NATIONAL INSTITUTE OF TECHNOLOGY: TIRUCHIRAPPALLI – 620 015.

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech. - INDUSTRIAL SAFETY ENGINEERING

The total minimum credits required for completing the M.Tech. Programme in Mechanical Engineering is 62

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Department of Mechanical Engineering
LIST OF ELECTIVES

SEMESTER – I

ELECTIVE –I

ME 671 - Human Factors Engineering
ME 672 – Environmental Pollution Control

SEMESTER – II

ELECTIVE – II, III & IV

ME 673 – Safety in Construction
ME 674 – Safety in On and Off Shore Drilling
ME 675 - Electrical Safety
ME 676 – Safety in Engineering Industry
CC 614 – Environmental Impact Assessment
CC 617 – Design of Air pollution control system

Any other elective offered by other department
SEMESTER – I

MA 611 - PROBABILITY AND STATISTICS

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

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

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.

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.


References:

ME 653 – SAFETY MANAGEMENT

CONCEPTS


TECHNIQUES

Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, Safety Audit.

ACCIDENT INVESTIGATION AND REPORTING


SAFETY PERFORMANCE MONITORING

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

SAFETY EDUCATION AND TRAINING


REFERENCES

ME 655 – OCCUPATIONAL HEALTH AND HYGIENE

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- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control

CHEMICAL HAZARDS
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

BIOLOGICAL AND ERGONOMICAL HAZARDS
Classification of Biohazardous agents –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.

OCCUPATIONAL HEALTH AND TOXICOLOGY
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

**OCCUPATIONAL PHYSIOLOGY**


**References:**


**ME 657 – SAFETY IN CHEMICAL INDUSTRY**

Safety in the design process of chemical plants- safety in erection and commissioning of chemical plants- safety in material handling – Pressure and leak testing.

Safety in operational and maintenance – Exposure of personnel, Operational activities and hazards – Work permit systems entry into confined space where toxic contaminants are present

Safety in storage and Handling of chemical and gases – Hazards during transportation – pipeline transport – safety in chemical laboratories.

Toxic release and control methodologies – toxic effects- threshold limit values – Awareness and preparedness for energy at local level

Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petro-chemical, rubber, fertilizer and distilleries.

**References**

ME 659 – REGULATIONS FOR HEALTH, SAFETY AND ENVIRONMENT

Factories act and rules; Workmen compensation act.
Indian explosive act - Gas cylinder rules - SMPV Act - Indian petroleum act and rules.
Environmental pollution act
Manufacture, Storage and Import of Hazardous Chemical rules 1989
Indian Electricity act and rules.
Overview of OHSAS 18000 and ISO 14000

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

SEMESTER – II

ME 652 – COMPUTER AIDED RISK ANALYSIS

HAZARD, RISK ISSUES AND HAZARD ASSESSMENT

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)

INSTRUMENTATION

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.
RISK ANALYSIS QUANTIFICATION AND SOFTWARES

Fault Tree Analysis & 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 Software on Risk analysis, CISCON, FETI, ALOHA

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.

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.

ME 654 – SAFETY IN MATERIAL HANDLING

General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Ergonomic consideration in material handling, design, installation, operation and maintenance of driving gear for hoisting mechanism – Traveling mechanism

Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane – Checklist - Competent persons.

Storage and Retrieval of common goods of various shapes and sizes in a general store of a big industry.
References


ME 656 – FIRE ENGINEERING AND EXPLOSION CONTROL

Fire chemistry – Dynamics of fire behavior – Fire properties of solid, liquid and gas – Fire spread – Toxicity of products of combustion

Industrial fire protection systems – Sprinkler – Hydrants- Stand pipe- Special fire suppression system like deluge and emulsifier.

Building evaluation for fire safety – Fire load –Fire resistance materials and fire testing – Structural Fire protection – Exits and egress.

Explosion protection systems – Explosion parameters – Explosion suppression system based on CO2 and Halon – Hazards in L.P.G handling.


References

ELECTIVE - I

ME 671 - HUMAN FACTORS ENGINEERING

Concept of man-machine system –Applications of human factors Engineering- Man as Sensor, Man as Information processor, Man as Controller


Factors impending safety – Technological factor –Physiological factor –Legal factor – Administrative factors
Personal protective equipments (different types, specifications, standards, testing procedures, and maintenance).

References

ME 672 – ENVIRONMENTAL POLLUTION CONTROL

Air pollution– Classification and properties of Air pollutants-Pollution sources- Control of air pollution – Gravitational settling chambers-Cyclone separators, ESP, Wet scrubber.

Dispersion of Air pollutants-Plume behavior-Control of gaseous pollutants, sulphur dioxides, nitrogen oxides, Carbon monoxide and Hydrocarbons. Air pollution laws and Standards.

Water pollution- Classification of water pollutant and their effects on receiving bodies. Advanced wastewater treatments by physical, chemical, biological and thermal methods- Effluent quality standards.


Pollution control in process industries – Cement, paper, petroleum, fertilizer and petrochemical.

REFERENCES:
ELECTIVE – II, III, IV

ME 673 – SAFETY IN CONSTRUCTION

General safety consideration – analyzing construction jobs for safety – Contract document – Safety certificate for statutory authorities for old building and construction


Safety in Erection and closing operation - Construction materials – Specifications – suitability – Limitations – Merits and demerits – Steel structures – Concrete structure

Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure- Regular Inspection and monitoring.

Maintenance – Training-Scheduling-Preventive maintenance-Lock out of Mechanical and Electrical maintenance-ground maintenance-hand tools-Gasoline operating equipment.

References

ME 674 – SAFETY IN ON AND OFF SHORE DRILLING


On and off shore oil operation – Construction of Installation – Pipe line Construction – Maintenance and repair activities – Safety and associated hazards

Drilling oil – Technique and equipment- Work position – Working condition – safety and associated hazards- lighting and its effects

Petroleum Extraction and transport by sea – Oil field products – Operation – Transport of crude by sea – Crude oil hazards.

Petroleum product storage and transport – Storage equipment – Precaution – Tank cleaning

References
ME 675 - ELECTRICAL SAFETY


Standards and statutory requirements – Indian electricity acts and rules - statutory requirements from Electrical inspectorate.


Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance

Hazardous area classification and classification of electrical equipments for hazardous areas ( IS, API and OSHA standards).

References
3. www.osha.gov

ME 676 – SAFETY IN ENGINEERING INDUSTRY

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.

PRINCIPLES OF MACHINE GUARDING

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.

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.

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.

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-pollution control in engineering industry-industrial waste disposal.

References

5. Indian Boiler acts and Regulations, Government of India.
CC 614 – ENVIRONMENTAL IMPACT ASSESSMENT


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


Socio cultural environment – Public participation – Resettlement and Rehabilitation.

Documentation of EIA – Environmental management plan – Post project monitoring – Environmental Audit- Life cycle assessment – EMS – case studies in EIA.

References:

CC 617 – DESIGN OF AIR POLLUTION CONTROL SYSTEM


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

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

Integrated Air pollution control systems.

References: