

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
M.E. INDUSTRIAL SAFETY ENGINEERING
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- I. Possess a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession.
- II. Knowledgeable safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
- III. Well communicate the information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.

PROGRAMME OUTCOMES (POs)

- PO1. Apply knowledge of Mathematics, Science, Engineering fundamentals and an engineering Specialization for hazard identification, risk assessment, analysis the source of incidents and control of occupational Diseases & hazards.
- PO2. Design, Establish, Implement maintain and continually improve an occupation health and safety management system to improve safety.
- PO3. Conduct investigations on unwanted incidents using e.g. (Root cause analysis, what if analysis) and generate corrective and preventive action to prevent repetition and happening of such incidents.
- PO4. Design complex man, machine, and material handling systems using human factors engineering tools so as to achieve comfort, worker satisfaction, efficiency, error free and safe work practice workplace environment.
- PO5. Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings so as to provide practical solutions to safety problems.
- PO6. Communicate effectively on occupational health and safety matters among the employees and with society at large.
- PO7. Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupation health and safety practices.
- PO8. Understand and commit to comply with legal and contractual requirements, professional ethics and responsibilities and general norms of engineering practice.
- PO9. Understand the impact of Health safety and environment solutions on productivity, quality and humanity protection at large.
- PO10. Demonstrate the use of state of the art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations.

PEO / PO Mapping

| Programme Educational Objectives | Programme Outcomes | | | | | | | | | |
|----------------------------------|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| I | ✓ | | ✓ | | | | | | | |
| II | | ✓ | | ✓ | ✓ | | ✓ | | | ✓ |
| III | | | | | | ✓ | | ✓ | ✓ | |

Semester Course wise PEO mapping

| | | Subject | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|----------------------|---|--|-----|-----|---------|---------|---------|---------|-----|---------|---------|--------|
| YEAR 1 | SEM 1 | Probability and Statistical Methods | I | | I | | | | | | | |
| | | Principles of Safety Management | | II | | II | II | | | | | |
| | | Environmental Safety | | | | | | I, III | | I, III | | I, III |
| | | Occupational Health and Industrial Hygiene | | | | | | II, III | | II, III | II, III | |
| | | Industrial Safety, Health and Environment Acts | | | | | | | II | | | II |
| | | Professional Elective - I | | | | | | | | | | |
| | | Technical Seminar - I | | | | | | | II | | | II |
| | SEM 2 | Fire Engineering and Explosion Control | | II | | II | II | | | | | |
| | | Computer Aided Hazard Analysis | I | | I | | | | | | | |
| | | Electrical Safety | | II | | II | II | | | | | |
| | | Safety in Chemical Industries | | | | | | III | | III | III | |
| | | Professional Elective-II | | | | | | | | | | |
| | | Professional Elective-III | | | | | | | | | | |
| | | Industrial Safety Laboratory | | | | | | | II | | | II |
| Technical Seminar-II | | | | | | | II | | | II | | |
| YEAR 2 | SEM 3 | Reliability Engineering | I | | I | | | | | | | |
| | | Professional Elective-IV | | | | | | | | | | |
| | | Professional Elective-V | | | | | | | | | | |
| | Project Work Phase I | | | | II, III | II, III | II, III | | | | | |
| | Industrial Safety Assessment – Internship | | | | II, III | II, III | II, III | | | | | |
| SEM 4 | Project Work Phase II | | | | II, III | II, III | II, III | | | | | |

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
M.E. INDUSTRIAL SAFETY ENGINEERING
I TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

SEMESTER I

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| THEORY | | | | | | | | |
| 1. | MA5164 | Probability and Statistical Methods | FC | 4 | 4 | 0 | 0 | 4 |
| 2. | IS5101 | Principles of Safety Management | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | IS5102 | Environmental Safety | PC | 4 | 4 | 0 | 0 | 4 |
| 4. | IS5103 | Occupational Health and Industrial Hygiene | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | IS5104 | Industrial Safety, Health and Environment Acts | PC | 4 | 4 | 0 | 0 | 4 |
| 6. | | Professional Elective I | PE | 3 | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | | |
| 7. | IS5111 | Technical Seminar - I | EEC | 2 | 0 | 0 | 2 | 1 |
| TOTAL | | | | 23 | 21 | 0 | 2 | 22 |

SEMESTER II

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| THEORY | | | | | | | | |
| 1. | IS5201 | Fire Engineering and Explosion Control | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | IS5202 | Computer Aided Hazard Analysis | PC | 4 | 4 | 0 | 0 | 4 |
| 3. | IS5203 | Electrical Safety | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | IS5204 | Safety in Chemical Industries | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | | Professional Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | | |
| 7. | IS5211 | Industrial Safety Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | IS5212 | Technical Seminar - II | EEC | 2 | 0 | 0 | 2 | 1 |
| TOTAL | | | | 25 | 19 | 0 | 6 | 22 |

SEMESTER III

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------------------|-------------|---|----------|-----------------|----------|----------|-----------|-----------|
| THEORY | | | | | | | | |
| 1. | IS5301 | Reliability Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | | Professional Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | | Professional Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| PRACTICAL | | | | | | | | |
| 4. | IS5312 | Project Work Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| 5. | IS5311 | Industrial Safety Assessment – Internship | EEC | 4 | 0 | 0 | 4 | 2 |
| TOTAL | | | | 25 | 9 | 0 | 16 | 17 |

SEMESTER IV

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------------------|-------------|-----------------------|----------|-----------------|----------|----------|-----------|-----------|
| PRACTICAL | | | | | | | | |
| 1. | IS411 | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |
| TOTAL | | | | 24 | 0 | 0 | 24 | 12 |

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 73

FOUNDATION COURSES (FC)

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|-------------------------------------|----------|-----------------|---|---|---|---|
| 1. | MA5164 | Probability and Statistical Methods | FC | 4 | 4 | 0 | 0 | 4 |

PROFESSIONAL CORE (PC)

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--|----------|-----------------|---|---|---|---|
| 1. | IS5101 | Principles of Safety Management | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | IS5102 | Environmental Safety | PC | 4 | 4 | 0 | 0 | 4 |
| 3. | IS5103 | Occupational Health and Industrial Hygiene | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | IS5104 | Industrial Safety, Health and Environment Acts | PC | 4 | 4 | 0 | 0 | 4 |
| 5. | IS5201 | Fire Engineering and Explosion Control | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | IS5202 | Computer Aided Hazard Analysis | PC | 4 | 4 | 0 | 0 | 4 |
| 7. | IS5203 | Electrical Safety | PC | 3 | 3 | 0 | 0 | 3 |
| 8. | IS5204 | Safety in Chemical Industries | PC | 3 | 3 | 0 | 0 | 3 |
| 9. | IS5211 | Industrial Safety Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 10. | IS5301 | Reliability Engineering | PC | 3 | 3 | 0 | 0 | 3 |

