

Fire Technology & Safety Engineering, VIII-Semester

FT-8001 Industrial Hygiene & Occupational Health

COURSE OBJECTIVE:

1. To have the knowledge of types of storage & handling process of hazardous material.
2. To learn about the understanding of impact of noise during working hours..
3. To have the knowledge to develop confidence for training & workers regarding occupational diseases.
4. To learn about stress related to work hazard.
5. To learn about various communicate risk factor in handling hazardous material.

COURSE CONTENT:

INTRODUCTION TO CHEMICAL HAZARDS: Dangerous properties of chemicals, dust, gases, fumes, mists, vapors and smoke. Exposure evaluation and air sampling, There sold limit values. Chlorine Exposure effects. Personal monitoring. Introduction to chemical processes and safety. Storage, Transport and handling of hazardous chemicals. Industrial ventilation. Natural ventilation. Opening in work area.

PHYSICAL HAZARDS: Improper illumination, Thermal radiation, ultra violet radiation, ionizing and non ionizing radiation. Preventive and control measures. Noise-Measurement, Noise-control techniques – Noise Survey, vibration. Thermal stress, heat balance, heat-stress, heat disorders, control measures.

WORK PHYSIOLOGY: classification of workload. Work capacity and man- Job alignment. Fatigue, Physiological tests – diet and exercise for work stress control. Ergonomics, Application of ergonomics in safety and health management, methods of reducing postural strain.

OCCUPATIONAL HEALTH: Common occupational diseases such as silicosis, asbestosis, and toxicity related to lead, nickel, chromium, and manganese. Causation of diseases and its effects. Methods of prevention. Compensation of occupational diseases. Occupational dermatitis, occupational cancers, Medical examination of workers, occupational health center, health records, fundamentals of first aid.

PERSONAL PROTECTIVE EQUIPMENTS: Non respiratory personal protective devices: Head protection , Ear protection. Face and Eye protection. Head protection. Feet protection. Body protection. Supply, use, care maintenance of personal protective equipments. Requirements under safety laws. Respiratory personal protective devices: classification of hazards. Selection of respirators. Instructions in use of breathing apparatus. Supply, Training for use, care & maintenance of breathing apparatus.

COURSE OUTCOME

1. Student will able to demonstrate the knowledge of types of storage & handling process of hazardous material.
2. Graduate will show the understanding of impact of noise during working hours..
3. Graduate will develop confidence for training & workers regarding occupational diseases.
4. Graduate will able to handle stress related to work.
5. Graduate will able to communicate risk factor in handling hazardous material.

LABORATORY

Experiments as suggested by the course coordinator.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

Occupational Health & Safety in manufacturing Industries – M K Potty.
Diseases of occupation – D. Hunter.
Code of Practice for Hazardous goods by NFPA
Dangerous properties of Industrial materials by Irvin Sex.
Handbook of occupation Health & Safety NSC Chicago 1982
Encyclopedia of occupational Health & Safety Vol I & II I.L.O. Geneva 1985.
Human Factors in Engineering & Design Tata McGraw-Hill 1982

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FT-8002 Environment Protection and Waste Management

COURSE OBJECTIVE:

To learn the various engineering techniques and management approaches for the prevention and control of air pollution, water pollution and pollution due to urban solid waste and hazardous waste.

COURSE CONTENT:

AIR POLLUTION MANAGEMENT: Air Pollution, Air pollution Measurement, Air quality monitoring, Air pollution modeling, Air pollution control Technology & method, Equipment Selection, Equipment design, Particulate emission control, Sources corrective methods, Air quality management concept.

WATER POLLUTION MANAGEMENT: Concept of water pollution, characteristic of waste water, standards of pollution parameters methodology of waste water treatment, Water Treatment process, Sedimentation, coagulation and flocculation, Filtration, Advanced Water Treatment processes, Industrial Water pollution management.

SOLID HAZARDOUS WASTE MANAGEMENT: Sources, Classification and composition of MSW (Municipal Solid Waste), Waste Minimization of MSW, Thermal Treatment (Combustion) of MSW, Hazardous Waste Transport & treatment facilities, Treatment systems for hazardous waste & handling of treatment plant residues.

ENVIRONMENTAL MANAGEMENT: Principles and requirements of ISO 14001 EMS, Environmental auditing and Auditing of waste minimization. Environment Impact Assessment, Environment Management Plan. EIA, EMP and Environmental Auditing Environmental impact assessment, base line for existing data collection and identification of impact, prediction of impacts, Evaluation of impacts.

HEALTH CARE WASTE: Handling storage and transportation of health care waste, Waste segregation packaging on site collection Transport & storage of waste treatment and disposal of health care waste. Incineration chemical infection wet and dry thermal treatment, microwave irradiation, land disposal, winterization treatment and disposal method from pharmaceutical & chemical waste; Training for health care personal and waste management operators.

