
M.Tech- Industrial Safety Engineering
CURRICULUM and SYLLABUS
(Regulation 2014)

Department of Mechanical Engineering



KALASALINGAM UNIVERSITY
(Kalasalingam Academy of Research and Education)
(Under sec.3 of UGC Ac,1956)
Anand Nagar, Krishnankoil-626126,
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M.TECH
(Industrial Safety Engineering)
CURRICULUM
AND
SYLLABUS

KALASALINGAM UNIVERSITY
[Kalasalingam Academy of Research and Education]
DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM FOR M.Tech (INDUSTRIAL SAFETY ENGINEERING)

SEMESTER – I

| Code No. | Course Title | L | T | P | C |
|----------|-----------------------------------------------|----|---|---|----|
| MAT 5008 | Statistics and Computational Techniques | 3 | 1 | 0 | 4 |
| MEC5401 | Safety Management | 3 | 0 | 0 | 3 |
| MEC5402 | Occupational Health and Hygiene | 3 | 0 | 0 | 3 |
| CHE5051 | Safety in Chemical Industries | 3 | 0 | 0 | 3 |
| MEC5403 | Regulation for Health, Safety and Environment | 3 | 0 | 0 | 3 |
| CIV5451 | Environmental Safety | 3 | 0 | 0 | 3 |
| ***** | Elective I | 3 | 0 | 0 | 3 |
| Total | | 21 | 1 | 0 | 22 |

SEMESTER – II

| Code No. | Course Title | L | T | P | C |
|----------|----------------------------------------------|----|---|---|----|
| MEC5404 | Computer Aided Hazard Analysis | 3 | 0 | 0 | 3 |
| MEC5405 | Fire Engineering and Explosion Control | 3 | 0 | 0 | 3 |
| MEC5406 | Safety in Engineering Industry | 3 | 0 | 0 | 3 |
| MEC5407 | Safety in Plant Layout and Material Handling | 3 | 0 | 0 | 3 |
| EEE5451 | Electrical Safety | 3 | 0 | 0 | 3 |
| ***** | Elective II | 3 | 0 | 0 | 3 |
| MEC5481 | Industrial Safety Lab | 0 | 0 | 3 | 2 |
| Total | | 18 | 0 | 3 | 20 |

SEMESTER - III

| Code No | Course Title | L | T | P | C |
|---------|----------------|---|---|----|----|
| ***** | Elective III | 3 | 0 | 0 | 3 |
| ***** | Elective IV | 3 | 0 | 0 | 3 |
| ***** | Elective V | 3 | 0 | 0 | 3 |
| MEC6498 | Field Project* | 0 | 0 | 18 | 4 |
| Total | | 9 | 0 | 18 | 13 |

*International Certification is mandatory

SEMESTER – IV

| Code No. | Course Title | L | T | P | C |
|----------|--------------|---|---|----|----|
| MEC6499 | Project Work | 0 | 0 | 36 | 12 |

Total Credits = 67

LIST OF ELECTIVES

M.Tech (INDUSTRIAL SAFETY ENGINEERING)

| Course Code | Course Title | L | T | P | C |
|-------------|----------------------------------------------------|---|---|---|---|
| MEC5409 | Human Factors Engineering | 3 | 0 | 0 | 3 |
| MEC5410 | Safety in Construction | 3 | 0 | 0 | 3 |
| MEC5411 | Transport Safety | 3 | 0 | 0 | 3 |
| MEC5412 | Fireworks Safety | 3 | 0 | 0 | 3 |
| MEC5413 | Safety in On and Off Shore Drilling | 3 | 0 | 0 | 3 |
| MEC5414 | Safety in Textile Industry | 3 | 0 | 0 | 3 |
| MEC5415 | Industrial Noise and Vibration Control | 3 | 0 | 0 | 3 |
| MEC5416 | Work Study and Ergonomics | | | | |
| MEC5417 | Reliability Engineering | 3 | 0 | 0 | 3 |
| MEC5418 | Probabilistic Safety Assessment | 3 | 0 | 0 | 3 |
| MEC5419 | Biomechanics and Human Body Vibration | 3 | 0 | 0 | 3 |
| MEC6401 | Nuclear Engineering and Safety | 3 | 0 | 0 | 3 |
| MEC6402 | Safety in Mines | 3 | 0 | 0 | 3 |
| MEC6403 | Dock Safety | 3 | 0 | 0 | 3 |
| MEC6404 | Safety in Powder Handling | 3 | 0 | 0 | 3 |
| MEC6405 | Radiographic Testing and Radiation Safety | 3 | 0 | 0 | 3 |
| MEC6406 | Disaster Management | 3 | 0 | 0 | 3 |
| MEC6407 | OHSAS 18000 and ISO 14000 | 3 | 0 | 0 | 3 |
| MEC6408 | Intelligent Industrial Systems | 3 | 0 | 0 | 3 |
| MEC5020 | Corrosion Engineering | 3 | 0 | 0 | 3 |
| MEC5211 | Automotive Systems Safety, Quality and Reliability | 3 | 0 | 0 | 3 |
| CIV5011 | Solid and Hazardous Waste Management | 3 | 0 | 0 | 3 |
| CIV5015 | Environmental Impact Assessment | 3 | 0 | 0 | 3 |
| CIV5452 | Air Pollution Control Equipment Design | 3 | 0 | 0 | 3 |
| ICE5451 | Process Modelling and Simulation | 3 | 0 | 0 | 3 |
| EEE5013 | Digital Signal Processing | 3 | 0 | 0 | 3 |
| EEE6001 | Soft Computing | 3 | 0 | 0 | 3 |
| ICE5004 | Process Control and Instrumentation | 3 | 0 | 0 | 3 |
| ICE5005 | System Identification and Adaptive Control | 3 | 0 | 0 | 3 |
| ICE6003 | Digital Image Processing | 3 | 0 | 0 | 3 |
| ICE6011 | Fault Diagnosis and Control | 3 | 0 | 0 | 3 |

Semester – I

| | | | | | |
|----------------|--------------------------------------------|---|---|---|---|
| MAT5008 | STATISTICS AND COMPUTATIONAL TECHNIQUES | L | T | P | C |
| | | 3 | 1 | 0 | 4 |

PROBABILITY DISTRIBUTIONS

Probability basic concepts - Binomial, Poisson, Geometric, Normal, Uniform, Exponential, Gamma and Weibull – distributions – Mean, Variance, Moment generating functions.

ESTIMATION THEORY

Estimation of parameters – Principles of least squares – Maximum likelihood estimation – Method of moments – Interval estimation.

TESTING OF HYPOTHESIS

Sampling distribution, Large sample tests – Mean and Proportion, Small sample tests – t –test , F- test and Chi-Square test.- Goodness of fit – Independence of attributes.

DESIGN OF EXPERIMENTS

Design of Experiments: Basic Designs, Factorial Design, Taguchi Techniques, ANOVA

OPTIMIZATION METHODS

Classical optimization methods, unconstrained minimization . Univariate, conjugate direction, gradient and variable metric methods, constrained minimization, feasible direction and projections.

REFERENCES

1. Freund John, E and Miller, Irvin, “Probability and Statistics for Engineering”, 5th Edition, Prentice Hall, 1994.
2. Jay, L. Devore, “Probability and Statistics for Engineering and Sciences”, Brooks Cole Publishing Company, Monterey, California, 1982
3. Gupta, S.C. and Kapoor, V.K, “Fundamentals of Mathematical Statistics”, 11th Edition (Reprint), Sultan Chand and Sons, New Delhi, 2007.
4. Trivedi, K.S., “Probability and Statistics with Reliability, Queuing and Computer Science Applications”, PHI
5. Kapur, J.N. and Saxena, H.C, “Mathematical Statistics”, 18th Revised Edition, S.Chand & Co. Ltd., 1997.
6. Douglas C. Montgomery, “Design and analysis of experiments”, John Wiley and sons, 7th edition, 2010.
7. Philip J.Ross, “Taguchi techniques for quality engineering”, McGraw Hill book Company, 2nd edition, 1995

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| MEC5401 | SAFETY MANAGEMENT | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

CONCEPTS

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. Techniques: Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non reportable accidents, 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.