LIST OF ELECTIVES FOR M.E. INDUSTRIAL SAFETY ENGINEERING

SEMESTER I (Elective I)

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|-------------------------------------|----------|-----------------|---|---|---|---|
| 1. | IS5001 | Plant Layout and Materials Handling | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | IS5002 | Work Study and Ergonomics | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | IS5003 | Dock Safety | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | IL5071 | Human Factors in Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | IS5091 | Maintainability Engineering | PE | 3 | 3 | 0 | 0 | 3 |

SEMESTER II (Elective II & III)

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--------------------------------|----------|-----------------|---|---|---|---|
| 1. | IS5004 | Transport Safety | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | IS5005 | Fireworks Safety | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | IS5006 | Safety in Construction | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | IS5007 | Nuclear Engineering and Safety | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | IS5008 | Safety in Textile Industry | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | IS5009 | Safety in Mines | PE | 3 | 3 | 0 | 0 | 3 |

SEMESTER III (Elective IV & V)

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--|----------|-----------------|---|---|---|---|
| 1. | IS5010 | Safety in Engineering Industry | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | IS5011 | Quality Engineering in Production Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | IS5012 | Disaster Management | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | IS5013 | OHSAS 18000 and ISO 14000 | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | IS5014 | Artificial Intelligence and Expert Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | MF5072 | Research Methodology | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | IL5091 | Data Analytics | PE | 3 | 3 | 0 | 0 | 3 |

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---|----------|-----------------|---|---|----|----|
| 1. | IS5111 | Technical Seminar - I | EEC | 2 | 0 | 0 | 2 | 1 |
| 2. | IS5212 | Technical Seminar - II | EEC | 2 | 0 | 0 | 2 | 1 |
| 3. | IS5312 | Project Work Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| 4. | IS5311 | Industrial Safety Assessment – Internship | EEC | 4 | 0 | 0 | 4 | 2 |
| 5. | IS5411 | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |

OBJECTIVES :

This course is designed to provide the solid foundation on topics in probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis, design of experiments and time series analysis.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye’s theorem - Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II ESTIMATION THEORY 12

Principle of least squares – Regression – Multiple and partial correlations – Estimation of parameters – Maximum likelihood estimates – Method of moments.

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions – Small and large samples and problems – Tests based on Normal, t - distribution, Chi - square, Goodness of fit and F – distributions.

UNIT IV DESIGN OF EXPERIMENTS 12

Analysis of variance – Completely randomized design – Randomized block design – Latin square design – 2² Factorial designs.

UNIT V TIME SERIES 12

Characteristics and representation – Moving averages – Exponential smoothing – Auto regressive processes.

TOTAL : 60 PERIODS**OUTCOMES :**

After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Least squares, correlation, regression, consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Differentiate between various time series models and application of these models appropriately to engineering problems.
- The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES :

1. Anderson, O.D, “Time Series Analysis : Theory and Practice”, North - Holland, Amsterdam, 1982.
2. Devore, J. L., “Probability and Statistics for Engineering and Sciences”, 8th Edition, Cengage Learning, 2014.
3. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan and Chand Company, New Delhi, 1999.
4. Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers, Pearson Education, Asia, 8th Edition, 2015.
5. Montgomery D.C and Johnson, L.A, “Forecasting and Time Series”, 6th Edition, McGraw Hill, 1990.

OBJECTIVES:

- To achieve an understanding of principles of safety management.
- To enable the students to learn about various functions and activities of safety department.
- To enable students to conduct safety audit and write audit reports effectively in auditing situations.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

UNIT I CONCEPTS AND TECHNIQUES**9**

History of Safety movement –Evolution of modern safety concept- general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy.

Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT II SAFETY AUDIT - INTRODUCTION**9**

Components of safety audit, types of audit, audit methodology, non conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

UNIT III ACCIDENT INVESTIGATION AND REPORTING**9**

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

UNIT IV SAFETY PERFORMANCE MONITORING**9**

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

UNIT V SAFETY EDUCATION AND TRAINING**9**

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

TOTAL: 45 PERIODS**OUTCOMES:**

The students will be able to

- To understand the functions and activities of safety engineering department.
- To carry out a safety audit and prepare a report for the audit.
- To prepare an accident investigation report.
- To estimate the accident cost using supervisors report and data.
- To evaluate the safety performance of an organization from accident records.
- To identify various agencies, support institutions and government organizations involved in safety training and promotion

REFERENCES

1. "Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982.
2. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973.
3. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
4. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980
5. John Ridley, "Safety at Work", Butterworth and Co., London, 1983
6. Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2nd edition, 1990.
7. Relevant Indian Standards and Specifications, BIS, New Delhi.
8. "Safety and Good House Keeping", N.P.C., New Delhi, 1985.

IS5102

ENVIRONMENTAL SAFETY

L T P C
4 0 0 4

OBJECTIVES:

- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
- To give understanding of air and water pollution and their control.
- To expose the students to the basis in hazardous waste management.
- To design emission measurement devices.

UNIT I AIR POLLUTION

12

Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution-hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation-ozone holes-automobile exhausts-chemical factory stack emissions-CFC.

UNIT II WATER POLLUTION

12

Classification of water pollutants-health hazards-sampling and analysis of water-water treatment - different industrial effluents and their treatment and disposal -advanced wastewater treatment - effluent quality standards and laws- chemical industries, tannery, textile effluents-common treatment.

UNIT III HAZARDOUS WASTE MANAGEMENT

12

Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse.

UNIT IV ENVIRONMENTAL MEASUREMENT AND CONTROL

12

Sampling and analysis – dust monitor – gas analyzer, particle size analyzer – lux meter-pH meter – gas chromatograph – atomic absorption spectrometer.
Gravitational settling chambers-cyclone separators-scrubbers-electrostatic precipitator - bag filter – maintenance - control of gaseous emission by adsorption, absorption and combustion methods-Pollution Control Board-laws.

UNIT V POLLUTION CONTROL IN PROCESS INDUSTRIES

12

Pollution control in process industries like cement, paper, petroleum-petroleum products-textile-tanneries-thermal power plants – dyeing and pigment industries - eco-friendly energy.

TOTAL: 60 PERIODS

OUTCOMES:

The students will be able to

- Illustrate and familiarize the basic concepts scope of environmental safety.
- Understand the standards of professional conduct that are published by professional safety organizations and/or certification bodies.
- Explain the ways in which environmental health problems have arisen due to air and water pollution.
- Illustrate the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.
- Discuss concepts of measurement of emissions and design emission measurement devices.