COURSE OUTCOME

On completion of this course the student would be able to:

1. Attain ability to choose the most suitable technique for air pollution monitoring and control technique for a given application.
2. Describe suitable techniques for water treatments and control technique for water pollution management.
3. Identify the techniques for the disposal and management of urban solid wastes and hazardous wastes
4. Demonstrate the ability to recognize the tools for environmental management in industries.
5. Demonstrate an ability to recognize the type of health care waste and processes involved in Transport & storage of waste treatment and disposal of health care waste

LABORATORY

Experiments as suggested by the course coordinator.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

- Environmental Management Handbook by Marcel Dekker.*
Environmental Management Handbook for Hydrocarbon Processing Indus.; James B. Wall.
Environmental Safety and Health Engineerings by Gayle wood side and Dianna Koeurek.
Waste Management by Rajiv K. Sinha.
Hazardous Waste Management by J.M. Dewan.
Perspectives in Nuclear Toxic and Hazardous Waste by Kadambari Sharma.
Water Pollution, Causes Effects & Control by P.K. Goel.
A to Z of Environmental Audit, A. Mehrotra.
Elements of Biotechnology -P.K. Gupta

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Elective-V FT-8003 (1) Hazardous Material Management

COURSE OBJECTIVE:

To learn fundamentals of various hazardous materials exposure with their source and dispersion models, chemical risk analysis, storage and handling consideration.

COURSE CONTENT:

EXPOSURE AND RESPONSE: General Principle of Chemical exposure and toxic response- Chemical exposure and cancer, chemical exposure and hypersensitivity, toxic response of lungs, liver, kidney, skin chemical exposure and health risk assessment.

DISPERSION MODEL: Toxic release and dispersion models-Design basis, Introduction to Source Models, source model, Flashing Liquids, Liquid Pool Evaporation or Boiling, Conservative Analysis, dispersion model, Pasquill- Gifford model, effect of release momentum, Buoyancy, Dense Gas Dispersion, Toxic Effect Criteria, Release Mitigation.

CHEMICAL RISK ANALYSIS: Flammability-vapour pressure, limits of flammability, Flash points, auto-ignition temperature. Stability- Experimental methods of determination, classifications of instability risk, quantitative approach. Toxicity- Evaluation parameter, level of toxic risk, problem posed by determination of toxicity risk level, Quantative estimation method.

EXPLOSION HAZARDS: Gas and vapor cloud explosion & means of preventing and mitigating in the process industry, Explosion in clouds of liquid droplets in air (spray/mist explosions), Dust Explosion. Stability and sensitivity tests, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations- diluting a release, purging and inerting, venting, explosion relief, flame arrestors, explosion suppression.

STORAGE AND HANDLING: Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief- relief valve sizing calculations- storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation- pipe line transport- safety in chemical laboratories. Safety provisions like level and flow indicators- alarms, colour coding for pipe lines and cylinders.

COURSE OUTCOME

1. Students will be able to explain chemicals exposure and their response in human body.
2. Students will be able to describe various source and dispersion models for any hazardous material leakage.
3. Students will be able to demonstrate chemical risk analysis for a given environment.
4. Students will be able to analyze impact of explosions in different conditions.
5. Students will be able to explain storage and handling requirement of different hazardous material.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

Chemical process safety, fundamental with application- Daniel A Crawl/ Joseph F Louver
Chemical exposure and toxic response- Edited by- Stephen K. Hall, Joana Chakraborty Randall J. Ruch.
Chemical Risk analysis- Bernard Martel
Explosion hazards in the process industries. - Rolf K. Eckhoff.
Chemical process Industries Shreve R.N.
Chemical Engineers handbook peoy JHJ & Chitten (Ed)
Hazardous materials emergency planning guide-NSC India.
Loss prevention in the process Industries F.P. Lees.
Technical guidance for hazard analysis - NSC India.
Process equipment design - MV Joshi
Major hazard control - A practical manual (ILO)
Chemical Process safety - Daniel A Crawl, Joseph Flouvar.

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Elective-V FT-8003 (2) Human Factor Engineering

COURSE OBJECTIVES:

To learn how man, machine and environment interact effectively to make the work and workplace better for ease of work and to maximise production.

COURSE CONTENT:

Unit-I Human Factors-Objectives and Approach: Systems thinking - human _ machine systems, characteristics of systems, system reliability. Human beings as information processors- information theory, displaying information, coding of information, characteristics of good coding system, compatibility, types of compatibility, perception, memory, decision making, attention, age and information processing. Workload and Its Measurement.

