

K.S. Rangasamy College of Technology

(Autonomous Institution)



Curriculum & Syllabus

of

M.E. Industrial Safety Engineering

R 2014

(for the batch admitted in 2017-2018)

**Courses Accredited by NBA, Accredited by NAAC with 'A' Grade, Approved by
AICTE, Affiliated to Anna University, Chennai.**

KSR Kalvi Nagar, Tiruchengode – 637 215.

Namakkal District, Tamil Nadu, India.

K.S.Rangasamy College of Technology - Autonomous Regulation		R 2014
Department	Industrial Safety Engineering	
Programme Code & Name	PIS : M.E. Industrial Safety Engineering	

VISION

To create industrial safety professionals and make them lead the safety team for achieving the goals of zero accident and excellence in the field of industrial safety management for the benefit of all the stake holders.

MISSION

To enrich the industrial safety knowledge, safety statues and effective safety management skills and techniques in the minds of young engineering professionals by imparting training, workshops, role play, seminars, group discussions, guest lectures, case studies, industrial visits and in-plant training by undertaking live industrial projects.

PROGRAMME EDUCATIONAL OBJECTIVES:

- I. Graduates of the programme will become professionally competent in the field of Safety, Health and Environment issues, expertise in all sorts of hazard evaluation, risk assessment and safety management systems.
- II. Graduates of the programme will become principal auditors in pinpointing vulnerable areas, therefore suggesting corrective/preventive actions to industries. They are also highly proficient enough in handling emergency scenario, disaster mitigation and extremely knowledgeable in developing emergency preparedness plan.
- III. Graduates of the programme will have adequate skill in investigating accidents thereby preventing accident in proactive and reactive approach. They will adhere to Indian and International standards in handling Safety, Health and Environment aspects enhancing life long learning and engineering ethical behavior,.

PROGRAM OUTCOMES:

- a. Apply knowledge of mathematics, science, engineering fundamentals to find solutions for industrial problems pertaining to safety, health and welfare of workers.
- b. Identify, formulate, research literature, conduct experiments and analyze complex industrial safety issues using first principles of mathematics, natural sciences, ergonomics, and engineering principles.
- c. Design solutions for complex industrial safety problems in domains such as safety management, ergonomics, occupational health, hazard assessment and electrical safety that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
- d. Use research based knowledge and research methods including design of safety

instrumented systems, hazard analysis and interpretations of data and synthesis of the information to provide valid conclusion related to safety engineering.

- e. Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex safety issues in industrial sector with an understanding of the limitations.
- f. Apply safety reasoning informed by the contextual knowledge to assess societal, health, safety ,legal and cultural issues and consequent responsibilities relevant to the professional safety engineering practice.
- g. Understand the impact of the professional safety engineering solutions in societal and environmental contexts and demonstrates the knowledge of, and need for sustainable development.
- h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the safe engineering practice.
- i. Function effectively as an individual, and as a member or leader in safety teams, and in multidisciplinary settings in industrial and societal environments.
- j. Communicate effectively on complex safety engineering activities in multi engineering community and with society at large, such as, being able to comprehend and write effective safety reports and design documentation, make effective presentations, and give and receive clear instruction.
- k. Demonstrate knowledge and understanding of the safety engineering and management principles and apply these to one's own work, as a member and leader in team to manage safety projects and in multidisciplinary environments.
- l. Recognize the need for safety and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

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Regulation	R 2014
Department	Industrial Safety Engineering
Programme Code & Name	PIS : M.E. Industrial Safety Engineering

Curriculum for the Programme under Autonomous Scheme

Semester I					
Course Code	Course Name	Hours / Week			Credit
		L	T	P	
	THEORY				
40PIS101	Probability and Statistics	3	1	0	4
40PIS102	Principles of Safety Management	3	0	0	3
40PIS103	Environmental Safety	3	0	0	3
40PIS104	Occupational Health and Industrial Hygiene	3	0	0	3
40PIS105	Safety in Chemical Industries	3	0	0	3
40PISE1*	Elective I	3	0	0	3
	PRACTICAL				
40PIS1P1	Industrial Safety Laboratory	0	0	3	2
TOTAL		18	1	3	21

Semester II					
Course Code	Course Name	Hours / Week			Credit
		L	T	P	
	THEORY				
40PIS201	Fire Engineering and Explosion Control	3	0	0	3
40PIS202	Human Factors Engineering	3	0	0	3
40PIS203	Electrical Safety	3	0	0	3
40PIS204	Computer Aided Hazard Analysis	3	1	0	4
40PIS205	Industrial Safety, Health and Environment (SHE) Acts	3	1	0	4
40PISE2*	Elective II	3	0	0	3
	PRACTICAL				
40PIS2P1	Industrial Visit Report Preparation and Presentation	0	0	5	2
40PIS2P2	Technical Report Preparation and Presentation	0	0	2	2
TOTAL		18	2	7	24

Semester III					
Course Code	Course Name	Hours / Week			Credit
		L	T	P	
	THEORY				
40PISE3*	Elective III	3	0	0	3
40PISE4*	Elective IV	3	0	0	3
40PISE5*	Elective V	3	0	0	3
	PRACTICAL				

Semester IV					
Course Code	Course Name	Hours / Week			Credit
		L	T	P	
	PRACTICAL				
40PIS4P1	Project Work - Phase II	0	0	40	15

40PIS3P1	Project Work - Phase I	0	0	12	5
	TOTAL	9	0	12	14

	TOTAL	0	0	40	15

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Regulation			R 2014		
Department			Industrial Safety Engineering		
Programme Code & Name			PIS : M.E. Industrial Safety Engineering		
Curriculum for the Programme under Autonomous Scheme					
Elective I					
Course Code	Course Name	Hours / Week			Credit
		L	T	P	C
40PISE11	Safety in Engineering Industry	3	0	0	3
40PISE12	Quality Engineering	3	0	0	3
40PISE13	Fireworks Safety	3	0	0	3
40PISE14	Mechanical Integrity Assessment	3	0	0	3
Elective II					
40PISE21	Reliability Engineering	3	0	0	3
40PISE22	Personal Protective Equipment	3	0	0	3
40PISE23	Safety in Textile Industry	3	0	0	3
40PISE24	Behaviour Based Safety and Safety Culture	3	0	0	3
Elective III					
40PISE31	Integrated Management Systems	3	0	0	3
40PISE32	Safety in Construction and Infrastructure	3	0	0	3
40PISE33	Disaster Management	3	0	0	3
40PISE34	Safety in Material Handling and Plant Layout	3	0	0	3
Elective IV					
40PISE41	Ergonomic tools and techniques	3	0	0	3
40PISE42	Safety in Mines	3	0	0	3
40PISE43	Transport Safety	3	0	0	3
40PISE44	Artificial Intelligence and Expert Systems	3	0	0	3
Elective V					
40PISE51	Dock Safety	3	0	0	3
40PISE52	Safety in Petrochemical Industries	3	0	0	3
40PISE53	Industrial Noise and Vibration Control	3	0	0	3
40PISE54	Nuclear Engineering and Safety	3	0	0	3
One Credit Courses					
40PISSE1	Safety in Nano Technology	1	0	0	1
40PISSE2	Non Destructive Testing	1	0	1	1
40PISSE3	Food Industry Safety	1	0	0	1