REFERENCES

1. E. C Wolfe, Race to Save to Save Planet, Wadsworth Publishing Co., Belmont, CA 2006.
2. G. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006
3. M.J Hammer,., and M.J Hammer,., Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006
4. Rao, CS, "Environmental pollution engineering:", Wiley Eastern Limited, New Delhi, 1992.
5. S. P. Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 1993.
6. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

IS5103

OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE

L T P C

3 0 0 3

OBJECTIVES:

- To understand the basic knowledge on anatomy of human organs and its basic functions.
- To enable the students to learn about various functions and activities of occupational health services.
- To enable students to compare the hazards with the permissible levels.
- To have knowledge about types of hazards arising out of physical, chemical and biological agents.

UNIT I PHYSICAL HAZARDS

9

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

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

UNIT II CHEMICAL HAZARDS

9

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

Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling

Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education

OBJECTIVES:

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

UNIT I FACTORIES ACT – 1948**10**

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948

UNIT II ENVIRONMENT ACT – 1986**10**

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

Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

UNIT III MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989**10**

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

UNIT IV OTHER ACTS AND RULES**20**

Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules-Explosives Act 1983-Pesticides Act

UNIT V INTERNATIONAL ACTS AND STANDARDS**10**

Occupational Safety and Health act of USA (The Willames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

TOTAL: 60 PERIODS**OUTCOMES:**

The students will be able

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.
- To understand the statutory requirements for an Industry on registration, license and its renewal.
- To prepare onsite and offsite emergency plan.

REFERENCES

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
5. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
6. The Mines Act 1952, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
7. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
8. National seminar on hazardous waste management organized by National Safety council, Ministry of environment and forests, Government of India, United States – Asia environmental partnership, Tamilnadu pollution control board and Indian chemical manufacturers association, April 2001.

IS5111

TECHNICAL SEMINAR - I

L T P C
0 0 2 1

OBJECTIVES

- To develop journal paper reading and understanding skill.
- To improve communication and presentation skill of students

GUIDELINES

- The students are expected to make a presentation on the state of research on a particular topic based on current journal publications in that topic.
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Students are encouraged to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

TOTAL: 30 PERIODS

OUTCOMES

The students will be able to

1. Select the method, analysis and optimize the given problem for the given field applications

IS5201

FIRE ENGINEERING AND EXPLOSION CONTROL

L T P C
3 0 0 3

OBJECTIVES:

- To provide an in depth knowledge about the science of fire.
- To understand the causes and effects of fire.
- To know the various fire prevention systems and protective equipments.
- To understand the science of explosion and its prevention techniques.
- To understand the various fire prevention techniques to be followed in a building.

OBJECTIVES:

- To provide knowledge on risk, hazard and their assessment techniques in Industry
- To understand the principles of operation of various equipment for safety application
- To know the consequences of fire, explosion and toxic release
- To know the various software available for risk quantification
- To conduct a risk assessment technique in Industries.

UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT 12

Introduction, hazard, hazard monitoring-risk issue, group or societal risk, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation.

Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis(PHA), human error analysis, hazard operability studies(HAZOP), safety warning systems.

UNIT II COMPUTER AIDED INSTRUMENTS 12

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter(DSC), Thermo Gravimetric Analyser(TGA), Accelerated Rate Calorimeter(ARC), Reactive Calorimeter(RC), Reaction System Screening Tool(RSST) - Principles of operations, Controlling parameters, Applications, advantages.

Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

UNIT III RISK ANALYSIS QUANTIFICATION AND SOFTWARES 12

Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - fire explosion and toxicity index(FETI), various indices - Hazard analysis(HAZAN)- Failure Mode and Effect Analysis(FMEA)- Basic concepts of Reliability- Software on Risk analysis, CISCON, FETI, HAMGARS modules on Heat radiation, Pool fire, Jet, Explosion. Reliability softwares on FMEA for mechanical and electrical systems.

UNIT IV CONSEQUENCES ANALYSIS 12

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

UNIT V CREDIBILITY OF RISK ASSESSMENT TECHNIQUES 12

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

TOTAL: 60 PERIODS

OUTCOMES:

- This course would make familiarizing of basic concepts in risk and hazard
- Course would be helpful to understand the various instruments to bring safety in Industries
- Students would be trained to find solution for risk assessment studies through the use of software
- Students would be able to make use of a risk assessment technique to quantify the risk
- Course would equip the students effectively to employ hazard analysis techniques in Industry and helpful to prevent the accidents in Industry

REFERENCES

1. Brown, D.B. System analysis and Design for safety, Prentice Hall, 1976.
2. Course Material Intensive Training Programme on Consequence Analysis, by Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka and CLRI, Chennai.
3. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AIChE 1992
4. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.
5. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
6. Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK 1990 (Vol.I, II and III)
7. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Common wealth Science Council, UK
8. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

IS5203

ELECTRICAL SAFETY

L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- To distinguish the various hazardous zones and applicable fire proof electrical devices

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS

9

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

UNIT II ELECTRICAL HAZARDS

9

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI.

Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS 9

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection.

FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

UNIT IV SELECTION, INSTALLATION, OPERATION AND MAINTENANCE 9

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

UNIT V HAZARDOUS ZONES 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- This course would make familiar of basic concepts in electrical circuit and hazards involved in it.
- Course would be helpful to understand the electrical hazards in Industries.
- Students would be able to understand the operation of various protection systems from electrical hazards
- Recognize different hazardous zones in Industries

REFERENCES

1. "Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers – Handbook of TNEB, Chennai, 1989.
4. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd., England, 1988.
5. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

**IS5204 SAFETY IN CHEMICAL INDUSTRIES L T P C
3 0 0 3**

OBJECTIVES:

- To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- To understand the various hazards and prevention in commissioning stage of industry.
- To recognise and identify the safe operation of equipment in process industry.
- To plan and trained for emergency planning in a process industry.
- To get fundamental knowledge on safe storage of chemicals.

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN 9

Design process, conceptual design and detail design, assessment, inherently safer design- chemical reactor , types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipments, utilities.

Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system.

UNIT II PLANT COMMISSIONING AND INSPECTION 9

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

UNIT III PLANT OPERATIONS 9

Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel

UNIT IV PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING 9

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

UNIT V STORAGEES 9

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

TOTAL : 45 PERIODS

OUTCOMES:

- This course would make familiar of safe design of equipment which are the essential to chemical industry and leads to design of entire process industries.
- Course would be helpful to understand the design of pressure systems.
- Students would understand the problems and find innovative solutions while industries facing Problems in commissioning and maintenance stages.
- Students can prepare the emergency planning for chemical industry problems
- Students would be able to create safe storage systems.

REFERENCES

1. "Accident Prevention Manual for Industrial Operations" NSC, Chicago, 1982.
2. "Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
3. Carbide of Calcium Rules, Government of India.
4. Fawcett, H.h. and Wood, "Safety and Accident Prevention in Chemical Operations" Wiley inters, Second Edition.
5. GREEN, A.E., "High Risk Safety Technology", John Wiley and Sons,. 1984.
6. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996
7. Petroleum Act and Rules, Government of India.