Unit-II Process of seeing, visual capabilities, accommodation, visual acuity, contrast sensitivity, factors affecting visual acuity and contrast sensitivity, adaptation, colour discrimination, perception. Design of hard copy and VDT screens. Graphic representations - symbols, objectives and criteria for selection, perceptual principles of symbolic design. Codes - dimension, colour. Design of dynamic information displays, uses of dynamic information, design of quantitative visual displays, design of qualitative visual displays, design of signal and warning lights, recommendations regarding signal and warning lights, representational displays, head-up displays. Hearing, nature and measurement of sound, complex sound, anatomy of ear, conversion of sound waves to sensations, masking. Auditory displays, detection of signals, relative discrimination and absolute identification of auditory signals, sound localization, principles of auditory display, cutaneous senses, tactual displays, substitutes for hearing and seeing, olfactory senses and displays.

Unit-III Physical work - muscle physiology, work physiology, measures of physiological strain, physical work load, work efficiency, energy consumption, grades of work, factors affecting energy consumption, controlling energy expenditure, strength and endurance, measurement of strength, factors affecting strength. Manual materials handling - lifting tasks, carrying tasks, pushing tasks, limits of MMH tasks, reducing risks of MMH overexertion. Motor skills - biomechanics of human motion, types of body movements, range of movements, classes of motor movements, Speed of movements _ reaction time, movement time, accuracy of movements.

Human control of systems - compatibility, spatial compatibility, movement compatibility. Supervisory control. Controls devices - functions of control, factors in control design. Principles of hand tool and device design.

Unit-IV Workplace design - anthropometry, static dimensions, dynamic dimensions, principles in the application of anthropometric data. Work spaces - work- space envelopes for sitting and standing personnel, out-of-reach and clearance requirements. Design of work surfaces. Science of seating _ general principles of seat design. VDT workstations.

Unit-V Arrangement of components within a physical space - principles of arranging components, methodologies for arranging components, types and uses of various data, link diagrams, general location of various controls and displays within work space, specific arrangements of controls and displays within work space, spacing of control devices. General guidelines in designing individual workplaces.

COURSE OUTCOMES: On completion of this course the student will be able to

1. Understand human information processing ability and the parameters influencing it.
2. Gain knowledge about information receptors and the visual and auditory displays.
3. Understand physical work load, energy consumption for various works, motor skills and hand tool design.
4. Apply workspace design and arranging components in work space.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

Human factors in engineering & design, (seventh edition). Sanders, M.M. and McCormick, E.J. (1993). McGraw-Hili, New York.

A guide to ergonomics of manufacturing. Martin Helander. (1996). Tata McGraw Hill, New Delhi.

Introduction to ergonomics. (third edition). Bridger, R.S. (2008). CRC Press

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Elective-VI FT-8004 (1) Special Fire Hazards

COURSE OBJECTIVES:

To learn about the special locations for hazards such as aviation industry, marine and high-rise building with their control measures.

COURSE CONTENT:

Constructional features of an Air Craft, Types of Engines, Basic Fire-Hazards in Aircraft, Nature of Air Crashes, Emergency Landings including belly leading; Access to Fire Service Personnel and Escape of trapped persons problems, Types of Safety Belts, Ejection-Seats; and their methods of release; Rescue and Fires in Air Craft and methods of fire-fighting; Problems of fire-fighting. Problems in dealing with Air Craft carrying ammunition, bombs nuclear weapons, Action to be taken in case of accidents involving Radio Active Cargo

Hazards in Airport, Protection & Types of Hangers, Refueling and Defiling in Air Cargo, Crash Fire Tender: Provision of Crash, Fire Tenders including Rapid Intervening appliances, Categorization of Air-Port, their extinguishing media and determination of the appliances for each category as per International Standard. B:

Marine Fire- The maritime environment, organizational role, vessel types, construction & systems of fire detection & suppression systems, Vessel plans, drawings & documents, cargo vessel hazards & safety, Incident strategies & tactics training & planning, vessel fire incidents, Marine incidents & Rescue operations.

C:HIGH RISE BUILDINGS

Fundamentals of Fire Safe Building design, Building and site planning for fire-safety, structural integrity during fire confinement of fire in building, Life safety systems for high, rise structures. Evacuation: Need of Evacuation plans in high rise buildings, Making of Evacuation Plans, types of Evacuation, Procedure of Evacuation.

Alarm signaling in high-rise building – Smoke movement in building – Residential highrise building-High-rise building with complex occupancy. Basic fire-fighting strategy. Study of model code of practice for high-rise building in metropolitan cities (Building Bye Laws).