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS 101 Probability and Statistics								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	1	0	60	4	50	50	100
Objectives	The course is aimed at developing the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many engineering fields, significantly in fluid mechanics, field theory and Industrial Safety Engineering.							
Course outcomes	<ol style="list-style-type: none"> 1. Recognize statistical methods and probability models as powerful decision-making tools. 2. Determine the probability density (or mass) function, cumulative distribution function, expected value, variance, standard deviation, and the probabilities of various intervals of continuous (and discrete) random variables. 3. Compute probabilities based on practical situations using the binomial and normal distributions 4. Know the basic discrete distributions (Binomial, Geometric, and Poisson) and how to work with them. 5. Able to perform and analyze hypotheses tests of means, proportions and variances using both one-and two-sample data sets. 6. Able to apply the appropriate Chi-Squared test for independence and goodness of fit 7. How to calculate basic two-variable statistics (covariance, correlation). 8. Know how to perform analysis of variance, One way classification, Two way classification, Randomized block design, Latin square design and Factorial design. 9. Know how to set exponential and parabolic trends and moving averages method. 10. Know how to apply the seasonal variations 							
Instructions: Approved Statistical tables are permitted during examinations.								
<p>Probability and Random Variable Probability – Random variables – Moments – Moment generating function — Two-dimensional Random Variables– Correlation and Regression.</p> <p>Standard Distributions Binomial, Poisson, Normal, Gamma, Exponential, Uniform, Geometric, Weibull distribution – Moment generating function, Mean and Variance – Problems.</p> <p>Testing of Hypothesis Test based on Normal, t-distribution, chi-square and F-distributions – Large sampling. Non-Parametric Methods: Mann-Whitney U-test – Kruskal-Wallis test (or H-test) - problems</p> <p>Design of Experiments Analysis of variance-One-way classification – Completely Randomized Block Design – Two-way classification – Randomized Block Design – Latin Square Design – Problems.</p> <p>Time Series Components of Time series – Method of Least squares – Moving averages method (3 years and 5 years) – Exponential trend – Parabolic trend – Seasonal variations: Method of simple averages – Ratio to trend method – Ratio to moving average method – Link relative method.</p>								
Reference(s) :								
1.	P.N.Arora, S.Arora, "Statistics for Management", S.Chand & Company Ltd, First Edition, 2003.							
2.	Gupta, S.C and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 11 th Edition, June 2002.							
3.	Jay, L.Devore, "Probability and Statistics for Engineering and Sciences", Brooks Cole Publishing Company, Monterey, California, 5 th Edition, 2002.							
4.	Montgomery D.C and Johnson, L.A, "Forecasting and Time Series Analysis," McGraw Hill, 1976.							
5.	Anderson, O.D, "Time Series Analysis: Theory and Practice," I. North – Holland, Amsterdam, 1982.							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS 102 Principles of Safety Management								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	50	50	100
Objectives	The syllabus framed is based on general principles and objectives so as to promote evolution of sound management and safe operating practices within the industry.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the concept, function and techniques of safety management. 2. Frame safety committee, safety policy, safety budget and apply safety techniques. 3. Learn the safety audit standards, audit methodology and ILO guidelines. 4. Document the report of inspection as per standard with adequate evidence. 5. Understand basic principles, theories of accident prevention methods 6. Investigate, Analyse, report and record accident to calculate accident cost. 7. Measure safety performance using accident indices as per standard. 8. Understand the categories of disabilities due to accident. 9. Practice BBS and safety culture in training and educating workers to promote, motivate safety in industry. 10. Understands the role played by government agencies and private consulting agencies in inculcating safety. 							
<p>Concepts and Techniques Evolution of modern safety concept- Safety Management functions- Safety as a integral part of business- Safety Organization- Safety Committee-budgeting for safety-safety policy- Statutory Provisions for safety management. Incident Recall Technique (IRT)- Job Safety analysis(JSA)/Job Hazard Analysis (JHA), safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.</p> <p>Safety Audit – Introduction Audit Standards ILO- OSH – 2001, IS 14489 1998 and OHSAS 18001 - Components of safety audit, types of audit, audit methodology, non conformity reporting (NCR) - Electrical Safety Audit - checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list.</p> <p>Accident, Investigation & Reporting Root cause analysis-RCA process-tools-cause effect diagram- corrective and preventive action-(CAPA). Basic Principle of Accident & Prevention concept of an accident, reportable and non reportable accidents, Near Miss Reporting and Analysis, At- Risk Behaviour Analysis - reporting to statutory authorities – principles of accident prevention – accident investigation and reporting – Response to Accidents -4P’s Evidences- Accident analysis-based on causes & injury-records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – Accident causation theories- domino sequence – supervisory role – role of safety committee –cost of accident - Accident Case Studies.</p> <p>Safety Performance Monitoring Proactive & Reactive Performance Monitoring – permanent total disabilities, permanent partial disabilities, temporary total disabilities – IS 3786:1984 Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.</p> <p>Safety Education and Training Importance of training-identification of training needs-training methods such as hands on training and table top exercise – 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 – Ethical Responsibilities - Domestic Safety and Training. Behaviour Based Safety(BBS) and safety culture :Pinpointing of Unsafe behavior-Positive reinforcement- observation and feedback. Evolution of Safety culture, Transformation requirement from reactive to proactive culture – Ethical responsibility for safety professional.</p>								
Reference(s):								
1.	Ray Asfahl. C “Industrial Safety and Health Management” Pearson Prentice Hall, 2003							
2.	John V. Grimaldi and Rollin H. Simonds, “Safety Management”, All India Travelers Book seller, New Delhi, 2001.							
3.	Heinrich H.W., “Industrial Accident Prevention”, McGraw-Hill Company, New York, 1980.							
4.	Philip Hagan, “Accident Prevention Manual for Business and Industry”, N.S.C.Chicago, 13th edition, 2009							
5.	“Occupational Safety Manual” BHEL, Trichy, 1988							
6.	“Accident Prevention Manual” – NSC, Chicago, 1982.							

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40 PIS 103 Environmental Safety								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	50	50	100
Objectives	The main emphasis is given on the topics relevant to air, water and pollution, the origin of various pollutants, the effects on man and on the environment and the methods available to control them. The fundamental aspects stressed and due importance is given to their application to the design of pollution control equipment.							
Course outcomes	<ol style="list-style-type: none"> 1. Associate air pollution, air pollutants, causes and effects and air pollution statuses. 2. Examine hazards and execute controls measures for air pollution at domestic and industrial level. 3. Associate Water pollution, water pollutants, causes and effects and its statuses. 4. Inspect hazards and execute controls measures for water pollution at domestic and industrial level. 5. Administer Hazardous waste management in Indian and global context with associated statuses. 6. Analyze hazard Categories, collection, storage, and treatment and disposal facilities of hazardous waste at various industries. 7. Experiment sampling techniques to measure the level of gaseous pollutants and particulate matters in industrial sector and environment. 8. Relate pollution control board laws, norms and government policies relevant to environment. 9. Discuss the significance of Environment Impact Assessment and NEAMA. 10. Investigate hazards and implement Pollution control measures at Major hazardous industries. 							
<p>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- stack emissions - CFC- Statutory Provisions related to Air Pollution - Emission standards : Permissible Limits –National Ambient Air Quality Standards(NAAQS) -MINAS – EURO Norms – Legal Compliance to statutory Norms.</p> <p>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 - Statutory Provisions related to Water Pollution- Effluent standards: Permissible Limits – Legal Compliance to statutory norms.</p> <p>Hazardous Waste Management Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, transport ,storage, treatment and disposal of hazardous waste- Disposal Facilities - Secured Landfills -selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic ,E-waste and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse- Statutory Provisions related to Hazardous waste management & handling.</p> <p>Environmental Measurement and Control Sampling and analysis – dust monitor – gas analyzer, particle size analyzer –pH meter – gas chromatograph – atomic absorption spectrometer- Inductive Coupled Spectrophotometer. 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 – National Forest Policy – National Water Policy – National Agriculture Policy – National Environment Policy – Ministry of Environment and Forest (MoEF) – CPCB, TNPCB- online monitoring, Corporate Social Responsibility (CSR) - Corporate Responsibility for environmental protection (CREP) – UNFCC – Stockholm convention on Persistent organic pollutants 2001.</p> <p>Pollution Control in Major hazardous (MAH)Industries Environmental Impact Assessment (EIA) – Pollution control in process industries like cement, paper, petroleum-petroleum products-textile-tanneries-thermal power plants -dyeing and pigment industries - eco-friendly energy - National Environment Assessment and Monitoring Authority (NEAMA).</p>								
Reference(s) :								
1.	Rao, .C.S, “Environmental Pollution Engineering”, Wiley Eastern Limited, New Delhi, Second Edition 2007.							
2.	S.P.Mahajan, “Pollution Control in Process Industries”, Tata McGraw Hill Publishing Company, New Delhi, 2006.							
3.	Varma and Brauer, “Air Pollution Equipment”, Springer Publishers, Second Edition.1981							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS 104 Occupational Health and Industrial Hygiene								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	50	50	100
Objectives	The subject offers work place - tested strategies for meeting the health and safety needs of a modern corporation emphasizing the practical means of achieving compliance with the regulations and also to provide a unique assessment of the more extensive factors that influence the management of work place health and safety.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the hazards of noise and vibration, compensation aspects, noise measuring instruments, vibration damping technique, suitable control methods and relevant statues. 2. Analyze the effects of radiations and temperature extremities. 3. Recognize the hazards of particulate matter and its relevant standards. 4. Compute Methods to control chemical hazards, training and to conduct industrial hygiene audit. 5. Assess biological and ergonomic hazards in workplace. 6. Estimate ergonomic risk factors of workers using posture evaluation tools. 7. Indicate the notifiable occupational diseases by imparting the significant role of Occupational health centre and fitness test in assessing these diseases. 8. Relate industrial toxicology with acute and chronic effects. 9. Point out the significant role of occupational physiology in man –machine interface. 10. Evaluate physiological requirement of job in an organization. 							
<p>Physical Hazards Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage- Noise Induced Hearing Loss (NIHL), risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, Noise and Vibration Mapping, noise control programmes, industrial audiometry, hearing conservation programmes- vibration - Standards, whole body vibration, Hand - Arm vibration types, effects, instruments, surveying procedure, permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programmes, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, Permissible level- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.</p> <p>Chemical Hazards Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure Vs. dose - Indian standards (IS), TLV, IDLH, LD₅₀, LC₅₀, STEL, PEL, REL- 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 - Industrial Hygiene Audit - training and education.</p> <p>Biological and Ergonomical Hazards Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control Programmes, employee health Programmes-laboratory safety programmes-animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders –carpal tunnel syndrome (CTS) - Repetitive Strain Injury (RSI) - Tendon pain-disorders of the neck- back injuries – Posture Assessment - Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA). Illumination and Ventilation –hazards – control and measurements.</p> <p>Occupational Health and Toxicology Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and Periodical medical examinations – occupational related diseases, levels of prevention of diseases, notifiable occupational diseases as per Schedule III of Factories Act 1948 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 – Routes of entry - Probit Analysis – Chemical Exposure Assessment – Legal requirements -Medical Surveillance and records – Occupational Health Centre – Factory Medical Officer - cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests - Fitness test . Industrial toxicology, local, systemic, acute and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.</p> <p>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.</p>								
Reference(s) :								
1.	Danuta Koradecka, "Hand book of Occupational Safety and Health", CRC Press, 2010.							
2.	"Hand book of Occupational Safety and Health", National Safety Council, Chicago, 1982.							
3.	"Encyclopedia of Occupational Health and Safety", Vol.I and II, International Labour Office, Geneva, 2011							

