PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To provide students with a good understanding of philosophy and integrated approach to managing safety, industrial hygiene and environment.

II. To inculcate the students in hazardous identification techniques, reliability analysis of the process system, event trees & fault trees analysis, hazards and operability analysis (HAZOP).

III. To introduce students to recent developments in analytical techniques, such as computer modelling of risk, reliability and safety problems.

IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to think and act an individual safety consultant.

PROGRAMME OUTCOMES (POs):

a. On successful completion of the programme,

I. Graduates will be able to assess the risks that may result from the physical, chemical, biological and psychological hazards.

II. Graduates will be able to effectively evaluate the current problems related to industrial safety and implement the remedial measures in the industries.

III. Graduates will be able to conduct detailed audit on the environment of existing industries to improve in-plant regimes for the management of hazards.

IV. Graduates will be able to design the safety models with regard to plant and machinery.

V. Graduates will demonstrate an ability to visualize the environmentally sound hazardous waste handling, storage, transportation, treatment and disposal.

VI. Graduates will demonstrate an ability to design of experiments, analyze and interpret data.

VII. Graduates will be familiar with the occupational health and safety act (OSHA) that apply to the work being performed in the workplace.

VIII. Graduates will demonstrate knowledge of professional and ethical responsibilities.

IX. Graduates will be able to communicate effectively to address promptly the concerns of workers in both verbal and written form to ministry of Labour.
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### M.TECH. INDUSTRIAL SAFETY AND HAZARDS MANAGEMENT

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**Employability Enhancement Courses (EEC)**

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OBJECTIVE
To provide basic concepts of Probability and Reliability.

UNIT I 10
Random variable – Two dimensional random variables – Standard probability distributions – Binomial, Poisson and Normal distributions - Moment generating function.

UNIT II 15
Special distributions – Uniform, Geometric, Exponential, Gamma, Weibull and Beta distributions – Mean, Variance, Raw moments from moment generating functions of respective distributions.

UNIT III 15
Sampling distributions – Confidence interval estimation of population parameters – Testing of hypotheses – Large sample tests for mean and proportion – t-test, F-test and Chi-square test.

UNIT IV 10
Curve fitting - Method of least squares - Regression and correlation – Rank correlation – Multiple and partial correlation – Analysis of variance - One way and two way classifications – Time series analysis.

UNIT V 10
Completely Randomized Design - Randomized Block design - Latin square design - 2 Factorial Design.

TOTAL : 60 PERIODS

OUTCOME
Students who successfully complete this course should be able to understanding of numeric and symbolic mathematical computations and use mathematical computation to solve ‘real-world’ problems.

REFERENCES

IH7101 COMPUTER AIDED HAZARDS ANALYSIS

OBJECTIVE
To provide comprehensive knowledge on PHA, HAZOP, Thermal analysis and BAM testing.

UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT 8
Introduction, hazard, hazard monitoring-risk issue - Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), hazard operability studies (HAZOP).
UNIT II INSTRUMENTATION AND TESTING

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), 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 Index(FEI)-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 software 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 - Software CAMEO, ALOHA & MARPLOT.

UNIT V DISPERSION MODEL ANALYSIS AND CASE STUDY

Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases. Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

TOTAL : 45 PERIODS

OUTCOME
Students who successfully complete this course should be able to understanding of Hazard, Risk issues and Hazard assessment. It also be able to develop the air dispersion modeling

REFERENCES
3. Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.
4. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.
OBJECTIVE
To ensure that potential hazards are identified and mitigation measures are in place to prevent accidents. Also to know how to monitor the safety performance importance of training.

UNIT I CONCEPTS 5
Evolution of modern safety concept - Safety policy - Safety Organization - line and staff functions for safety - Safety Committee - budgeting for safety.

UNIT II TECHNIQUES 8
Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit. Pareto Analysis

UNIT III ACCIDENT INVESTIGATION AND REPORTING 12
Concept of an accident, reportable and non-reportable accidents, Accident Frequency Rate, Accident Severity Rate, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports-Class exercise with case study. Cause and Effect Analysis.

UNIT IV SAFETY PERFORMANCE MONITORING 10
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 10

OUTCOME
This course should be to able to know how to monitor the safety performance importance of training.