OBJECTIVES:

- To provide opportunity to operate the equipment to acquire practical knowledge.
- To know the various PPEs and software.
- To carry out experiments to find out the environmental parameters.
- To assess the impact of sensitivity of chemicals on explosivity.
- To run the software to assess the consequence effects of major accidents.

NOISE LEVEL MEASUREMENT AND ANALYSIS

Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values.

FRICITION TEST

Explosive materials like barium nitrate, gun powder, white powder, amorces composition etc.

IMPACT TEST

Explosive materials like gun powder, white powder, amerce composition etc.
Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc.
Auto ignition temperature test.

EXHAUST GAS MEASUREMENT AND ANALYSIS

Measurement of Sox, Nox, Cox, hydrocarbons.

ENVIRONMENTAL PARAMETER MEASUREMENT

Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, wind flow and effective corrective effective.

Particle size Measurement

Air sampling analysis

TRAINING IN USAGE AND SKILL DEVELOPMENT**Personal protective equipment:**

Respiratory and non-respiratory-demonstration-self contained breathing apparatus. Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, anti static and conducting plastics/rubber materials, apron and leg guard.

Fire extinguishers and its operations

Water Co₂

Foam

Carbon dioxide (Co₂)

Dry chemical powder and

Currently amendment fire safety systems

Static charge testing on plastic, rubber, ferrous and non-ferrous materials.

Illumination testing - by lux meter and photo meter.

Electrical safety

Insulation resistance for motors and cables

Estimation of earth resistance

Earth continuity test

Sensitivity test for MCB, ELCB, RCCB, MCCB

Software Usage

Dispersion modeling of various highly dangerous chemicals using ALOHA software

First-Aid

Road safety signals and symbols

Equipments Required

| | | | |
|-----|------------------------|---|------|
| 1. | Noise level meter | : | 1 No |
| 2. | Friction tester | : | 1 No |
| 3. | Impact tester | : | 1 No |
| 4. | Exhaust gas analyzer: | | 1 No |
| 5. | High volume sampler | : | 1 No |
| 6. | PPE Set | : | 1 No |
| 7. | Fire extinguisher set | : | 1 No |
| 8. | Static charge tester | : | 1 No |
| 9. | First aid kit | : | 1 No |
| 10. | Lock out/Tag out | : | 1 No |
| 11. | Software: ALOHA, CAMEO | | |

TOTAL: 60 PERIODS

OUTCOMES:

- This course would make students to know and run the various equipments to bring out the safety environment in the industry.
- Course would be helpful for the students to measure the particulate matter and assess the impact of air pollution.
- Students would be trained to conduct experiments to find out various environmental parameters. Students would be able to use personal protective equipment in-dependently.
- Students can recognise the various problems with the use of software and hence to predict the real situations on major accidents.

IS5212

TECHNICAL SEMINAR-II

L T P C
0 0 2 1

OBJECTIVE:

To enrich the communication skills of the student through presentation of topics in recent advances in Industrial safety engineering/technology

OUTCOME:

Students will develop skills to read, write, comprehend and present research papers.

Students shall give presentations on recent areas of research in industrial safety engineering in two cycles. Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

TOTAL: 30 PERIODS

OBJECTIVES

- To provide provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which includes ventilation, comfort, lighting and its effect based on various nature of work.
- To provide knowledge on effective and safe layout design of an industry.

UNIT I RELIABILITY CONCEPT**9**

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

UNIT II FAILURE DATA ANALYSIS**9**

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

UNIT III RELIABILITY PREDICTION MODELS**9**

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

UNIT IV RELIABILITY MANAGEMENT**9**

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

UNIT V RISK ASSESSMENT**9**

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

TOTAL: 45 PERIODS**OUTCOMES:**

The students will be able to

1. Identify equipment requirements for a specific process and for various locations and working conditions.
2. Design an efficient material handling system.
3. Understand the difficulties during the design and implementation of the plant layout.

REFERENCES

1. Srinath L.S, "Reliability Engineering", Affiliated East-West Press Pvt Ltd, New Delhi, 1998.
2. Modarres, "Reliability and Risk analysis", Maral Dekker Inc.1993.
3. John Davidson, "The Reliability of Mechanical system" published by the Institution of Mechanical Engineers, London, 1988.
4. Smith C.O. "Introduction to Reliability in Design", McGraw Hill, London, 1976.

OBJECTIVES

- To get an industrial exposure through various industrial environmental experiences and learning safety measures.
- To enhance the collective skills between theoretical knowledge and real-time safety implementations.

GUIDELINES

- The students are expected to undergo meaningful, practical and hands-on-work experiences related to safety measures through industrial training.
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the Student's training activities and maintain attendance also.
- Minimum duration of internships period is 3-4 weeks.
- Post internship program, Students should submit a report (within 50 pages) which contains brief observations of training (process, product, layout, safety measures and methods, etc.,) and give a presentation.
- Internship should be evaluated through final presentation with viva-voce exam.

TOTAL: 60 PERIODS**OUTCOMES**

The students will be able to

1. Select and analysis the effective industry safety methods for the given field applications.

OBJECTIVES

- To provide provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which includes ventilation, comfort, lighting and its effect based on various nature of work.
- To provide knowledge on effective and safe layout design of an industry.

UNIT I PLANT LOCATION**9**

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions

Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants

UNIT II PLANT LAYOUT**9**

Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers.

Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works

UNIT III WORKING CONDITIONS

9

Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application.

Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- House keeping, principles of 5S.

UNIT IV MANUAL MATERIAL HANDLING AND LIFTING TACKLES

9

Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations

Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection

UNIT V MECHANICAL MATERIAL HANDLING

9

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications.

Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

1. Identify equipment requirements for a specific process and for various locations and working conditions.
2. Design an efficient material handling system.
3. Understand the difficulties during the design and implementation of the plant layout.

REFERENCES:

1. "Accident prevention manual for industrial operations" N.S.C., Chicago, 1982.
2. Alexandrov. M.P. "Material handling equipment" Mir Publishers, Moscow, 1981
3. APPLE M. JAMES "Plant layout and material handling", 3rd edition, John Wiley and sons.
4. "Encyclopedia of occupational safety and health", ILO Publication, 1985

IS5002

WORK STUDY AND ERGONOMICS

**L T P C
3 0 0 3**

OBJECTIVES:

- To study the applications of ergonomic principles and physiology of workers
- To know the concepts of personal protective equipment and its usages
- To create the knowledge in process and equipment design in safety aspects

OBJECTIVES:

- To understand safety legislation related to dock activities in India.
- To understand the causes and effects of accidents during dock activities.
- To know the various material handling equipment and lifting appliances in dock.
- To know the safe working on board the ship and storage in the yards.
- To understand the safe operation of crane, portainers, lift trucks and container handling equipment.