4.	Barbara A.Plog, Patricia J.Quinlan, MPH, CIH and Jennifer Villareal "Fundamentals of Industrial Hygiene", 6th edition 2012, National Safety Council, 2012
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40 PIS 105 Safety in Chemical Industries								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	50	50	100
Objectives	The subject features systematic and safe operating procedures and unfolds how to detect and eliminate the process of dangerous mishaps and virtually hazard proof process industries. In an equivocally clear and practical terms enhancing safety in all means till the end product.							
Course outcomes	<ol style="list-style-type: none"> 1. Recognize Chemical plant design, process, facilities, statues and inherent safe design 2. Relate Reactor, types, design ,operating conditions ,pipe works, valves and safety measures 3. Conduct pre and post plant commissioning with HMIS labeling ,documentation 4. Inspect Pressure vessel, pipeline using non destructive testing 5. Devise operating procedures and emergency procedures start up and shut down operation 6. Operate Safety instrumented system using PLC and DCS 7. Approve Work permit for maintenance with recommended safety measures. 8. Devise emergency preparedness and plan to mitigate emergency situations. 9. Relate chemical storage and transportation 10. Diagnose hazards in storage and transportation of chemicals and recommends adequate safety measures 							
<p>Safety in Process Design and Pressure System Design Chemical Plant Location and Layout – Inter Distance between facilities - 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.Pressure system, pressure vessel design, standards and codes,ASME section 8 division I,II,III- pipe works and valves- IS 2379:1990 Colour coding of pipelines- 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 - Static Electricity, Earthing and bonding.</p> <p>Plant Commissioning and Inspection Commissioning phases and organization, process safety information ,P&I,preliminary hazard analysis-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 - Hazardous Materials Identification Systems (HMIS) Labelling.</p> <p>Plant Operations Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system-start up and shut down operation- Distributed Control Systems (DCS)and Programmable Logic control (PLC)Systems-refinery units- operation of fired heaters, driers, storage- operating activities and hazards- Safety Instrumented System (SIS) – Safety Critical Equipments, trip systems- Safety Integrity Level (SIL), SOP - exposure of personnel – Safety in batch processes – Reactive Hazards.</p> <p>Plant Maintenance, Modification and Emergency Planning Management of maintenance, hazards- Corrosion Effects- 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 preparedness, onsite emergency- offsite emergency, disaster planning -APELL.</p> <p>Storage of hazardous chemicals General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, excess flow valve,RoV valve,emergency shutdown valve,atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection- LPG storages, pressure storages - Mounded Bullet - layout, instrumentation, vapourizer, refrigerated storages- LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- Plant and Cross Country Pipelines – Trucks - loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG.</p>								
Reference(s) :								
1.	Sam Mannan., "Lees"Loss Prevention in Process Industries", Vol1,Vol2,Vol3,Butterworth-Heinemann,, London, 4 th Edition 2012.							
2.	"Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.							
3.	H.H. Fawcett and W.S. Wood, "Safety and Accident prevention in Chemical Operations", 2nd Edition, John Wiley &Sons, New York, 1982.							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS 1P1 Industrial Safety Laboratory								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	0	0	3	45	2	50	50	100
Objectives	<p>To expertise the students in selection and usage of PPE, to monitor Lux & Noise level. To know how to measure and analyze ambient air and the exhaust gas from the stack / chimney, monitor temperature extremities. To detect leakage of gas using gas monitor. To emphasis their knowledge in electrical installation in a safety means. To study the classes of fire and how to extinguish it using a suitable fire extinguisher. To estimate the effluent characteristic using volumetric analysis To determine the tearing strength of packing materials To assess the ergonomic condition using posture evaluation tool. To study about emergency kits,First aid,road safety signals.</p>							
Course outcomes	<ol style="list-style-type: none"> 1. Study and train in use of the respiratory and non-respiratory personal protective equipment and its usage. 2. Measure Light intensity level measurement. 3. Measure the noise level of various sources. 4. Measure the percentage exhaust gas in IC engine emission. 5. Measurement of temperature extremities 6. Measurement of obnoxious gases present in confined spaces 7. Calculate the insulation, earth resistance and test the earth continuity 8. Know the classes of fire and to study the principle and operation of respective fire extinguishers for all classes 9. Determine the characteristics of the given effluent using DO,COD,BODand pH test 10. Determine the tearing strength of paper,cardboard,corrugated board using bursting strength tester 11. Assess the ergonomic hazards using posture evaluation tool 12. Learn safety software to assess industrial hazards. 							
<p>Training in usage of Personal Protective Equipment (PPE) Respiratory and non-respiratory-demonstration-self contained breathing apparatus. Safety helmet, Safety Harness, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, anti static and conducting plastics/rubber materials, apron and leg guard.</p> <p>Illumination Testing lux meter</p> <p>Noise Level Measurement And Analysis Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values</p> <p>Exhaust Gas Measurement And Analysis Measurement of SO_x, NO_x, CO_x, hydrocarbons , Particulate matter</p> <p>Measurement of DBT and WBGT</p> <p>Leak Detection Multi gas detectors</p> <p>Electrical Safety Insulation resistance for motors and cables, Estimation of earth resistance, Earth continuity test, Sensitivity test for ELCB</p> <p>Fire Extinguishers And Its Operations Water CO₂, Foam , Carbon dioxide (CO₂), Dry chemical power and ABC type.</p> <p>Effluent Characteristics Estimation of DO,BOD,COD,TDS,TSS and pH</p> <p>Bursting Strength Tester Paper & Cardboard</p> <p>Posture Evaluation Tools Rapid Upper Limb Assessment(RULA), Rapid Entire Body Assessment(REBA),NIOSH Lifting equation Study of Emergency Kits,First – aid, road safety signs and signals -Safety Software Demo</p>								
References:								
1	Industrial Safety Laboratory Manual							

K.S.Rangasamy College of Technology – Autonomous					R 2014			
40 PIS 201 Fire Engineering and Explosion Control								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	50	50	100
Objectives	To give a clear illustration in regard with principles of fire management systems and accident analysis as a means of improving performance in order to provide a fire free environment.							
Course outcomes	<ol style="list-style-type: none"> 1. Recognize the principle of combustion and explosion theory, fire properties of solid, liquid and gases. 2. Infer from process fires and relevant case studies 3. Interpret from fire triangle, tetrahedron, principles of fire extinguishing and classes of fires. 4. Conduct fire mock drill, plan fire escape routes and give first aid for burns. 5. Choose fire protection systems for industrial needs. 6. Devise installation and maintenance fire protection systems as per statues. 7. Express the objective of building fire safety and relevant standards 8. Calculate fire load and recognize fire resistant and fire testing systems 9. Summarize basic principles of fire explosion and protection systems 10. Identify qualifying standards and approving agencies 							
<p>Physics and Chemistry of Fire Fire properties of solid, liquid and gases – Flammability limits-Minimum Ignition energy (MIE)- 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 and spontaneous ignition – Boiling Liquid Expanding Vapour Explosion (BLEVE)– case studies – Flixborough, Mexico disaster, BP Texas, Piper Alpha, Peterborough & Bombay Victoria dock ship explosions - Buncefield fire – Jaipur oil fire 2009- Bombay high-vizag</p> <p>Fire Prevention and Protection Sources of ignition – fire triangle – fire tetrahedron - principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D – types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – designing of fire station – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills – notice-first aid for burns.</p> <p>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 – CO₂ system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – server room and tank farms safety – indices of inflammability-fire fighting systems – Relevant standards - Oil Industry Safety Directorate(OISD),American Petroleum Institute & other standards.</p> <p>National Building Code Introduction to National Building Codes (NBC)-Objectives of fire safe building design, fire load and calculation , fire resistant material and fire testing – fire water requirements-structural fire protection – structural integrity – concept of egress design – exits width calculations - fire certificates – fire safety requirements for high rise buildings – snookers- National Fire Protection Administration (NFPA) -Life code</p> <p>Explosion Protecting Systems Principles of explosion-Explosion Pentagon- 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-Explosion protection for flammable, toxic and compressed gases and liquid storages- Qualifying Standards and approving agencies.</p>								
Reference(s) :								
1.	V.K.Jain,"Fire Safety in buildings", New age International (P) Ltd. Publishers, New Delhi, 2 nd Edition 2010.							
2.	Derek, James, "Fire Prevention Hand Book '.Butterworth-Heinemann, London, 1986							
3.	Gupta, R.S., "Hand Book of Fire Technology", Orient Longman, 2 nd edition ,Bombay 2010.							
4.	"Accident Prevention manual for industrial operations", N.S.C., Chicago, 1982							
5.	Dinko Tuhtar, "Fire and explosion Protection" – A system approach, Ellis Horwood Ltd, 1999.							
6.	"Fire fighters hazardous materials reference book Fire Prevention in Factories", Van Nostrand Rein Hold, New York, 1991.							
7.	National Building code,OISD Standards and other Fire standards							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS 202 Human Factors Engineering								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	50	50	100
Objectives	The syllabus portrays human factors as a environmental, organizational job factors, human and individual characteristics which influence behavior at work and illustrates how careful consideration of human factors can improve health and safety by reducing the number of accidents and cases of ill – health at work.							
Course outcomes	<ol style="list-style-type: none"> 1. State the significance of ergonomics and its area of application. 2. Explain human anatomy, anatomy of spine and pelvis, posture and biomechanics. 3. Identify human behaviour using BBS and motivate through management theories. 4. Assess difficulties in Fitting the Man to the job concept. 5. Design work station for standing worker considering anthropometric factors and work station parameters. 6. Design work station for sitting worker considering anthropometric factors and work station parameters. 7. Identify risk factors in Man machine system and manual handling task. 8. Assess ergonomic risk factors of workers using posture evaluation tool. 9. Employ Principles for design of visual and auditory displays in real time situation. 10. Analyze the performance and skill level of human in virtual environment 							
<p>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, and future directions for ergonomics. Anatomy, Posture and Bio Mechanics: Some basic bio mechanics and anatomy of the spine and pelvis, Bio Mechanical aspect of body movement .Posture: Good posture and bad posture, Posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioral aspects of posture, effectiveness and cost effectiveness, research directions.</p> <p>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- Behavior Based Safety (BBS) – ABC theory – Implementation.</p> <p>Anthropometry for Work Design 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.</p> <p>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, lifting, pushing, pulling, carrying and postural stability. Postural Evaluation Tools :Rapid Upper Limb Assessment(RULA), Rapid Entire Body Assessment(REBA), The Strain Index ,NIOSH Lifting equation,Measurement of work effort and fatigue: Borg rating of perceived exertion scale, Muscle Fatigue Assessment method, Hand Activity Level (HAL).</p> <p>Display, Controls and Virtual Environments A general information-processing model of the users, cognitive system, problem solving, effectiveness. Principles for the design of visual and auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues on human skill and performance.</p>								
Reference(s) :								
1.	Mark S Sanders, Ernest J McCormick, "Human Factors In Engineering & Design", Mcgraw-hill Book Company, 7 th Edition 1993.							
2.	R.S. Bridger ,"Introduction to Ergonomics", Taylor & Francis, 2 nd Edition, 2007.							
3.	Dan Mc Leod, "The Ergonomics Manual", Philip Jacobs & Nancy Larson, 2000.							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS 203 Electrical Safety								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	50	50	100
Objectives	To let know the facts of electrical installations, maintenance, faulty electrical appliances and the safer means of accessing it with compliance to Indian Electricity Act and Rules.							
Course outcomes	<ol style="list-style-type: none"> 1. Understands the basic electrical concepts and working principles of electrical equipment. 2. Indicate Statues, standards pertaining to electrical safety and first aid measures. 3. Classify and identify Electrical hazards and recommends remedial measures. 4. Diagnose Classes of insulation and hazardous conditions. 5. Advise on Protection against over voltage and under voltage. 6. Inspect FRLS insulation ,grounding, circuit breaker and PPE. 7. Choose adequate electrical protection systems for respective industrial operation. 8. Plan and schedule lock out tag out and work permit. 9. Identify hazardous zones and certifying agencies. 10. Setup Safe and explosion proof electrical apparatus. 							
<p>Concepts and Statutory Requirements Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act 2003 and rules-statutory requirements from electrical inspectorate-international and Indian standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR)- case studies.</p> <p>Electrical Hazards Primary and secondary hazards-shocks, burns, scalds, falls- burns classification, burn chart-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control-electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.</p> <p>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. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-rubber mats and relevant standards-Earth Leakage Circuit Breaker (ELCB)- Residual Current Circuit Breaker(RCCB)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.</p> <p>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 tag out (LOTO)-work permit system- contact prevention techniques-Human protection – rubber mat-discharge rod and earthing devices- cabling and cable joints-preventive maintenance.</p> <p>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.</p>								
Reference(s) :								
1.	Fordham Cooper .W, "Electrical Safety Engineering", Butterworth and Company, London, 3 rd Edition, 2002.							
2.	John Cadick, "Electrical safety Handbook", Third Edition, Mc Graw Hill,2006							
3.	"Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.							
4.	Dr.Massim A.G.Mitolo, "Electrical safety of Low voltage systems", Mc Graw Hill, 2009							
5.	Indian Electricity Act and Rules, Government of India, 2003.							
6.	"Power Engineers – Handbook of TNEB", Chennai, 1989.							

