# ANNA UNIVERSITY, CHENNAI
**AFFILIATED INSTITUTIONS**
**REGULATIONS 2013**
**M.E. INDUSTRIAL SAFETY ENGINEERING**
**I TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS**

## SEMESTER I

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
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<tr>
<td>1.</td>
<td>MA716</td>
<td>Probability and Statistical Methods</td>
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<td>2.</td>
<td>IS7101</td>
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<tr>
<td>1.</td>
<td>IS7201</td>
<td>Fire Engineering and Explosion Control</td>
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## SEMESTER III

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### SEMESTER IV

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**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 74**

### LIST OF ELECTIVES FOR M.E. INDUSTRIAL SAFETY ENGINEERING

#### SEMESTER I (Elective I)

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<td>1.</td>
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MA7167 PROBABILITY AND STATISTICAL METHODS

UNIT I PROBABILITY AND RANDOM VARIABLE

UNIT II ESTIMATION THEORY

UNIT III TESTING OF HYPOTHESIS
Sampling distributions – Test based on Normal, t-distribution, chi-square, and F-distributions – Analysis of variance – One-way and two way classifications.

UNIT VI DESIGN OF EXPERIMENTS
Completely Randomized Design – Randomized Block Design – Latin Square Design – 2 Factorial Design.

UNIT V TIME SERIES
Characteristics and Representation – Moving averages – Exponential smoothing – Auto Regressive Processes.

REFERENCES

IS7101 PRINCIPLES OF SAFETY MANAGEMENT

UNIT I CONCEPTS AND TECHNIQUES

UNIT II SAFETY AUDIT - INTRODUCTION
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
Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents,

UNIT IV SAFETY PERFORMANCE MONITORING


UNIT V SAFETY EDUCATION AND TRAINING


TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES
2. Relevant India Acts and Rules, Government of India.

IS7102 ENVIRONMENTAL SAFETY

UNIT I AIR POLLUTION

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


UNIT III HAZARDOUS WASTE MANAGEMENT

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 10
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 7

T = 15, TOTAL: 60 PERIODS

REFERENCES

IS7103 OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE

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

UNIT III BIOLOGICAL AND ERGONOMICAL HAZARDS 9
Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design.
Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

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UNIT IV OCCUPATIONAL HEALTH AND TOXICOLOGY

9

Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests.

Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems

UNIT V OCCUPATIONAL PHYSIOLOGY

9


TOTAL: 45 PERIODS

TEXT BOOK

REFERENCE

IS7104 INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS  L T P C
                  4 0 0 4

UNIT I FACTORIES ACT – 1948
10
Stuatutory 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.


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

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

UNIT V INTERNATIONAL ACTS AND STANDARDS


REFERENCES


IS 7201 FIRE ENGINEERING AND EXPLOSION CONTROL

UNIT I PHYSICS AND CHEMISTRY OF FIRE


UNIT II FIRE PREVENTION AND PROTECTION


UNIT III INDUSTRIAL FIRE PROTECTION SYSTEMS


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UNIT IV  BUILDING FIRE SAFETY
Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exists – width calculations - fire certificates – fire safety requirements for high rise buildings – snookers.

UNIT V  EXPLOSION PROTECTING SYSTEMS
Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas-rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO$_2$) and halons-hazards in LPG, ammonia (NH$_3$), sulphur dioxide (SO$_2$), chlorine (CL$_2$) etc.

TOTAL: 60 PERIODS

TEXT BOOK

REFERENCES
3. Dinko Tuhtar, “Fire and explosion protection”

IS7202  COMPUTER AIDED HAZARD ANALYSIS

UNIT I  HAZARD, RISK ISSUES AND HAZARD ASSESSMENT
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
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
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

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

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

T=15, TOTAL: 60 PERIODS

REFERENCES

6. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.
7. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

IS7203 ELECTRICAL SAFETY

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS


UNIT II ELECTRICAL HAZARDS

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity.

Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-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

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 12
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 12
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: 60 PERIODS

TEXT BOOK:

REFERENCES
2. Indian Electricity Act and Rules, Government of India.