REFERENCES
IH7103 REGULATION FOR HEALTH, SAFETY AND ENVIRONMENT  

**OBJECTIVE**

To impart knowledge about regulations for health, safety and environment.

**UNIT I**

Factories act and rules; Workmen compensation act.

**UNIT II**


**UNIT III**


**UNIT IV**


**UNIT V**

Overview of OHSAS 18000 and ISO 14000. ISO9000

**TOTAL : 45 PERIODS**

**OUTCOME**

Students who successfully complete this course, explains common hazards, how workers are protected, and precautions taken to ensure a safe workplace and environment.

**REFERENCES**

7. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria & Sons, Delhi.

IH7201 FIRE ENGINEERING AND EXPLOSION CONTROL  

**OBJECTIVE**

To provide basic concepts of fire engineering and explosion control.

**UNIT I** PHYSICS AND CHEMISTRY OF FIRE

UNIT II  FIRE PREVENTION AND PROTECTION  

UNIT III  INDUSTRIAL FIRE PROTECTION SYSTEMS  

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 - exit – width calculations - fire certificates – fire safety requirements for high rise buildings.

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 (CO₂) and halons-hazards in LPG, ammonia (NH₃).

TOTAL : 45 PERIODS

OUTCOME :  
Students who successfully complete this course should be able to understanding the industrial fire protection systems.

TEXT BOOKS:

REFERENCE BOOKS:
IH7202 FUNDAMENTALS IN ENVIRONMENTAL PROTECTION  
L T P C  
3 0 0 3

OBJECTIVE
To provide advanced concepts of EIA and EMS.

UNIT I  

UNIT II  
Rapid and Comprehensive EIA – Legislative and Environmental Clearance procedure in India – Prediction tools for EIA.

UNIT III  

UNIT IV  
Socio cultural environment – Public participation – Resettlement and Rehabilitation.

UNIT V  

TOTAL : 45 PERIODS

OUTCOME
Students who successfully complete this course should be able to frame the EIA documentation

REFERENCES

IH7203 SAFETY IN CHEMICAL INDUSTRY  
L T P C  
3 0 0 3

OBJECTIVE
To provide comprehensive knowledge on safety in process equipment.

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN  
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 equipment, 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, Effects Estimation of hazard assessment.

TOTAL : 45 PERIODS
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 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 IV  STORAGES AND TRANSPORTATION  
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 (NOT arrest) arrestors, Spark Arrestor, fire relief- fire prevention and protection- LPG storages, pressure storages, layout, instrumentation, vapourizer, refrigerated storages, Cryogenic Storage- LNG storages, hydrogen storages, toxic storages, toxic release & control methodologies, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder and Pressure Vessel storage — Importance of Ullage - ware house, storage hazard assessment of LPG and LNG Hazards during transportation-pipeline transport.

UNIT V  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. Specific safety consideration of cement, Paper, pharmaceutical, petroleum, petro-chemical, rubber, fertilizer and distilleries.

TOTAL : 45 PERIODS

OUTCOME  
Gain the comprehensive knowledge on safety in process equipment, storage vessels and Gas transportation pipelines.

REFERENCES  
OBJECTIVE
To ensure that safety in Engineering industry.

UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES
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

UNIT III SAFETY IN WELDING AND GAS CUTTING
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 FORMING AND HOT WORKING OF METALS
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
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-industrial waste disposal.

TOTAL : 45 PERIODS

OUTCOME
Students who successfully complete this course should be able to know the safety in cold forming and hot working of metals, welding and gas cutting.

REFERENCES
5. Indian Boiler acts and Regulations, Government of India.
8. Safety and Health for Engineers - Roger L. Brauer, Ph.D & CSP (USA)
OBJECTIVE

To provide comprehensive knowledge on analyzing instrument.

