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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(ISTAR)

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SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR
Web site: www.spuvvn.edu

July 2014
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registration, which violates above requirements, will automatically be cancelled and grades obtained, if any, shall be withdrawn.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:

<table>
<thead>
<tr>
<th>LETTER GRADE</th>
<th>QUALITATIVE MEANING</th>
<th>EQUIVALENT GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>10</td>
<td>A</td>
</tr>
<tr>
<td>Good</td>
<td>8</td>
<td>B</td>
</tr>
</tbody>
</table>
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.P.G.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.P.G.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.P.G.TE. 17) whether or not he subsequently obtains another letter grade in a repeat attempt.

R.P.G.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,

\[ \text{SPI} = \frac{g_1c_1 + g_2c_2 + \ldots}{c_1 + c_2 + \ldots} \]

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

**R.P.G.T.E. 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.P.G.T.E. 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.P.G.T.E. 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.P.G.T.E. 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.P.G.T.E. 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:

<table>
<thead>
<tr>
<th>Class</th>
<th>CPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISTINCTION</td>
<td>not less than 8.00</td>
</tr>
<tr>
<td>FIRST CLASS</td>
<td>less than 8.00 but not less than 6.75</td>
</tr>
<tr>
<td>SECOND CLASS</td>
<td>less than 6.00 but not less than 4.50</td>
</tr>
<tr>
<td>PASS CLASS</td>
<td>less than 4.50 but not less than 4.00</td>
</tr>
</tbody>
</table>

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**

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

*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

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

TOPICS & SUB TOPICS

Introduction of Industrial Hygiene

1.1 Historical 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

2.1 Occupational 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

3.1 Notifiable 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

3.6 Occupational 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) Hemoptysis
3) 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

4.0 Occupational health services at the work place

Occupational health center
Ambulance van.
Factory medical officer, staff and equipment

5.0 Introduction of Toxicology

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

6.1 Hematotoxicity, Hepatotoxicity
6.2 Nephrotoxicity, Neurotoxicity
6.3 Dermatotoxicity, Pulmonotoxicity

7.0 Toxic effects of heavy metals

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

8.0 Toxic effects of Solvents

Benzene, Carbon Disulphide, Formaldehyde

9.0 Toxic effects of Gases

Chlorene, Ammonia, Carbon monoxide, SOX, NOX

10.0 Toxic effects of Pesticides (Any Two)
### PRACTICAL / SEMINAR/ WORKSHOP

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

**Reference Book**

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
9. Occupational Lung Diseases by Hans Weill and Ter
10. Pulmonary Function Tests In Clinical and Occupational Lung Diseases by Albert Miller
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
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
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. Copper's Pocket Environmental Compliance Dictionary by Copper Sr.
25. The VNR Dictionary
26. Hundred (100) Problems in Environmental Health by Jack E McKeen
27. Environmental Health: New Directions by J Shields
28. Asbestos Sampling and Analysis by Gyan S Rajhans and John L Sullivan
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

<table>
<thead>
<tr>
<th>Topic No</th>
<th>Name of Topics</th>
<th>Marks (Theory)</th>
<th>Lectures Hrs (Theory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scope of human physiology</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Structure of cell, functions of its component</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Structure &amp; function of skeleton, joints, classification functions &amp; their movements.</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Blood-Composition &amp; functions of blood elements, blood groups, coagulation of blood, blood transfusion</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>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</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Cardiovascular system- Heart: Functional Anatomy, Properties of the heart, The heart as a pump, Heart rate, Blood Pressure</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>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</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Digestive system-Gross anatomy of alimentary canal, functions of different parts including liver &amp; pancreas, G.I.T. motility and secretion</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>General aspects of Neurology, Elementary Neuroanatomy, The receptors</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Physiology of special senses (ear, eye, smell &amp; taste), structure and function of skin</td>
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<td>Endocrine system: Physiological considerations of pituitary, thyroid, parathyroid, pancreas and suprarenal glands.</td>
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<td>12</td>
<td>Reproductive system: Anatomy and physiology of male and female reproductive system- spermatogenesis, ovulation, menstrual cycle, pregnancy, milk secretion, and menopause.</td>
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<td>13</td>
<td>Excretory System: Various parts, Structure and functions of kidney, physiology of urine formation.</td>
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<td>Total</td>
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</table>

Reference Books

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 Prakashan Ahmedabad*
6. Best and Taylor- Physiological basis of medical physiology
7. Human Physiology and Anatomy by Tortora
IH 673 INTRODUCTION TO BIOSTATISTICS AND EPIDEMIOLOGY
CREDITS 4 (L = 3, P = 0)