K.S.Rangasamy College of Technology – Autonomous					R 2014			
40 PIS 204 Computer Aided Hazard Analysis								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	1	0	60	4	50	50	100
Objectives	To provide ample amount of qualitative and quantitative methods for risk analysis so as to renovate the working methodologies and to make available an atmosphere with safe.							
Course outcomes	<ol style="list-style-type: none"> 1. Comprehend hazard, hazard monitoring and hazard reduction approaches. 2. Selection and suitability of hazard evaluation techniques for industrial issues. 3. Understand and apply hazard analysis techniques for non scenario based. 4. Understand and apply hazard analysis techniques for scenario based. 5. Estimate risk using risk matrix and assess safety integrity level. 6. Utilize software aids for hazard evaluation. 7. Analyze the causes of runaway reaction using micro calorimetric techniques. 8. Evaluate the sensitivity of pyrotechnic mixtures using mechanical sensitiveness test and explosive testing. 9. Perform consequence analysis for hazardous chemicals. 10. Estimate heat radiation effect and damage distance using gas/Vapour dispersion. 							
<p>Introduction Introduction, hazard, hazard monitoring, different stages of process life time – Hazard reduction approaches and inherent safety review Selection of hazard evaluation techniques - Factors influencing the selection of hazard evaluation techniques- decision making process- hazard review for management changes -combined hazard review- hazard evaluation - Risk issues</p> <p>Hazard Evaluation Techniques Non Scenario Based:- Checklist analysis, safety review, relative ranking, preliminary hazard analysis (PHA), fire explosion and toxicity index (FETI) Scenario Based:- Fault Tree Analysis & Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - various indices – what-if analysis/checklist analysis - hazard operability studies (HAZOP) -Hazard analysis (HAZAN) - Failure Mode and Effect Analysis (FMEA)</p> <p>Risk-Based Determination of The Adequacy of Safeguard Scenarios from scenario-based Hazard Evaluations- Severity of consequence- Frequency of Initiating Causes- Effectiveness of Safeguards- Risk Estimation using Risk Matrix or Direct Calculation, Layer of Protection Analysis (LOPA), Safety Integrity Level (SIL). Hazard evaluation software aids – Risk Phast V 6.6 (DNV), HazardReview LEADER, HAZOP manager, HAZOP+ (Reliability workbench), PHA manager, LOPA manager, PHAPro, FEME-Pro, ALOHA</p> <p>Instrumentation Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, Applications, advantages. Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.</p> <p>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.</p>								
Reference(s) :								
1.	Sam Mannan., "Lees'Loss Prevention in Process Industries", Vol1,Vol2,Vol3,Butterworth-Heinemann,, London, 4 th Edition 2012							
2.	"Methodologies for Risk and Safety Assessment in Chemical Process Industries", Commonwealth Science Council, UK.							
3.	Course Material – "Intensive Training Programme on Consequence Analysis", Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka & CLRI, Chennai.							
4.	"Guidelines for Hazard Evaluation Procedures", Centre for Chemical Process safety, AIChE 3rd edition, 2008.							
5.	"Guidelines for Chemical Process Quantitative Risk Analysis", second edition, Centre for Chemical Process safety, AIChE, 2000							
6.	Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS 205 Industrial Safety, Health and Environment(SHE) Acts								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	1	0	60	4	50	50	100
Objectives	To provide indispensable guidance regarding statutory requirements and compliance with SHE Acts.							
Course outcomes	<ol style="list-style-type: none"> 1. Understands the constitutional background of factories act, Tamilnadu factories rules and tamilnadu safety officer's rule and its amendments. 2. Summarize all Sections, schedules, rules, forms ,registers and able to implement in industries 3. Understands Constitutional background of Environment act and allied rules. 4. Select Provisions relevant to Environment, water and air act and allied rules and PCB norms. 5. Summarize MSIHC rules, safety reports, safety datasheets and duties of occupier. 6. Prepare and conduct Offsite and Onsite emergency preparedness. 7. Make use of legal provisions pertaining to transport and handling of hazardous materials. 8. Make use of legal provisions pertaining to boilers, explosive, motor, mines electricity and other acts. 9. Recognize on ILO conventions, statutory boards and OSHA Regulations. 10. Choose Indian and International Certification standards based on industrial requirement. 							
<p>Factories Act – 1948 Constitutional Background, Chapters-sections-schedules –powers of 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- Forms, Registers and notices – Tamilnadu Safety officer Rules 2005 - with updated Amendments.</p> <p>Environment Act (protection) 1986 with allied rules Constitutional Background, General powers of the central government, prevention, control and abatement of environmental pollution- Biomedical waste Management Rules, 2016-The Noise Pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001 – E-waste regulations- Classification of industries, consent order from pollution control board. Air Act 1981 and Water Act 1974: powers and functions of Pollution control boards -Central and state boards for the prevention and control of air pollution— prevention and control of air pollution and water pollution –penalties and procedures.</p> <p>Manufacture, Storage and Import of Hazardous Chemical Rules 1989 and Major Accident Hazard Control Rules and Amendment 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, Major Accident Hazard Control Rules. Hazardous Wastes (management, handling and Transboundary Movement) Rules 2016</p> <p>Other Acts and Rules Indian Boiler Act 2007, Static and Mobile Pressure Vessel Rules (SMPV), Motor Vehicle Rules, Mines Act 1952, Workman Compensation Act, Rules – Electricity Act and rules 2003 – Petroleum Rules 2002, Gas cylinder rules 2010-Explosives Act and rules 2008-Pesticides Act, Dock workers (Safety Health and welfare) Act 1986 and regulations 1990, Disaster Management Act 2005.- Ammonium nitrate rules.</p> <p>International Acts and Standards International Labour Organisation (ILO) Conventions and Recommendations, OSHA Regulations – Health and Safety At Work Act (HASAWA 1974, UK) – Elements and benefits of OSHAS 18001 – ISO 14001 –, European Safety and Health Legislations, American Petroleum Institute (API) Standards, Oil Industry Safety Directorate (OISD) Standards, National Fire Protection Association (NFPA) Standards, Atomic Energy Regulatory Board (AERB), American National Standards Institute (ANSI).</p>								
Reference(s) :								
1.	The Constitution of India 1950.							
2.	The Factories Act 1948, Madras Book Agency, Chennai, 2000.							
3.	The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.							
4.	The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.							
5.	The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.							
6.	Objects and Reasons of all the relevant Act and Rules.							
Web References								
1	www.dgfasli.nic.in							