1. NOISE LEVEL MEASUREMENT AND ANALYSIS


2. VIBRATION MEASUREMENT AND ANALYSIS


3. FRICTION SENSITIVITY TEST


4. IMPACT SENSITIVITY TEST

Measurement of impact sensitivity for unstable materials: Instrument – BAM fall hammer

5. THERMAL REACTIVITY TEST

Measurement of thermal reactivity for unstable materials: Instrument – DSC/TGA

6. EXHAUST GAS MEASUREMENT AND ANALYSIS

Measurement of Exhaust gas measurement of IC engines: Instrument – Gas analyzer

7. BREATHING ZONE CONCENTRATION

Measurement of breathing zone concentration of dust and fumes: Instrument – personal air sampler

8. AMBIENT AIR MONITORING

Measurement of respirable and non-respirable dust in the ambient air: Instrument – High volume sampler

9. CONSEQUENCE ANALYSIS

Soft computing skills on developing effects of fire & explosion and dispersion: Software – PHAST 1 and ALOHA

10. STUDY OF PERSONAL PROTECTIVE EQUIPMENT

Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, apron and leg guard.

11. STUDY OF FIRE EXTINGUISHERS

Selection and demonstration of first-aid fire extinguishers: soda acid, foam, carbon dioxide (CO₂ ), dry chemical powder, halon.

TOTAL: 60 PERIODS
OBJECTIVE
To provide comprehensive knowledge on physical, chemical and biological hazards and its effects on human health.

UNIT I ANATOMY, PHYSIOLOGY, HAZARD AND PATHOLOGY
Definition- Anatomy and Physiology of human organs – The lungs, Skin, Ear and Eyes – Functions of organs – Impairment of organs – Effects of various hazards on organs - Cardio pulmonary resuscitation - audiometric tests, eye tests, vital function tests.

UNIT II PHYSICAL HAZARDS
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 of hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.

UNIT III CHEMICAL HAZARDS

UNIT IV BIOLOGICAL AND ERGONOMICAL HAZARDS
Classification of Bio-hazardous 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.

UNIT V OCCUPATIONAL HEALTH, PHYSIOLOGY AND TOXICOLOGY

TOTAL : 45 PERIODS

OUTCOME:
Gain the significance knowledge on occupational health, physiology and toxicology.

TEXTBOOKS:
OBJECTIVE
To provide comprehensive knowledge on Reliability testing and risk analysis techniques

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

UNIT IV  RELIABILITY MANAGEMENT 9

UNIT V  RISK ASSESSMENT 9
Definition and measurement of risk – risk analysis techniques – risk reduction resources industrial safety and risk assessment.

TOTAL : 45 PERIODS

OUTCOME :
Students who successfully complete this course should be able to analyze the failure data analysis and apply the non parametric models to risk analysis in safety industries.

TEXT BOOK:

REFERENCE BOOKS:
IH7006 ELECTRICAL SAFETY

OBJECTIVE
To provide electrical protection and maintenance in working environment and ensure that electrical safety.

UNIT I BASIC ELECTRICAL

UNIT II STANDARDS AND REQUIREMENTS
Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate.

UNIT III ELECTRICAL HAZARDS

UNIT IV ELECTRICAL PROTECTION AND MAINTENANCE
Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

UNIT V CLASSIFICATION OF HAZARDOUS AREAS
Hazardous area classification and classification of electrical equipments for hazardous areas (IS, NFPA, API and OSHA standards).

TOTAL : 45 PERIODS

OUTCOME
Gain the knowledge on classification of electrical equipments for hazardous areas and Protection measures from electrical shock.

REFERENCES
3. www.osha.gov

IH7010 INDUSTRIAL NOISE AND VIBRATION CONTROL

OBJECTIVE
To provide an understanding of sources of noise and industrial vibration control.

UNIT I INTRODUCTION
Basic definitions and terminology used in Vibrations and acoustics – Mathematical concepts and degrees of freedom in vibratory systems – Natural frequencies and vibration modes – continuous systems and wave theory concept – wave equation and relation to acoustics – theory of sound propagation and terminology involved – Plane wave and spherical waves – Concepts of free field and diffuse field, nearfield and farfield – frequency analysis and vibration and noise spectrum – Signature analysis and condition monitoring.
UNIT II INSTRUMENTATION AND AUDITORY 10
Sensors used in vibration and measurements – Frequency and spectrum analysers – Weighting networks – Hearing mechanism – relation between subjective and objective sounds – Auditory effects of noise and audiometric testing – Speech interference levels and its importance.

UNIT III SOURCES OF NOISE AND RATINGS 10
Mechanism of noise generation and propagation in various machinery and machine components, vehicles etc. – Directivity index – Concept of Leq and estimation – Noise ratings and standards for various sources like industrial, construction, traffic, aircraft community etc. – industrial safety and OSHA regulations – Noise legislations and management.