UNIT I HISTORY OF SAFETY LEGISLATION**9**

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

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

UNIT II WORKING ON BOARD THE SHIP**9**

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

UNIT III LIFTING APPLIANCES**9**

Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances – portainers – transtainers – toplift trucks – derricks in different rigging etc.

Use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears.

UNIT IV TRANSPORT EQUIPMENT**9**

The different types of equipment for transporting containers and safety in their use-safety in the use of self loading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes.

Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation

Handling of different types of cargo – stacking and unstacking both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.

**UNIT V EMERGENCY ACTION PLAN AND DOCK WORKERS (SHW)
REGULATIONS 1990**

9

Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report.

Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading and unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.

TOTAL: 45 PERIODS

OUTCOMES:

- This course would make the student to familiar of various operations carried out in a dock.
- Students would know the different acts and rules for safe dock operations.
- Students could be able to understand the operation of various types of material handling equipments.
- Students would be prepared to response at the time of emergency in a dock.
- Students can recognize the various problems associated with the use of lifting equipments and in the storage yards.

REFERENCES

1. "Dock Safety" Thane Belapur Industries Association, Mumbai.
2. Bindra SR "Course in Dock and Harbour Engineering"
3. Safety and Health in Dock work, IInd Edition, ILO, 1992.
4. Srinivasan "Harbour, Dock and Tunnel Engineering"
5. Taylor D.A., "Introduction to Marine Engineering".

IL5071

HUMAN FACTORS IN ENGINEERING

**L T P C
3 0 0 3**

OBJECTIVES:

- Studying the work procedure and understanding the relationships between the workers and working environments.
- To study the applications of ergonomic principles and physiology of workers.
- To know the concepts of personal protective equipment and its usages.
- To create the knowledge in process and equipment design in safety aspects.

UNIT I ERGONOMICS AND ANATOMY

9

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics

Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions

UNIT II HUMAN BEHAVIOR

9

Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes-Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting, Motivational requirements.

UNIT III ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS 9

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness

Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions

UNIT IV MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND MANUAL HANDLING TASK 9

Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine.

Ergonomics interventions in Repetitive works, handle design, key board design- measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability

UNIT V HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS 9

A general information-processing model of the users, cognitive system, problem solving, effectiveness.

Principles for the design of visual displays- auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues.

TOTAL: 45 PERIODS

OUTCOMES:

- Students can have the knowledge in work procedure and applications in hazardous workplaces.
- Students can design their own safety devices and equipment to reduce the accidents possibilities.
- Students will be able to incorporate human factors in design of Personal protective equipment.
- They know the risk factors, guide lines for safe design of man machine systems considering human factors.

REFERENCES

1. Ergonomic design for organizational effectiveness, Michael O'Neill
2. Human factors in engineering and design, MARK S.SANDERS
3. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis
4. The Ergonomics manual, Dan McLeod, Philip Jacobs and Nancy Larson

**IS5091 MAINTAINABILITY ENGINEERING L T P C
3 0 0 3**

OBJECTIVES:

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

UNIT I MAINTENANCE CONCEPT 6

Maintenance definition – Need for maintenance – Maintenance objectives and challenges – Tero technology – Maintenance costs - Scope of maintenance department.

| | | |
|--|-------------------------------------|-----------|
| UNIT II | MAINTENANCE MODELS | 12 |
| Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – PM schedule and product characteristics – Inspection models-Optimizing profit/downtime – Replacement decisions. | | |
| UNIT III | MAINTENANCE LOGISTICS | 11 |
| Human factors – Maintenance staffing: Learning curves – Simulation – Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning and scheduling – Spare parts planning. | | |
| UNIT IV | MAINTENANCE QUALITY | 8 |
| Maintenance excellence – Five Zero concept –FMECA –Root cause analysis – System effectiveness – Design for maintainability – Reliability Centered Maintenance. | | |
| UNIT V | TOTAL PRODUCTIVE MAINTENANCE | 8 |
| TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars – Autonomous maintenance – TPM implementation | | |

OUTCOMES:

The students will be able to

1. Understand the various terms and terminologies about the maintenance concept.
2. Understand the various maintenance modes and logistics meant for the execution of various services.
3. Apply their knowledge in areas where the down time, over replacement are existing and could lead to improve the productivity and quality.

TOTAL: 45 PERIODS

REFERENCES

1. Andrew K.S.Jardine & Albert H.C.Tsang, “Maintenance, Replacement and Reliability”, Taylor and Francis, 2006.
2. Bikas Badhury & S.K.Basu, “Tero Technology: Reliability Engineering and Maintenance Management”, Asian Books, 2003.
3. Seichi Nakajima, “Total Productive Maintenance”, Productivity Press, 1993.

| | | |
|---------------|-------------------------|----------------|
| IS5004 | TRANSPORT SAFETY | L T P C |
| | | 3 0 0 3 |

OBJECTIVES:

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

| | | |
|--|--|----------|
| UNIT I | TRANSPORTATION OF HAZARDOUS GOODS | 9 |
| Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries -static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures – communication. | | |

UNIT II ROAD TRANSPORT 8

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

UNIT III DRIVER AND SAFETY 9

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

UNIT IV ROAD SAFETY 10

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.- factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers – street lighting and illumination overloading-concentration of driver.

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

UNIT V SHOP FLOOR AND REPAIR SHOP SAFETY 9

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

TOTAL : 45 PERIODS

OUTCOMES:

The students will be able to

1. Recognize various safety activities undertaken in transporting of hazardous goods
2. Understand the various symbols which are specific to the road safety and able to reduce the accidents occurred in the roads.
3. Apply for the safe transportation of hazardous goods, creating TREM card and safe loading and unloading procedure.

REFERENCES

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

IS5005

FIREWORKS SAFETY

**L T P C
3 0 0 3**

OBJECTIVES:

- To study the properties of pyrotechnic chemicals
- To know about the hazards in the manufacture of various fireworks
- To understand the hazards in fireworks industries related processes
- To study the effects of static electricity
- To learn pyrotechnic material handling, transportation and user safety

UNIT I PROPERTIES OF FIREWORKS CHEMICALS 9

Fire properties – potassium nitrate (KNO₃), potassium chlorate (KClO₃), barium nitrate (BaNO₃), calcium nitrate (CaNO₃), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (Al) powder-Reactions-metal powders, Borax, ammonia (NH₃) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.

UNIT II STATIC CHARGE AND DUST 9

Concept-prevention-earthing-copper plates-dress materials-static charge meter lightning, Causes-effects-hazards in fireworks factories-lightning arrestor :concept-installation-earth pit-maintenance-resistance-legal requirements-case studies.

Dust: size-desirable, non-respirable-biologicalbarriers-hazards-personal protective equipment-pollution prevention.

