Microbalance, Filters, Brush, Pettry Disc etc.	03	04
	1.1	Introduction of Industrial hygiene analysis laboratory			
	1.2	Introduction, Calibration and Use of Microbalance			
	1.3	Filter media such as PVC, Glass, MCEF etc.			
2	2.1	Calibration of Personal (1.5 L/min, 2.5 L/min) and Pocket Sampler (100 ml/min, 250 ml/min) by using Burette (Bubble) Method	SKC Make Personal Sampler and SKC Make Pocket Samplers, Calibrated Burette, Electronics Calibrator	03	04
	2.2	Calibration of Personal and Pocket Sampler by using Electronics Calibrator			04
	2.3	Comparison of Result of both methods			

3	3.1	Personal sampling of nuisance dust/wood dust/silica dust/ Any of inorganic dust) for any occupation/industry for 8 hours/Shift/Short time duration	do	05	08
	3.2	Workplace Sampling of nuisance dust/wood dust/silica dust/ Any of inorganic dust) for any occupation/industry for 8 hours/Shift/Short time duration	do		
		Respirable dust Sampling by using Cyclone			
		Inhalable dust sampling by using IOM Sampler			
		Total dust sampling by using cassette			
	3.3	Personal sampling/Work Place of any toxic solvent use in any occupation/industry/Chemical Laboratory/Petrol Pump for 8 hours/Shift/Short time duration	do		08
4	A	Oxides of nitrogen	High Volume Sampler, Stack Monitoring Kit etc.	05	01
	B	Sulphur dioxide			01
	C	Ammonia	--do--		01
	D	Chlorine	--do--		01
	E	Suspended and Respirable Particulates	--do--		02
5		Analysis of Heavy Metal by using ICP/AAS	All Laboratory glassware, standards and AAS/ICP	05	04
6		Analysis of Solvent by using G.C/H.P.L.C.	All Laboratory glassware, standards	05	04

			and G.C./H.P.L.C.		
7		Analysis of Nuisance Dust/Silica bearing dust by using FTIR/XRD	All Laboratory glassware, standards and F.T.I.R./XRD.	05	04
8		Asbestos fiber identification and counting by using Phase Contrast Microscope/Electron Microscope	All Laboratory glassware, standards Microscope/Electron Microscope	05	04
9		Quantitative Solvent/Dust Exposure Assessment by using Direct Reading Monitor	Direct Reading Monitor	05	02
10		Quantitative Solvent Assessment by using Dragger tube		05	02
11		Qualitative & Quantitative Exposure Assessment for Biological contaminants in Food/Pottery/Farm/Any other Occupation		04	06
		Total		50	60

Reference Book

1. The Calculation Atomospheric Dispersion From A Stack by A Concawe Publication
2. Smoke, Dust and Haze : Fundamentals of Aerosol Behavior by S K Friedlander
3. Statistical Method For Environmental Pollution Monitoring by Richar O Gillbert
4. Advances in the Analysis of Air Contamnants by Morris Katz
5. Proceedings Operation and Maintenance Procedures for Gas Cleaning Equipment Speciality Conference by Air Pollution Control Association
6. Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air
7. Human Exposure Assessment for Airborne Pollutants : Advances and Opportunities by National Academy Press
8. Monitoring Toxic Substances by Dennis Schuetzle
9. Methods ofAir Sampling and analysis by Inter Society Committee
10. A Decade of Respirable Dust Research for the Mineral Industries by Raja V Ramani, Roberts L Frantz & Richand Bajura

11. Air Sampling Instruments for Evaluation of Atmospheric Contaminents Eidtion 3 by ACGIH
12. Air Sampling Instruments for Evaluation of Atmospheric Contaminents Eidtion 7 by Susanne V Hering (13 copies)
13. Air Sampling Instruments for Evaluation of Atmospheric Contaminents Eidtion 7 by Susanne V Hering
14. SKC The World Leader in Air Sampling Technology : 1998 Comprehensive Catalog & Air Sampling guide
15. SKC The World Leader in Air Sampling Technology : 1996 Comprehensive Catalog & Air Sampling guide
16. Aerosol Science for Industrial hygienists by James H Vincent
17. ***Bisesi and Kohn's Industrial Hygiene Evaluation Methods ,Second Edition Lewis Publishers, London UK***

IH676 INDUSTRIAL VENTILATION
CREDITS 5 (L = 3, P = 2)
SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Introduction of ventilation	5	2
2	General principles of ventilation	12	8
3	General Industrial Ventilation	8	5
4	Local exhaust ventilation systems	26	15
5	Non-Standard Condition	8	5
6	HVAC and makeup air systems	8	5
7	Testing of Ventilation Systems	8	5
	Total	75	45

TOPICS AND SUBTOPICS

1.Introduction of ventilation **2**

1.1 Purpose of ventilation

1.2Types of ventilation

2.General principles of ventilation **8**

Introduction

Supply system, Exhaust systems, Basic Definitions such as static pressure, velocity pressure, total pressure, etc.

Principles of Air flow

Acceleration of Air and Hood Entry losses

Duct Losses

Multiple-Hood Exhaust systems

Air Flow Characteristics of Blowing and Exhausting

3.General Industrial Ventilation **5**

3.1 Introduction, Dilution Ventilation Principles, Dilution Ventilation for Health

3.2 Mixtures-Dilution Ventilation for Health

3.3 Dilution Ventilation for Fire and Explosion

3.4 Ventilation for Heat control, Heat Balance and Exchange

3.5 Ventilation system

4.0 Local exhaust ventilation systems **15**

4.1 Applications, components of a local exhaust system, types of losses, losses and velocity pressure, friction, elbow and branch entry losses

4.2 Hood design and selection, selecting and designing ductwork, fan selection

4.2.1 Hood Design

4.2.1.1 Contaminant Characteristics, Hood Types

4.2.1.2 Hood Design Factors, Hood Losses, Special hood Requirement

4.2.2 Duct

4.2.2.1 Types, Flow in Ducts

4.2.2.2 Losses, Correction in ductwork

4.2.3 Air Cleaning Devices

4.2.3.1 Selection of Dust Collection Equipment, Dust Collector Types
4.2.3.1 Control of Mist, Gas and Vapor Contaminants
4.2.3.2 Gaseous Contaminant Collectors
4.2.3.3 Selection of Air Filtration Equipment
4.2.4 Fans
4.2.4.1 Basic Definitions, Fan selection

5.0 Non-Standard Condition **5**

5.1 Corrections for water vapor in air (Relative Humidity)
5.2 Density Correction factor
5.3 Air flow, Velocity Pressure, Vapor generation, System design

6.0 HVAC and makeup air systems **5**

6.1 Introduction of HVAC
6.2 Makeup air systems
6.3 Placement of supply registers, Supplied-air islands
6.4 HVAC component and system types

7.0 Testing of Ventilation Systems **5**

7.1 Introduction
7.2 Pressure Measurement, Volumetric Flow Measurement
7.3 Air Velocity Instruments, Calibration of Air/Measuring Instruments
7.4 Evaluating Exhaust Systems

Particles/Seminar/Work Practices

Sr. No.	Particles/Seminars/Work Exercise	Hrs	Marks
1	Seminar on need of general ventilation in Factory	2	2
2	Seminar on need of local exhaust ventilation system in factory	2	2
3	Exercise on emission source behaviour and problem characterization of industrial ventilation	3	3
4	Seminar indoor air quality study	2	2
5	Exercise on air density, Velocity pressure, Duct diameter, selection of fan and air horse power etc.	4	3
6	Exercise on Design of General and Local /Exhaust Ventilation system	7	5
7	Introduction of Velometer and Anenometer Practical on measurement of velocity and pressure from LEV and General Ventilation installed for various occupations	10	9
	Total	30	25

Reference Books

1. Industrial ventilation "A manual of recommended practice": Committee on industrial ventilation, sold by ACGIH 1220 kemper – Meadow Drive, Cincinnati, CH 45240
2. D Jeff Burton, Industrial Ventilation Workbook, Edition III
3. Ventilation: 91 3rd International Symposium on Ventilation for Contaminant Control by : Robert T Hughes, Howard D Goodfellow, gyan S Rajhans
4. Industrial ventilation, A Manual of Recommended Practice Edition 14, by ACGIH
5. ***Industrial ventilation, A Manual of Recommended Practice Edition 28,2013, by ACGIH***
6. Industrial ventilation, A Manual of Recommended Practice Edition 23, by ACGIH
7. Vitalized Ventilation and Air Conditioning by ILG
8. ***Industrial Ventilation Workbook Edition 4 by D Jeff Burton***
9. Managing Indoor Air Quality by Shirley J Hansen
10. Indoor Air Quality by Phillip J Walsh, Charles S Dudney and Emily D Copenhaver
11. Indoor Air Quality: Design Guide by Milton Meckler
12. Controlling Radon Measurment, Mitigation and Prevention by Kenneth Q.Lao
13. Industrial Ventilation 23rd Edition,A Self sudy companion to the ACGIH ventilation manual

IH677 HAZARD IDENTIFICATION, ASSESSMENT AND CONTROL TECHNIQUES
CREDITS 6 (L=6)

SCHEME OF TEACHING

Sr. No.	Name of Topics	Marks (Theory)	Lectures Hrs. (Theory)
1	Types of accidents and performance rates	20	12
2	Accident and incident investigation reporting and analysis.	25	15
3	Safety appraisal and control techniques	25	15
4	Hazard identification and risk assessment techniques	35	20
5	Major accident hazard (MAH) Controls	45	28
	TOTAL		90

TOPICS & SUB TOPICS:

1. Types of accidents and performance rates 12

1.0 Definitions

1.0.1 Accidents – Reportable, Non-Reportable, Fatal, Non-Fatal. Near miss and loss time accidents. Disabling injury.

1.0.2 Accidents reportable under the factories act, ESI Act and Electricity Act.

1.1 Safety Performance Rates

1.1.1 Frequency rate, severity rate, incidence rate, frequency severity index, safety score.

1.1.2 Worked examples.

1.2 Types of disablement

1.2.1 Temporary and permanent disablement

1.2.2 Partial and total disablement

1.2.3 Time charges schedules in workmen's compensation act 1923

1.2.4 National and international standards.

1.2.5 Worked examples

2. Accident and incident investigation, reporting and analysis 15

2.0 Accident and incident investigation

2.0.1 Philosophy, purposes, process and types of investigations.

2.0.2 Identifying the key factors and the immediate and basic causes. Corrective action.

2.0.3 Agencies investigating accident.

2.0.4 Accident investigation form.

2.0.5 Methods of writing of accident investigation report.

2.1 Accident reporting

2.1.1 Reporting to authorities in statutory forms.

2.1.2 Writing reports. Essential elements

2.1.3 Reporting within prescribed time limits.

2.1.4 Reporting of dangerous occurrences.

2.2 Accident and incident analysis
2.2.1 Standard classification of factors associated with accident
2.2.2 Methods of collating and tabulating data.
2.2.3 Record keeping.

2.3 Safety appraisal and control techniques 15

3.0 Plant safety rules and procedures
3.1 Safe operating procedures (SOP)
3.2 Safety checklists.
3.3 Safety work permits
3.4 Plant safety inspections
3.5 Safety sampling
3.6 Safety survey.
3.7 Job safety analysis (JSA).
3.8 Safety inventory system.
3.9 Safety tag system
3.10 Total loss control and prevention

Hazard identification and risk assessment techniques **20**

4.1 Hazards and risks

4.1.1 Definitions and terminology for hazard and risk assessment
4.1.2 Difference between hazard and risk and their co-relation
4.1.3 Prioritization of hazards and risks
4.2 Hazard and risk progression chart
4.2.1 Hazard identification
4.2.2 Hazard analysis
4.2.3 Risk analysis
4.2.4 Risk assessment
4.2.5 Risk management
4.3 Hazard and risk analysis
4.3.1 Quantitative and qualitative risk analysis
4.3.2 Failure mode and effect analysis (FMEA).
4.3.3 Failure mode, effect and criticality analysis (FMECA)
4.3.4 Maximum credible accident analysis. Example of each
4.3.5 Preliminary hazard analysis (PHA) and Hazard Analysis (HAZAN).
4.3.6 Hazard and Operability study (HAZOP).
4.3.7 Management oversight review technique (MORT)
4.3.8 Incident Recall Technique
4.3.9 Critical incident review techniques etc.
4.3.10 Use of safety audit and checklists for Hazard Analysis.
4.4 Risk Assessment
4.4.1 Comparing analysed risks with acceptable criteria (permissible limits) and giving judgement for further safety measures if necessary.
4.4.2 Variety of risks and assessment methods including FTA, ETA etc.
4.4.3 Use of Computer Models.

5.0 Major accident hazard (MAH) controls **28**

5.1 Concept of MAH:
5.1.1 Definition of "Major Accident Hazard"
5.1.2 Identification and assessment of MAH units. criteria and classification of threshold quantities of hazardous materials.
5.1.3 Applicability of respective rules (MSIHC Rules or Rule 68-J, GFR).
5.1.4 Compliance of statutory provisions.
5.2 Assessment of fire, explosion and toxicity by Dow and Mond Index.

5.3 Assessment of reliability of vessels and safety fittings. Data of failures rates and its utility.
5.4 Gas dispersion, fire and explosion events.
5.4.1 Assessment of probability (frequency) and consequence (effect) of such hazardous events. Scenario identification and Consequence Analysis.
5.4.2 Computer modeling
5.4.3 Population density, vulnerable zones, probit equation and percentage fatality,
5.4.4 Types of damage and damage distances. Risk counter.
5.4.5 F-X and F-N curves
5.4.6 Criteria for acceptable risks. Assessment and areas of evacuation.
5.5 Safety audit, safety report and risk assessment report.
5.5.1 Preparation of safety audit as per IS:14489
5.5.2 Preparation of Risk Assessment Report and its compliance.
5.5.3 Preparation of Safety Report.
5.5.4 Use of identified risks and scenarios from safety audit, safety report and risk assessment report for emergency planning. Compliance.
5.6 Emergency planning (disaster management plans)
5.6.1 Preparation of Rehearsal of On site and off site emergency plans
5.6.2 Execution of chemical accidents (EPPR) rules. Role of govt., role of management local authorities and public.

REFERENCES

1. Accident prevention manual for industrial manual for industrial Operations, national Safety Council 425, North Michigan Ave, Chicago, Illinois, USA.
2. Encyclopedia of occupational Health and safety, fourth edition, ILO, Geneva.
3. Safety and Health for engineers, by Roger L. Brauer, Van Nostrain Reinhold, New York.
4. Loss prevention in the process industries, Frank P Lees, Butterworth Heinemann,
5. Occupational Safety Management & Engineering by Willi Hammer.
3. Safety At work by John Ridley.
4. Handbook of Industrial safety by K.U. Mistry, Siddharth Prakashan, 108 western plaza, Near Bhulka Bhavan School, Adajan Road, Surat – 395 009. (Gujarat)
5. Major Hazard Control – A Practical Manual, ILO, Geneva.
6. Chemical Process Safety Fundamentals with applications by Daniel A crawl and Joseph F. Louvar, Prantice Hall, New Jersey.

IH678 PHYSICAL ASPECTS OF THE ENVIRONMENT
CREDITS 5 (L = 4, P = 2)

SCHEME OF TEACHING:

Sr. No.	Name of Topics	Marks (Theory)	Lectures Hrs. (Theory)
1	Basic of Noise	4	2
2	Instrumentation for Sound Measurement	5	3
3	Sound Measurement Techniques	10	4
4	Effects of Noise	5	3
5	Control of Noise	12	9
6	Human Vibration	17	10
7	Heat Stress	17	10
8	Ionisation Radiation	20	12
9	Non Ionisation Radiation	10	7
	Total	100	60

TOPICS & SUB TOPICS

Noise

1. Basic of Noise 2

1.1 Physiology of Hearing, Definition, How to produce, Characteristics of Noise, Physics of sound, Properties of Noise

1.2 Operation with Decibels: Sound pressure, Sound Powar, Internsity, Conversion, Amplitude, Sound weighing

1.3 Kind of Noise

1.4 Limit of ACGIH, NIOSH, OSHA, Factory Act 1948

2.**Instrumentaion for Sound Measurement 3**

2.1 Types of Instruments: Sound Level Meter, Dosimeter, And Integrated Sound Level Meter, Octave Band Analyzer (Frequency Analyzer), Calibrator

2.2 Application, Purpose and use of Instruments

2.2Basic elements of Sound Level Meter with block diagram, Introduction of Microphone, Attenuator, Amplifier, Networking Weighing and display.

2.3 Definitions: Criterian Level, Exchange Rate and Threshold

3. **Sound Measurement Techniques 4**

3.1 Identification of Noise problem in Workplace, General Noise inspection data

3.2 Important points while planning noise measurement

3.3 Measurement Method

3.4 Addition Method

3.1 Background Noise Level Correction

3.2 Environmental Factor Consideration during Noise Survey

3.3 Contour (Noise Mapping)

3.4 Continuous, variable, Impulsive/Impact Noise Measurement

3.5 Noise Calculation: Dose, TWA, LA, Permissible Noise Exposure

3.6 Octave Band Analysis

4. **Effects of Noise** **3**

4.1 Audiometry

4.2Non audiometry

5. Control of Noise **9**

5.1 Basic Principles of noise control

5.2 Single and double wall transmission loss calculations.

5.3 Application of engineering Noise control measures

5.4 Vibration measurement and control

5.5 Sound level specifications

5.6 Personal Hearing- Protective Devices

5.7 Noise Monitoring Programme

6.Human Vibration **10**

6.1 Definitions: vibration, frequency, amplitude, acceleration, and resonance.

6.2 Types of vibration: Segmental and whole body vibrations and examples

6.3 Quantifying vibration level, vibration parameters, acceleration, velocity and displacement

6.4 Industrial Equipment causes vibration and reasons.

6.5 Health effects of hand and arm vibrations and its symptoms.

6.1 Accelerometer types, characteristic, frequency range and mounting of accelerometer.

6.2 Taylor-Pelmear classification of vibration-induced white finger by stages and The Stockholm Workshop classification scale for cold-induced vascular (blood flow) Symptoms in fingers with hand-arm vibration syndrome.