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS 2P1 Industrial Visit Report Preparation and Presentation								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	0	0	5	45	2	100	00	100
Objectives	To emphasize hazardous unit processes and safety measures practiced and health issues of the process industries to the safety students by means of this curriculum and to know-how the statutory requirements are put into practice in the process and engineering industries so as to make the pupil competent enough in pinpointing the risk and to develop their auditing and documenting skills							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the industrial process, safety management systems, policies, education and training about the concern industry. 2. Investigate accident and find the root cause analysis. 3. Interpret personal protective equipment, communication, employee behavior, emergency preparedness and planning, problems faced on implementing safety in industry by safety engineers etc 4. Document and present the report of the industrial visit undergone. 							
Methodology	<p>Industrial Visit is compulsory for every student. Atleast one faculty must accompany the students during industrial visit. Before the day of industrial visit the student should furnish the undertaking form and he/she must have a sound knowledge of the process whatever is going on in the visiting industry. The student has to submit the walk through survey / plant safety inspection report pertaining to the industrial Visit within 3 working days to the faculty Incharge. The student has to collect accident data, investigate on it and perform a root cause analysis The student must undergo first aid and fire fighting training in this phase. The student must undergo Internal Auditor training course. The student must undergo ergonomics training course and be aware of material handling and posture evaluation tools. The faculty incharge will evaluate the report and award marks in the basis of the content. The content should have a manufacturing process, process flow diagram, safety management systems, identified gaps, accident investigation, root cause analysis, trainings undergone, suggestions and recommendations. The evaluated report has to be submitted to the professor and HOD. A final presentation will be there to sum up the entire activity undergone.</p>							
Execution	Week				Activity			
	I				Planner			
	II				Industrial Visit –I and report submission			
	III				Industrial Visit –II and report submission			
	IV				Industrial Visit –III and report submission			
	V				Mid semester Presentation			
	VI				Industrial Visit –IV and report submission			
	VII				Industrial Visit –V and report submission			
	VIII				Final Presentation			
	IX				Final Report submission			
Evaluation	100% by Continuous Assessment and 2 credits							
	Component				Weightage			
	Attendance				10%			
	Training Undergone (attach evidence in report)				10%			
	Report (for each Industrial visit 10 Marks)				50%			
	Presentation (Mid semester and Final)				30 %			
Total				100%				

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS 2P2 Technical Report Preparation and Presentation								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	0	0	2	30	2	100	00	100
Objectives	<p>To provide exposure to the students to refer, read and review the research articles in referred journals and conference proceedings.</p> <p>To Improve the technical report writing and presentation skills of the students.</p>							
Course outcomes	<ol style="list-style-type: none"> 1. Select problems prevailing in industries/ societal and confirm the title. 2. Collect 20 such relevant literatures from the journals and conference proceedings. 3. Review the papers and make presentation before the committee. 4. Prepare and submit the final report with adequate recommendation. 							
Methodology	<p>Each student is allotted to a faculty of the department by the HOD By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student. For problem statement the student must visit the industry atleast twice to analyze the prevailing status of industrial problems. The students have to refer the Journals and Conference proceedings and collect the published literature. The student is expected to collect at least 20 such Research Papers published in the last 5 years. Using OHP/Power Point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion. The student has make three presentations, one at the beginning then mid presentation and the last near the end of the semester. The student has to write a Technical Report for about 30-50 pages (Title page, One page Abstract, Review of Research paper under various subheadings, Concluding Remarks and List of References). The technical report has to be submitted to the HOD one week before the final presentation, after the approval of the faculty guide.</p>							
Execution	Week				Activity			
	I				Allotment of Faculty Guide by the HoD			
	II				Finalizing the topic with the approval of Faculty Guide			
	III-IV				Collection of Technical papers			
	IV				First Presentation			
	V-VI				Mid semester presentation			
	VII-VIII				Report writing			
	IX –X				Report submission			
	X				Final presentation			
Evaluation	<ul style="list-style-type: none"> ❖ 100% by Continuous Assessment ❖ 2 Hrs/week 							
	Component				Weightage			
	Phase -I Presentation				25 %			
	Phase - II Presentation				25 %			
	Report Preparation and Submission				30 %			
	Final Presentation				20 %			
Total				100 %				

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS 3P1 Project Work - Phase I								
M.E.(ISE)								
Semester	Hours / Week			Total hrs / Week	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	0	0	12	12	5	75	25	100
Objectives	To impart the practical knowledge to the students and also to make them to carry out the technical procedures in their project work. To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work and placing this as their beginning stage for their final presentation.							
Course outcomes	<ol style="list-style-type: none"> 1. Select problems prevailing in industries/ societal by EHS audit and confirm the title. 2. Understands the Literature review process and technical writing. 3. Able to explain and prepare a project report for the stated problem. 4. Able to present and justify the work done for the identified problem. 							
Methodology	<p>Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide</p> <p>Problem should be selected through EHS audit in the concerned industries.</p> <p>Students have to collect journal papers related to their work minimum of 25 journals.</p> <p>Report has to be prepared by the students as per the then format by the institution</p> <p>Preliminary implementation can be done if possible</p> <p>Internal evaluation and external evaluation is allotted 75 marks and 25 marks respectively.</p>							

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS 4P1 Project Work - Phase II								
M.E.(ISE)								
Semester	Hours / Week			Total hrs / Week	Credit	Maximum Marks		
	L	T	P			C	CA	ES
IV	0	0	40	40	15	50	50	100
Objectives	This enables and strengthens the students to carry out the project on their own and to implement their innovative ideas to forefront the risk issues and to retrieve the hazards by adopting suitable assessment methodologies and stating it to global.							
Course outcomes	<ol style="list-style-type: none"> 1. Select problems prevailing in industries/ societal by EHS audit and confirm the title. 2. Understands the Literature review process and technical writing. 3. Able to explain and prepare a project report for the stated problem. 4. Able to present and justify the consolidated work done for the identified problem in the forum. 5. Acquire competence in suggesting methodology to minimize and eliminate the problem or redesign workstation / equipment to overcome hazardous situations. 							
Methodology	<p>Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide</p> <p>Each review has to be evaluated for 100 marks.</p> <p>Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or two chance may be given.</p> <p>The project carried out must address industrial safety issues/societal issues which mainly pose threat to life, property and environment</p> <p>They should publish the paper preferably in the journals/conferences.</p> <p>Final review will be done by the committee that consists of minimum of three members one of which should be the guide (if possible include one external expert examiner).</p> <p>Report has to be prepared by the students as per the then format by the institution</p> <p>The report should be submitted by the students at the end of the fourth semester</p>							

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40 PIS E11 Safety in Engineering Industry								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – I	3	0	0	45	3	50	50	100
Objectives	The subject imparts various machines, its operation and guarding system relevant standards and codes. The course also develops the knowledge related to health and welfare measures in engineering industry.							
Course outcomes	<ol style="list-style-type: none"> Understand the General safety rules, principles, maintenance, Inspections of metal and wood working machinery Recognize Material handling, standards, codes and types of hazards. Identify ZMS, machine guarding and its types. Choose suitability for metal working machinery, fly wheel and gear for industrial operation. Point out common hazards, safety precautions and PPE in industrial welding operations. Summarize storage, generation, distribution and handling of industrial gases safety. Formulate safety measures in cold working, inspection and maintenance of metal sheers, press brakes. Formulate safety measures in hot rolling mills by analyzing hazards and control measures.. Interpret safety in Heat treatment operations, electro plating, hydro testing and shot blasting. Draft Health and welfare measures in engineering industry and waste disposal. 							
<p>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.</p> <p>Machine Guarding and ZMS. Basic Principle of Machine guarding- Machinery Hazards- 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.Design of machine guarding –IS standards – Special machines 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. Maintenance-Types- Zero Mechanical State (ZMS), Definition, Policy for ZMS</p> <p>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 – Non Return Valve (NRV) - flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.</p> <p>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, Ferrous and Non Ferrous Furnace, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.</p> <p>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, Health and welfare measures in engineering industry-, PPE - pollution control in engineering industry-industrial waste disposal.</p>								
Reference(s) :								
1.	Philip Hagan, "Accident Prevention Manual for Business and Industry", N.S.C.Chicago, 13th edition, 2009							
2.	"Occupational Safety Manual" BHEL, Trichy, 1988.							
3.	"Accident Prevention Manual" – NSC, Chicago, 1982.							
4.	N.V. Krishnan, "Safety in Industry", Jaico Publishery House, 1996.							
5.	Safety in the use of wood working machines, HSE, UK 2005.							
6.	"Health and Safety in Welding and Allied Processes", welding Institute, UK, High Tech. Publishing Ltd., London, 1989.							

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40 PIS E12 Quality Engineering								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – I	3	0	0	45	3	50	50	100
Objectives	The objectives is to provide machine and equipment reliability laws and maintenance .To study about control deviation of the process through quality control tools and also to learn how to provide best quality of the product through quality management.							
Course outcomes	<ol style="list-style-type: none"> 1. Recognize Quality objectives, quality control and importance of quality assurance. 2. Understand and make use of Control charts. 3. Compute and calculate sampling. 4. Compute Sampling using variables and attributes. 5. Solve Factorial Experiments using single and multiple factor. 6. Make use of taguchi methods and orthogonal arrays. 7. Relate ISO 9000 and TQM concepts for industrial practice. 8. Apply 5S concepts, six sigma, zero defect manufacturing in real time situations. 9. Describe Reliability concepts and prediction. 10. Solve Series and parallel systems reliability problems 							
<p>Statistical Process Control Quality objectives – Quality control – Quality Assurance – Process variability – Control charts for variables and attributes, multivarichart - demerit control chart – process capability studies.</p> <p>Acceptance Sampling Economics of sampling – Acceptance sampling by variables and attributes – Single, double and sequential plans – OC curves – ATI, ASN, AOQL – Standard sampling tables.</p> <p>Design of Experiments Factorial experiments – single factor, multi factor, 2^K design– Taguchi methods – use of orthogonal arrays.</p> <p>Quality Management ISO 9000 and TQM concepts - Quality circles, tools – 5s, Zero defect management, six sigma – Quality Function Deployment (QFD) – Lean Manufacturing.</p> <p>Reliability Reliability concepts - Reliability prediction – Series and Parallel systems – Reliability Engineering, Design for Reliability, Reliability testing.</p>								
Reference(s) :								
1.	Logothetis .N, “Managing for total quality from Deming to Taguchi and SPC”, PHI, 1997.							
2.	Taguchi G, Elsayed E A and Hsiang, T.C.,”Quality Engineering In Production Systems”, Mc-Graw-Hill Book Company, Singapore, International edition, 1989.							
3.	Douglas .C Montgomery, “Introduction to Statistical quality control”, Second Edition, John Wiley & Sons, 1991.							
4.	nath L S, “Reliability Engineering”, Affiliated East-West Press Pvt. Ltd, New Delhi, 4 th Edition 2006.							
5.	Grant E. L., and Leavenworth, R. S. (1980), Statistical Quality Control. (5th ed.), New York: McGraw Hill.							