UNIT III PROCESS SAFETY 8

Safe-quantity, mixing-filling-fuse cutting – fuse fixing – finishing – drying at various stages-packing-storage-hand tools-materials, layout: building-distances- factories act – explosive act and rules – fire prevention and control – risk related fireworks industries.

UNIT IV MATERIAL HANDLING AND TRANSPORTATION: 10

Manual handling – wheel barrows-trucks-bullock carts-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material movement-godown-waste pit.

Packing-magazine-design of vehicles for explosive transports loading into automobiles-transport restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers-loose chemicals handling and transport.

UNIT V WASTE CONTROL AND USER SAFETY 9

Concepts of wastes – Wastes in fireworks-Disposal-Spillages-storage of residues. Consumer anxiety-hazards in display-methods in other countries-fires, burns and scalds-sales outlets-restrictions-role of fire service.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course the students will be able

- To gain knowledge of the chemical reactions of Fireworks chemicals
- To know safe manufacture of Fireworks items
- To improve process safety in fireworks industries
- To analyse safety measures applicable against static electricity
- To suggest safe practices for handling of fireworks in factories, transport and at user end

REFERENCES

1. “Seminar on explosives”, Dept.of of explosives.
2. J.A.Purkiss, “Fireworks-Fire Safety Engineering”
3. Bill of once, “Fireworks Safety manual”
4. “Goeff, “Dust Explosion prevention, Part 1”
5. A.Chelladurai, “Fireworks related accidents”
6. A.Chelladurai, “Fireworks principles and practice”
7. A.Chelladurai, “History of the fireworks in India” Brock, “History of fireworks”
8. K.N.Ghosh, “Principles of fireworks”, H.Khatsuria, Sivakasi, 1987.
9. “Proceedings of National seminar on Fireworks Safety-1999”, MSEC-1999.

OBJECTIVES:

- To know causes of accidents related to construction activities and human factors associated with these accident
- To understand the construction regulations and quality assurance in construction
- To have the knowledge in hazards of construction and their prevention methods
- To know the working principles of various construction machinery
- To gain knowledge in health hazards and safety in demolition work

UNIT I ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS 9

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

UNIT II HAZARDS OF CONSTRUCTION AND PREVENTION 9

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

UNIT III WORKING AT HEIGHTS 9

Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, height pass – accident case studies.

UNIT IV CONSTRUCTION MACHINERY 9

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

UNIT V SAFETY IN DEMOLITION WORK 9

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

TOTAL: 45 PERIODS**OUTCOMES:**

Upon completion of the course the students will be able

- To identify the problems impeding safety in construction industries.
- To identify types and causes of accidents, and designing aids for safe construction.
- To understand the hazards during construction of power plant, road works and high rise buildings.
- To understand the safety procedure for working at heights during construction.

- To have knowledge in selection, operation, inspection and testing of various construction machinery.
- To list out construction regulations and Indian standards for construction and demolition work.

REFERENCES

1. Handbook of OSHA Construction safety and health Charles D. Reese and James V. Edison
2. Hudson, R., "Construction hazard and Safety Hand book, Butter Worth's, 1985.
3. Jnathea D.Sime, "Safety in the Build Environment", London, 1988.
4. V.J.Davies and K.Thomasin "Construction Safety Hand Book" Thomas Telford Ltd., London, 1990.

IS5007

NUCLEAR ENGINEERING AND SAFETY

L T P C
3 0 0 3

OBJECTIVES:

- To know about nuclear energy and fission fusion process.
- To gain knowledge in reactor types, design considerations and their operational problems.
- To know the current status of India in nuclear energy.

UNIT I INTRODUCTION

9

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

UNIT II REACTOR CONTROL

9

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

UNIT III REACTOR TYPES

9

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

UNIT IV SAFETY OF NUCLEAR REACTORS

9

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

UNIT V RADIATION CONTROL

9

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

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

1. Demonstrate nuclear fission and fusion process and their utilization.
2. Understand types of reactors and their Control requirements.
3. Explain the safety design principles and safety regulation process.

REFERENCES

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

IS5008

SAFETY IN TEXTILE INDUSTRY

L T P C
3 0 0 3

OBJECTIVES:

- To provide the student about the basic knowledge about the textile industries and its products by using various machineries.
- To enforce the knowledge on textile processing and various processes in making the yarn from cotton or synthetic fibres.
- To understand the various hazards of processing textile fibres by using various activities.
- To inculcate the knowledge on health and welfare activities specific to the Textile industries as per the Factories Act.

UNIT I INTRODUCTION

9

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

UNIT II TEXTILE HAZARDS I

9

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

UNIT III TEXTILE HAZARDS II

9

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

UNIT IV HEALTH AND WELFARE

9

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

UNIT V SAFETY STATUS

9

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

TOTAL: 45 PERIODS

OUTCOMES:

- The student will able to know about the overall picture about the textile industries and its operations.
- The student could understand the various concepts underlying in the processes involved in processing of fibres to yarn.

- The student will be able to find out various hazards in the textile industry and will be able to apply the control measures to mitigate the risk emanating from the hazard.
- The student could have the capability to handle the various health and welfare activities as per the Factories act and could implement statutory requirements.
- The student could create of his own arrangement in designing various methods meant for mitigating the risk and able to guide his subordinates in executing the work safely.

REFERENCES

1. 100 Textile fires – analysis, findings and recommendations LPA
2. Groover and Henry DS, “Hand book of textile testing and quality control”
3. “Quality tolerances for water for textile industry”, BIS
4. Shenai, V.A. “A technology of textile processing”, Vol.I, Textile Fibres
5. Little, A.H., “Water supplies and the treatment and disposal of effluent”
6. “Safety in Textile Industry” Thane Belapur Industries Association, Mumbai.

IS5009

SAFETY IN MINES

L T P C
3 0 0 3

OBJECTIVES:

- To provide in depth knowledge on Safety of mines of various types.
- To study, know and understand about the types of mines and various risk involved in the mining operations.
- To get exposed to various types of accidents happened in mines and how to manage during accidents.
- To analyse the nature of mining activities and developing a safety system to reduce the risk and also to implement the Emergency preparedness in the working environment of mines and to plan for the disaster management.

UNIT I OPENCAST MINES

9

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

UNIT II UNDERGROUND MINES

9

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

UNIT III TUNNELLING

9

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

UNIT IV RISK ASSESSMENT

9

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

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT

9

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

TOTAL: 45 PERIODS

OUTCOMES:

- This course would make the student familiar with the concept of safety aspects in the mining industries.
- Course would be helpful in understanding the various types of mining activities like open case mines, underground mines and tunnel ling.
- The students will understand about the various risks involved in the mining activities and come to know about the various safety activities to be taken to ensure the safety of the workers.
- Students could able to implement the techniques like risk assessment Disaster management and emergency preparedness with the proper knowledge on accident prevention.
- Course would equip the students to effectively employ their knowledge on accident prevention in mines.