6.3 Vibration measurement, calibration, frequency analysis, force and impedance measurement , logarithmic scale and decibels, defining filter bandwidth and filter bandwidth considerations, environmental influences on vibration

6.9 Controlling exposure to vibrations with examples, safe work practices, employee education

6.10 Standards Or Guidelines For Exposure To Hand-Arm Vibration and whole body Vibration.

Heat Stress

7.1 **Introduction of Heat Stress**: **10**

Causal Factors,Definitions:Heat,Calories,Conduction,Convection,Evoprative Cooling,Radiation,globe Temperature, Metabolic Heat, Natural Wet Bulb Temperature, Dry bulb Temperature, Globe Temperature

7.2 **Investigation Guidel**ine : Employer and Employee Interview Examples"

7.2.1 Activity

7.2.2Assessment of Work

7.2.3. Walk around inspection

7.2.4 Work load Assessment

7.3 **Sampling Methods** : Body Temperature Measurement and Environmental Temperature Measurement

7.4 Wet bulb globe temperature index

7.4.1 Average Web Bulb Globe Temperature (WBGT)

7.4.2 WBGT measurement for Indoor

7.4.3 WBGT measurement for Outdoor

7.4.4 WBGT correction Factor

7.2 Permissible heat exposure threshold limit values

8. **Ionizing radiation** **12**

8.1 Definitions, Types of ionizing radiation: Alpha, beta, neutrons, X- radiation, gamma radiation, Atomic and nuclear structure, Radiation source: Natural and Manmade

8.2 Biological Effect of Radiation: Types of injuries, Relating dosage to damage

8.3 Standards and Guides

8.4 Monitoring Instruments: Film Badge,Thermoluminescence detectors, Pocket Dosemeter,Other dosemeter,Ionization Chamber, Geiger-Mueller Counters, Calibrator

8.5 Basic Safety Factors: Time, Distance and Shielding with Examples

8.6 Control Programmes : Consider the sources of radiation, consider operational factors, consider employee exposure potential, records
8.7 Radioactive Waste and Standards
8.8 Radiation protection and emergencies
8.9 Radiation Protection Rule and Act

9.Non-Ionizing Radiation 07

9.1 Review of electromagnetic energy spectrum
9.2 Physics of Non ionizing radiation (Microwave and radio Frequency)
9.3 Bioeffects of Non-ionizing radiation
9.4 Exposure criteria and future concerns

Practical/Seminar/Work Practices

Sr. No.	Particles/Seminars/Work Exercise	Instruments	Hrs	Marks
1	Demonstration and Practice of Sound Level Meter, Integrated Sound Level Meter, Noise Dosimeter, Calibrator	SLM, Dosimeter, Calibrator	2	2
2	Preparation of Noise Monitoring Form, Checklist, Interview sheet	-----	2	2
3	Workplace Noise monitoring in Workshop/Engineering Unit	SLM, ISLM, Calibrator	4	4
4	Personal Noise Monitoring in Industry/Bus Driver by using Sound Level Meter	Noise Dosimeter, Calibrator	4	4
5	Hand Arm and Whole body Vibration monitoring by using vibration meter/accelerometer	Vibration meter with attachment of accelerometer	4	3
7	Illumination measurement in Factory by using luxmeter	Lux meter	4	3
8	Environmental heat stress monitor in foundry operation by using quest heat stress monitor	Quest Heat Stress Monitor	4	3
9	Seminar on Ionisation and non ionization radiation (30 mins per student)		6	4
	Total		**30**	**25**

Reference Books

1. Bruel & Kjaer : Noise Control : Principles and Practice
2. Arnold P G Peterson & Ervin E Gross Jr. : Handbook of Noise Measurement
3. Peter L. Pelmear, William Taylor, Donald E. Wasserman : Hand-Arm vibration : A Comprehensive Guide for Occupational Health Professionals
4. A J Brammer & W. Taylor : Vibration Effects on the Hand and Arm In Industry
5. Donald C Gasaway : Hearing Conservation : A Practical manual and Guide
6. NIOSH: Manual for measuring occupational Electric and Magnetic Field Exposure
7. Vibration Effects on the Hand and Arm in Industry by A J Brammer and W. Taylor
8. Guidelines on Noise by American petroleum Institute
9. Environmental Radioactivity Edition 3, by Merril Eisenpud
10. Electron Impact Phenomena and the Properties of Gaseous Ions by F H Field
11. Low-Level Radioactive Waste Regulation : Science, Politics and Fear by Michael E Burns
12. A Handbook of Radioactivity Measurements Procedures by Natonal Council
13. Understanding Radioactive Waste Edition 3, by Raymond L Murray
14. Environmental Aspects of Nuclear Power by Geoffrey G Eichholz
15. and-Arm Vibration by Pelmear, Taylor and Wasserman
16. Hearing Conservation : A Practical manual and Guide by Donald C Gasaway
17. Noise Control in Industry : A Practical Guide by Nicholas P Cheremisinoff

18. Industrial Noise and Hearing Conservation by Ollishifiski and Harford
19. Extremely Low Frequency Electromagnetic Fields : The Question of Cancer by Bary W Wilson, Richard G. Stevens, Larry E. Anderson
20. Basic Industrial Hearing Conservation by Barr and Miller
21. An Introduction to Radiation Protection Edition 3 by Martin and Harbison
22. Hearing Conservation Programs Practical Guidelines for Success by julia Doswell Royster and Larry H Royster
23. Handbook of Noise Measurement by Arnol P G Peterson and Ervin E Gross
24. Occupational Noise Exposure Revised Criteria 1998 CDC
25. Radiation Protection (Which was xerox from notes given by Dr. Narayan)

IH 679 SAFETY ENGINEERING – 1

CREDITS 6 (L = 5, P = 0)

SCHEME OF TEACHING

Sr No.	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Plant design and layout	12	7
2	Housekeeping	12	7
3	Machine guarding	12	9
4	Machine tools	12	7
5	Lighting (illumination) and colour	20	12
6	Electrical safety	10	6
7	Static electricity	03	2
8	Fire and explosion	20	11
9	Material handling	10	5
10	Hand tools and power tools	05	3
11	Working at different levels	06	4
12	***SAFETY IN DEMOLITION OPERATIONS***	***02***	***2***
	Total	125	75

TOPICS & SUB TOPICS

1. Plant design and layout **07**

1.1 Citing Criteria
1.1.1 General and Environmental guidelines. Meteorological aspects
1.1.2 Separation distances
1.2 Need for planning and follow up
1.3 Plant layout and design. General principles for factory building Plant & equipment layout and fire protection
1.4 Statutory Provisions
1.4.1 Under the factories act and rules

1.4.2 1.4.2 Indian Standards National Building Code and other codes of practice
1.5 Ergonomic considerations for plant design and layout

2.0 Housekeeping 07
2.1 Housekeeping and its effects on safety
2.1.1 Indicators of bad housekeeping
2.1.2 Typical accidents due to bad housekeeping
2.1.3 Benefits of good housekeeping
2.2 Management of good housekeeping
2.2.1 Disposal of scrap and other trade wastes. prevention of spillage.
2.2.2 Marking of aisles, space and other locations.
2.2.3 Housekeeping contests
2.2.4 Use of colour as an aid for good housekeeping
2.3 Cleaning Methods
2.4 Employee assignment
2.4.1 Inspections and checklists
2.4.2 Role of preventive and productive maintenance for housekeeping
2.5 Concept of "Five S" (1) Seiri (Segregation) (2) Seciton (arrangement) 01
(3) Seiso (Cleaning) (4) Seiketsu (Maintenance of Standard) and (5) Shitsuke (Discipline)
2.6 Six Sigma
3.0 Machine guarding 09
3.1 Principles of machine guarding
3.2 Ergonomics of machine guarding
3.3 Design and types of guards
3.3.1 Design and selection of guards
3.3.2 Material for guard construction
3.3.3 Guarding of different types of machinery including special precautions for wood working, rubber, centrifugal machines and paper mill machinery.
3.3.4 Built in safety devices
3.4 Maintenance and repairs of guards.
3.4.1 Zero mechanical state (ZMS)
3.4.2 Incidental safety devices and tools
3.4.3 Lockout and Tagout
4.0 Machine tools 07
4.1 Definition and classification of machine tools
4.2 Safety in the use of power presses, shearing, slitting, cutting, bending, rolling, drawing, turning, boring, drilling, milling, shaping, planning, broaching, slotting, grinding and CNC machines.

4.3 Total productive maintenance (TPM) and care, periodic checks for safe operation
5.0 Lighting (illumination) and colour 12
5.1 Purpose and benefits of good lighting. Increase of safety and productivity due to good lighting.

5.1.1Principles of Illumination
Adequate illumination
5.1.2Glare, shadow, contrast and colour effect
5.1.3 Recommended standards of illumination
5.2 Types of light
5.2.1 Natural and artificial, direct and indirect
5.2.2 Light source, lighting fittings and types of artificial lighting
5.2.3 Design of lighting installation coefficient of utilization, light loss factor and day light factor

5.3 Effects of colour on safety
5.3.1 Colours to identify hazards
5.3.2 Indian standards
5.3.3 Accident prevention signs
5.3.4 Psychological effects of colour
5.3.5 Maintenance for lighting and colour.

6.0 Electrical safety **06**

6.1 Hazards of electrical energy
6.2 Physiology of electric shocks
6.3 Safe limits of amperages and voltages. Safe distance from high voltage Sources
6.4 Resistance of skin and other materials
6.5 Capacity and protection of conductors, joints and connections
6.6 Safety from portable electrical apparatus. Use of ELCB
6.7 Means of cutting of power
6.7.1 Overload and short circuit protection
6.7.2 No load protection
6.7.3 Earth fault protection
6.7.4 Protection against surges and voltage fluctuations
6.7.5 Hazards of "borrowed" neutral
6.7.6 Earth insulation and continuity tests
6.7.7 Earthing standards
6.7.8 Lockout and Tag out
6.8 Electric work in Hazardous Atmosphere
6.8.1 Hazardous area classification
6.8.2 Types of protection for electrical equipment in hazardous atmosphere
6.8.3 Criteria in their selection, installation, maintenance and use.
6.8.4 Latest types of flameproof fittings and equipment.
6.9 Lightening arrestors

7.0 Static electricity **02**

7.1 Introduction
7.1.1 Electrostatic charges and discharges (sparks)
7.1.2 Operations and machines generating static charge
7.2 Hazards and Controls
7.2.1 Earthing and Bonding
7.2.2 Recommended earthing resistance for control of electricity.
7.2.3 Static charge eliminators
7.2.4 Dip Pipes
7.2.5 Increasing conductivity with additives.
7.2.6 Handling solids with and without flammable vapours.