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40 PIS E13 Fireworks Safety								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – I	3	0	0	45	3	50	50	100
Objectives	To expound the process of fire works industry, hazards associated with it. To deal with the procedures for manual handling and transportation. To highlight the legal requirements to run a fire works industry in a safer manner.							
Course outcomes	<ol style="list-style-type: none"> 1. Relate Fire properties with fireworks chemicals. 2. Identify Fire and explosion hazards and suggest recommendation. 3. Make use of static charge meter to find static charge and dust hazards in fireworks industry 4. Recognize the significance of Lightning arrestor, earth pit maintenance and legal requirements. 5. Compose Process safety measures in Packaging and storing. 6. Formulate recommendations on Building layout, distance and fire prevention & control. 7. Prepare Guidelines on Material handling issues. 8. Schedule and streamline Transportation of fireworks 9. Instruct and educate handling of waste in fireworks and significance of fire service handling emergency situations.. 10. Assess Hazards in display works, and give first aid for fire burns. 							
<p>Properties of Fireworks Chemicals Fire properties – potassium nitrate (KNO₃), potassium chlorate (KClO₃), 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.</p> <p>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.</p> <p>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 – emergency planning in fireworks – Automation of manual process.</p> <p>Material Handling Manual handling – wheel barrows-trucks-bullock carts-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material movement-godown-waste pit.</p> <p>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.</p> <p>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.</p>								
Reference(s) :								
1.	K.N.Ghosh, "The Principles of Firecrackers", Economic Enterprises, Sivakasi, 1981							
2.	Shanmugam G et al , "Proceedings of National seminar on Fireworks Safety-1999", MSEC,Sivakasi,1999.							
3.	Conkling.J., "Chemistry of Pyrotechnics: Basic Principles and Theory" Marcel Dekker Inc.: New York; 1985.							
4.	Pyrotech 2013, Proceedings of the 2nd National Fireworks Conference, TamilNadu Fireworks and Amorcres Manufacturers' Association (TANFAMA), 2013.							
5.	Conkling J., "Chemistry of Pyrotechnics: Basic Principles and Theory", Marcel Dekker Inc., New York; 1985.							
6.	Shimizu. T., "Firecrackers: The Art, Science and Technique", Maruzen Co, Tokyo; 1981. 6. Brock H., "Pyrotechnics - The History and Art of Fireworks Making", D.O'Connor, London, 1949.							

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40 PIS E14 Mechanical Integrity Assessment								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – I	3	0	0	45	3	50	50	100
Objectives	To provide guidelines for mechanical integrity assessment by providing the state of the art concept and practices of mechanical integrity as well as inspection, testing, examination and assessment for mechanical integrity.							
Course outcomes	<ol style="list-style-type: none"> 1. Recognize the concepts and practices of mechanical integrity 2. Relate the classification of equipments, inspecting, testing and assessment. 3. Make use of legal requirements for mechanical integrity testing. 4. Perform non destructive testing. 5. Understands the risk based mechanical integrity programme. 6. Formulate SIS, SOP,LOTO and other safety systems for industries. 7. Assess Pitting, corrosion, cracking, and intergranular corrosion. 8. Recommend corrosion prevention methods by assessing corrosion. 9. Infer from stability test and critical utility systems. 10. Execute mechanical integrity audit and documentation. 							
<p>Concepts and Practices of Mechanical Integrity Definition – chemical manufacturers association approach – ongoing fitness for service – components of mechanical integrity – engineering design, documented standard operating procedures, Training, Inspection – Preventive / predictive maintenance – Equipment, covered by MI – pressure vessels, storage Tanks, piping system-valves & fittings-pressure Relief systems-controls such as sensors, Alarms and Interlocks-Emergency shutdown system-classification of equipments-critical consequence equipments(Class I) –serious consequence equipments (Class II) – Normal consequence equipments (Class III) – Requirements for inspection, testing, examination and assessment.</p> <p>Inspection, Testing, Examination and Assessment Form Competency required for inspection-knowledge of inspection techniques-deterioration mechanisms, process & operations, design & Technology, Metallurgy and maintenance-periodical testing-legal requirements-relevant provisions of the factories Act 1948, Boilers Act 2007, the Electricity Act 2003, static and mobile pressure vessels Rules 1981-control of major accident hazards rules 1999-pressure system safety regulations 2000-dangerous substances and explosive atmosphere regulations 2002-visual examination-external examination and internal examination-non-invasive techniques such as non-destructive examination-destructive testing such as pneumatic test and hydraulic test-written scheme of examination-examination report and conclusions-integrity assessment-condition monitoring-temperature, noise, vibration, deterioration mechanism-thermography application-quality assurance.</p> <p>Maintenance and Repair of Equipments Objectives and Responsibilities for maintenance organization-types of maintenance-Repair complexities of machinery-preventive/predictive maintenance-Risk-based mechanical integrity programme-programme scope, Risk Ranking, acceptance criteria-individual inspection and test programme specifying inspection technique and frequency-safe system of work-safety integrity level-safety instrumented system-standard/safe operating procedures(SOP)-Lockout/Tagout system(LOTO)-safe isolation procedures-blinding and blanking-double block and bleed valve(DBB)-work permit system-hot work, confined space work, excavation work, working at heights-chimney cleaning work-silo cleaning work.</p> <p>Corrosion Prevention and Control Corrosion mechanism-different forms of corrosion-general/uniform corrosion, inter granular corrosion, pitting corrosion, crevice corrosion, stress corrosion cracking, Erosion corrosion, Hydrogen embrittlement, Galvanic corrosion-Electrochemical potential for different metals and noble metals-potential corrosion damages-materials of construction-metal alloying for corrosion prevention-inspection programme for each piece of equipment-special equipment or “bad actors” requiring individualized attention-inspection strategy and interval-corrosion control-organic coatings, Electrochemical methods-Anodic protection and cathodic protection-corrosion inhibitors-corrosion monitoring-vefrasonic thickness measurement-Radiography testing-pipeline inspection-Assessment of corrosion under insulation-corrosion rate estimation-Remaining café Assessment.</p> <p>On-Going Fitness for Service of Buildings, Machines and Electrical Systems Stability of structural and civil system-foundations-anchor bolts-supports-pipe hangers, pipe bridges-assessment-repair work-key utility service systems-electric power, electronic gadgets, electrical junctions, joints cable tray, electrical distribution system and connections-thermography examination-electrical/electronic equipments, requiring the hazardous Area classification-critical utility systems such as fire water, cooling water, absorption tank, exploding suppression, quenching-failure analysis of alarms, sensors and interlocks-voltage drop calculation-integrity of fire fighting equipments-their maintenance and up keeping-mechanical integrity audits-documentation.</p>								
Reference(s) :								
1.	Guidelines for mechanical integrity of systems: centre for chemical process safety/AICHE: Wiley, 2006.							
2.	American petroleum institute: Recommended practice for fitness-for-service: API RP 579, Washington-D.C., 2000.							
3.	Pressure safety system regulation, 2000 (PSSR)							
4.	Dangerous substances and explosive atmosphere regulations, 2009 (DSEAR)							

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40 PIS E21 Reliability Engineering								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective II	3	0	0	45	3	50	50	100
Objectives	To ascertain functionality / availability of safety barriers system ensuring safety for the human beings. To study the probability of failure on demand in regard with factory setting.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the significance of reliability engineering and its terms. 2. Understand the priori and post priori concepts and mortality curve and ability to calculate the system effectiveness. 3. Calculate the time to failure, based on various distributions. 4. Draw hazard plotting using plotting techniques. 5. Solve problems and work on m/n configuration systems, series parallel systems 6. Relate concepts and work on cut and tie set methods and markov analysis 7. Apply the concepts of reliability testing in real time scenario. 8. Make use of the concepts of reliability and cycle costs 9. Explain risk analysis techniques and relationship between industrial safety and risk assessment 10. Carry out risk reduction technique for industrial problem. 							
<p>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.</p> <p>Failure Data Analysis Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting.</p> <p>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.</p> <p>Reliability Management Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model.</p> <p>Risk Assessment Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.</p>								
Reference(s) :								
1.	Srinath .L.S, "Reliability Engineering", Affiliated East-West Press Pvt. Ltd, New Delhi, 4 th Edition 2006.							
2.	Charles E Ebeling, "An Introduction to Reliability and Maintainability Engineering", Tata Mcgraw Hill, 2009.							
3.	Mohammed Modarres et al, "Reliability and Risk analysis", CRC Press, 2 nd edition, 2009.							
4.	John Davidson, "The Reliability of Mechanical system" published by the Institution of Mechanical Engineers, London, 1994.							
5.	"Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.							
6.	Smith C.O., "Introduction to Reliability in Design", McGraw Hill, London, 1976.							

40 PIS E22 Personal Protective Equipment

M.E.(ISE)

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – II	3	0	0	45	3	50	50	100

Objectives

To expertise the student in selecting the personal protective equipment for appropriate work and making him competent enough to impart how the personal protection equipment can be used.