SAFETY EDUCATION, TRAINING AND PERFORMANCE MONITORING

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

PERSONAL PROTECTIVE EQUIPMENT

Need for personal protection equipment - Non-respiratory personal protective devices: Head protection, Ear protection. Face and Eye protection. Hand protection, Foot protection, body protection. Respiratory personal protective devices : Classification of hazards. Classification of respiratory personal protective devices. Selection of respiratory personal protective devices. Instructions and training in the use, maintenance and care of self containing breathing apparatus. Testing Procedures and Standards.

BEHAVIOUR BASED SAFETY

Human behavior : Individual differences, behavior as function of self and situation, perception of danger and acceptance of risk, knowledge, and responsibility vis-a-vis safety performance, theories of motivation and their application to safety, role of supervisors and safety departments in motivation. Conflict & Frustration : Identification of situations leading to conflict and frustration and techniques of management. BBS Program

References

1. Accident Prevention Manual for Industrial Operations, N.S.C. Chicago, 1982
2. Heinrich H.W., Industrial Accident Prevention, McGraw-Hill Company, New York, 1980.
3. John V.Grimaldi and Rollin H.Simonds, Safety Management, All India Travellers Bookseller, New Delhi – 1989.
4. William Handley, “Industrial Safety Hand Book”, McGraw Hill, 2nd Edition, 1969.
5. Krishnan N.V., Safety Management in Industry, Jaico Publishing House, Bombay, 1997.
6. John Ridley, Safety at Work, Butterworth & Co., London, 1983.
7. Blake R.B., Industrial Safety, Prentice Hall, Inc., New Jersey, 1973
8. Occupational Safety Manual-BHEL
9. Dan Petersen, “Techniques of Safety Management”, McGraw-Hill Company, Tokyo, 1981.
10. “Safety and Good House Keeping”, N.P.C., New Delhi, 1985.

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|-----------------|----------------------------------------|----------|----------|----------|----------|
| MEC 5402 | OCCUPATIONAL HEALTH AND HYGIENE | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

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.

Ergonomics-Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS-Tendon pain- disorders of the neck- back injuries-Ergonomical Tools-RULA-REBA-NIOSH LIFTING Equations.

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

Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.

References

1. Handbook of Occupational Health and Safety, NSC Chicago, 1982
2. Encyclopedia of Occupational Health and Safety, Vol. I & II, International Labour Organisation, Geneva, 1985.
3. McCornick, E.J. and Sanders, M.S., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.

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|----------------|--------------------------------------|----------|----------|----------|----------|
| CHE5051 | SAFETY IN CHEMICAL INDUSTRIES | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

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 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.

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.

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

STORAGES AND TRASPORATION

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 Hazards during transportation – pipeline transport. Cascaded N-capacities – Hybrid tank system for level control and temperature control

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. Multi-loop control for distillation column and boiler systems.

Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petrochemical, rubber, fertilizer and distilleries.

Text Book

1. Lees, F.P., Loss Prevention in Process Industries, Butterworths and Company, 1996.

References

1. Guidelines for Chemical Process Quantitative Risk Analysis by Center for Chemical Process Safety (CCPS), Wiley-AIChE; 2 edition 1999
2. Fawcett, Howard H., Wood William. S., Safety and Accident Prevention in Chemical Operations, Wiley inters, Second Edition, 1984.

3. Roy E. Sanders, Chemical Process Safety - Learning from Case Histories, Elsevier Butterworth–Heinemann, USA, 2005.
4. “Accident Prevention Manual for Industrial Operations” NSC, Chicago, 1982.
5. Green, A.E., High Risk Safety Technology, John Wiley and Sons,. 1984.
6. Johnson.C.D., Process control instrumentation technology, PHI learning pvt. Ltd., New Delhi, 2010
7. Petroleum Act and Rules-1934, Government of India.
8. Carbide of Calcium Rules-1987, Government of India.

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| MEC5403 | REGULATIONS FOR HEALTH, SAFETY AND ENVIRONMENT | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

FACTORIES ACT – 1948

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

ENVIRONMENT ACT – 1986

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

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

MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989

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

OTHER ACTS AND RULES

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

INTERNATIONAL ACTS AND STANDARDS

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

References

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd. New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
5. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
6. The Mines Act 1952, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
7. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
8. Explosive Act, 1884 and Explosive rules, 1883 (India), (2002), Eastern Book company, Lucknow, 10th Edition
9. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria & Sons, Delhi

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| CIV5451 | ENVIRONMENTAL SAFETY | L | T | P | C |
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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.

WATER POLLUTION

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

SOLID AND 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- processing and energy recovery – waste minimization, health hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse.

ENVIRONMENTAL MEASUREMENT AND CONTROL

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

POLLUTION CONTROL IN PROCESS INDUSTRIES

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

Text Book

1. Rao, CS, Environmental pollution engineering, Wiley Eastern Limited, New Delhi, 1992.

References

1. H. S. Peavy, D. R. Rowe, G. Tchobanoglous Environmental Engineering - McGraw- Hill Book Company, New York, 1987.
2. H.Ludwig, W.Evans, Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands, N.J., 1991.
3. Arcadio, P. Sincero and G. A. Sincero, Environmental Engineering – A Design Approach, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
4. G. Masters Introduction to Environmental Engineering and Science, Prentice Hall of India Pvt Ltd, New Delhi, 2003.
5. S.P.Mahajan, Pollution control in process industries, Tata McGraw Hill Publishing Company, New Delhi, 1993
6. Varma and Braner, Air pollution equipment, Springer Publishers, Second Edition

Semester – II

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|----------------|---------------------------------------|----------|----------|----------|----------|
| MEC5404 | COMPUTER AIDED HAZARD ANALYSIS | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

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.

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.

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.

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.

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

References

1. Frank P. Less, Loss Prevention in Process Industries, (Vol.I, II and III) , Butterworth-Hein UK 1990
2. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
3. Course Material Intensive Training Programme on Consequence Analysis, by Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka and CLRI, Chennai.
4. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
5. Brown, D.B., System analysis and Design for safety, Prentice Hall, 1976.
6. Hazop and Hazom, Trevor A Klett, Institute of Chemical Engineering, 1983.

7. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety, 1992
8. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AICHE 1992.

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|----------------|-----------------------------------------------|----------|----------|----------|----------|
| MEC5405 | FIRE ENGINEERING AND EXPLOSION CONTROL | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

PHYSICS AND CHEMISTRY OF FIRE

Fire properties of solid, liquid and gases - fire spread - toxicity of products of combustion - theory of combustion and explosion – vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves - auto-ignition – boiling liquid expanding vapour explosion – case studies – Flixborough, Mexico disaster, Pasedena Texas, Piper Alpha, Peterborough and Bombay Victoria dock ship explosions.

FIRE PREVENTION AND PROTECTION

Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – fire watchers – lay out of stand pipes – fire station-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills – notice-first aid for burns.

INDUSTRIAL FIRE PROTECTION SYSTEMS

Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – tank farms – indices of inflammability-fire fighting systems.

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.

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), sulphur dioxide (SO₂), chlorine (CL) etc.

Text Book

1. Derek, James, Fire Prevention Hand Book, Butterworths and Company, London, 1986.

References

1. Gupta, R.S., Hand Book of Fire Technology, Orient Longman, Bombay 1977.
2. Accident Prevention manual for industrial operations, N.S.C., Chicago, 1982.
3. Dinko Tuhtar, Fire and explosion protection – A System Approach, Ellis Horwood Ltd , Publisher, 1989
4. William E. Clark , “Firefighting Principles & Practices ”, Fire Engineering Books and Videos, 2nd edition 1991.
5. Dennis P. Nolan, “Handbook of Fire & Explosion Protection Engineering Principles for Oil, Gas, Chemical, & Related Facilities “,William Andrew Publishers, 1997
6. Fire fighters hazardous materials reference book, Fire Prevention in Factories, an Nostrand Rein Hold, New York, 1991.

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| MEC5406 | SAFETY IN ENGINEERING INDUSTRY | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

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.

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

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.

References

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

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| MEC5407 | SAFETY IN PLANT LAYOUT AND MATERIAL HANDLING | L | T | P | C |
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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

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

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- Housekeeping, principles of 5S.