8. Fire & explosion **11**

Fire Phenomenon
Chemistry of fire
Stages of fire
Factors contributing to fire
Classification of fires
Common causes of industrial fires
Spread of fire
Determination of fire load
Design of building, plant, exists, etc. for fire safety and fire resistance of building materials

Prevention of fire

Types of Portable Fire extinguishers. Water systems. Carbon dioxide systems. Foam extinguisher system. Dry chemical extinguishing systems.

Halon alternatives

Hydrant and fixed installations

Special industrial fire detectors and alarms

Sprinkler Systems

Automatic fire detection and extinguishing

Special Safety Precautions

Control of fire and explosion in handling / processing flammable liquids, gases, vapours, mists, dusts etc.

PIPA for automatic fire and gas detection and getting probable scenarios on DCS.

Fighting fire-involving pesticides.

Electrical fire

Effects of combustion products.

Explosion phenomena

Deflagration

Detonation

Confined and unconfined vapor cloud explosion (VCE)

Boiling Liquid Expanding Vapor Explosion (BLEVE)

Fire emergency action plan and drill. Control room

9. Material handling 05

Manual handling

Kinetics of manual handling

Maximum loads that could be lifted or carried

Safe method and procedure for lifting and carrying of objects of different shapes, size and weight

Safe use of accessories for manual handling.

Storage of materials. Safety in stacking and un-stacking, floor loading conditions. Layout condition for safety in storage.

Ergonomics of manual handling and storage

Mechanical handling

Lifting machinery, lifts and hoists

Safety aspects in design and construction, testing, use and care, signaling, inspection and maintenance.

Safety in operation, inspection and maintenance of industrial trucks, cranes lifting tackles, loose gears, conveyors etc.

Types of ropes including Nylon and PP ropes.

Hazards of remote operated lifting machines.

Training of operators

Safe working load for all mechanical material handling equipment.

Competent persons in relation to safety legislation – duties and responsibilities

Worked examples

10. Hand tools and power tools 03

Main causes of tool accidents. Prevention and control of such accidents.

Centralized and personal tool issue system. Purchase, storage and supply of tools.

Inspection, maintenance and repair of tools. Detectable causes of tool failures. Tempering, safe ending and dressing of certain tools.

Safe use of various types of hand tools used for metal cutting, wood cutting and miscellaneous cutting work.

Special hand tools such as torsion tools, shock tools, non sparking tools safe use of hand tools in hazardous area.

Portable power tools and their selection, operation, inspection, maintenance, repair and safe use. Double protection. Dead man control (operation till the button is pressed).

11.Working at different levels **04**

Working at height

Incidence and seriousness of fall accidents

Safety features associateed with design, construction and use of stairways, ramps, working platforms, gangways, ladders of different types, scaffolds of different types including crawling board, Boatswain's while working at heights.

Safety bets their types, use and limitations. Whole body harness with double lifelines.

Fall arrestor device.

Work permit system.

Working in a confined space

Meaning of confined space

Vessel entry permit and its safe execution under supervision

Working underground

Hazards and controls

12 SAFETY IN DEMOLITION OPERATIONS ***02***

Planning and permit.

Planning the sequence of demolition

Safety precaution to be taken for and during demolition carrying out repairs, addition and alterations.

REFERENCE

1. Accident Prevention Manual for Industrial operations, national safety council, 425, North Michigan Ave., Chicago, Illinois, USA.
2. Encyclopedia of occupational health and safety, Fourth Edition, ILO, Geneva.
3. Safety and Health for Engineers, by Roger L Brauer, Van Nostrain Reinhold, New York.
4. Process Plant Layout by Mecklen Burgh
5. Safety at work by John Ridley.
6. Safety engineering by Jems CoVan
7. Engineering design for control of Workplace Hazards by Richard A. Wadden & Peter A Scheff, McGraw Hill Book Co.
8. More Great Safety Meeting Ideas by Ar Fattig
9. Lift Truck Fleet Management and Operator Training by Bud Cohan
10. Safety and Accident Prevention in Chemical Operation,Second Edition,Howard H.
11. What Went Wrong? By Trevor Kletz
12. Prudent Practices in th Laboratory (Handling and Disposal of Chemicals)
13. NIOSH A Technical Report : A guide to Industrial Respiratory protection
14. Safety Training methods by Revelle and Stephens
15. Accident Prevention Manual for Industrial Operations Edition 8 y National Safety Council

16. Handbook of Occupational Safety and Health by Lawrence Slote
17. Fundamentals of Industrial Safety and health by Dr K U Mistry 2012 Revised
18. Construction safety planning by David V Maccollum
19.The Six SIGMA Way: How GE, Motorola, and Other Top Companies Are Honing Their Performance by Peter S. Pande (Goodreads Author), Roland R. Cavanagh, Robert P. Neuman

IH680 SAFETY IN CHEMICAL INDUSTRY

CREDITS 4 (L = 6, P = 0)

SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	General	34	21
2	Storage hazards and controls	27	18
3	Process hazards and controls	30	20
4	Transfer of chemicals	20	08
5	Transportation of chemicals	12	05
6	Inspection, Testing & maintenance	27	18
	TOTAL	150	90

1.0 GENERAL 21

Inevitable place of Chemical Industry in society. Need of safety in chemical industry. Types of chemical industries.

1.1 Process flow chart and its importance for safety inspection

1.2 Types of Chemical Hazards – Hazards due to material (property), unloading and transfer, process, vessel or equipment, utility, pollution, fire explosion, toxic release, packing and loading etc. appropriate control measures.

1.3 Interpretation, use and training of material safety data sheets (MSDS)

1.4 Supervision by qualified supervisors

1.5 U.N, HAZCHEM and other classification of chemical. Classification as solid, liquid, gases, explosive, reactive, toxic, radioactive, corrosive etc.

1.6 Safety and Risk Phrases.

1.7 Criteria for sitting and safe layout of chemical plants

1.8 Statutory provisions

1.9 Information to workers (Safety Manual), Factory Inspectorate, District Authorities and the Public. Information to surrounding hospitals.

1.10 Instrumentation for safe plant operations. Auto controls, trips, alarms interlocks, PLC, DCS etc. for storage and process vessels.

2. Storage Hazards and Controls: 18

2.1 Receiving, Storing and Handling of Chemicals

2.1.1 Safe unloading procedure to storage tank or go-down

2.1.2 Purpose and design of dyke, its floor, slope, pit, valve and lining

2.1.3 Prevention of overflow, pressure, temperature and process flow.

2.1.4 Types of gauges and valves for the vessel, its inlets and outlets.

2.1.5 Need of remote and auto control valves.

2.2 Safety measures for storage tanks of Oleum, Acids, Alkalis, Chlorine, Ammonia, LPG and Ethylene oxide.

2.3 Safety of storing and using gas cylinders, colour coding, marking and ensuring safe connection of cylinder. Testing of safety fittings.

2.4 Design of storage shed or go down, retention basin, catch pot or dump vessel etc. safe placement of containers. Compatibility considerations.

3. PROCESS HAZARDS AND CONTROLS: 20

3.1 Safe design of process vessels and their fittings. Material of construction and lining depending on type of chemical and its process.

3.2 Hazards and controls in Unit Processes and Unit Operations including exothermic or runaway reaction, solvent distillation, toxic reaction and other hazardous processes evolving gas, dust vapor etc.

3.3 Use of measuring vessel for safe transfer, safe charging of material in close or vacuum system, use of scrubber, column, condenser, catch pot, vent, header and safe discharges. Use of appropriate gauges, valves, trips, alarms, interlocks, auto controls and other instrumentation. Safety features of DCS control room.

3.4 Process Safety Management .

Product Safety

Product Secret

3.5 Safety in Laboratory. Sampling and analysis.

4. **TRANSFER OF CHEMICALS** **08**

4.1 Pipeline Transfer

4.1.1 Safe transfer of chemicals by pipelines within and outside installations, above and underground and submarines.

4.1.2 Safety of pipelines

4.1.3 Work permit while opening or repairing pipelines of hazardous contents.

4.1.4 Colour coding, earthing, bonding and testing of pipelines

4.1.5 Work permit while opening or repairing pipelines of hazardous contents.

4.2 Avoiding use of air pressure transfer in open condition so as to cause hazard.

4.3 Transfer in closed system or vacuum with appropriate controls and with the use of PPE.

4.4 Safety in connection and operation of valves and fittings.

4. TRANSPORTATION OF CHEMICALS: 05

5.1 Safety precautions for transporting hazardous / toxic / flammable / explosive / radioactive substances by all modes.

5.2 Threshold quantities as per Public Liability Insurance Act.

5.3 Training to drivers, safety checklists for transport vehicles and use of "Tremcard".

5. INSPECTION, TESTING AND MAINTENANCE 18

6.1 Inspection techniques for plants, storage and reaction vessels

6.2 Checklists for routine inspection, preventive and break down maintenance.

6.3 Testing, certification and records in prescribed Forms.

6.4 Types of testing including NDT.

6.5 Fired and unfired pressure vessels, their design, construction, operation and testing. Compliance of codes and statutory provisions. Role of a competent Person.