REFERENCES

1. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan - DHANBAD, 2002.
2. Kejriwal, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.
3. "Mine Health and Safety Management", Michael Karmis ed., SME, Littleton, Co.2001.

IS5010**SAFETY IN ENGINEERING INDUSTRY****L T P C
3 0 0 3****OBJECTIVES:**

- To know the safety rules and regulations, standards and codes
- To study various mechanical machines and their safety importance
- To understand the principles of machine guarding and operation of protective devices.
- To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
- Developing the knowledge related to health and welfare measures in engineering industry

UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES**9**

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines,

Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT II PRINCIPLES OF MACHINE GUARDING**9**

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

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

UNIT III SAFETY IN WELDING AND GAS CUTTING 9

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

UNIT IV SAFETY IN COLD FORMING AND HOT WORKING OF METALS 9

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

Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures.

Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING 9

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

TOTAL: 45 PERIODS**OUTCOMES:**

- Students can have the knowledge in safety rules, standards and codes in various mechanical engineering processes
- They can design machine guarding systems for various machines such as lathe, drilling, boring, milling etc.,
- They can implement the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes etc.,
- Students will have knowledge in testing and inspection as per rules in boilers, heat treatment operations etc.,
- They can take preventive measures in health and welfare of workers' aspects in engineering industry.

REFERENCES

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

OBJECTIVES:

- To know the quality engineering concepts in product design and development processes.
- To know the control and process parameters' characteristics with feedback system.
- To know the methods for production and diagnosis process improvements.
- To have knowledge on ISO quality systems and types of quality tools such as failure and effect analysis.
- To understand the six-sigma concepts and its implementation in engineering industries.

UNIT I INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION 9

Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service. Loss function Derivation – use-loss function for products/system- justification of improvements-loss function and inspection- quality evaluations and tolerances-N type, S type, L type

UNIT II ON-LINE QUALITY CONTROL 9

On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems-measurement error and process control parameters.

UNIT III ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS 9

Checking intervals- frequency of process diagnosis. Production process improvement method- process diagnosis improvement method- process adjustment and recovery improvement methods.

UNIT IV QUALITY ENGINEERING AND TPM 9

Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools–fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems.

UNIT V SIX SIGMA AND ITS IMPLEMENTATION 9

Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method-roles and responsibilities –leaders, champion, black belt, green belts. Do's and don't's - readiness of organization – planning-management role- six sigma tools – sustaining six sigma.

TOTAL: 45 PERIODS**OUTCOMES:**

1. Students can understand the loss function derivation and quality engineering in product design and development processes.
2. Students can develop their knowledge in online quality control systems and process an control parameters.
3. The students will be able to improve the production and process diagnosis and production process.
4. The students will be able to gain knowledge in ISO quality management systems.
5. The students will be able to list the roles and responsibilities of leaders.

REFERENCES

1. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, New Delhi, Second reprint, 2002.
2. De Feo J A and Barnard W W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, New Delhi, 2005.
3. Pyzdek T and Berger R W,"Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996
4. Taguchi G, Elsayed E A and Hsiang, T.C., "Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, International Edition, 1989

OBJECTIVES:

- To study the disaster types and their control using space technology with case studies.
- To study about on site and off site emergency plans.
- To create awareness on global warming, eco-friendly products, environmental impact assessment and environmental policies with proper case studies.
- To study about the marine pollution and earth quake disasters and their effects.
- To give the knowledge on environmental education including laws, risk & disaster assessment disaster profile of India.

UNIT I**10**

Philosophy of Disaster management-Introduction to Disaster mitigation-Hydrological, Coastal and Marine Disasters-Atmospheric disasters-Geological, meteorological phenomena-Mass Movement and Land Disasters-Forest related disasters-Wind and water related disasters-deforestation-Use of space technology for control of geological disasters-Master thesis

UNIT II**10**

Technological Disasters-Case studies of Technology disasters with statistical details-Emergencies and control measures-APELL-Onsite and Offsite emergencies-Crisis management groups-Emergency centers and their functions throughout the country-Softwares on emergency controls-Monitoring devices for detection of gases in the atmosphere-Right to know act

UNIT III**8**

Introduction to Sustainable Development-Bio Diversity-Atmospheric pollution-Global warming and Ozone Depletion-ODS banking and phasing out-Sea level rise-El Nino and climate changes-Eco friendly products-Green movements-Green philosophy-Environmental Policies-Environmental Impact Assessment-case studies-Life cycle

UNIT IV**8**

Offshore and onshore drilling-control of fires-Case studies-Marine pollution and control-Toxic, hazardous and Nuclear wastes-state of India's and Global environmental issues-carcinogens-complex emergencies-Earthquake disasters-the nature-extreme event analysis-the immune system-proof and limits

UNIT V**10**

Environmental education-Population and community ecology-Natural resources conservation-Environmental protection and law-Research methodology and systems analysis-Natural resources conservation-Policy initiatives and future prospects-Risk assessment process, assessment for different disaster types-Assessment data use, destructive capacity-risk adjustment-choice-loss acceptance-disaster aid- public liability insurance-stock taking and vulnerability analysis-disaster profile of the country-national policies-objectives and standards-physical event modification-preparedness, forecasting and warning, land use planning

TOTAL: 45 PERIODS**OUTCOMES:**

Upon completion of the course the students will be able

- To explain the philosophy of disaster management and their control using the sophisticated technologies.
- To understand the emergency measures and how to control with monitoring devices.
- To understand earth quake disasters and nuclear wastes disposals.
- To gain knowledge in risk and disaster assessment processes including standards, and national policies.

REFERENCES

1. Introduction to Environmental Engineering and Science, Gilbert, M. Masters
2. Environmental Science, Miller, G. Tylor
3. Environmental Science sustaining the earth, G. Tylor, Miller
4. Principles of Environmental Science and Engineering, Bagad Vilas.
5. Principles of Environmental Science and Engineering, R. Sivakumar

IS5013

OHSAS 18000 AND ISO 14000

L T P C
3 0 0 3

OBJECTIVES:

- The course could provide the basic knowledge on Occupational Health and Safety Management System and Environmental Management System standards.
- To inculcate the knowledge on various terms and terminologies which are used in the Occupational Health, Safety and Environmental Management system.
- To educate about the various steps to be taken for certification of Occupational Health and Safety Assessment Series (OHSAS) and ISO14001 (Environmental Management Systems) standards.
- To impart knowledge on Environment Impact Assessment (EIA), Life Cycle Assessment of product and principles of Eco labelling.

UNIT I OHSAS STANDARD

9

Introduction – Development of OHSAS standard – Structure and features of OSHAS 18001 – Benefits of certification-certification procedure – OH and S management system element, specification and scope - correspondence between OHSAS 18001, ISO 14001:1996 and ISO 9001:1994 – Guidelines (18002:2000) for implementing OHSAS 18001.