IS7204 MAINTAINABILITY ENGINEERING

UNIT I MAINTENANCE CONCEPT 6

UNIT II MAINTENANCE MODELS 12

UNIT III MAINTENANCE LOGISTICS 11

UNIT IV MAINTENANCE QUALITY 8

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

TOTAL: 45 PERIODS

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REFERENCES

IS7211 INDUSTRIAL SAFETY LABORATORY

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.

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

IMPACT TEST
Explosive materials like gun powder, white powder, amerces 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
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 ELCB
Software Usage
Accident Analysis

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Safety Audit Packages
Consequence Analysis (CISCON)
Fire, Explosion and Toxicity Index (FETI)
Reliability Analysis for Mechanical system and Electrical System
Failure Mode Analysis

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 analyszer: 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 kid : 1 No
10. Software : CISION, FETI and Failure Mode analysis

TOTAL: 45 PERIODS

IS7212 HAZAD ASSESSMENT IN INDUSTRY – MINI PROJECT L T P C
0 0 3 2

OBJECTIVE:
• It is proposed to carryout detailed design calculations and analysis of any mechanical component or mechanical system. This helps the students to get familiar with respect to the design methodologies applied to any component or mechanical system subjected to static, dynamic and thermo-mechanical loads.

OUTCOME:
• It helps the students to get familiarized with respect to design standards, design calculations and analysis in designing any mechanical component or system.

Each student is required to select any new component or an integrated mechanical system that involves various sub components which are to be designed as per design standards and further required to be analyzed for optimum dimensions with respect to the strength and stiffness.

TOTAL: 45 PERIODS

IS7301 RELIABILITY ENGINEERING L T P C
4 0 0 4

UNIT I RELIABILITY CONCEPT 12

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UNIT II  FAILURE DATA ANALYSIS  12
Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting.

UNIT III  RELIABILITY PREDICTION MODELS  12

UNIT IV  RELIABILITY MANAGEMENT  12

UNIT V  RISK ASSESSMENT  12
Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

TOTAL: 60 PERIODS

REFERENCES

IS7001 QUALITY ENGINEERING IN PRODUCTION SYSTEMS

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 dont’s - readiness of organization – planning-management role- six sigma tools – sustaining six sigma.

TOTAL : 45 PERIODS

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REFERENCES

IS7002 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

UNIT I INTRODUCTION
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
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
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

UNIT V INTRODUCTION TO NEURAL NETWORKS

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
UNIT I  WORK STUDY

UNIT II  ERGONOMICS

UNIT III  PERSONAL PROTECTION

UNIT IV  PROCESS AND EQUIPMENT DESIGN

UNIT V  MAN MACHINE SYSTEMS

Man-machine interface-controls -types of control-identification and selection-types of displays- compatibility and stereotypes of important operations-fatigue and vigilance-measurement characteristics and strategies for enhanced performance.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES

UNIT I  HISTORY OF SAFETY LEGISLATION
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.

UNIT II WORKING ON BOARD THE SHIP
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-pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo.

UNIT III LIFTING APPLIANCES
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
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
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

TEXT BOOKS:

REFERENCES
2. Srinivasan “Harbour, Dock and Tunnel Engineering”
3. Bindra SR “Course in Dock and Harbour Engineering”

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UNIT I ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS
Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accidents – construction regulations, contractual clauses – Pre contract activities, 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

UNIT III WORKING AT HEIGHTS
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

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

TOTAL : 45 PERIODS

REFERENCES
4. Handbook of OSHA Construction safety and health charles D. Reese and James V. Edison
UNIT II ROAD TRANSPORT

UNIT III DRIVER AND SAFETY
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
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
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

TEXT BOOKS:

REFERENCES
5. K.W.Ogden, “Safer Roads – A guide to Road Safety Engineering”

IS7007 FIRE WORKS SAFETY

UNIT I PROPERTIES OF FIREWORKS CHEMICALS
Fire properties – potassium nitrate (KN03), potassium chloride (KCl03), barium nitrate (BaNO3), calcium nitrate (CaNO3), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (A1) 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
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  10
handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material
movement-godown-waste pit.