6.6 Corrosion, erosion, location, causes, inspection and prevention. Cathodic protection.

6.7 Safe start up and shut down procedures emergency shutdown. Use of work permit or checklist.

REFERENCES

1. Laboratory Health and Safety Handbook : A Guide for the Preparation of a Chemical Hygiene Plan by R Scott Stricoff, Douglas B Walters
2. Accident Investigation and Loss Control by Jeffry W Vincoli
3. Product Labeling And Health Risks : By Louis A Morris
4. Guide to Safe Handling of Compressed Gases by Matheson

5. Responding to Community Outrage : Strategy for Effective Risk Communication by Peter M Sandman
6. Handbook of Occupational Safety and Health by Lawrence Slote
7. Accident Prevention Manual for Industrial Operations Edition 8 y National Safety Council
8. A Safe Place of Work by D W B James
9. Compendium of Safety Data Sheets for research and industrial Chemicals Part 4 by Keith and Walters
10. Compendium of Safety Data Sheets for research and industrial Chemicals Part 5 by Keith and Walters
11. Handbook of Emergency Response to Toxic Chemical Releases by Nicholas P Cheremisinoff
12. The MSDS - your Guide to Chemical Safety
13. Chemical Process Safety Fundamental with Applications by Daniel Crowl
14. Safety and Accident Prevention in Chemical Operation,Second Edition,Howard H.
15. Process Safety Management : OSHA Audit Protocol

IH 681 MEDICAL SURVELLIANCE & BIOLOGICAL MONITORING

CREDITS 3 (L = 3, P = 0)

SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Medical Surveillance	25	15
2	Introduction of Biological Monitoring	10	5
3	Sampling, Laboratory Methods and Result	23	15
4	Biologic Marker	17	10
	Total	75	45

1.0 Medical Surveillance **15**

1 Occupational Health Services- Role of medical and non- medical team, required facilities and equipment

1.1 Occupational Health Management, Occupational & Environment Medicine (OEM)

1.1.1 Scope of OEM, Prevention in OEM, Discipline of environmental and occupational Medicine.

1.2 Medical Surveillance Programme

1.2.1 Industrial/ occupational site medical Programme

1.2.2 Medical history and Pre/periodical-employment screening

1.2.3 First medical examination

1.2.3 Termination examination

1.2.3.1 Return to work assessment

1.2.4 Emergency and non- emergency treatment: First Aid First aid for burns, fractures, suffocation, toxic ingestion, bleeding, wounds and bandaging. Artificial respiratory techniques, First aid and antidotes for poisoning

1.2.5 Medical Records and program review.

1.2.6 Ambulance van

1.2.7 Medical surveillance programme for chemicals mentioned in schedule II and III as per Factory Act 1948

1.3 Integration of Industrial Hygiene and Medical Surveillance data.

2.0 Introduction of Biological Monitoring **5**

2.1 General Principles

2.2 Application of Biological Monitoring in various occupations

2.2.1Advantages of Biological Monitoring

2.2.3 Limitation of Biological Monitoring

3.0 Sampling, Laboratory Methods and Result **15**

3.1 Sampling Strategies

3.2 Collections of Samples: Urine, Blood faeces, adipose tissue, hair, nail, saliva, breast milk, sputum or amniotic fluid

3.2.1 Sources of possible error

3.2.2 Interpretation of Result

3.3 Confidentiality, Ethical Consideration, data interpretation

Biological monitoring for specific substances/Chemicals

3.3.1 As per Factory Act: Schedule II and III

3.3.2 Metals: Pb, Hg, As, Cd, Cr, Mn, Cu and required metal causes occupational health related problem in India

3.3.3 Solvents: Benzene, Carbon disulfide, Vinyl Chloride and required solvents causes occupational health related problem in India

3.3.4 Pesticides (Any four) causes occupational health related problem in India

3.3.5 Dust (Any Four) causes occupational health related problem in India

3.3.6 Gases (Any Four) causes occupational health related problem in India

4.0 Biological Marker **10**

4.1 Rationale for the development and use of biomarkers

4.2 Definition and classification

4.3 Biomarker of susceptibility

4.4 Characterization of biomarkers

4.5 Validation of biomarkers

4.6 Biologic samples: Non-invasive, Minimal invasive and invasive sampling

4.7 Biotransformation: Metabolism of xenobiotic compounds

Reference Books

1. Matheson, Effects of Exposure to toxic gases – First Aid and Medical Treatment – Second Edition
2. Biological Monitoring, Edited by Shane S.Que Hee
3. Preventing Illness and Injury in the Workplace
4. Surface and Dermal Monitoring for Toxic Exposures by Shirley A.Ness
5. The Blood Borne Pathogen Standards by John T O'Nel
6. Get the Health Care you Deserve: A Manual for Managers by Solomayer and Boardman
7. Guidelines for Develooping Community Emergency Exposure Levels for Hazardous Substances by Committee on Toxicology National Research Council
8. Effects of Exposure to Toxic Gases: First Aid & Medical Treatment Edition 3 by Matheson Gas Products
9. The Dose Makes the Poison Edition 2 by Allice Ottoboni
10. Infectious Waste Management by Frank L Cross, Howard E Hesketh, P Kay Rykowski (2 copies)
11. Pesticide Users' Health and Safety Handbook by Andrew Watterson
12. Reproductive Health Hazards in the Workplace by Office of Technology Assessment Task Force
13. Medical Toxicology, Diagnosis and Treatment of Human Poisoning by Ellenhorn and Barceloux

IH682 HAZARDOUS WASTE MANAGEMENT
CREDITS 4 (L = 4, P = 0)

SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Introduction to waste, definitions, types, characteristic, physical and chemical property.	15	10
2	Solid waste management	15	10
3	Hazardous waste management Definitions, types, EPA, RCRA, CERCLA international act for hazardous waste, Environmental impact assessment	10	6
4	Volume reduction, strength reduction, equalization and proportioning of wastewater	15	10
5	Hazardous waste treatment technology- Physical treatment, chemical treatment, biological treatment.	8	5
6	Major industrial waste: Dairy industry, Pharmaceuticals industry, Textile industry, Pesticide waste, Acid waste in chemical industry, Metal plating industry, Petrochemical, Glass industry waste, Paint waste, hazardous household waste, waste oils, PCB waste, mine waste	22	12
7	Biomedical waste and its management.	8	3
8	ACTS: Hazardous waste act and rules, biomedical waste act, etc	7	4
	Total	100	60

TOPICS & SUBTOPICS

1.0 Introduction to waste, definitions, types, characteristic, physical and chemical property. 10

Sampling, method, preservation of liquid waste sample

BOD, COD, ThoD, TOC, TOD and Bioassay test

Effluent treatment for domestic waste, ET for Industrial waste in a detail, functions of different pathways, limitation, problems and its solutions

Difference between industrial and municipal waste, environmental impact of industrial waste.

Chlorine, ozone, UV treatment of waste.

Neutralization of waste

2.0 Solid waste management 10

2.1 Definitions, types, characteristic of solid waste, industries generating solid waste

2.2 Factors affecting generation of solid waste, flow chart for solid waste collection

2.3 Collection and their factors, transportations and storage of solid waste

2.4 Treatment and disposal- Incineration, composting, mechanical separator, magnetic separator, landfill, pyrolysis, sanitary landfills, trench method, area method, pit and quarry method, etc.

3.0 Hazardous waste management 06

Definitions, types, EPA, RCRA, CERCLA international act for hazardous waste, Environmental impact assessment

Cradle to grave approach, Priority in Hazardous Waste management, superfund amendment and reauthorization act 1986, Dose-response relationship, effect of hazardous waste on aquatic system and how do they enter the foods chain, route of entry, fate of toxicant in body.

4.0 Volume reduction, strength reduction, equalization and proportioning of Wastewater 10

Removal of suspended solids- sedimentation, flotation, and screening.

Removal organic solids by- Lagooning, activated sludge treatment, aeration, trickling filter, wet combustion, anaerobic digestion, well injection, foam phase separation, pure oxygen treatment, etc.

Removal inorganic dissolved solids by- evaporation, dialysis, ion exchange, and reverse osmosis, etc.

Treatment and disposal of sludge solids- Aerobic and anaerobic digestion, vacuum filtration, drying beds, drying and incineration, sanitary landfills, etc.

5.0 Hazardous waste treatment technology-

Physical treatment, chemical treatment, biological treatment.