UNIT IV NOISE CONTROL 10

UNIT V ABATEMENT OF NOISE 5
Active noise attenuators and scope for abatement of industrial noise.

TOTAL : 45 PERIODS

OUTCOME
Students gain the knowledge on industrial vibration control in a specific industries.

REFERENCES

IH7015 SAFETY IN CONSTRUCTION L T P C 3 0 0 3

OBJECTIVE
To ensure that safety in Construction Industry – Safety when working at height – Underground Excavation and Tunnels- Bridges.

UNIT I INTRODUCTION 10
UNIT II    SAFETY IN EXCAVATION AND DEMOLITION
Extraction for foundation and basement identification of utilities and protection – Safety in deep excavation - Safety during Demolition – Cordonning – Dismantling – Clearing debris

UNIT III  FORMWORK AND SCAFFOLD SAFETY  8

UNIT IV   INSPECTION IN HUGE STRUCTURES  10
Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

UNIT V    PLANT AND MACHINERY INSPECTION AND MAINTENANCE  9
Plant and Machinery regular inspection and Maintenance – Training, appointment of qualified for operators-Scheduling-Preventive maintenance-Lock out Tag out of Mechanical and Electrical equipment during maintenance-ground maintenance-hand tools-Gasoline operating equipment.

TOTAL : 45 PERIODS

OUTCOME
Gain the safety in Construction Industry – Safety when working at height – Underground Excavation and Tunnels- Bridges.

REFERENCES

OBJECTIVE
To ensure that safety in ergonomics of conveying and hoisting mechanisms and handling of heavy equipment.

UNIT I    MATERIAL HANDLING  8
General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

UNIT II    ERGONOMICS OF CONVEYING MECHANISMS  10
Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipment, hoisting, traveling and slewing mechanisms.

UNIT III   ERGONOMICS OF HOISTING MECHANISMS  8
Ergonomic consideration in material handling, design, installation, operation and maintenance of driving gear for hoisting mechanism – Traveling mechanism.

UNIT IV    HANDLING OF HEAVY EQUIPMENTS  9
Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane – Checklist - Competent persons.

UNIT V    STORAGE OF GOODS AND EQUIPMENTS  10
OUTCOME
To ensure that General safety consideration in material handling

REFERENCES

IH7017 SAFETY IN ON AND OFF SHORE DRILLING L T P C
3 0 0 3

OBJECTIVE
To ensure that knowledge on safety measures in textile industries, extraction and transportation.

UNIT I PETROLEUM PRODUCTS

UNIT II ON AND OFF SHORE OPERATION
On and off shore oil operation – Construction of Installation – Pipe line Construction – Maintenance and repair activities – Safety and associated hazards.

UNIT III DRILLING

UNIT IV EXTRACTION AND TRANSPORTATION
Petroleum Extraction and transport by sea – Oil field products – Operation – Transport of crude by sea – Crude oil hazards.

UNIT V STORAGE AND CLEANING
Petroleum product storage and transport – Storage equipment – Precaution – Tank cleaning

TOTAL : 45 PERIODS

OUTCOME
Gain the knowledge on safety measures in On and Off shore Drilling

REFERENCES

IH7007 ENVIRONMENTAL POLLUTION CONTROL L T P C
3 0 0 3

OBJECTIVE
To train in computer programming and use of software tools for solving chemical engineering problems.
UNIT I  
**AIR POLLUTION**  

UNIT II  
**WATER POLLUTION**  

UNIT III  
**HAZARDOUS WASTE MANAGEMENT**  

UNIT IV  
**ENVIRONMENTAL MEASUREMENT AND CONTROL**  

UNIT V  
**POLLUTION CONTROL IN PROCESS INDUSTRIES**  

**TOTAL : 45 PERIODS**

**OUTCOME**  
Students gain the knowledge on pollution control in Process industries

**REFERENCES**
3. Pollution Control Law Series: Pollution Control Acts, Rules and No-tification Issued There under, Central Pollution Control Board, Ministry of Environment and Forest, Government of India. 2006
IH7009  HUMAN FACTORS IN PROCESS SAFETY  L  T  P  C
3  0  0  3

OBJECTIVE
To provide comprehensive knowledge on application of ergonomics in a work system.