SCHEME OF TEACHING

<table>
<thead>
<tr>
<th>Topic No</th>
<th>Name of Topics</th>
<th>Marks (Theory)</th>
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<tr>
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<td>Introduction of Biostatistics</td>
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<td>2</td>
<td>Sources and Presentation of Data</td>
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<td>3</td>
<td>Descriptive statistics: Measures of location</td>
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<td>Averages and percentiles</td>
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<td>4</td>
<td>Sampling Variability and Significance</td>
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<td>5</td>
<td>Introduction to epidemiology</td>
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<td>Routine sources of Epidemiological Data</td>
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<td>7</td>
<td>Analytical and experimental methods used in studies of disease in human</td>
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<td>8</td>
<td>Descriptions of source of data, methods of collection, causation, interpretation of observations in case-comparison and cohort studies</td>
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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 unit, Data, Population, Sampling unit, Sample, Parameter, 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, Surveys 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. Routine 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
3. Introduction to Biostatistics by P.S.Sundar rao J Richard 3rd edition
4. Methods in Biostatistics by Dr. B.K.Mahajan
6. Statistical Methods for Environmental Pollution Monitoring By Richard O.Gilbert

IH 674 SAFETY MANAGEMENT
CREDITS 6 (L = 6, P = 0)
SCHEME OF TEACHING

<table>
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<td>Philosophy of safety</td>
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<td>Safety psychology</td>
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<td>General Management</td>
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<td>SHE Management &amp; Planning for Safety</td>
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TOPICS & SUB TOPICS

1. Introduction

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
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 Grosses Multiple Causation Theory
2.3 Accident Prevention
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
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

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 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

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

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

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

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

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

10.1 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 competitions
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:
   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
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
5. Safety at work by John Ridley.
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)

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<td>Introduction to air sampling and analysis</td>
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<td>Gas detector tubes</td>
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<td>Preparation of known concentration of air contaminants (Solid, Liquid, Gas)</td>
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<td>Environmental (Personal &amp; Workplace area) Air Sample Analysis</td>
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<td>Sampling Airborne Microorganisms and Aeroallergens</td>
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1) Introduction to air sampling and analysis

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
1.3.4 Why 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

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

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

5) Preparation of known concentration of air contaminants

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

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

8) **Sampling Airborne Microorganisms and Aeroallergens**
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**

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<th>Sr.No.</th>
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<td>1.2 Introduction, Calibration and Use of Microbalance</td>
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<td>2.3 Comparison of Result of both methods</td>
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<td>Personal sampling/Work Place of any toxic solvent use in any occupation/industry/Chemical Laboratory/Petrol Pump for 8 hours/Shift/Short time duration</td>
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<td>Quantitative Solvent Assessment by using Dragger tube</td>
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<td>Qualitative &amp; Quantitative Exposure Assessment for Biological contaminants in Food/Pottery/Farm/Any other Occupation</td>
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**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 Contaminants 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
8. Monitoring Toxic Substances by Dennis Schuetzle
9. Methods of Air 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 & Richard Bajura
11. Air Sampling Instruments for Evaluation of Atmospheric Contaminents Edition 3 by ACGIH
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

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

<table>
<thead>
<tr>
<th>Topic No</th>
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<td>HVAC and makeup air systems</td>
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TOPICS AND SUBTOPICS

1. **Introduction of ventilation**  
   1.1 Purpose of ventilation  
   1.2 Types of ventilation

2. **General principles of ventilation**  
   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**  
   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. **Local exhaust ventilation systems**  
   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
5.1 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
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
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

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<td>Exercise on emission source behaviour and problem characterization of industrial ventilation</td>
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<td>Seminar indoor air quality study</td>
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<td>Exercise on air density, Velocity pressure, Duct diameter, selection of fan and air horse power etc.</td>
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<td>Introduction of Velometer and Anemometer</td>
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<td>Practical on measurement of velocity and pressure from LEV and General Ventilation installed for various occupations</td>
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Reference Books
1. Industrial ventilation “A manual of recommended practice”: Committee on industrial ventilation, sold by ACGIH 1220 kemper – Meadow Drive, Cincinnati, CH 45240
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 Measurement, Mitigation and Prevention by Kenneth Q.Lao
IH677 HAZARD IDENTIFICATION, ASSESSMENT AND CONTROL TECHNIQUES
CREDITS 6 (L=6)

SCHEME OF TEACHING

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<td>Accident and incident investigation reporting and analysis.</td>
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<td>Safety appraisal and control techniques</td>
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<td>Hazard identification and risk assessment techniques</td>
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<td>Major accident hazard (MAH) Controls</td>
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TOPICS & SUB TOPICS:

1. **Types of accidents and performance rates** 12
   1.0 Definitions
   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
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.
IH678 PHYSICAL ASPECTS OF THE ENVIRONMENT
CREDITS 5 (L = 4, P = 2)

SCHEME OF TEACHING:

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<td>Instrumentation for Sound Measurement</td>
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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 Power, Intensity, Conversion, Amplitude, Sound weighing
   1.3 Kind of Noise
   1.4 Limit of ACGIH, NIOSH, OSHA, Factory Act 1948

2. **Instrumentation 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
   2.2 Basic 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
4.1 Audiometry
4.2 Non audiology
5. Control of Noise
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
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.
6.6 Accelerometer types, characteristic, frequency range and mounting of accelerometer.
6.7 Taylor-Pelmar 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.
6.8 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:
7.1.1 Causal Factors, Definitions: Heat, Calories, Conduction, Convection, Evaporative Cooling, Radiation, globe Temperature, Metabolic Heat, Natural Wet Bulb Temperature, Dry bulb Temperature, Globe Temperature
7.2 Investigation Guideline: Employer and Employee Interview Examples”
7.2.1 Activity
7.2.2 Assessment of Work
7.2.3 Walking 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 Wet 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
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

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

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<td>Workplace Noise monitoring in Workshop/Engineering Unit</td>
<td>SLM, ISLM, Calibrator</td>
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<td>Personal Noise Monitoring in Industry/Bus Driver by using Sound Level Meter</td>
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<td>Hand Arm and Whole body Vibration monitoring by using vibration meter/accelerometer</td>
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Reference Books

1. Bruel & Kjaer: Noise Control: Principles and Practice
6. NIOSH: Manual for measuring occupational Electric and Magnetic Field Exposure
8. Guidelines on Noise by American petroleum Institute
10. Electron Impact Phenomena and the Properties of Gaseous Ions by F H Field
12. A Handbook of Radioactivity Measurements Procedures by National Council
15. and-Arm Vibration by Pelme, Taylor and Wasserman
17. Noise Control in Industry: A Practical Guide by Nicholas P Cheremisinoff
18. Industrial Noise and Hearing Conservation by Ollishifiski and Harford
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
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**

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**TOPICS & SUB TOPICS**

1. **Plant design and layout**
   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
2.0 Housekeeping

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

2.6 Six Sigma

3.0 Machine guarding

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

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

5.1 Purpose and benefits of good lighting. Increase of safety and productivity due to good lighting.
5.1.1 Principles of Illumination
5.1.2 Glare, 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
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
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

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**

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**

- 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**

- Working at height
  - Incidence and seriousness of fall accidents
  - Safety features associated 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**

Planning and permit.

- Planning the sequence of demolition
- Safety precaution to be taken for and during demolition carrying out repairs, addition and alterations.

**REFERENCE**

4. Process Plant Layout by Mecklen Burgh
5. Safety at work by John Ridley.
6. Safety engineering by Jems CoVan
8. More Great Safety Meeting Ideas by Ar Fattig
9. Lift Truck Fleet Management and Operator Training by Bud Cohan
11. What Went Wrong? By Trevor Kletz
12. Prudent Practices in the Laboratory (Handling and Disposal of Chemicals)
14. Safety Training methods by Revelle and Stephens
IH680 SAFETY IN CHEMICAL INDUSTRY
CREDITS 4 (L = 6, P = 0)

SCHEME OF TEACHING

<table>
<thead>
<tr>
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<td>Process hazards and controls</td>
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1.0 GENERAL

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.
4. **TRANSFER OF CHEMICALS**

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**


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
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


IH 681 MEDICAL SURVEILLANCE & BIOLOGICAL MONITORING
CREDITS 3 (L = 3, P = 0)

SCHEME OF TEACHING

<table>
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<td>1</td>
<td>Medical Surveillance</td>
<td>25</td>
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<tr>
<td>2</td>
<td>Introduction of Biological Monitoring</td>
<td>10</td>
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<td>Sampling, Laboratory Methods and Result</td>
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<td>Biologic Marker</td>
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1.0 Medical Surveillance

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
   1.2.3.1 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

2.1 General Principles

2.2 Application of Biological Monitoring in various occupations

2.2.1 Advantages of Biological Monitoring

2.2.3 Limitation of Biological Monitoring

3.0 Sampling, Laboratory Methods and Result

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

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

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 Developing 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

<table>
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<td>Introduction to waste, definitions, types, characteristic, physical and chemical property.</td>
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<td>Solid waste management</td>
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<td>Hazardous waste management Definitions, types, EPA, RCRA, CERCLA international act for hazardous waste, Environmental impact assessment</td>
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<td>Volume reduction, strength reduction, equalization and proportioning of wastewater</td>
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<td>Hazardous waste treatment technology- Physical treatment, chemical treatment, biological treatment.</td>
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<td>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</td>
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<td>Biomedical waste and its management.</td>
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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.