05

6.0 Major industrial waste: 12

Dairy industry, Pharmaceuticals industry, Textile industry, Pesticide waste, Acid wastes in chemical industry, Metal plating industry, Petrochemical; Glass industry waste, Paint waste. Hazardous household waste, waste oils, PCB waste, mine waste

7.0 ***Biomedical waste and its management.*** ***03***

Biomedical Waste Management: Definition, Health ad environment issues, Category of waste, segregation ,collection and transportation, Treatment systems

8.0 ACT 04

8.1 Hazardous wastes (management and handling) rules 1989

8.2 Bio-Medical Waste (Management and Handling) rules 1998

Reference Book

1. Charles A Wentz Mc Graw Hill International Edn., Hazardous Waste Management
2. US EPA: Encyclopedia of Environment and Pollution Control
3. Hazardous Material Emergiencies : Response and Control Edition 2 by Johm R Cashman
4. Waste Minimization and Cost Reduction for Process Industries by Poul N Cheremisinoff
5. Environmental Health Hazards : Recognition and Avoidance by Donald E Waite
6. Hazardous Waste Handbook for Health and Safety by Martin, Liwppitt and Prothero
7. Managing Hazardous Substances Accident by Al J Smith
8. Hazardous Ocupational Environments by Paul N Cheremisinoff
9. Infectious Waste Management by Frank L Cross, Howard E Hesketh, P Kay Rykowski
10. Protecting Personnel at hazardous Waste sites Edition 2 by Martine and Ilevine
11. Hazardous Materials and Hazardous Waste Management by Gayle Woodsite
12. Solving the hazardous Waste Problem y EPA
13. Sara Title III Intent and Implementation of Hazardous Materials Regulations by Frank L Fire, Nancy K Grant, David H Hoover
14. The Complete Guide to the Hazardous Waste Regulations Edition 2 by Travis P Wagner
15. ***Joseph A Salvato Environment Engineering and Sanitation : 4th Edition***
16. ***Indian Legislation on related to Solid Waste, Hazardous Waste and Biomedical . MoEF Govt . Of India (Use latest One)***

IH 683 PRINCIPLES OF ERGONOMICS
CREDITS 5 (L = 4, P = 2)

SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Introduction to occupational ergonomics, history and human work physiology	10	***06***
2	Engineering Anthropometry	5	3
3	Human Biomechanics- Muscles strength, Assessment of muscles strength, Measuring techniques, and the strength test protocol	10	5
4	Manual material handling	5	3
5	Man- machine communication: Words and symbols, Displays, Controls	***15***	***12***
6	Seating and Posture	7	4
7	Tool Design	10	6
8	Workstation design, workplace design, office workstations	16	***07***
9	Ergonomic evalution method	***22***	***14***
	Total	100	60

1.0 Introduction to occupational ergonomics, history, man machine interrelationship.

12

1.1 Human work physiology

1.1.1 Structure of human skeleton

1.1.2 Capacity for physical work, energy cost of work, heart rate, matching people and their work, rating the perceived effort, work/ rest cycles

1.1.3 Physiology of body movement- bones joints and muscles.

1.1.4 Muscles strength, endurance and fatigue

1.1.5 Problems Associated With Load Carrying and solutions to this problems and guidelines to avoid this problem

2.0 Engineering Anthropometry- Definition **3**

2.1 Variability in body shapes and sizes

2.2 Sources of anthropometeric variability

3 Human Biomechanics- **5**

3.1 Muscles strength, lever system in the body

3.2 Assessment of muscles strength by EMG

3.3 Measuring techniques, and the strength test protocol.

4.0 Manual material handling. **3**

4.1 The body as energy source.

4.2 Matching people with their tasks.

4.3 Training for safe lifting practices: rules for lifting**.**

4.4 Personal Selection For material handling.

4.5 Assessment methods.

4.6 Screening techniques.

4.7 Permissible loads for manual material handling.

4.8 Examples - Limits for lifting, lowering, pushing, pulling and carrying.

4.9 The elements of lifting task

5 Man- machine communication: Words and symbols, Displays, Control **3**

5.1 Meaning, communication and message

5.2 Perceptual process in written communication

5.3 Typographical features of written communication

5.4 Alternative ways presenting information and instruction

5.5 Readability

5.6 Visuals displays, design

5.7 VDU design and use

5.8 Auditory displays- warnings displays, tracking displays

5.9 Types of control

5.10 Factors important in control design

6 Seating and Posture **4**

6.1 Orthopedic aspects of sitting

6.2 Muscular aspects of sitting

6.3 Behavioral aspects of sitting

6.4 Seat design

7.0 Tool Design **6**

7.1 Introduction

7.2 Anatomy of hand and anthropometry of hand

7.3 Types of Grip

7.4 Principles of hand tool

7.5 Vibration ,controlling hand arm vibration exposure

7.6 Attribute of common industrial hand tool- shovels, hammers, saws, pliers, screwdrivers, knives etc

7.7 Attributes of common industrial power tools- power drills, nut runners, etc

7.8 Safety while handling tools

7.9 Tool evaluation checklist

8.0 Workstation design, workplace design, office workstations **07**

8.1 General principles, sitting vs. standing.

8.2 Physical requirements of the workplace

8.3 Social requirements in the workplace

8.4 Workstation, workplace and office workstation checklist

9.0 Ergonomic hazard evaluation method **14**

9.1 NIOSH lifting equation

9.2 Single task

9.3 Multiple Task

9.4 RULA's method

9.5 REBA

Practical/Seminar/Work Practices

Sr. No.	Particles/Seminars/Work Exercise	Hrs	Marks
1	Anthropometry – Practical measurements of a few body dimensions, its treatment and application	3	03
2.	Skin Fold Caliper for measurement of body dimension	3	02
3	Use of Dynamometer for measurement of force	3	02
4	NIOSH lifting Index: Manual lifting or loading unloading activity: Single Task Multiple Task	5	04
5	Apply of RULA method for assessing	3	02

	ergonomic problem		
6	Apply of REBA method for assessing ergonomic problem	3	02
7	Designing of IT work station, Administration department, tool designing, work area by using principles of Ergonomic	5	05
8	Seminar	5	05
	Total	30	25

Reference Book

1. Ergonomic design for people at Work, volume III, Eastman Kodak, Human factors section, Health Safety and Human Factors Laboratory
2. Ergonomic design for people at work Vol. I, Eastman Kodak, Human factors section, Health Safety and Human Factors Laboratory
3. Fitting the Task to the man by E Gradjean, 4th ed. 1988
4. Ergonomics by Murrell K.F.H., Champian and Hall, London.
5. Ergonomics at work by David J. Oborne, John Wiley and Sons
6. Ergonomics By Pennathur Krishnamoorthy.
7. Human factors in Engineering and Design by EJ Mc Cornick.
8. Research technique in Human Engineering by Chapanis, A., Baltimore, John Hopkins.
9. A pain in your workplace? : Ergonomic Problems and Solutions by Health & Safety Executive
10. NIOSH Elements of Ergonomics Programs : A Primer based on Workplace Evaluations of Musculoskeletal Disorders by CDC
11. Ergonomics in Backpain : A guide to Prevention and Rehabilitation by Khalil, Rosomoff
12. Ergonomics of Workstation Design by T O Kwalseth
13. Ergonomics at Work Edition 2 by David J Obrne
14. VDTs and Radiation Safety
15. Working with Displays VDTs and Vision
16. Revised NIOSH Lifting Equation by NIOSH
17. ***The Rapid Entire Body Assessment (REBA) method developed by Dr. Sue Hignett and Dr. Lynn McAtamney , ergonomists from University of Nottingham in England (Dr. McAtamney is now at Telstra, Australia) Cornell University Ergonomic***

18 **.Web*ergo.human.cornell.edu/ahReba.html***

IH 684 SAFETY ENGINEERING – II

CREDITS 5 (L = 6, P = 0)

SCHEME OF TEACHING

Topic No	Name of Topics	Marks (Theory)	Lectures Hrs (Theory)
1	Metallurgical Industry	27	20
2	Textile Industry	16	15
3 & 4	Construction Industry and IT Industry	16	15
5	Cement Industry	15	05
6	Fertilizer Industry	12	05
7	Pesticide Industry	11	05
8	Petroleum (Refinery)& Petrochemical Industry	12	10
9	Miscellaneous Industries	20	15
	Total	150	90

SCHEME OF TEACHING:

1. Metallurgical Industry 20

Manufacture of Basic Metals

Manufacture of Ferrous & Non – Ferrous Metals

Hazards and controls in steel industry

Metallurgical processes

Foundry operations of mixing of materials, mold and core making melting (furnaces), casting, knockout and dressing, forging etc.

Working on hot rolling and cold rolling mills.

Hazards and safety measure of heat treatment operations.

Hazards and safety measures of other operations like blasting, welding and cutting, brazing, soldering, polishing, buffing, cleaning etc.

2. Textile Industry 15

Introduction to Textile Industry. Flow chart of textile processes including synthetic textile industry.

Machine guarding for blow room, spinning, weaving and processing machinery for cotton and synthetic fiber industry.

Fire, explosion and health hazards and their control measures.

3. Construction Industry 15

Basic parameters governing the safety in construction such as site planning and layout, safe access, safety works permit and checklist, good housekeeping.

Safety in the use of construction machinery and equipment.

Underground and above ground works. Hazards and controls. Statutory safety requirement.

Health and welfare of construction workers – Dust, noise, vibration, heat, humidity and other hazards. First aid, medical examination and health records.

4. Information Technology

Safety features of manufacture of electronic valves, tubes, other electromagnetic devices, semiconductors and superconductors.

Safety features of manufacture of computers, radio, television and communication equipment and apparatus.

Hazards involved in testing of IT equipments and their safety measures.

5. Cement Industry 05

Types of cement and manufacturing process

Hazards due to bulk storages of raw materials, conveyers and machineries, rotary kiln, mixers and driers, loading, unloading and packing etc.

Control measures for dust collection, noise, vibrations, heat exposure etc.

Cement pneumoconiosis.

6. Fertilizer Industry 05

Types of fertilizer and manufacturing processes

Flow chart and safety aspects of machinery in use.

Hazards due to bulk storages, processes, transfer and transportation of chemicals, dust, noise etc. and their control measures.

7. Pesticide Industry 05

Types of pesticides and their lethal dosages

Marking, labeling and safe disposal of containers

Manipulation processes, their hazards and controls.

Medical treatment in case of exposure. Antidotes.

8. Petroleum (Refinery) & Petrochemical Industry 10

Petroleum classification and hazards due to petroleum products.

Hazards of bulk storages

8.2.1. Storage of Naptha, propylene, ethylene, xylene, benzene, LPG, Petrol, diesel, kerosene etc and their control measures.

8.2.2. Testing of storage vessels and their safety fittings.

8.2.3. safety in Pipeline transport

Stages of manufacturing processes.

Hazards and controls during manufacturing process. Testing of pressure vessels.

DCS control rooms and instrumentation for safety.

Fire and gas detectors and fire fighting system. PIPA Software.

Filling of Road and Rail Tankers

Safety measures associated with filing of tankers.

Safety of workers employed for this purpose.

OISD norms for petroleum industries

9. Miscellaneous Industries 15

Pottery and Ceramic Industry:

9.1.2 Raw materials and process flow chart

9.1.3 Hazard of raw material mixing and manufacturing processes.

9.1.4 Machine guarding

9.1.5 Control measures for dust, heat, noise, vibration and other hazards. Temperature control near kilns and glaze driers. Local exhaust ventilation.

9.1.6 Medical examinations of workers

9.1.7 Washing facilities

9.1.8 Statutory provisions

Glass and quartz industry

Products of Glass Industries

Raw materials and process flow chart.

Hazards of Raw Material mixing and manufacturing processes.

Hazards of quartz grinding and handling.

Machine guarding.

Control measures for dust, heat, noise, vibration, glass breaking and flying fuel and exhaust gases. Other hazards. Temperature control near furnaces and heaters. Local exhaust ventilation. LEV for Quartz, Akik and Diamond grinding and polishing.

Washing facilities

Statutory provisions.

Paper Industry

Products of paper industries. Pulp, paper and containers.

Raw materials and process flow chart.

Hazard of raw material mixing and manufacturing processes.

Machine guarding. Nip Guards near moving rollers. Trips and interlocks. Guards near straw cutters and paper cutting blades. Fencing or conveyer feeding to Pulper for preventing fall accidents.

Control measures for grass, dust, waste paper, digesters, bleaching agent like Cl_2 or H_2O_2, steam exposure, noise, vibration and other hazards.

Washing facilities.

Statutory Provisions

Sugar Industry

Process flow chart from sugar canes entry to the sugar godown and molasses tanks.

Hazards of machinery for sugar cane unloading, crushing, juice making boiling, evaporating, centrifugating, sugar grading and packing.

Machine guarding for V-belt drivers, gear wheels, fly wheels, rollers etc.

Control of dusting from baggase, coal, SO_2, noise and vibration.

Control of hazards from Juice Heaters, Evaporation and Boiling Pans, Syrup and Molasses Tanks

REFERENCES

1. Conference on Advanced Composites
2. CDC - National program for occupational safety and health in construction
3. Construction Industry
4. Construction lost-time injuries
5. Crane or Derrick Suspended Personnel Platformss
6. NIOSH Alert - Preventing Injuries and Deaths from Falls during Construction and Maintenance of Telecommunication Towers
7. NIOSH Construction
8. NIOSH Health and safety guide for concrete products industry
9. NIOSH health and safety guide for construction and related machinery manufacturers
10. NIOSH Health and Safety Guide for Highway and street construction
11. Off-shore construction
12. Excavating and Trenching operations
13. NIOSH safety and health in Soldering and brazing
14. NIOSH alert - preventing entrapment and suffocation caused by the unstable surfaces of stored grain and other materials
15. NIOSH Research Report standardization of friction testing of industrial working surfaces
16. NIOSH health and safety guide for bulk petroleum plants
17. Spray Painting good practices for employees : Your health and saafety are in your hands
18. NIOSH Health and safety guide for paperboard - container industry
19. Refinery Process by Maharshi Mehta
20. NIOSH Research Report Engineering control Technology assessment for the plastics and resins industry
21. NIOSH health and safety guide for plumbing, heating, and air conditioning contractors
22. NIOSH Employee health and safety in lithographic printing Industry
23. NIOSH health and safety guide for the printing industry
24. NIOSH good work practices for tannery workers

IH685 LEGISLATION ON SAFETY HEALTH AND
CREDITS 5 (L = 6, P = 0)

SCHEME OF TEACHING:

Sr. No.	Name of Topics	Marks (Theory)	Lectures Hrs. (Theory)
1	Legislative process	05	1
2	ILO Convention and recommendations	07	3
3	The factories act, 1948 and rules	45	36
4	Other legislations	40	36
5	Legislations on environmental protection	28	14
	Total:	150	90

TOPICS & SUB TOPICS

1. Legislative Process **01**

Meaning of legislation, legislative process and other legal terminology such as statement of objects and reasons, bill, act, rules, amendment, section rule, schedule and form, preamble, penal section, prosecution, judicial process, judgment, citation etc.

2. ILO convention and recommendations **03**

2.1 Role of ILO for Safety, Health & Environment

2.2 ILO Conventions and Recommendations in the furtherance of safety, health and environment. Some examples.

Year	Convention	Recommendation
1981	155-OHS	164-OHS
1985	161-OHS	171-OHS
1988	167-Safety and health in construction	175-safety and health in construction

1990	170 – safety in the use of chemicals at work	177 – Chemicals
1993	174 – Prevention of major industrial accidents	181 – Prevention of major industrial accidents
She as human right issue. Trade policy-affecting OHS.		

3.0 The factories act, 1948 and the Gujarat factories rules 1963: 36

3.1 History of the safety movement in the world and India, including the factories acts and their amendments.

3.2 Provisions of the factories act 1948 and Gujarat Factories Rules made their under with special reference to definitions u/s 2, chapter 3, 4-, 4-A, 5,6,9 & 10 and schedules and forms pertaining to dangerous operations and hazardous processes.

4.0 Other legislations: 36

Sections pertaining to safety, health and environment from the following statutes (latest with last amendment)

4.1 The Gujarat Lifts and Escalators Act 2000 and Rules 2001.

4.2 Boilers Act 1923, Gujarat Boilers Rules 1966 and Indian Boiler Regulations 1950 (IBR).

4.3 Electricity Act 2000 and Rules 2000.

4.4 Petroleum Act 1934 and rules 1976.

4.5 Explosives act 1884 and rules 1983

4.6 Static and mobile (Unfired) Pressure Vessels Rules 1981.

4.7 Gas Cylinders Rules 1981.

4.8 Insecticides act 1968 and Rules 1971.

4.9 Rules for transportation of hazardous goods from the motor vehicles rules 2000.

4.10 The dock workers (Safety, health & welfare) Act 1986, Rules and Regulations 1990.

4.11 The dock workers (Safety, health & welfare) Act 1986, Rules and Regulations 1990.

4.12 The buildings and other construction workers (Regulation of employment and conditions of service) Act 1996 and the Central Rules 1998.The buildings and other construction workers (Regulation of employment and conditions of service) Act 1996 and the Central Rules 1998.

5.0 Legislation on environmental protection: 14

5.1 Water (Prevention and control of pollution) Act 1974 and Rules 1975.

5.2 Air (prevention and control of pollution) act 1981 and rules 1982.

5.3 Environment (protective) Act 1986 and rules 1986.

5.4 Manufacture, Storage and import of hazardous chemicals rules 1989.

5.5 Rules for the manufacture, use, import, export and storage of hazardous microorganisms, genetically engineered organisms or cells.

5.6 Chemical Accident (Emergency Planning, Preparedness and Response) Rules 1996.

5.7 Recycled plastics manufacture and usage rules 1999.

5.8 Ozone Depleting Substances Rules 2000.

5.9 Batteries (Management & Handling) Rules 2001.

REFERENCES

1. Casualty Claim Practice by James H Donaldson
2. Consumer Product Safety Law by McGillan and Brown
3. Occupational Safety and Helath Law by rothsteain
4. National Electrical Code 1981 by NFPA
5. General Safety Code Volume I by Alaska Department of Labor
6. General Safety Code Volume II by Alaska Department of Labor
7. General Safety Code Volume III by Alaska Department of Labor
8. Industrial Safety is Good Business by Mottel Long and Morison
9. OSHA Complaince & Management Handbook by Charleston C K Wang Esq.
10. Fire Law by Thomas D Schneid
11. The Clean Air Act Amendments and Update Strategies for the 1990's by Hale and Dorr
12. The Clean Air Act Amendments Strategies for the 1990's by Hale and Dorr
13. The Americans with Disabilities Act : A Practical Guide for Managers by Thomas D Schneid
14. Loss Control for Small to Medium Size Business by Robert E Brissbin
15. The Gujarat Factories (Amendment) Rules, 1995 by K U Mistry
16. The Factories Act 1948 with the Maharashtra Factories Rules, 1963
17. The Environment (Protection)
18. ILO Conventions and recommendations on safety, health and environment
19. Book of bare acts and rules mentioned in Topics and subtopics (Para 4 to 6).
20. Handbook of industrial safety K.U. Mistry, Siddarth Prakashan, 108, Western Plaza, Near Bhulka Bhavan School, Adajan Road, Surat – 395 009. (Gujarat)

21. CPCB Manual of Environmental Legislation

IH686 ADVANCED SAFETY MANAGEMENT AND ENGINEERING TECHNIQUES

CREDITS 3 (L = 5,P = 0)

SCHEME OF TEACHING

Sr. No.	Name of Topics	Marks (Theory)	Lectures Hrs. (Theory)
1	Plant Sitting	12	6
2	Bulk storages	15	11
3	Plant inspection	07	03
4	Safety in transportation	10	06
5	Safety through design	10	06
6	Pressure system design	20	10
7	Control system design	07	03
8	Principles of reliability engineering	07	03
9	Risk management	10	08
10	Emission and dispersion	10	07
11	Biological hazards	03	02
12	Advanced fire protection systems	06	04
13	***Lessons from World Disasters***	***08***	***06***
	Total	125	75

TOPICS & SUB TOPICS

1. **Plant siting** **6**

Sitting criteria for hazardous industries.