UNIT I
9
Man-machine system Concept – Human factors Engineering and its Applications - Man as Information processor, Sensor, Controller.

UNIT II
9
Human Behaviour – Individual difference –Motivation –Frustration and Conflicts – Attitudes - Learning concepts..

UNIT III
9
Ergonomic Principles – ergonomics Application in a work system – motion economy Principle – environmental effects.

UNIT IV
9

UNIT V
9
Personal protective equipments (different types, specifications, standards, testing procedures, and maintenance).

TOTAL : 45 PERIODS

OUTCOME
Students who successfully complete this course should be able know the Personal protective equipments in industries

REFERENCES

IH7011  NUCLEAR ENGINEERING AND SAFETY  L  T  P  C
3  0  0  3

OBJECTIVE
To provide basic concepts on safety of nuclear reactors and radiation control

UNIT I  INTRODUCTION
9

UNIT II  REACTOR CONTROL
9
Design considerations – Control requirements – control means – control and shut down - rods – their operation – Problems in operations – 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

UNIT V RADIATION CONTROL

TOTAL : 45 PERIODS

OUTCOME
Students who successfully complete this course should be able understanding the safety of nuclear reactors and radiation control.

TEXT BOOKS:

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OBJECTIVE
To provide knowledge on quality engineering and on-line quality control

UNIT I INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION
Engineering and quality value and - quality system overview- product design using quality engineering - designing production processes based on quality engineering - quality engineering used in production - service provided with quality engineering. 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
Characteristics of on-line feedback quality control variable - measurement interval control - one unit, multiple units- for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances feedback control systemsmasurement error and process control parameters.
UNIT III  ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS
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
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
Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method-roles and responsibilities –leaders, champion, black belt, green belts. Do’s and don’ts - readiness of organization – planning-management role- six sigma tools – sustaining six sigma.- Introduction to Quality Control Circle (QCC)

OUTCOMES
Gain the knowledge on implementation of six sigma and Quality Control Circle.

TEXT BOOKS:

REFERENCE BOOKS:

IH7012  OHSAS 18000, ISO 14000 AND ISO 9000  L  T  P  C
3  0  0  3

OBJECTIVE
To provide the concepts on OHSAS Standard and policy

UNIT I  OHSAS STANDARD

UNIT II  OHSAS 18001 POLICY & PLANNING, IMPLEMENTATION AND OPERATION
UNIT III  CHECKING AND REVIEW GUIDELINES  
Checking- Performance measurement and monitoring-Evaluation of compliance-Non-conformity, corrective action and preventive action-Control of records- Internal audit-Management review - guidelines for implementation of 18001:2007 - Examples of items for hazard identification checklist – Comparison of risk assessment tool and methodologies.

UNIT IV  ISO 14001 and ISO 9000  
ISO 14001 - Environmental management systems - Requirements with guidance for use - Environmental policy- Environmental aspects - Legal and other requirements - Objectives, targets and programme(s)- Implementation and operation – Checking - Management review- Guidance for use - Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for ISO 14000 based EMS, steps in ISO 14001. Implementation plan, Registration, Importance of ISO 14000 to the Management. Guidelines for environmental management systems auditing - General principles, Managing audit programme - Audit activities, steps in audit, Audit plan. Competence of auditors.

UNIT V  ENVIRONMENT IMPACT ASSESSMENT  
ISO 14040 (LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco labelling) – History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco labelling 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

OUTCOME  
Gain the concepts on OHSAS Standard and policy, review guidelines with respect to specific industries.

TEXT BOOKS:  

REFERENCE BOOKS:  

IH7020  SAFETY IN UNDERGROUND STRUCTURES AND MINES  
L    T    P    C  
3    0    0    3

OBJECTIVE  
To provide knowledge on accident analysis and management in mine industries

UNIT I  OPENCAST MINES  
UNIT II UNDERGROUND MINES
Fall of roof and sides—effect of gases—fire and explosions—water flooding—warning sensors—gas detectors—occupational hazards—working conditions—winding and transportation.—Confined space classifications—Safe entry, working and evacuation from confined space.

UNIT III TUNNELLING
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

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT

TOTAL: 45 PERIODS

OUTCOME
Gain the knowledge on accident analysis and management in mine industries, hazards from tunneling and underground mines.