Course outcomes

1. Understand the Concepts of PPE.
2. Justify and identify the need, principle and procurement for PPE.
3. Choose and recommending suitable non respiratory PPE for workers.
4. Inspect and train non respiratory PPE for workers.
5. Choose and recommending suitable respiratory PPE for workers
6. Devise Maintenance procedures and perform inspection for Respiratory protective equipment
7. Formulate selection, storage of PPE, PPE matrix and work zone monitoring
8. Conduct PPE audit and document the report
9. Understand psychology and how it is related to work and ergonomic application
10. Relate IS standard and EU directives relevant to PPE

Introduction

Concepts of personal protective equipment -Need for Personal Protective Equipments-general Principles- sources of help-requirements-procurement procedures - user involvement.

Non Respiratory Personal Protective Equipments

Head protection-helmet, hoods, bump caps, soft caps, Hair net and caps-Eye and Face protection-spectacles, goggles ,types of goggles and face shields-Hearing Protection – ear muff, ear plugs and combination- Body Protection: coats, aprons, full suits, proximity suits, high visibility clothing, personal flotation devices, puncture resistant and cut resistant clothing- Fall Protection: safety belt, safety harness, lanyard, grabbing device, lifeline, fall arrestor, climbing safety system and safety net- emergency showers- eye wash fountains- eye and face wash fountain- Hand, finger and arm protection: gloves and its types, pads, finger guard, sleeves, creams and lotions-Foot and Leg protection: safety shoes-instep guard, steel insole, rubber boots, non sparking shoes, non conductive shoes and slip resistant shoes – maintenance procedures - limitations - relevant Indian standards - Personal Training.

Respiratory Personal Protective Equipments

Respiratory Protection, selection of the respiratory protective equipment, quality of breathing air, respiratory fit testing, SCBA, Hose mask, Air-line respirator, air-supplied suits and hoods, air-purifying respirators, canister mask, filter respirator and others- maintenance procedures- limitations

Pre Employment – Fitness test - health surveillance relevant Indian standards – Personal Training.

Procurement, Storage, Inspection, Quality Testing And Ergonomic Considerations

Types – selection of PPE: selection, suitability, approved lables, usage, training, monitoring, retraining, instruction aids, safety reminders, specialized training- storage of PPE -Inspection: PPE Matrix- PPE Audit –Quality – work zone monitoring Psychology-human factors- ergonomic application -PPE design considerations.

Testing and design

IS Standards

Safety Helmet IS 2925:1984; Eye Protectors – IS 5983:1980;Ear protectors – IS 9167:1979;Safety goggles- IS 7524 (Part I & II):1979 ,IS 5983:1980; Welding Helmets – IS 1179-1967; Safety Shoes – IS 5852-1996/IS 11226:1993 ;Gumboots-IS 12254:1993 /IS 13695:1993 Hand Protectors – IS 4770:1991; Safety clothing – IS 2573 – 1986; Canister type respirator – IS 8523:1977 Cartridge type respirator IS 8522:1977; Dust Respirator IS 9473:1980 and Introduction to EU Directive 89/686/EEC

Reference(s) :

1.	"Industrial Safety "National Institute of Industrial Research, New delhi,2003
2.	John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travelers Book seller, New Delhi, 2001.
3.	"Industrial safety I & II ",National safety council, Mumbai
4.	www.bis.in

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40 PIS E23 Safety in Textile Industry								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – II	3	0	0	45	3	50	50	100
Objectives	The syllabus deals with safe handling of materials involved in work atmosphere, exposure to noise levels and certain ergonomic considerations to be accomplished in textile industry.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the process flow of textile manufacturing. 2. Choose adequate guarding of textile machineries. 3. Identify hazards in sizing process. 4. Identify hazards due to steam. 5. Identify hazards in scouring and bleaching process. 6. Identify hazards due to dyeing process. 7. Understand the health hazards in textile industry related to dust, fly and noise. 8. Recognize suitable personal protective equipments used industries. 9. Relate legal provisions pertaining to textile industry. 10. Understand effluent treatment and waste disposal in textile. 							
<p>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 – Automated machines.</p> <p>Process Hazards-I 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 – fire prevention in textile industry.</p> <p>Process Hazards- II Scouring, bleaching, dyeing, printing, mechanical finishing operations and effluents in textile processes.</p> <p>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.</p> <p>Safety Statues Relevant provision of factories act and rules and other statues applicable to textile industry – effluent treatment and waste disposal in textile industry.</p>								
Reference(s) :								
1.	"Safety in Textile Industry", Thane Belapur Industries Association, Mumbai.							
2.	100 Textile Fires – analysis, findings and recommendations LPA.							
3.	Groover and Henry DS, "Hand Book of Textile Testing and Quality Control".newyork,1960							
4.	Shenai V.A., "A technology of textile processing", Vol.I, Evak Publicationa,1990.							
5.	Little A.H., "Water supplies and the treatment and disposal of effluent". The Textile Institute Manchester,1975							

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40 PIS E24 Behaviour Based Safety and Safety Culture								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – II	3	0	0	45	3	50	50	100
Objectives	This course will provide insight into current knowledge of human error and how it can be reduced. The course focuses on human errors related to undesired behaviors (habits), what causes these, and how to effectively remedy these.							
Course outcomes	<ol style="list-style-type: none"> 1. Describe the fundamentals of Behavioural safety. 2. Review the effectiveness of behavioral safety. 3. Explain the Monitoring activators. 4. Describe the consequence classification. 5. Understand the observation process. 6. Execute communication process. 7. Explain behaviour Modification. 8. Identifies need based training with real life examples. 9. Describes Behavior models for error reduction. 10. Apply critical error reduction techniques. 							
<p>Fundamentals of Behavioral Safety Historical background-H.W-Heinrich Theory and pyramid-Accident causal Analysis-Unsafe conditions, Unsafe acts, personal factors and proximate factors-ABC Analysis for a behavior of Activator. Behavior and consequences-components of behavior of Safety Programme – Critical behaviors and observation process-Near Miss Management Programme-Suggestion schemes for the effective implementation-Feedback to workers-Improvement, Review and effectiveness of feedback.</p> <p>Performance Monitoring and Consequences Goals and objectives for monitoring activators-policies and procedures-priorities and accountabilities-Training and education-Job Aids such as checklists and flow-charts-pre-job safety Instructions-manuals and pocket guides-Recognition and Rewards for positive performance-Reinforcement of monitoring process-Demerit factors for Negative performance-Consequence classification-positive/Negative(P/N)-Immediate/Future (I/F)-certain/Uncertain (C/V)-positive, Immediate and certain (PIC)-case study on Respiratory Hazards.</p> <p>Observation and Communication Process Observation procedure-Observation checklist-communication of Near Miss Behaviors, Injury causes and critical Behaviors-Observation Result charts, graphs and displays-Tool Box Talks-Frequent observations of safety critical activities such as startup/Shutdown-orientation programme-watch over new employees, younger employees, workers under pressure/stress, workers running/rushing, and new contractors/sub-contractors.</p> <p>Behavior Modification Safety first approach to all Work-management responsibilities-supervisor responsibilities-worker responsibilities-New, young, and contract workers responsibilities-project safety rules-safe operating procedures (SOP)-workplace Hazardous material information system (WHMIS)-PPE and work clothing-compliance monitoring-Harassing behaviors-Disciplinary actions-verbal warning, written warning and removal from the site-safety signage-safety meetings – Digital display of precautionary information-training needs, and need based training with real life examples.</p> <p>Safety Culture Safety culture- Commitment –policy-management-individual- safety culture framework- assumptions-espoused values – artefacts -Attitude towards safety-Traditional safety Vs behavioral safety-Acts of indifference-Acts of improper attitude-Acts due to lack of knowledge-At-Risk Behavior model-intentional, unintentional and Habitual At-Risk Behaviors-Four stages of Being-Rushing, Frustration, fatigue and complacency-four critical errors-eyes not on the task, mind not on the task, Being in or moving into the “Line of Fire” and losing the balance, traction or group-critical Error reduction techniques(CERT)-Advanced safety skills and awareness training-case study on the knowledge of hazards and relevant procedures.</p>								
Reference(s) :								
1.	Aubrey Daniels-Bringing out the best in people, Mc Graw Hill publications ,2 nd edition,2000.							
2.	Aubrey Daniels-Performance management, 5 th edition, 2012.							
3.	Tutorial – The war against complacency, Don Wilson, 2011.							
4.	Dow chemical- Behavior Based performance system, 2013.							
5.	Synerude-Behavior based safety process.							