UNIT II OHSAS 18001 POLICY AND PLANNING

9

Developing OH and S policy– Guidelines – Developments - procedure - Content of OH and S policy – General principle, strategy and planning, specific goals, compliance – methodology. Planning – Guidelines, methodology steps developing action plan – Analysis and identify the priorities, objective and Targets, short term action plan, benefits and cost of each option, Development of action plan.

UNIT III IMPLEMENTATION AND OPERATION, CHECKING AND REVIEW

9

Guidelines for structure and Responsibilities, Top Management, middle level management, coordinator and employees - Developing procedures, identifying training needs, providing training, documentation of training, Training methodology consultation and communications. Checking and Review; performance measurement and monitoring, Proactive and Reactive monitoring, measurement techniques, inspections, measuring equipment - Accidents reports, Process and procedures, recording, investigation corrective action and follow up - records and records management. Handling documentation, information, records.

UNIT IV ISO 14001

9

EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001. Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing ISO14000- General principles of Environmental Audit, Auditor, steps in audit, Audit plan.

UNIT V ENVIRONMENT IMPACT ASSESSMENT 9

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

Audit-methodology, Auditors Audit results management review-Continual improvement.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would be able to remember the various standards which is meant mainly for maintaining the Health of the employee and for the maintenance of the Environment.
- The student could be able to understand the basic difference between the ISO 9000 series and OHSAS 18001 and ISO 14000 standards and the various clauses which governs the system in maintaining the standard.
- The course could provide the sufficient knowledge on various clauses and subsequent preparation of procedures and related documents and could be able to apply their knowledge in preparing the OHSAS manual for getting the certification from the external certifying agencies.
- Course could help the students in acquiring the knowledge on various standards and provide the skill in analysing the various clauses and its suitability and applicability on the nature of organization.

REFERENCE

1. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria and Sons, Delhi.

IS5014 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

**L T P C
3 0 0 3**

OBJECTIVES:

- To know the fundamental concepts and applications of Artificial intelligence.
- To familiarize with AI languages like PROLOG and LISP.
- To understand the various features of expert system
- To have knowledge about Neural Network and corresponding selection of parameters.

UNIT I INTRODUCTION 9

Intelligence – Definition, types cognitive aspect approach, measuring intelligence – early efforts, IQ and AI: aspects of intelligence – learning, problem solving, creativity, behaviour and biology. Artificial intelligence: Historical background, applications of AI, objections and myths, AI languages: Introduction to PROLOG and LISP.

UNIT II COGNITIVE PSYCHOLOGY 11

The mind – informative and cybernetics, components for thought, modes of perception – visual, auditory and other systems: memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote, parameter, method and concept: Game playing, reasoning, Artificial Vision – picture processing – identifying real objects; Vision programs, factory vision systems.

UNIT III KNOWLEDGE ENGINEERING 9

Introduction – role of knowledge engineer, knowledge representation – psychology, production rules, logic and programming, Common sense and fuzzy logic, semantic networks, learning systems.

UNIT IV EXPERT SYSTEMS 9
 Introduction, knowledge acquisition for Expert system, features of Expert systems –System structure, inference Engines, uncertainties, memory mechanisms, range of applications, actual expert systems – VP expert. Assignment – Development of a simple expert system.

UNIT V INTRODUCTION TO NEURAL NETWORKS 7
 Neural Network Architecture – Learning methods – Architecture of a Back Propagation Network – Selection of parameters – Simple variations of BPN.

TOTAL: 45 PERIODS

OUTCOMES:

- To apply various aspects of intelligence to diverse industrial situations
- To list out the applications of expert system To develop a simple expert system related to industrial safety Engineering.
- To apply neural network concepts in safety engineering discipline

REFERENCES

1. Charnaik, E., and McDermott, D., “Introduction to Artificial Intelligence”, Addison Wesley, 1985.
2. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Prentice Hall of India, 1992.
3. Elaine R., and Kevin, “Artificial Intelligence”, 2nd Edition, Tata McGraw Hill, 1994.
4. Nilsson, N.J., “Principles of AI”, Narosa Publishing House, 1990.
5. Rajasekaran S and Vijayalakshmi Pai, G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications”, PHI, 2003.
6. Schalkoff, R.J., “Artificial Intelligence” – An Engineering Approach”, McGraw Hill International Edition, Singapore, 1992.
7. Winston, P.H., “Artificial Intelligence”, Addison Wesley, 1990.

MF5072 RESEARCH METHODOLOGY L T P C
3 0 0 3

OBJECTIVES

- To impart scientific, statistical and analytical knowledge for carrying out research work effectively.

UNIT I INTRODUCTION TO RESEARCH 9

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques –Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

UNIT II EXPERIMENTAL DESIGN 9

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales – Validity testing of scales –Reliability concept in scales being developed – Stability Measures.

UNIT III DATA COLLECTION METHODS 9

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

UNIT IV MULTIVARIATE STATISTICAL TECHNIQUES 9

Data Analysis – Factor Analysis – Cluster Analysis – Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation – Application of Statistical (SPSS) Software Package in Research.

UNIT V RESEARCH REPORT 9

Purpose of the written report – Concept of audience – Basics of written reports. Integral parts of a report – Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report – Experimental, Results and Discussion – Recommendations and Implementation section – Conclusions and Scope for future work.

TOTAL = 45 PERIODS

OUTCOME

- After completion of the syllabus students will able to get knowledge about the different research techniques and research report.

REFERENCES

1. C.R.Kothari, Research Methodology, WishvaPrakashan, New Delhi, 2001.
2. Donald H.McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.
3. Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000
4. G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999.
5. Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.
6. Raymond-Alain Thie'tart, *et.al.*, Doing Management Research, Sage Publications, London, 1999
7. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.

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DATA ANALYTICS

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OBJECTIVES:

The Student should be made to:

- Be exposed to big data
- Learn the different ways of Data Analysis
- Be familiar with data streams
- Learn the mining and clustering
- Be familiar with the visualization

UNIT I INTRODUCTION TO BIG DATA 8

Introduction to Big Data Platform – Challenges of conventional systems - Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools, Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT II DATA ANALYSIS 12

Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics - Rule induction - Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT III MINING DATA STREAMS 8

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window - Realtime Analytics Platform(RTAP) applications - case studies - real time sentiment analysis, stock market predictions.

UNIT IV FREQUENT ITEM SETS AND CLUSTERING**9**

Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

UNIT V FRAMEWORKS AND VISUALIZATION**8**

Map Reduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications:

TOTAL : 45 PERIODS**OUTCOMES:****The student should be made to:**

- Apply the statistical analysis methods.
- Compare and contrast various soft computing frameworks.
- Design distributed file systems.
- Apply Stream data model.
- Use Visualisation techniques

REFERENCES:

1. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
2. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
3. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
4. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.
5. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.