6.0 Major industrial waste:
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.
Biomedical Waste Management: Definition, Health and environment issues, Category of waste, segregation, collection and transportation, Treatment systems

8.0 ACT
8.1 Hazardous wastes (management and handling) rules 1989
8.2 Bio-Medical Waste (Management and Handling) rules 1998

Reference Book
2. US EPA: Encyclopedia of Environment and Pollution Control
4. Waste Minimization and Cost Reduction for Process Industries by Poul N Cheremisinoff
5. Environmental Health Hazards: Recognition and Avoidance by Donald E Waite
7. Managing Hazardous Substances Accident by Al J Smith
8. Hazardous Occupational Environments by Paul N Cheremisinoff
9. Infectious Waste Management by Frank L Cross, Howard E Hesketh, P Kay Rykowski
11. Hazardous Materials and Hazardous Waste Management by Gayle Woodsite
12. Solving the hazardous Waste Problem by EPA
13. Sara Title III Intent and Implementation of Hazardous Materials Regulations by Frank L Fire, Nancy K Grant, David H Hoover
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

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<td>Engineering Anthropometry</td>
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<td>Human Biomechanics- Muscles strength, Assessment of muscles strength, Measuring techniques, and the strength test protocol</td>
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<td>6</td>
<td>Seating and Posture</td>
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<td>Tool Design</td>
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**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

2.1 Variability in body shapes and sizes
2.2 Sources of anthropometric variability

3 Human Biomechanics

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

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

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

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

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

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

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

<table>
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<td>Skin Fold Caliper for measurement of body dimension</td>
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<td>3</td>
<td>Use of Dynamometer for measurement of force</td>
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</tbody>
</table>

**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
5. Ergonomics at work by David J. Oborne, John Wiley and Sons
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
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. Webergo.human.cornell.edu/ahReba.html
IH 684 SAFETY ENGINEERING – II
CREDITS 5 (L = 6, P = 0)

SCHEME OF TEACHING

<table>
<thead>
<tr>
<th>Topic No</th>
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<th>Marks (Theory)</th>
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SCHEME OF TEACHING:

1. **Metallurgical Industry**

   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**

   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**

   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**

   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**

   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**

   Types of pesticide 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.
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

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

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.


Control measures for grass, dust, waste paper, digesters, bleaching agent like Cl₂ or H₂O₂, 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 baggage, coal, SO₂, 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 Platforms
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 safety 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:

<table>
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<tr>
<th>Sr. No.</th>
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<th>Lectures Hrs. (Theory)</th>
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<td>Legislative process</td>
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<td>ILO Convention and recommendations</td>
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<td>The factories act, 1948 and rules</td>
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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.

<table>
<thead>
<tr>
<th>Year</th>
<th>Convention</th>
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<tbody>
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<td>1981</td>
<td>155-OHS</td>
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<td>161-OHS</td>
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<td>1988</td>
<td>167-Safety and health in construction</td>
<td>175-safety and health in construction</td>
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</table>
3.0 The factories act, 1948 and the Gujarat factories rules 1963:  

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:  

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

4.5 Explosives act 1884 and rules 1983
4.6 Static and mobile (Unfired) Pressure Vessels Rules 1981.
4.7 Gas Cylinders Rules 1981.

5.0 Legislation on environmental protection:  

61
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 Health Law by rothstein
5. General Safety Code Volume I by Alaska Department of Labor
8. Industrial Safety is Good Business by Mottel Long and Morison
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
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
IH686 ADVANCED SAFETY MANAGEMENT AND ENGINEERING TECHNIQUES
CREDITS 3 (L = 5, P = 0)

SCHEME OF TEACHING

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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.

2. Bulk storages

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

Non destructive tests: its significance and limitations.
Radiography, Ultrasonic, Magnetic Particle Methods, Eddy Current Method, Dye Penetration test.

Strain measurement

4. Safety in transportation

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

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

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

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

Principles of Reliability engineering

Application of reliability for plant design

Engineering concepts of critical equipments and devices

9. Risk management

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

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

Biological agents and sources


Sick building syndrome.

Statutory provisions

12. Advanced fire protection systems

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

Case studies and lessons learnt form major industrial disasters.

Flixborough Seveso, Chernobyl, Bhopal, Mexico etc.

REFERENCES


5. Occupational safety management and engineering by Willi Hammer
8. Chemical Process Safety Fundamentals with Applications by Daniel A Crowl and Joseph F Louvar, Prantice Hall, New Jersey, USA.
10. Gas dispersion modeling, Engineers India Ltd. Central Labour Institute, Mumbai.
15. Impact of hazardous waste on Human Health by Johnson.
18. OISD Guidelines
19. DOT Guidelines, USA
20. IMDG Code.
23. Major Chemical Hazards by Marshal, Ellis Horwood
24. AlChE, USA Publications.
25. HAZOP and HAZAN by Kletz.
28. Safety in process plant design by Wells.
30. What Went Wrong; Catastrophy of Process Plant Disasters by Klez.
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.
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.