TEXT BOOK:

REFERENCE BOOKS:
UNIT III
ENVIRONMENTAL DISASTER MANAGEMENT
8

UNIT IV
POLLUTION ASPECTS
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
INCIDENT MANAGEMENT
9
The fundamentals of incident management, essential for effective industrial incident management covering: Incident Command System; Emergency Leadership, Emergency Risk Management; Mutual Aid & Joint Operations; Crisis Organization & Management; Response Functions & Priorities; Media Management; Scene Safety & Security; Damage Assessment; Salvage & Repair; Business Continuity; Employee Assistance; Incident Investigation; Cleanup & Restoration; and Incident Termination

TOTAL : 45 PERIODS

OUTCOME
Gain the knowledge on disasters, emergence control and effective industrial incident management covering

REFERENCE BOOKS:
3. G. Tylor, Miller., “Environmental Science sustaining the earth”, 2005

IH7019
SAFETY IN TEXTILE INDUSTRY
L T P C
3 0 0 3

OBJECTIVE
To provide knowledge on safety measures in textile industries.

UNIT I
INTRODUCTION
9
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 shuttles looms iii) knitting machines iv) nonwovens.

UNIT III
TEXTILE HAZARDS II
9
Scouring, bleaching, dyeing, puntng, 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, 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

OUTCOMES

Students who are able to know the safety measures of machinery in textile industries.

TEXT BOOK:


REFERENCE BOOKS:

1. 100 Textile fires – analysis, findings and recommendations LPA.
3. “Quality tolerances for water for textile industry”, BIS.
2. Little, A.H. “Water supplies and the treatment and disposal of effluent” the textile institute, Manchester, 1975.

IH7005 DOCK SAFETY L T P C

OBJECTIVE

To provide knowledge on dock safety status and lifting appliances

UNIT I HISTORY OF SAFETY LEGISLATION

History of dock safety status 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

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 truckspay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo – Oil, Chemicals and Flammable Liquids Tankers – Man Entry, Dock Entry & Hot work of hazardous cargo ships.
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

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

OUTCOME
Gain the knowledge on dock safety status and emergency action plan and dock workers regulations

TEXT BOOKS:

REFERENCE BOOKS:

IH7018  SAFETY IN POWDER HANDLING

OBJECTIVE
To provide basic concepts on dust handling plants and safety measures in dust explosion

UNIT I  INTRODUCTION
UNIT II  METAL POWDERS AND CHARACTERIZATION  

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 - handling of nano powders in the presence of flammable gases and vapour.

UNIT V  DUST EVALUATION AND CONTROL  

TOTAL : 45 PERIODS

OUTCOME
Gain knowledge on dust handling plants and safety measures in dust explosion and control.

REFERENCES

IH7008  FIREWORKS SAFETY  
L  T  P  C
3  0  0  3

OBJECTIVE
To provide basic knowledge on fire chemistry and process safety in firework industry.
UNIT I PROPERTIES OF FIREWORKS CHEMICALS
Combustion properties – potassium nitrate (KNO3), potassium chlorate (KClO3), barium nitrate (BaNO3), calcium nitrate (CaNO3), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminium (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

UNIT III PROCESS SAFETY

UNIT IV MATERIAL HANDLING
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.
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
Consumer anxiety-hazards in display-methods in other countries-fires, burns and scalds – sales outlets-restrictions-role of fire service.

TOTAL : 45 PERIODS

OUTCOME
Students should be able to know the fire chemistry and safety issues in firework industry.

TEXT BOOKS:

REFERENCE BOOKS:
IH7001 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

OBJECTIVE
To provide basic concepts on artificial intelligence and neural networks.

UNIT I INTRODUCTION
Definition Intelligence and its 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 of thoughts, perception modes – 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 knowledgeable engineer role, 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

OUTCOME
Students who successfully complete this course should be to analyse the risk and hazards by artificial intelligence.

TEXT BOOK:

REFERENCE BOOKS:
OBJECTIVE
To provide knowledge on road safety and insurance policy.

UNIT I TRANSPORTATION OF HAZARDOUS GOODS 9

UNIT II ROAD TRANSPORT 8
Introduction – Road safety Improving factors – Accidents Causes due to drivers and pedestrians - design, selection, operation and maintenance of motor trucks preventive maintenance - motor vehicles act – motor vehicle insurance and surveys.