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 and safety 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 - ergonomic and safety considerations

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 - ergonomic and safety considerations

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 - ergonomic and safety considerations

Text Books

1. Apple .M. James, Plant layout and material handling, 3rd edition, John Wiley and sons, 1991
2. Fred E. Meyers and Matthew P. Stephens, “Manufacturing Facilities Design and Material Handling”, Prentice Hal, 3rd edition, 2004.

References

1. Encyclopedia of occupational safety and health, ILO Publication, 1985
2. Accident prevention manual for industrial operations, N.S.C., Chicago, 1982.
3. Alexandrov. M.P., Material handling equipment, Mir Publishers, Moscow, 1981
4. Spivakosky, Conveyors and related Equipment, Vol.I and II Peace Pub. Moscow, 1982.
5. Rudenko, N., Material handling Equipments, Mir Publishers, 1981.
6. Reymond, A.Kulwice, Material Handling Hand Book - II, John Wiley and Sons, New York, 1985.
7. Safety and good housekeeping, N.P.C. New Delhi, 1985.
8. Industrial ventilation (A manual for recommended practice), American conference of Governmental Industrial Hygiene, USA, 1984.

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| EEE5451 | ELECTRICAL SAFETY | L | T | P | C |
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INTRODUCTION AND STATUTORY REQUIREMENTS

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

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, causes of fire and explosion-ionization, spark and arc-ignition energy-
Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth bit maintenance.

PROTECTION SYSTEMS

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

Flame Retardant Low Smoke (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.

SELECTION, INSTALLATION, OPERATION AND MAINTENANCE

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 -safety in the use of portable tools-cabling and cable joints- preventive maintenance.

HAZARDOUS ZONES

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.

Text Book

1. Fordham Cooper, W., Electrical Safety Engineering, Butterworth and Company, London, 1986.

References

1. Accident prevention manual for industrial operations, National Safety Council, N.S.C., Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers – Handbook of TNEB, Chennai, 1989.
4. Martin Glov., Electrostatic Hazards in powder handling, Research Studies Pvt.LTd., England, 1988.

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| MEC5481 | INDUSTRIAL SAFETY LAB | L | T | P | C |
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NOISE LEVEL AND VIBRATION MEASUREMENT AND ANALYSIS

Measurement of noise level for various sources – Impact, continuous and intermittent. Frequency and spectrum analysis of noise: Instrument – precision type of Noise level meter with frequency and spectrum analyzer.

Measurement of whole body vibration for various acceleration: Instrument – vibration simulator and vibration analyzer

FRICTION AND IMPACT SENSITIVITY TEST

Measurement of friction sensitivity for unstable materials: Instrument – BAM friction tester

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

THERMAL REACTIVITY TEST

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

EXHAUST GAS MEASUREMENT AND ANALYSIS

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

BREATHING ZONE CONCENTRATION

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

AMBIENT AIR MONITORING

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

CONSEQUENCE ANALYSIS

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

ELECTRICAL SAFETY

- Experiment on the basic circuit explaining the effects of grounding
- Test the strength of insulators like oil, thermal insulation
- Experiment on fuses/relays/MCBs to understand the operational differences
- Test on the discharge rod to understand the operation of it
- Circuit connection explaining the use of isolators
- Static charge testing & illumination testing: On plastic, rubber, ferrous and non-ferrous materials – by lux meter – photometer

SAFETY MANGEMENT

- Identification of Unsafe Acts and Unsafe Condition
- Preparation of JSA in Workplace
- Hazard Analysis using ETA,FTA and FMEA
- Design a types of Work Permit system in Workplace

STUDY OF FIRST AID, PERSONAL PROTECTIVE EQUIPMENT AND FIRE EXTINGUISHERS

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, apron and leg guard.

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

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| MEC5409 | HUMAN FACTORS ENGINEERING | L | T | P | C |
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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

HUMAN BEHAVIOR

Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness.

Motivation, Complexity of Motivation, Job satisfaction - Management theories of motivation, Job enrichment theory. Frustration and Conflicts - Reaction to frustration, Emotion and Frustration. Attitudes - Determination of attitudes, Changing attitudes - Learning, Principles of Learning, Forgetting, Motivational requirements.

ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS

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

MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND MANUAL HANDLING TASK

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

HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS

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.

References

1. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis, 2007
2. Michael O’Neill, Ergonomic Design for Organizational Effectiveness, Lewis Publishers, 1998
3. M.S.Sanders and McCormick, Human Factors in Engineering and Design, McGraw Hill Book Co., New York, 1993
4. Dan Mc Leod, Philip Jacobs and Nancy Larson, The Ergonomics Manual, (Saunders Group), Trade paperback, 1990.
5. McCornick, E.J., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.
6. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.

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| MEC5410 | SAFETY IN CONSTRUCTION | L | T | P | C |
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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 accident – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training

HAZARDS OF CONSTRUCTION AND PREVENTION

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

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.

CONSTRUCTION MACHINERY

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

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.

References

1. Hudson, R., Construction hazard and Safety Hand book, Butterworth’s Publication, 1985.
2. Jnathia D.Sime, Safety in the Build Environment, London, 1988.
3. V.J.Davies and K.Thomasin, Construction Safety Hand Book, Thomas Telford Ltd., London, 1990.
4. Handbook of OSHA Construction safety and health, Charles D. Reese and James V. Edison
5. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982
6. Fulman, J.B., Construction Safety, Security, and Loss Prevention, John Wiley and Sons, 1979.

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| MEC5411 | TRANSPORT SAFETY | L | T | P | C |
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TRANSPORTATION OF HAZARDOUS GOODS

Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries – earth chains-static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list-decanting procedures – communication.

ROAD TRANSPORT

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

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-road transport act and rules – driver relaxation and rest pauses – speed and fuel conservation – emergency planning.

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-Ground speed-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.

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.

References

1. Popkes, C.A., Traffic Control and Road Accident Prevention, Chapman and Hall Limited, 1986.
2. Babkov, V.F., Road Conditions and Traffic Safety, MIR Publications, Moscow, 1986.
3. Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 1983.
4. Motor Vehicles Act, 1988, Government of India.
5. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
6. Pasricha, Road Safety guide for drivers of heavy vehicle, Nasha Publications, Mumbai, 1999.
7. K.W.Ogden, Safer Roads – A guide to Road Safety Engineering, Amazon.com., 1995.

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| MEC5412 | FIREWORKS SAFETY | L | T | P | C |
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PROPERTIES OF FIREWORKS CHEMICALS

Fire properties – potassium nitrate (KN03), potassium chlorate (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.

STATIC CHARGE AND DUST

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

Dust: size-respirable, non-respirable-biological barriers – hazards – personal protective equipment – pollution prevention.

PROCESS SAFETY

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.

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-go down-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.

WASTE CONTROL AND USER SAFETY

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.

References

1. Ronald Lancaster, “Fireworks, Principles and Practice”, Chemical Publishing Company, 4th edition, 2005.
2. K.N.Ghosh, “Principles of fireworks”, H.Khatsuria, Sivakasi, 1987.
3. J.A.Purkiss, “Fire Safety Engineering”, Butterworth-Heinemann, 2nd edition, 2006.
4. Bill of Ofca, “Fireworks Safety manual: a collection of essays” B & C Products, 1991
5. John Barton C Chem FRSC, “Dust Explosion Prevention and Protection: A Practical Guide”, Gulf Professional Publishing, 1st edition, 2002.

6. Goeff Lunn, "Guide to Dust Explosion Prevention and Protection", Butterworth-Heinemann, 2nd edition, 1992.
7. Alan St. H Brock, "A history of fireworks", G.G. Harrap publishers, 1st edition, 1949
8. "Proceedings of National seminar on Fireworks Safety-1999", MSEC-1999.