Meterological factors

Environmental guidelines

Reports to authorities

Environmental impacts Assessment (EIA)

Environmental statement

Definition, inventory, preparation and submission of report to competent authorities.

Separation distances and its relevance. Statutory requirements. National and international standards.

2. Bulk storages **11**

General Considerations

NFPA & OISD Standards

Design of storage layout. Dyking requirements. Incompatibility Criteria.

Types and Safe Layout of Storages.

Tank layout of LPG, Chlorine, Ammonia, EQ and Oleum.

Isolated storages

Mounded storages

Cryogenic storages

3. Plant inspection **03**

Non destructive tests: its significance and limitations.

Radiography, Ultrasonic, Magnetic Particle Methods, Eddy Current Method, Dye Penetration test.

Strain measurement

4. Safety in transportation **06**

Transportation risk estimation

Safety criteria for transportation

Threshold qualities

Statutory provisions

Pipeline transport

Road transport

Rail transport

Sea transport

Air transport

Hazard Communication

UN No., HAZ CHEM No.

Safety and risk phrases

TREM CARD

Day night release and consequences

Emergency planning for the transportation of hazardous chemical

5. Safety through design 06

The component involved in design process.

Preliminary hazard analysis (PHA) and HAZOP exercise

Different tires of protection and redundancy

General considerations of design for emergency shutdown and start up

Operating considerations

6. Pressure system design 10

Pressure system components

Fundamentals of pressure vessel design

Codes, standards and specifications

Over pressure protection

Pressure relief and blow down

Basic requirements of protection and their practical application for Flare Systems.

7. Control system design 03

Process and control system characteristics

Instrument system for safety and safety features of instruments.

Safety integrity levels.

Testing and certification of vessels and equipments and their records.

8. Principles of reliability engineering 03

Principles of Reliability engineering

Application of reliability for plant design

Engineering concepts of critical equipments and devices

9. Risk management 08

Definition of risk and allied terminology

Acceptable risk. Individual and group risk. Social risk. ALARP (as low as reasonably practicable) concept.

Computation of risk

Risk assessment techniques – detailed and quick

Risk assessment report – its preparation and utility

Engineering feasibility.

10. Emission and dispersion **07**

Liquid discharge, gas discharge, vapour – liquid discharge, fugitive emissions and measurement.

Ambient air monitoring

Stack monitoring

Risk contours, population density, probit equation for probability assessment, consequence analysis and inference of scenarios. Software modeling.

Safety audit and safety report. Their preparation, assessment and utility for emergency planning.

On site emergency plan.

Off site emergency plan.

11. Biological hazards **02**

Biological agents and sources

Hazards and controls. Biohazard symbol. Safety aspects of genetic engg.

Sick building syndrome.

Statutory provisions

12. Advanced fire protection systems **04**

Halon alternatives. Comparision on the basis of advantages and disadvantages.

At once Fire / Gas Detection System

Linear heat detection system and its suitability.

Tank farm fire fighting system.

Design of a Fire Training Ground.

13. LESSONS FROM THE WORLD DISASTERS ***06***

Case studies and lessons learnt form major industrial disasters.

Flixborough Seveso, Chernobyl, Bhopal, Mexico etc.

REFERENCES

1. Accident prevention manual for industrial operations, national safety council 425, north Michigan Ave, Chicago, Illinois, USA.
2. Encyclopaedia of occupational health and safety, fourth edition, ILO, Geneva.
3. Safety and Health for Engineers, By Roger L Brauer, Van Nostrain Reinhold, new York.
4. Loss Prevention in the process industries, Frank P Lees, Butterworth Heinemann.
5. Occupational safety management and engineering by Willi Hammer

6. Handbook of industrial safety by K.U.Mistry, Siddarth Prakashan, 108, Western Plaza, Near Bhulka havan School, Adajan Road, Surat – 395 009. (Gujarat).
7. Major Hazard Control – A Practical Manual, ILO, Geneva.
8. Chemical Process Safety Fundamentals with Applications by Daniel A Crowl and Joseph F Louvar, Prantice Hall, New Jersey, USA.
9. Effects and Damage Calculations of accidents with hazardous materials, M. Molag, T.N.O Course Book – Risk Analysis, T.N.O Apaldoorn, Netherlands.
10. Gas dispersion modeling, Engineers India Ltd. Central Labour Institute, Mumbai.
11. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Raghvan K.V., Khan A.K, Common wealth Science Council, London.
12. Chemical Reactor Design for Process Plant, Haward F. Rase, Wiley Interscience Publications, New York.
13. Pressure Vessel Deisgn, John F. Hurvey, Affiliated East West Press (P) Ltd., New Delhi.
14. Process control, Harriott, Tata McGraw Hill Book Co.
15. Impact of hazardous waste on Human Health by Johnson.
16. OHSAS – 18001, Training Manual
17. Fire Protection Manual of NFPA, USA.
18. OISD Guidelines
19. DOT Guidelines, USA
20. IMDG Code.
21. IATA Code.
22. Explosions, their anatomy and desctritiveness by Robinson, McGraw Hill, NY.
23. Major Chemical Hazards by Marshal, Ellis Horwood
24. AlChE, USA Publications.
25. HAZOP and HAZAN by Kletz.
26. Assurance technologies, by Raheja, McGraw Hill, NY.
27. Technique for assessing industrial hazards, Manual by World Bank.
28. Safety in process plant design by Wells.
29. Probit Analysis by Finney, Cambridge University Press.
30. What Went Wrong; Catastrophy of Process Plant Disasters by Klez.
31. Industrial Accidents – Their Causes and Remedial Measure by K.U. Mistry, Siddarth Prakashan, 108, Western Plaza, Near Bhulka Bhavan SCHOOL, Adajan Road, Surat – 395 009. (Gujarat).

32. ***Fundamentals of Industrial Hygiene Safety and Health by Dr.K U Mistry 2012 Third Edition***
33. ***Response to Occupational Health Hazards ,Jacqueline Karnell Corn (IHS Cor 12 LIBRARY NO.)***

IH 687 INDUSTRIAL VISIT AND SEMINARS

(Credits = 6(3 ,6)

Theory 75 Marks and VIVA of VISIT & Seminar 75 marks

- **Industry visits to learn about processes and Industrial Hygiene & Safety Management practice.**
- **Practical workshop in industry include all exercise of industrial hygiene and safety**

1) Industrial Visit :First Two Months of Semester and as when possible during course of study)

1. As a part fulfillment of study for Master of Industrial Hygiene & Safety, the students are required to make industrial visit, study the existing Hygiene and Safety conditions on shop floor.
2. The students along with faculty shall carry out ***at least 10 Industrial visits.***
3. Each student will prepare his/her **visit report** and **submit to the faculty**.

Industrial visits are useful to see and experience the actual implementation of the best hygiene and safety provisions including statutory requirements. The students see the application of various control measures including ventilation system, machine guards, safety devices, personal protective equipment and process controls.

2) Seminars (First in first Month of the Semester)

1. Preparation of the Seminar on various issue on Industrial hygiene, safety and health .

The preparation and presentation of seminar will also help the students to understand the subject thoroughly and to improve his drafting and presentation skill for a technical document.

Sample topics for the seminar are given below(IH 687)

1. The concept of safety
2. Importance of "Man" in Accident Prevention Work.
3. Main problems of industrial safety.
4. Usefulness of Accident causation theory

5. Accident pronness
6. Best Method for safety motivation
7. Managerial Functions for a safety officer.
8. Planning for Safety.
9. Organising for safety
10. Directing and controlling for safety
11. Participation for safety
12. Good Housekeeping
13. Machine Guarding
14. Safety while using hand tools
15. Effects of good ventilation
16. Effects of good lighting
17. Effects of colour on Safety
18. Electrical hazards and control measures
19. Static electricity – hazards and controls
20. Best fire control measures
21. Techniques of noise control
22. Fall accidents and remedial measures
23. Working in a confined space
24. Storage hazards and controls
25. Process hazards and controls
26. Transportation hazards and controls
27. Safety in textile industry
28. Safety in pesticides industry
29. Accident investigation technique
30. Difference between hazard and risk
31. Difference between hazard and risk
32. Step of Risk Assessment
33. MAH Control
34. Concept of threshold quantities
35. Difference between industrial Hygiene and Health
36. Co-ordination between safety officer, industrial hygienist and factory medical officer.
37. Works of Competent Person

38. Ergonomics and its usefulness
39. Hazards of load carrying
40. Criteria for Work Station Design
41. Best use of PPE
42. Occupational Diseases – Detection and Control
43. First Ad – Its Key Point
44. Safety provisions under the factories act 1948
45. Safety provisions under the Gujarat Factories Rules 1963
46. Sitting Criteria
47. Bulk Storages – Hazards and Controls
48. Safety in Pipeline Transport
49. Safety aspects of Pressure Vessel
50. Any accident case study.

IH 688

Dissertation/project work guideline of faculties

(Credit = 15 At least four months of Semester, Total Marks 375)

Each student has to work in industry or complete the assigned project work on hygiene/safety in research institute/small scale industries/ institutions.