TRANSPORTATION:
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 fire works-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

TEXT BOOKS :

REFERENCES
1. “Seminar on explosives”, Dept.of of explosives.
2. J.A.Purkiss, “Fireworks-Fire Safety Engineering”
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”

IS7008  SAFETY IN POWDER HANDLING  L T P C
UNIT I  INTRODUCTION  8
3 0 0 3
Powder classification-physical, chemical and other properties-metal powders-other non-metallic
powders-handling methods-manual, mechanical, automatic-charges on powders-charge distribution-
charging of powders.

UNIT II  METAL POWDERS AND CHARACTERIZATION  10
Atomization, types – milling – electro deposition – spray drying, Production of iron powder, Aluminium
powder, Titanium – screening and cleaning of metals – Explosivity and pyrophoricity – toxicity
Particle size and size distribution – measurement, types and significance – particle shape analysis,
methods, surface area, density, porosity, flowrate – testing.
Metal powders, applications as fuel, solid propellants, explosives, pyrotechnics.

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UNIT III DUST EXPLOSION

UNIT IV DUST HANDLING PLANTS AND ELECTRO STATIC HAZARDS
Grinding mills, conveyors, bucket elevators, dust separators, dust filters, cyclones, driers, spray driers, silos, grain elevators, typical applications, hazards.
Electrostatic charges-energy released-type of discharge-spark-carona-insulating powders-propagating brush discharge-discharge in bulk lightning hazards in powder coating-electroplating.

UNIT V DUST EVALUATION AND CONTROL
Evaluation procedures and control measures for particulates (Respirable), Asbestos and other fibres, silica in coal mine - NIOSH guide to the selection and use of particulate respirators – case studies.

TOTAL : 45 PERIODS

REFERENCES

IS 7009 NUCLEAR ENGINEERING AND SAFETY

UNIT I INTRODUCTION

UNIT II REACTOR CONTROL
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
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

UNIT V  RADIATION CONTROL

TEXT BOOKS:

REFERENCES

IS7010 SAFETY IN TEXTILE INDUSTRY

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

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

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

TOTAL: 45 PERIODS

TEXT BOOK
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
5. Little, A.H.,“Water supplies and the treatment and disposal of effluent”

IS7011 SAFETY IN MINES L T P C 3 0 0 3

UNIT I OPENCAST MINES 9

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

UNIT IV RISK ASSESSMENT 9

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT 9

TOTAL: 45 PERIODS

TEXT BOOK:

REFERENCES

www.annauniversityplus.com
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.

UNIT III SAFETY IN WELDING AND GAS CUTTING 9
Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT IV SAFETY IN COLD FARMING 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.

REFERENCES
5. Indian Boiler acts and Regulations, Government of India.
UNIT I PLANT LOCATION
Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions
Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants

UNIT II PLANT LAYOUT
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
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
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
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

TEXT BOOKS:
4. APPLE M. JAMES “Plant layout and material handling”, 3rd edition, John Wiley and sons.
REFERENCES

IS7014 DISASTER MANAGEMENT

UNIT I
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
Technological Disasters-Case studies of Technology disasters with statistical details-Emergencies and control measures-APPELL-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

UNIT IV
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
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

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
5. Principles of Environmental Science and Engineering, R. Sivakumar
### IS7015 OHSAS 18000 AND ISO 14000

**UNIT I OHSAS STANDARD**

**UNIT II OHSAS 18001 POLICY AND PLANNING**
- 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**
- Guidelines for structure and Responsibilities, Top Management, middle level management, co-ordinator 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**
- 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**
- 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**

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

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### IS7016 HUMAN FACTORS IN ENGINEERING

**UNIT I ERGONOMICS AND ANATOMY**
- 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

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

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

IS7017    SAFETY IN CHEMICAL INDUSTRIES  L T P C
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
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
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
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 STORAGES
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

TEXT BOOK:

REFERENCES