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| MEC5413 | SAFETY IN ON AND OFF SHORE DRILLING | L | T | P | C |
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PRODUCTS

Petroleum and Petroleum products – Fuels- Petroleum solvents – Lubricating oils – Petroleum wax, greases – Miscellaneous product

OPERATIONS AND HAZARDS

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

DRILLING EQUIPMENTS AND HAZARDS

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

EXTRACTION AND TRANSPORT

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

STORAGE

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

References

1. Encyclopedia of Occupational Health and Safety, Vol. I & II, International Labour Organization, Geneva, 1985.
2. D.A. Ardu and C.D. Green, "Safety in Offshore Drilling: The Role of Shallow Gas Surveys (Advances in Underwater Technology, Ocean Science and Offshore Engineering)", Springer, 1st edition, 1990.
3. Jan-Erik Vinnem, "Offshore Risk Assessment: Principles, Modelling and Applications of QRA Studies", Springer, 1st edition, 2010.

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| MEC5414 | SAFETY IN TEXTILE INDUSTRY | L | T | P | C |
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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.

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.

TEXTILE HAZARDS-II

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

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.

SAFETY STATUS

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

References

1. Safety in Textile Industry, Thane Belapur Industries Association, Mumbai.
2. 100 Textile fires – analysis, findings and recommendations LPA
3. Elliot B. Grover and D. S. Hamby, Handbook of Textile Testing and Quality Control, Textile Book Publishers (Interscience), New York, 1960.
4. Quality Tolerances for Water for Textile Industry, BIS
5. Shenai, V.A., A Technology Of Textile Processing, Vol.I, Sevak Publications, 1980
6. Little, A.H., Water supplies and the treatment and disposal of effluent, The Textile Institute, Manchester, 1975.

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| MEC5415 | INDUSTRIAL NOISE AND VIBRATION CONTROL | L | T | P | C |
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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, near field and far field – frequency analysis and vibration and noise spectrum – Signature analysis and condition monitoring.

INSTRUMENTATION AND AUDITORY

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.

SOURCES OF NOISE AND RATINGS

Mechanism of noise generation and propagation in various machinery and machine components, vehicles etc. – Directivity index – Concept of L_{eq} 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.

NOISE CONTROL

Energy transferring and dissipating devices Source: Structure borne and flow excited. Vibration isolation and absorption. Spring and damping materials, Dynamic absorbers, Mufflers and silencers, Path: Close filter and loosely covered enclosures – Acoustic treatment and materials – Transmission loss and absorption coefficient of materials and structures and their estimation – Reverberation time and room constant – Design of rooms / industrial halls/ auditorium for minimum noise. Receiver: Measure to control at the receiver end – use of enclosures, ear muffs and other protective devices.

ABATEMENT OF NOISE

Active noise attenuators and scope for abatement of industrial noise.

Text Book

1. Irwin, J.D and Graf, E. R, Noise and Vibration Control, Prentice Hall Inc. New Jersey, 1979.

References

1. Irwing B Crandall, Theory of Vibrating Systems and Sound, D. Vannostrand Company, New Jersey, 1974.
2. Cyril M. Harris, Hand Book of Noise Control, McGraw Hill Book Company, New York, 1971.
3. White R. G. Walker J. G, “Noise and Vibration”, John Wiley and sons New York, 1982.

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| MEC5416 | WORK STUDY AND ERGONOMICS | L | T | P | C |
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WORK STUDY

Study of operations – work content – work procedure – breakdown – human factors – safety and method study – methods and movements at the workplace – substitution with latest devices – robotic concepts – applications in hazardous workplaces – productivity, quality and safety (PQS).

ERGONOMICS

Definition – applications of ergonomic principles in the shop floor – work benches – seating arrangements – layout of electrical panels- switch gears – principles of motion economy – location of controls – display locations – machine foundations – work platforms, fatigue, physical and mental strain – incidents of accident – physiology of workers.

PERSONAL PROTECTION

Concepts of personal protective equipment – types – selection of PPE – invisible protective barriers – procurement, storage, inspection and testing – quality – standards – ergonomic considerations in personal protective equipment design.

PROCESS AND EQUIPMENT DESIGN

Process design – equipment – instrument – selection – concept modules – various machine tools - in-built safety – machine layout-machine guarding-safety devices and methods – selection, inspection, maintenance and safe usage – statutory provisions, operator training and supervision – hazards and prevention.

MAN MACHINE SYSTEMS

Job and personal risk factors – standards-selection and training-body size and posture-body dimension (static/dynamic) – adjustment range – penalties – guide lines for safe design and postures – evaluation and methods of reducing posture strain.

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.

Text Book

1. Introduction to work study, International Labor Organization, Geneva, 4th edition, 1992.

References

1. Curri and Faraday, Work Study, ELBS, 4th edition, 1978.
2. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 1982.
3. Barnes, R.M., Motion and Time Study, John Wiley, 1980.
4. Stephen Konz., Work Design, Publishing Horizon Inc., Second Edition, 1979.
5. Bridger, R.S., Introduction to Ergonomics, McGraw-Hill, 1995.

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| MEC5417 | RELIABILITY ENGINEERING | L | T | P | C |
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RELIABILITY CONCEPT

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.

FAILURE DATA ANALYSIS

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

RELIABILITY PREDICTION MODELS

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

RELIABILITY MANAGEMENT AND RISK ASSESSMENT

Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model.
 Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

HUMAN RELIABILITY ANALYSIS

Development of HRA – Approaches and trends in HRA – Human reliability methods – Human reliability data – Human actions – Interdisciplinary analysis of human reliability – Probabilistic Safety Analysis

References

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

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| MEC5418 | PROBABILISTIC SAFETY ASSESSMENT | L | T | P | C |
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INTRODUCTION TO PROBABILISTIC SAFETY ASSESSMENT

Quantitative Aspects of Risk -Safety Goals -Risk-informed Integrated Decision Making -- Categorization by Safety Significance- Realization of Category Requirements-- Hazard Identification and Risk Reduction --Probabilistic Risk Assessment

Mathematics for Probabilistic Safety -Boolean Algebra ,Venn Diagram - Probability and Frequency -Combining Probabilities -Distributions -Continuous Distributions - Confidence Limits -Markov Modeling -Summary of Functions and their Generating Functions -Bayesian Methods, Uncertainty Analysis-Sensitivity Analysis and Importance Measures

SYSTEM & ACCIDENT ANALYSIS METHODS

Chemical and Nuclear Accident Analysis Methods- PSM Rule -Process Hazard Analysis -Qualitative Methods of Accident Analysis- Quantitative Methods of Accident Analysis- Computer Codes for System Reliability Analysis- Code Suite-Failure Rates, Incidents and Human Factors Data- Databases- Human Reliability Analysis- Incorporating Human Reliability into a PSA- External Events- Seismic Events- Fires- Flood

Analyzing Nuclear Reactor Safety Systems- Nuclear Power Reactors TMI-2 and Chernobyl Accidents -Preparing a Nuclear Power Plant PSA -Analyzing an Emergency Electric Power System -Analyzing Chemical Process Safety Systems - Chemical Process Accidents - Chemical Process Accident Analysis -Analyzing a Chemical Tank Rupture

ACCIDENT CONSEQUENCE ANALYSIS

Chemical Process Accident Consequence Analysis Hazardous Release - Chemical Accident Consequence Codes - EPA's Exposure Model Library and Integrated Model Evaluation System - Assembling and Interpreting the PSA- Integrated and Special PSAs

Nuclear Accident Consequence Analysis : -Meltdown Process -Source Terms for In-Plant Radionuclide Transport- Ex-Plant Transport of Radionuclides

LEVELS OF PSA

Level 1 PSA – Accident Frequency analysis - Plant Familiarization -Event-tree Construction -System Models - Accident-sequence Screening and Quantification- Dependent Failure Analysis -Human-reliability Analysis Database Analysis -Uncertainty Analysis- Level 2 PSA – Accident Progression and Source Term Accident-progression Analysis Source-term Analysis Level 3 PSA – Offsite Consequence Evaluation of Seismic Hazards Risk Calculations

APPLICATIONS OF PSA

U.S. Commercial Nuclear PSAs - PSA of the CANDU (Heavy Water Power Reactor) - Research and Production Reactor PSAs - Chemical Process PSAs- Issues in the near future-PSA Technology Utilization- case studies

Text Books

1. Ralph R. Fullwood, “Probabilistic Safety Assessment in the Chemical and Nuclear Industries”, Butterworth-Heinemann, 2000
2. Hiromitsu Kumamoto. “Satisfying safety goals by probabilistic risk assessment.- (Springer series in reliability engineering)”, Springer-Verlag London Limited 2007.
3. R. B. Solanki and Mahendra Prasad, “Probabilistic Safety Assessment Of Nuclear Power Plants:A Monograph” Atomic Energy Regulatory Board, Mumbai. November 2007
4. Probabilistic Safety Assessment (PSA), Japan Nuclear Energy Safety Organization(JNES), December 2007

Reference

1. International Atomic Energy Agency. "Applications of probabilistic safety assessment (PSA) for nuclear power plants"-IAEA-TECDOC-1200, Vienna, Austria, February 2001
2. International Atomic Energy Agency. “Living probabilistic safety assessment (LPSA)- IAEA-TECDOC-1200, Vienna, Austria August 1999
3. Pekka Pey, Human reliability analysis methods for probabilistic safety assessment, VTT Automation, Technical research centre of Finland, December 2000

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|----------------|------------------------------------|----------|----------|----------|----------|
| MEC5419 | BIOMECHANICS AND HUMAN BODY | L | T | P | C |
| | VIBRATION | 3 | 0 | 0 | 3 |

VIBRATION

Introduction, vibration exciters, control systems, Performance specification, motion sensors and transducers.

MUSCULARSKELETAL SYSTEM AND ANTHROPOMETRY IN BIOMECHANICS

Introduction, structure and function of musculoskeletal system - Connective Tissue, Skeletal Muscle, Joints Measurement of body segment, physical properties, Anthropometric data for biomechanical studies in industry.

MECHANICAL WORK CAPACITY EVALUATION AND BIOINSTRUMENTATION

Joint motion, human motion analysis system, applied electromyography, intradiscal pressure measurement, intrabdominal measurement, force platform system, whole body vibration measurement.

BIOMECHANICAL MODELS

Planar static biomechanical models, static 3D modelling, dynamic biomechanical models, special purpose biomechanical models.

WHOLE BODY AND SEGMENTAL VIBRATION

Vibration on human body, whole body vibration, Hand-Transmitted Vibration, segmental vibration, vibration exposure criteria.

References

1. Vibration and Shock Handbook, Clarence W. De Silva, Taylor and Francis Group, 2005
2. Occupational Biomechanics, Don B. Chaffin and Gunnar B.J.Andersson, John Wiley and sons,Inc

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| MEC6401 | NUCLEAR ENGINEERING AND SAFETY | L | T | P | C |
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INTRODUCTION

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

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.

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.

SAFETY OF NUCLEAR REACTORS

Safety design principles – engineered safety features – site related factors – safety related systems – heat transport systems – reactor control and protection system – fire protection system – quality assurance in plant components – operational safety – safety regulation process – public awareness and emergency preparedness.

RADIATION CONTROL

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

References

1. M.M.EL.Wakil, Nuclear Power Engineering, (McGraw-Hill Series in Nuclear Engineering), McGraw-Hill Book Company, Inc., 1962
2. Serman U.S., Thermal and Nuclear Power Stations, MIR Publications, Moscow, 1986.
3. Frank P.Lees, Loss prevention in the process Industries, Butterworth-Hein-UK, 1990.
4. R.L.Murray, Introduction to Nuclear Engineering, Prentice Hall, New York, 1954.
5. K.Sri Ram, Basic Nuclear Engineering, Wiley Eastern Ltd., New Delhi, 1990.
6. Loffness, R.L., Nuclear Power Plant, Van Nostrand Publications, 1979.

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|----------------|------------------------|----------|----------|----------|----------|
| MEC6402 | SAFETY IN MINES | L | T | P | C |
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OPENCAST MINES

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

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.

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.

RISK ASSESSMENT

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

ACCIDENT ANALYSIS AND MANAGEMENT

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

References

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

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|----------------|--------------------|----------|----------|----------|----------|
| MEC6403 | DOCK SAFETY | L | T | P | C |
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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.

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

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 hole of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like forklift trucks-pay loaders etc.

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.

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, pay loaders etc., dock railways, conveyors and safety and ports.

Safe use of special lift trucks inside containers – 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.

GENERAL

Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of dock workers, responsible persons – authorized person etc., Emergency action Plans for fire and explosions – good storage at Port area and hazardous chemical safety – 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.

References

1. Safety and Health in Dock work, 2nd Edition, ILO, 1992.
2. Taylor D.A., “Introduction to Marine Engineering” Butterworth-Heinemann, 2nd edition, 1996
3. Srinivasan “Harbour, dock and tunnel engineering: an elementary text-book for engineering students”, Charotar Books Distributors, 2003
4. S P Bindra, “A Course in Docks and Harbour Engineering”, Dhanpat Rai and Sons, New Delhi, 1993.

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|----------------|----------------------------------|----------|----------|----------|----------|
| MEC6404 | SAFETY IN POWDER HANDLING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

INTRODUCTION

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- Pyro and agro applications.

IGNITION OF POWDERS AND DUST CONTROL

Ignition-minimum ignition energy-powder dispersion-spark, generation-characteristics-pressure concentration-flammable gases-solvent vapours-vapour clouds-decomposition-exothermic and endothermic reaction.

Dust: definition-type-concepts- exposure-dispersion-control-monitoring and measure-control of dust at the source-control approaches and strategies-occupational diseases-house keeping and environmental protection.

POWDER HAZARDS

Electrostatic charges-energy released-type of discharge-spark-carona-insulating powders-propagating brush discharge-discharge in bulk lightning hazards in powder coating-electroplating.

Paint manufacture - powder milling-sieving, mixing, blending-pesticides and insecticide-dust hazards-polymer powder hazard-fireworks hazards-health and hygiene.

HAZARD MEASUREMENT

Volume reference – resistivity of solids-powders in bulk-surface resistance-static charge, conductivity – electric field, ratio signals-min. Ignition energy-particulate measurement-air sampler-dust monitor.

Hazard identification and assessment in metal powder, cement, pesticides, chemical, foundry, powder coating, roller flour mill and other industries.

SAFETY MEASURES

Main stages from charge build up to ignition and safety measures-control-earthing-elimination of incendiary discharge.

Safety in practice-general guidelines-loading and unloading pneumatic transfer, sieving, grinding and mixing, dust generation-handling of powders in the presence of flammable gases and vapours. Safety measures in industries.

References

1. Martin Glor, Electro Static Hazard in Powder Handling, Research studies Press Ltd., England, 1988.
2. Major hazard control, ILO Geneva, 1987.
3. Seminar on “Hazard recognition and prevention in the work place-airborne dust” Vol.I and 2, SRMC, Chennai, 4/5, Sept.2000.

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| MEC 6405 | RADIOGRAPHIC TESTING AND RADIATION | L | T | P | C |
| | SAFETY | 3 | 0 | 0 | 3 |

BASIC PRINCIPLES OF RADIOGRAPHY:

Geometric exposure principles, shadow formation, shadow sharpness, etc – Radioisotopic sources – types and characteristics- Production and processing of radioisotopes - radiographic cameras - X-ray sources generation and properties - industrial X-ray tubes - target materials and characteristics- change of mA and KVP effect on “quality” and intensity of X-rays. High energy X-ray sources - linear accelerators.

FILM RADIOGRAPHY:

X-ray film – structure and types for industrial radiography - sensitometric properties -use of film, characteristic curves (H & D curve) - latent image formation on film - radiographic exposure, reciprocity law, photographic density - X-ray and gamma ray exposure charts - exposure time calculations -film handling and storage - Effect of film processing on film characteristics - Processing defects and their appearance on films - control and collection of unsatisfactory radiographs - Automatic film processing.

RADIOGRAPHIC IMAGE QUALITY AND RADIOGRAPHIC TECHNIQUES:

Radiographic Contrast, film Contrast, Subject Contrast, Definition, Radiographic density-penetrimeters or Image Quality Indicators - Intensifying screens -intensification factor, control of scattered radiation, filters, diaphragms, masks- Radiography of Weldments – single and double wall Radiography - panoramic radiography-interpretation of radiographs and inspection standards - applicable codes, standards and specifications (ASME, ASTM, AWS, BS, IBR etc.)

SPECIAL RADIOGRAPHIC TECHNIQUES:

Principles and applications of Fluoroscopy/Real-time radioscopy - advantages and limitations - recent advances, intensifier tubes, vidicon tubes. Etc - Digital Radiography - Principle of neutron radiography - attenuation of neutrons - direct and indirect technique - advantages and limitations – Principle and application of in-motion and flash radiography.

RADIATION SAFETY:

Special and SI Units of radiation - Photoelectric effect, Compton effect, Pair production - Principle of radiation detectors - ionisation chamber, proportional counter, G. M. counters, scintillation counters, solid state detectors - Biological effect of ionising radiation - Operational limits of exposures - Radiation hazards evaluation and control - Design of radiography installation and shielding calculations.

References

1. Non-Destructive Testing Hand Book: Radiography and Radiation Testing, Vol.3, 2nd ed, Columbus, OH, American Society for Non-Destructive Testing, 1985.
2. Halmshaw. R, Industrial Radiography, Applied Science Publishers Inc. Englewood, NJ, 1982.
3. Radiographic Testing, Classroom training hand book, (CT -6-6) SanDiego, CA, General Dynamics/Convair Division, 1983.
4. Baldev raj, Practical Non – Destructive Testing, Narosa Publishing House,2009.

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| MEC 6406 | DISASTER MANAGEMENT | L | T | P | C |
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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

TECHNOLOGICAL DISASTERS

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

SUSTAINABLE DEVELOPMENT

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

OFFSHORE AND ONSHORE DRILLING

Control of fires-Case studies-Marine pollution and control-Toxic, hazardous & 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-

ENVIRONMENTAL EDUCATION AND POLICY

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

References

1. Gilbert, M. Masters, Introduction to Environmental Engineering and Science, Prentice Hall, 2005
2. G. Tyler Miller and Scott Spoolman, "Environmental Science: Principles, Connections and Solutions", Brooks Cole, 12th edition, 2007
3. G. Tyler Miller, "Environmental Science: Sustaining the Earth (Environmental Science: Working with the Earth)", Wadsworth Publishing Company, 3rd edition, 1991.

4. Mackenzie Leo Davis and Susan J. Masten, “Principles of Environmental Engineering and Science”, McGraw Hill Higher Education, 2nd edition, 2008

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| MEC6407 | OHSAS 18000 AND ISO 14000 | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

OHSAS STANDARD

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

OHSAS 18001 POLICY AND PLANNING

Developing OH and S policy– Guidelines – Developments - procedure - Content of OH and S policy – General principle, strategy and planning, specific goals, compliance – methodology.

Planning – Guidelines, methodology steps developing action plan – Analysis and identify the priorities, objective and Targets, short term action plan, benefits and cost of each option, Development of action plan.

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.

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.

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 its advantages. EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits.

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

Reference

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

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| MEC 6408 | INTELLIGENT INDUSTRIAL SYSTEMS | L | T | P | C |
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BASIC CONCEPTS

Artificial intelligence and expert systems - System Components - System architecture and Data flow – System Operations

KNOWLEDGE BASED SYSTEMS

Knowledge representation – knowledge acquisition and optimization - Knowledge based approaches to design mechanical parts and mechanisms and design for automated assembly

MATERIAL SELECTION AND PROCESS PLANNING

Knowledge based system for material selection – Intelligent process planning system.

INTELLIGENT SYSTEM

Intelligent system for equipment selection - Intelligent system for project management & factory monitoring. Scheduling in manufacturing – scheduling the shop floor – Diagnosis & trouble shooting

AI ROLE AND ITS APPLICATIONS

The role of Artificial Intelligence in the factory of the future – Intelligent systems.

References

1. Andrew Kussiak,, “Intelligent Manufacturing Systems”, Prentice Hall , 1990.
2. Simons, G.L, “Introducing Artificial Intelligence”, NCC Pub, 1990.
3. Rich,E., “Artificial Intelligence”, Mc Graw Hill, 1986.

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| MEC5020 | CORROSION ENGINEERING | L | T | P | C |
| | | 3 | 0 | 0 | 3 |

[Common for M.Tech (CAD/CAM), M.Tech (Energy Engineering) and M.Tech (ISE)]

PRINCIPLES

Corrosion principles -Electro-chemical aspects, environmental effects, metallurgical aspects. Forms of corrosion -characteristics and mechanisms.

TYPES OF CORROSION

Types of corrosion – basic classifications.

CORROSION PREVENTIONS

Corrosion prevention -cathodic and anodic protection, inhibitors, coatings and design.

CORROSION IN METALS AND ALLOYS

Metals and alloys, their corrosion resistance to different environments.

CORROSION TESTING

Types and techniques – Instruments – Advances in corrosion testing.

References

1. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill, 1988
2. Pierce R.Roberge, Hand Book of Corrosion Engineering, McGraw Hill, 2005
3. Zaki Anand, Principles of Corrosion Engineering and Corrosion Control, Oxford Press, 2006
4. R.Winston Revie, Corrosion and Corrosion Control, John Wiley & Sons INC, 2008
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| MEC5211 | AUTOMOTIVE SYSTEMS SAFETY, QUALITY AND RELIABILITY | L | T | P | C |
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[Common for M.Tech (Automotive Systems Engineering) and M.Tech (ISE)]

SAFETY MANAGEMENT PRACTICES IN AUTOMOTIVE INDUSTRIES

Need for safety - safety concepts – safety management functions – safety committee - safety audit and survey- safety inspection – safety sampling -job safety analysis - damage control - disaster control – emergency preparedness plan - accident types – causes and cost of accidents - house keeping – safety education and training - accident reporting - accident investigation – accident prevention programs - first aid - fire fighting - personal protective equipments.

SAFETY SYSTEM ANALYSIS

Introduction – definitions - safety systems - safety control systems - organisations and management of safety - safety information system, basic concepts, information sources, coding sources, documentation, processing of information - safety budget allocation - cost benefit analysis - allocating the budget - total loss control – benefits.

HAZARDS AND RISKS IN AUTOMOTIVE INDUSTRIES

Introduction – hazard - risk – safety analysis - risk assessment - Techniques and methodologies for risk analysis – checklist - what if analysis - Hazard and Operability Studies (HAZOP) - Fault Tree Analysis (FTA) - Even Tree Analysis (ETA) - Failure Mode Effect Analysis (FMEA) – Material Safety Data Sheet (MSDS) - computer aided hazard analysis - expert system and artificial intelligence application - fault detection and diagnosis.

TRANSPORT SAFETY

introduction - factors for improving safety on roads - causes of accidents due to drivers and pedestrians – safety in design, selection, operation and maintenance of transport vehicles -

preventive maintenance – servicing - check list - insurance - Transport emergency card (TREM) - warning symbols- responsibility of driver - transport precaution- safe driving - history of legislations related to safety - safety provisions in the factory act - indian motor vehicles act and rules - workmen compensation act - ESI act - OSHA standards.

RELIABILITY AND QUALITY

Reliability – reliability function – MTBF - MTTF - mortality curve - availability – maintainability- failure data analysis – repair time distributions - graphical evaluation - reliability prediction - failure rate estimates - effect of environment and stress - series and parallel systems - RDB analysis – standby systems - complex systems - total quality management – QC Tools – quality circles – quality function deployment – 5S – Kaizen – Six sigma – quality management system – ISO – implementation steps.

Text Books

1. Brown D.B., System Analysis and Design for Safety, Prentice Hall Inc., New Jersey, 1976.
2. Dale H. Besterfield, et al., Total Quality Management, Person Education, 2002.
3. Ebeling, An Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill, 2004.
4. John.V.Grimaldi and Rollin H.Simonds , Safety management , All India Travelers book seller, 1989.

References

1. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
2. Babkov.V.F, Road conditions and traffic safety, MIR Publications, Moscow, 1986.
3. Dhillon.B.S. and Singh.C, Engineering Reliability- New Techniques and Applications , John Wiley and sons,1981.
4. Ernest J.Henley and Hiromitsu Kumamoto, Designing for reliability and safety control, Prentice Hall,1985.
5. Ernest J.Henly and Hiromitsu Kumamoto, Reliability Engineering and Risk Assessment, Prentice Hall,1981.
6. ILO-Major Hazard Control- A Practical Manual, ILO, Geneva,1988.
7. John Bank, The Essence of TQM, PHI, 1993.
8. Lees, F.P., Loss Prevention in Process Industries, Butterworths, New Delhi, 1986.
9. Motor vehicles act, 1988, Government of India.
10. Occupational Safety manual, BHEL
11. Popkes. C.A Traffic Control and Road Accident Prevention, Chapman and Hall Limited, 1986.
12. Richard A. Stephans and Warner W.Talso, System safety analysis handbook, The system safety society , 1993.
13. David S. Gloss., Introduction to safety Engineering, Wiley-Interscience,1984.
14. Rose, J.E., Total Quality Management, Kogan page limited, 1993.

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| CIV5011 | SOLID AND HAZARDOUS WASTE MANAGEMENT | L | T | P | C |
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SOLID AND HAZARDOUS WASTE

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management - Legislations on management and handling of municipal solid wastes, hazardous wastes, and biomedical wastes.

WASTE GENERATION

waste generation rates – Composition - Hazardous Characteristics – TCLP tests – waste sampling- Source reduction of wastes – Recycling and reuse. Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations - labeling and handling of hazardous wastes.

WASTE PROCESSING

Processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

DISPOSAL

Disposal in landfills - site selection - design and operation of sanitary landfills- secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – landfill remediation

INTEGRATED WASTE MANAGEMENT

Elements of integrated waste management

References

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw- Hill, New York, 1993
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

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| CIV5015 | ENVIRONMENTAL IMPACT ASSESSMENT | L | T | P | C |
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INTRODUCTION

Evolution of EIA – Concepts –Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA

METHODOLOGIES

Methods of EIA –Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives – Case studies. Rapid and Comprehensive EIA – Legislative and Environmental Clearance procedure in India – Prediction tools for EIA.

PREDICTION AND ASSESSMENT

Assessment of Impact on land, water and air, noise, social, cultural flora and fauna; Mathematical models; public participation – Resettlement and Rehabilitation- Rapid EIA.

ENVIRONMENTAL MANAGEMENT PLAN

Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, air and land, flora and fauna

EIA CASE STUDIES

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

Text Books

1. Canter,L., Environmental Impact Assessment, McGraw-Hill Inc., New Delhi, 1996

References

1. Canter. R. L., Environmental Impact Assessment, McGraw Hill, 1981.
2. John G. Rau and David. C. Wooten (Ed)., Environmental Impact Analysis Hand Book, McGraw Hill Book Company, 1980.

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| CIV5452 | AIR POLLUTION CONTROL EQUIPMENT DESIGN | L | T | P | C |
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INTRODUCTION:

Air Pollutant Sources, Effects and clean Air Acts; Population of air: Sources and effects of air pollutants on physical environment and living systems, Monitoring air pollution, Air pollution Laws and Minimum national standards

METHODS AND TECHNIQUES:

Air Pollutant Formation, Dispersion , Analysis: Formation of pollutants through large-scale combustion of fossil fuels, mineral processing, automobiles in urban areas and at source minimization of release – Meteorological aspects of air pollutant dispersion. Chemical reactions in a contaminated atmosphere, urban air pollution, acid rain Air sampling and measurement, Analysis of air pollutants

PARTICULATE POLLUTION CONTROL:

Air pollution Control Methods for Particulates Removal: Control Methods – Source Correction methods – Particulate emission control: Dry techniques industrial dust collectors, cyclone and multiclone separators, bag filters, electrostatic precipitators, relative merits and demerits, choice of equipments, design aspects economics. Wet techniques wet dust collection, wet cyclone, empty scrubber, column (packed) scrubber, ventury scrubber, suitability, merits and demerits, design aspects and economics.

GASEOUS POLLUTANTS:

Control of Specific Gaseous Pollutants: Cleaning of Gaseous effluents – Control of sulphur dioxide emission by various methods – Control of nitrogen oxides in combustion products – Control of release of carbon monoxide and hydrocarbons to the atmosphere.

HAZARDOUS WASTE MANAGEMENT AND RISK ASSESSMENT:

Type of hazardous Wastes – Health effects – Nuclear fission and radioactive waste treatment and disposal methods. Risk assessment.

Text Books

1. Y.B.G. Verma, H. Brauer, “ Air Pollution Control Equipments”, Springer, Verlag Berlin, 1981
2. M.N. Rao and H.V.N. Rao, “ Air Pollution “, Tata McGraw Hill, New Delhi, 1993.

Reference

1. Rao C.S. “Environmental Pollution Control Engineering,” 2nd Edition, New Age International Publishers, 2006
2. A.P. Sincero and G.A. Sincero Environmental Engineering : A design Approach , Prentice Hall of India pvt Ltd, N. Delhi.1996
3. Noel de Nevers, Air Pollution Control Engineering, McGraw-Hill, 1999.

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| ICE 5451 | PROCESS MODELLING AND SIMULATION | L | T | P | C |
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[Common for M.Tech (CI) and M.Tech (ISE)]

INTRODUCTION

Introduction to modeling, a systematic approach to model building, classification of models. Conservation principles, thermodynamic principles of process systems.

MATHEMATICAL MODEL

Development of steady state and dynamic lumped and distributed parameter models based on first principles. Analysis of ill-conditioned systems, Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.

SOLUTION STRATEGIES

Distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods, Solution strategies for lumped parameter models. Stiff differential equations.

COMPUTER SIMULATION

Solution methods for initial value and boundary value problems. Euler’s method. R-K method, shooting method, finite difference methods. Solving the problems using MATLAB.

CASE STUDIES

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, - steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries.

Text Books

1. K. M. Hantos and I. T. Cameron, "Process Modelling and Model Analysis", Academic Press, 2001.
2. W.L. Luyben, "Process Modelling, Simulation and Control for Chemical Engineers", 2nd Edn., McGraw Hill Book Co., New York, 1990.
3. W. F. Ramirez, "Computational Methods for Process Simulation", Butterworths, 1995.

References

1. M.M. Denn, "Process Modelling", Wiley, New York, 1990.
2. B. Wayne Bequette, "Process control modelling design and simulation", Prentice Hall, New Jersey, 2003

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| EEE5013 | DIGITAL SIGNAL PROCESSING | L | T | P | C |
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[Common for M.Tech (PSE) and M.Tech (ISE)]

DISCRETE TIME SIGNALS AND SYSTEMS

Discrete Time Signals-Sequences - Stability and Casuality - Linear Shift invariant Systems- Frequency Domain representation of Discrete Time Systems and Signals. Two Dimensional Sequences and Systems-Z-Transform- Theorems and Prospects- Two Dimensional Z-transform-inverse Z- transform. Structures for Discrete time system.

DISCRETE FOURIER TRANSFORM

Representation of Periodic sequences-Fourier Series, Fourier Transform, Discrete Fourier series, Discrete Fourier transform and its properties-Linear and Circular convolutions-Decimation in time and Decimation in frequency, FFT Algorithm (Radix 2)-Two dimensional discrete Fourier transform.

FILTER DESIGN TECHNIQUES

Design of Butterworth and Chebyshev (Analog) filters-Properties of Digital and Analog Filters-Design of Digital filters (FIR & IIR)-FIR design using windows, IIR filter design using Bilinear and impulse invariant transformation-Comparison of IIR and FIR digital filters.

FINITE LENGTH EFFECTS IN DIGITAL FILTERS

Sampling-A/D and D/A conversion-Effect of coefficient of Quantization-Quantization in sampling Analog Signals-Finite Register Length effects in Realisation of Digital Filters-Discrete Fourier transform Computations.

DIGITAL SIGNAL PROCESSORS

Fixed Point DSP Architecture-floating point DSP Architecture – Fixed and floating point number Representations- Study of TMS 320C50 Processors-Basics of Programming using TMS 320C54 Processor.

Text Books

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2003 / PHI.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill, New Delhi, 2001.

References

1. Alan V. Oppenheim, Ronald W. Schaffer and John R. Buck, 'Discrete – Time Signal Processing', Pearson Education, New Delhi, 2003.
2. Venkataramani, B., Bhaskar,M., 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw Hill, New Delhi, 2003.

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| EEE 6001 | SOFT COMPUTING | L | T | P | C |
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[Common for M.Tech (PSE) and M.Tech (ISE)]

INTRODUCTION TO SOFT COMPUTING

Conventional Artificial Intelligence system-Fundamental constituents of soft computing,- Computational learning theory- Hybrid soft computing system.

NEURAL NETWORKS

Overview of biological Neuro-system - Mathematical Models of Neurons -Learning rules - Learning Paradigms – Supervised, Unsupervised and reinforcement Learning - Perceptron networks - Training rules – Multilayer perceptron - Back Propagation Algorithm - Associative Memories- Hopfield Networks - Boltzman machine – Self Organizing Map.

FUZZY LOGIC

Fuzzy Sets - Fuzzy rules and Fuzzy reasoning- Fuzzy inference systems- Fuzzy classifiers- Fuzzy logic control- Application of Fuzzy logic

NEURO FUZZY MODELLING

Adaptive Neuro Fuzzy Inference Systems (ANFIS)- architecture-hybrid learning algorithm- Parameter identification-Rule base structure identification – input selection- input space partitioning - Neuro-Fuzzy control.

EVOLUTIONARY COMPUTATION

Robustness of Traditional optimization and search techniques - The goals of optimization Introduction to Evolutionary programming – Evolutionary strategy – Comparison - Genetic Algorithm – Principles of Genetic operators - GA for optimization problems – Implementation issues - Applications.

References

1. J.S.R. Jang, C.T. Sun and E. Mizutani, “Neuro Fuzzy and soft computing”, PHI, 1997
2. Timothy J.Ross. “Fuzzy Logic with Engineering Applications”, McGraw- Hill, 3rd edition, 2010.
3. Goldberg, Genetic Algorithm in search, Optimization and machine learning, Addison Wesley,1998
4. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.

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| ICE5004 | PROCESS CONTROL AND INSTRUMENTATION | L | T | P | C |
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[Common for M.Tech (CI) and M.Tech (ISE)]

PROCESS DYNAMICS

Introduction to process control - objective of modeling - models of industrial process - hydraulic tanks - fluid flow systems - mixing process - chemical reactions - thermal systems-heat exchangers - distillation column

CONTROL ACTIONS AND CONTROLLER TUNING

Basic control actions-on/off – P - P+I - P+I+D - floating control - pneumatic - electronic controllers - controller tuning-time response - frequency response methods - non-linear controllers

COMPLEX CONTROL TECHNIQUES

Feed forward-ratio – cascade - split range – inferential – predictive - adaptive - multivariable control

PROGRAMMABLE LOGIC CONTROLLERS

Evolution of PLC – Sequential - Programmable controllers – Architecture – Programming of PLC – Relay logic - Ladder logic – Functional blocks – Communication Networks for PLC

DISTRIBUTED CONTROL SYSTEM

Evolution of DCS – Architecture – Local control unit – Operator interface – Engineering interface – Display – Case studies in DCS

Text Books

1. Dale E. Seborg, et al, Process dynamics and control, Wiley John and Sons, 1989
2. Norman A Anderson, Instrumentation for Process Measurement and Control, CRC Press LLC, Florida, 1998

References

1. George Stephanopoulos, Chemical Process Control, Prentice Hall India
2. Harriot P., Process Control, Tata Mc Graw-Hill, New Delhi, 1991
3. Marlin T. E., Process Control, Tata McGraw hill, New York, 2nd edition, 2000
4. Balchan J. G., Mumme G., Process Control Structures and Applications, Van Nostrand Renhold Co., New York, 1988

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| ICE5005 | SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL | L | T | P | C |
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[Common for M.Tech (CI) and M.Tech (ISE)]

SYSTEMS AND MODELS

Models of LTI systems - Linear Models - State space Models - Model sets - Structures and Identifiability - Models for Time-varying - Non-linear systems - Models with Nonlinearities – Non-linear state - space models - Black box models - Fuzzy models - Model approximation – validation - Random Process Modelling

PARAMETRIC AND NON-PARAMETRIC ESTIMATION METHODS

Transient response - Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square – Maximum Likelihood – Instrumental Variable methods – Pseudo Linear Regression

LINEAR AND NON-LINEAR ESTIMATION TECHNIQUES

Open - Closed loop identification - Approaches – Direct - indirect identification – Joint input - output identification – Non-linear system identification – Wiener models – Power series expansions - Multidimensional Identification – State estimation techniques – FFT based - Model based Spectral estimation techniques

CLASSIFICATION OF ADAPTIVE CONTROL

Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR - MRAC – Different approaches to self-tuning regulators – Stochastic Adaptive control – Gain Scheduling

APPLICATIONS OF ADAPTIVE CONTROL

Recent trends in self – tuning – Stability, Convergence and Robustness studies - Model Updating – General purpose Adaptive regulator – Applications to process control

Text Books

1. Narendra , Annasamy, Stable Adaptive Control Systems, Prentice Hall, 1989

References

1. Ljung, System Identification Theory for the User, PHI, 1987
2. Astrom, Wittenmark, Adaptive Control , PHI

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| ICE6003 | DIGITAL IMAGE PROCESSING | L | T | P | C |
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[Common for M.Tech (CI) and M.Tech (ISE)]

DIGITAL IMAGE PROCESSING SYSTEMS, VISUAL PERCEPTION & IMAGE MODEL

Image acquisition, storage, processing, communication and display, Structure of human eye, image formation in the human eye, brightness, adaptation and discrimination. Uniform and non-uniform sampling and quantization

DISCRETE 2-D LINEAR PROCESSING & IMAGE TRANSFORMS

Superposition and convolution, unitary transforms linear processing techniques. 2-D DFT / FFT, Walsh, Hadamard Transforms, Discrete Cosine and Sine transforms, Haar Transform, Slant Transform, Hotelling Transform

IMAGE ENHANCEMENT

Contrast manipulation, Histogram modification, noise cleaning, edge sharpening, frequency domain methods like low-pass and high-pass filtering, homomorphic filtering

IMAGE SEGMENTATION

Detection of discontinuity, point line and edge detection, edge linking and boundary detection, thresholding, image interpretation

IMAGE COMPRESSION

Coding redundancy. Psycho-visual redundancy. Fidelity criteria, MSE, fundamental coding theorem. Error -free compression, variable length coding .bit plane coding. Loss-less predictive coding. Lossy predictive coding, Transform coding, DPCM, OM, ADM

Text Books

1. Pratt.W., Digital Image Processing, Wiley Publication, 3rd edition, 2002
2. Gonzalez & Woods, Digital Image Processing, Pearson Education, 2nd edition, 2003

References

Jain.K., Fundamentals of Image processing; Prentice Hall of India Publication, 1995

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| ICE6011 | FAULT DIAGNOSIS AND CONTROL | L | T | P | C |
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[Common for M.Tech (CI) and M.Tech (ISE)]

INTRODUCTION

Introduction- Definition for fault-fault detection and diagnosis-Process monitoring procedures-process monitoring measures-monitoring

MULTIVARIATE STATISTICS AND PATTERN CLASSIFICATION

Data pre-treatment-Univariate statistical monitoring- T^2 Statistic- threshold for T^2 Statistic- Data requirement- Discriminant analysis- feature

DATA DRIVEN METHODS

Principal Component analysis- Reduction order-fault detection, identification, diagnosis, Dynamic PCA and other methods- Fisher Discriminant Analysis- Partial least squares- Canonical Variate analysis

ANALYTICAL AND KNOWLEDGE-BASED METHODS

Fault description- Parameter estimation- Observer based methods- Parity relations- Casual analysis- Expert system- Pattern- Combination of various techniques

APPLICATIONS

Tennessee Eastman Process- Application description- Case studies results and discussion

Text Books

1. L.H.Chiang, E.L.Russell and R.D Braatz, "Fault Detection and Diagnosis in Industrial Systems", Springer, 2000.

References

1. George Vachtsevanos, Frank L.Lewis, Michael Roemer, Andrew Hess, "Intelligent Fault Diagnosis and Prognosis for Engineering Systems", Wiley, 2006s, 1987.
2. Computational Intelligence in Fault Diagnosis (Advanced Information and Knowledge Processing) Springer, 2006.
3. Krzysztof Patan, "Artificial Neural Networks for Modelling and Fault Diagnosis of Technical Processes", Springer, 2008-07.