COURSE OUTCOMES:

1. Student will be able to explain constructional features of air craft with safety measures.
2. Student will be able to describe hazards and their protection in all category of airport.
3. Student will be able to explain vessel plan, drawing and document used in marine.
4. Student will be able to explain life safety systems in high-rise buildings.
5. Student will be able to describe building bye laws in metropolitan cities.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

- Aero plane knowledge for Rescue Personnel by F. Engineering Division.*
Fire Protection and Maintenance of Aircraft by N.F.P.A.
The Fire Hazards of Fuelling Aircraft in the Open by D.S.I.R., H.M.S.O. London.
I.C.A.O. Standard
Marine fire manual
High-Rise building fires and fire safety – N.F.P.A.
High-Rise Fire & Life Safety by B. Hagan
N.F.P.A.
National Building Code of India.

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Elective-VI FT-8004 (2) Safety in Rail and Road Transport

COURSE OBJECTIVES:

To learn the basic working principles involved in various transportation systems and their safety aspects and to be able to identify defects in planning and design of transportation systems.

COURSE CONTENT:

Railway Engineering: Permanent way- components. Rails- Functions, requirements, defects, rail joints and fastenings, check and guard rails, coning of wheels, creep of rails. Sleepers- functions, requirements, types, density. Ballast- functions, requirements types.

Geometric Design- Horizontal curves, Super- elevation, Negative super elevation in branches, Length of transition curves- Grade compensation on curves, Widening of Gauge on curves.

Railway operation Control: Points and crossings- Design features of a turn out –Types of Railway track- Points- Details of Station Yards and Marshalling Yards- Signaling and interlocking- Principles of track circuiting- Control of train movement by absolute block system- Automatic block system- Centralized traffic control Systems.

Classification of highways- Historical development of road construction- Typical cross section of roads - Definition of various cross- sectional elements- Requirements & factors controlling alignment of roads - Basic Geometric design.

Traffic Engineering: Traffic characteristics- various traffic studies and their applications – Traffic Regulations and Controls- Traffic Control devices- Traffic signals- Classification of signals- carriage- way markings- Traffic islands- Highway intersections- Principles of highway lighting.

COURSE OUTCOMES:

On successful completion of this course the student will develop a broad understanding of the:

1. Working of railways and safety aspects in railway operation.
2. Basic geometric design features of roads.
3. Traffic studies and traffic safety.
4. Basic layout and facilities of docks and harbours. .

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

- Railway Engineering*, Rangwala, S. C. (2012).. Charotar Book Distributors, Anand.
- Railway Engineering*, Chandra, S. & Agarwal, M. M. (2007).. Oxford University Press, New Delhi.
- Highway Engineering*, Khanna, S. K. and Justo, c. E. G. (2001). (9th ed). Nem Chand & Brothers, New Delhi.
- Traffic Engineering and Transport Planning*, Kadiyali, L. R. (2004).. Kharna Publishers, New Delhi
- Dock and Tunnel Engineering*, Srinivasan, R. (2013). Harbour,. Charotar Publishing House Pvt. Ltd, Anand

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FT-8006 Fire Fighting Skills

COURSE CONTENT:

PRACTICE AND PERFORMANCE OF APPLIANCE DRILLS :

Instructions for officer incharge, Duty of drill incharge, Command and action meaning - crew number, Fall in, Fall out, Mount, Dismount, Get to work, Water ON, Knock-off, Make up, Carry ON, Stand from under, still, slip, Counter Balance, Step In, Step out, Extend, Lower, Pitch.

PRACTICE AND PERFORMANCE OF HOSE DRILLS :

Lifting a roll of delivery hose, Carrying of a roll delivery hose, Connecting a delivery hose, Unrolling a delivery hose, disconnecting a delivery hose, under- running delivery hose, Rolling up a delivery hose.

PRACTICE AND PERFORMANCE OF HYDRANT DRILL (THREE MEN):

Requirement, Position of three crew members, Add one length of hose, Remove one length of hose, Replacing burst length of hose, Getting a branch to work, Dividing a line in to two line of hose, Collecting two hose line to make one line, Knock off and make off.

PRACTICE AND PERFORMANCE OF HYDRANT DRILL (FOUR MEN):

Requirement, Position of four crew member, Function of individual crew member, Add one length of hose, Removing one length of hose, Replacing a burst length of hose use of dividing breeching, Use of collecting Breeching, Getting a branch to work, knock off and make up.

PRACTICE AND PERFORMANCE OF TRAILER PUMP DRILL (FOUR MEN AND SIX MEN):

Requirement, Single delivery, Single suction, Double suction, Double delivery, Position of six crew members in trailer pump, Change round, Mount, Dismount, Close up position, Fall in position, Towing Tender, Ladder drill, Extension ladder, Position of four crew members, Position at Pitching, Fire Escape ladder drill requirement, close up position, Pitching.

REFERENCES

Drill manual for Fire Services of India by Govt. of India.

Fire Fighters Skill drill manual by NFPA.