UNIT III DRIVER AND SAFETY 9

UNIT IV ROAD SAFETY 10

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

OUTCOME
Students should be able to know the road safety and insurance policy.

TEXT BOOKS:

REFERENCE BOOKS:
IH7003 DESIGN OF INDUSTRIAL VENTILATION  L  T  P  C
3 0 0 3

OBJECTIVE
To provide comprehensive knowledge on design of industrial ventilation system

UNIT I GENERAL PRINCIPLES OF VENTILATION 9
Introduction, supply and Exhaust systems-Basic definitions-Principles of air flow-Acceleration of air and Hood entry losses-Duct losses-Multiple hood exhaust system.

UNIT II GENERAL INDUSTRIAL VENTILATION 9

UNIT III LOCAL EXHAUST HOODS AND AIR CLEANING DEVICES 9

UNIT IV DESIGN AND TESTING OF INDUSTRIAL VENTILATION 9

UNIT V VENTILATION SYSTEM FOR SPECIFIC OPERATIONS 9

TOTAL : 45 PERIODS

OUTCOME
Students who successfully complete this course should be able to design the ventilation system for specific operations.

TEXTBOOKS:

REFERENCE BOOK:
IH7002  DESIGN OF AIR POLLUTION CONTROL SYSTEM  

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**OBJECTIVE**

To provide comprehensive knowledge on design of air pollution control system.

**UNIT I  AIR POLLUTION**


**UNIT II  PARTICULATE POLLUTANTS AND CONTROL**


**UNIT III  GASEOUS POLLUTANTS AND CONTROL**

Gaseous Pollutant control: Gas absorption in tray and packed towers – Absorption with / Without chemical reaction – Removal of SO2 – Absorption in fixed blades- Breakthrough.

**UNIT IV  TOXIC POLLUTANTS REMOVAL**

Removal of HCs / VOCs – NOx removal – Wet scrubbers.

**UNIT V  AIR POLLUTION CONTROL**

Integrated Air pollution control systems.

TOTAL : 45 PERIODS

**OUTCOMES**

Students who successfully complete this course should be able to design the air pollution control system.

**TEXTBOOKS:**


IH7013  PRINCIPLES OF TECHNICAL ANALYSIS  

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**OBJECTIVE**

The elective is aimed to instill in the students a good grasp of the fundamentals and generalizations underlying technical analysis.

**UNIT I  QUANTITATIVE ESTIMATION - PRINCIPLE**

Types of Analysis- Principles underlying Quantitative estimation- Purity of simple sugarsPrinciple underlying BERTRAND’S method- Estimation of percentage purity of phenol (By tribromo phenol formation method)- Estimation of percentage purity of glycerol- Principles underlying above estimations.

**UNIT II  ANALYSIS OF COAL AND FERTILIZER**

Analysis of Coal- Suitability for thermal power plants- Proximate and ultimate analysis of coal -underlying principles- Correlation between thermal energy and fixed carbon- Estimation of nitrogen in ammonical fertilizers and soil- Principles underlying Kjeldahl’s method.
UNIT III  STANDARD AND RAPID METHODS OF ANALYSIS OF CEMENT  10
Types of analysis of cement- Standard and rapid methods- Fundamentals generalizations underlying the above estimations- Quality assessment of Cement.

UNIT IV  PURITY INDEX OF OIL  9
Estimation of freshness and purity of a vegetable oil- Principles underlying estimation of free acid value, Saponification value and iodine value- Causative factors of rancidity of oil.

UNIT V  QUALITY STANDARDS OF DINKING WATER  10
Estimation of Chloride, Sulphate, Total Dissolved Solids and Dissolved Oxygen in the given sample of water- Principles underlying estimation of chemical oxygen demand (COD) - Principles underlying water purification strategies- World Health Organization prescribed standards of drinking water.

TOTAL : 45 PERIODS

OUTCOME
Students who successfully complete this course should be able to analyze the purity of the substance and to measure the TDS and TSS in water.

REFERENCES
2. Technical Analysis Lab Manuals- Volume I and II by Dr.K.Srinivasan and Dr.P.Gnanasundaram, Anna University, Chennai.