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40 PIS E31 Integrated Management Systems								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – III	3	0	0	45	3	50	50	100
Objectives	To scrutinize the standards from the elementary view and to make the learner competent in the subject.							
Course outcomes	<ol style="list-style-type: none"> 1. Understands the structure and features of OHSAS 18001. 2. Recognize the benefits and certification of OHSAS 18001. 3. Devise OH & S Policy for industries. 4. Identify and practice as per the content of OH & S Policy. 5. Understand the significance of roles and responsibilities of management, coordinator and employees. 6. Formulate procedures and training methodology. 7. Recognize the benefits and certification of ISO 14001 series. 8. Understands the specification and scope of ISO 14001series. 9. Understand the objective of to ISO 9001. 10. Recognize the benefits and certification of ISO 9001. 							
<p>OHSAS Standard Introduction – Development of OHSAS standard – Structure and features of OSHAS 18001 – Benefits of certification of OHSAS 18001-certification procedure – OH & S management system element, specification and scope - correspondence between OHSAS 18001,ISO 22000,ISO 18001,ISO 15001, ISO 14001:1996 and ISO 9001:1994 – Guidelines (18002:2000) for implementing OHSAS 18001.</p> <p>OHSAS 18001 Policy & Planning Developing OH & S policy– Guidelines – Developments - procedure - Content of OH & S policy – General principle, strategy and planning, specific goals, compliance – methodology-FOHSR. Planning – Guidelines, methodology steps developing action plan-OHSAP – Analysis and identify the priorities, objective & Targets, short term action plan, benefits and cost of each option, Development of action plan.</p> <p>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 & Review; performance measurement and monitoring, Proactive and Reactive monitoring, measurement techniques, inspections, measuring equipment - Accidents reports, Process & procedures, recording, investigation corrective action and follow up - records and records management. Handling documentation, information, records. Practical exposure to OSHAS 18001 and environment management series- Case studies.</p> <p>ISO 14001 EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines & Principles (ISO 14004), environmental aspects and management programmes, 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 – comparative study between OHSAS 18001 and ISO 14001 - Case studies.</p> <p>ISO 9001 Introduction to ISO 9001- Scope, Application - Range of ISO standards - Principles of quality management-Steps for implementing ISO 9001:2008: Check list - Process approach – Documentation- Clause-wise explanation and Audit concepts – Measurement, analysis and improvement: General – Monitoring and measurement – Control of nonconforming product – Analysis of data – Improvement - Certification of quality management system – Steps involved - Audit of quality management system: Purpose – Types of quality audits - Case studies.</p>								
Reference(s) :								
1.	Dr. K.C. Arora, “ISO 9000 to OHSAS 18001”, S.K. Kataria & Sons, Delhi.							

2.	OHSAS 18001, BSI.UK,2007
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K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS E32 Safety in Construction and Infrastructure								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – III	3	0	0	45	3	50	50	100
Objectives	To introduce construction industry, its safety and health issues and to discuss the nature of the industry by way of background and to highlight how it differs from one industry as the construction industry is rather different from the majority of industries.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the construction industry, hazards, causes and activities 2. Relate BOCW with construction activities, educate and train accordingly.. 3. Identify and assess Types of Excavation, hazards and suggest adequate control measures. 4. Recognize and investigate Types of Scaffold ,hazards and scaffold accidents 5. Relate OSHA standards for fall protection in construction practice. 6. Formulate fall prevention measures in real time situations. 7. Understands the Operation and maintenance of Earth moving machinery. 8. Investigate Accidents in Earth moving machineries and document. 9. Understands and formulate Demolition, types and safe demolition activity in industrial and domestic site. 10. Relate Indian standards with demolition activity. 							
<p>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 – the building and other construction workers act and rules 1996- Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – tool box meeting-quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training.</p> <p>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.</p> <p>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 harness, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, Safety pass – Alternative equipments for scaffolding work - accident case studies.</p> <p>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, scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.</p> <p>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 –Case studies.</p>								
Reference(s) :								
1.	V.J.Davies and K.Tomasin “Construction Safety Hand Book”, Thomas Telford Ltd., London, 1990.							
2.	Charles D. Reese & James V. Edison, “Handbook of OSHA Construction Safety and Health”,CRC press,2006							
3.	Hudson R.,”Construction hazard and Safety Hand book, Butter Worth’s, 1985.							
4.	Janthea D.Sime, “Safety in the Build Environment”, London, 1988.							

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS E33 Disaster Management								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – III	3	0	0	45	3	50	50	100
Objectives	The syllabus addresses all the special considerations important in planning for disaster from natural disaster to catastrophic events. It covers all aspects from assessing the risk prior to a disaster to the legal ramification following a disaster.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand disaster, types and disaster mitigation. 2. Relate the consequence of deforestation with disaster. 3. Analyze the consequence and cases of technological disasters. 4. Develop, organize and conduct APELL. 5. Understands the significance of sustainable development. 6. Analyze the problems faced by rising global issues. 7. Evaluate the risk in offshore and onshore drilling. 8. Understand the problems faced by marine pollution and need to control. 9. Propose and promote environmental education in society 10. Relate law of protection with disaster management. 							
<p>Introduction 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-national policy-community awareness.</p> <p>Emergency Measures 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.</p> <p>Impact on Environment and Management Issues Introduction to Sustainable Development-Bio Diversity-Atmospheric pollution-Global warming and Ozone Depletion- 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.</p> <p>Marine Issues 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.</p> <p>Risk Analysis & Law Of Protection Environmental education-Population and community ecology-Natural resources conservation-Environmental protection and law-Research methodology and systems analysis-Natural resources conservation-Policy initiatives and future prospects-Risk assessment process, assessment for different disaster types-Assessment data use, destructive capacity-risk adjustment-choice-loss acceptance-disaster aid- public liability insurance-stock taking and vulnerability analysis-disaster profile of the country-national policies-objectives and standards-physical event modification-preparedness, forecasting and warning, land use planning.</p>								
Reference(s) :								
1.	Gilbert, M. Masters," Introduction to Environmental Engineering and Science",3 rd edition,2008							
2.	G. Tylor, Miller, "Environmental Science Sustaining the Earth",2005							
3.	Bagad Vilas, "Principles of Environmental Science and Engineering",2004							
4.	R. Sivakumar, "Principles of Environmental Science and Engineering",2005							
5.	Miller, G. Tylor, "Environmental Science".14 th edition,.Mcgraw Hill,2012							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS E34 Safety in Material Handling and Plant Layout								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – III	3	0	0	45	3	50	50	100
Objectives	The syllabus portrays the overall safety measures to which plant should abide by, and also focuses on the working atmosphere including the standard operating procedures for material handling so as to provide a better and safer environment to work with.							
Course outcomes	<ol style="list-style-type: none"> 1. Explain the basic concepts of plant location and layouts. 2. Describe the design requirements of safety layout of plant location. 3. Recognize the properties of physiological and comfort levels. 4. Compose the basic concepts used in design of good ventilation and ventilation standards. 5. Describe the design principles of material handling systems. 6. Asses the concepts related with team lifting & carrying. 7. Analyze the problems related with hazardous materials and processes. 8. Organize the type of shipping & receiving process. 9. Asses the concepts related with powered industrial trucks. 10. Discuss the various methods of inspection and maintenance. 							
<p>Plant Location & Layout 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. Safe layout and types of 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.</p> <p>Working Conditions Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- House keeping, principles of 5S - design of workplace for noisy and vibratory environment.</p> <p>Manual Material Handling Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations.</p> <p>Lifting Tackles and Hoisting Criteria 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, testing, inspection and replacement according to statutory requirements - Competent person – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection. Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, criteria's : Safe working Load, Centre of gravity and factor of safety- maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications.</p> <p>Mechanical Material Handling 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, testing and inspection according to statutory requirements.</p>								
Reference(s) :								
1.	Alexandrov. M.P, "Material Handling Equipment", Mir Publishers, Moscow, 1981.							
2.	Apple M. James, "Plant Layout and Material Handling", 3 rd edition, John Wiley & sons.,1997							
3.	James.M.Moore,"Plant Layout and Design",Prentice hall,1962							
4.	Accident Prevention Manual – Vol. I & II							
5.	Spivakosky, "Conveyors and related Equipment", Vol.I & II Peace Pub. Moscow, 1982.							
6.	Rudenko N., "Material Handling Equipments", Mir Publishers, 1981.							
7.	Reymond, A.Kulwice, "Material Handling Hand Book - II", John Wiley and Sons, New York, 1985.							
8.	"Safety and Good House Keeping", N.P.C. New Delhi, 1985.							

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS E41 Ergonomic Tools and Techniques								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – IV	3	0	0	45	3	50	50	100
Objectives	This intention of this course is to make the learner competent in assessing ergonomic hazards, plan and train ergonomic team and recommends appropriate ergo work station.							
Course outcomes	<ol style="list-style-type: none"> 1. Recall the basics of biomechanics and anthropometry of human body. 2. Understands the fundamentals of ergonomic tools. 3. Apply subjective assessment tools to assess WMSD. 4. Describe the advantages and disadvantages of subjective assessment tools. 5. Assess physiological discomfort of the worker using ergonomic tools. 6. Assess psychological discomfort of the worker using ergonomic tools. 7. Select posture evaluation tools to assess WMSD. 8. Utilize posture evaluation tools to assess WMSD. 9. Understands the human factor tools for project management. 10. Analyze from case studies about the human factors tools. 							
<p>Introduction Basics of biomechanics and anthropometry of human body – work station design-working posture Assessment tools- fundamentals of RULA,REBA,NIOSH lifting equation,OCRA.</p> <p>Subjective Assessment Tools Introduction- methods for assessing work related Musculoskeletal disorder risk factors-qualities of good questionnaires- advantage and disadvantages of questionnaire.</p> <p>Assessment of physiological and psychological discomfort Methods to assess levels of musculoskeletal discomfort -The Dutch Musculoskeletal Questionnaire (DMQ)-Nordic Musculoskeletal questionnaire, Methods to assess levels of mental discomfort – job stress questionnaire –NIOSH generic job stress questionnaire.</p> <p>Postural Evaluation Tools Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), NIOSH Lifting equation,OCRA – hands on exercises.</p> <p>Human factors – project planning Introduction- project management- human factors tools for project management-case studies</p>								
Reference(s) :								
1.	Dennis A. Attwood et al, "Ergonomic Solutions for Process industries" Gulf Professional Publishing, 2004							
2.	R.S. Bridger, "Introduction to Ergonomics", Taylor & Francis, 2 nd Edition, 2007.							
3.	Amit Bhattacharya et al, " Occupational Ergonomics theory and applications" Merceel Dekker Inc,							

K.S.Rangasamy College of Technology – Autonomous						R 2014		
40 PIS E42 Safety in Mines								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – IV	3	0	0	45	3	50	50	100
Objectives	The syllabus focuses on how to control the possibility of fire, float, explosion and collapse which has the potential to simultaneously affect a large no of people and also elucidate the risk assessment techniques to be carried out in mines ambience.							
Course outcomes	<ol style="list-style-type: none"> 1. Identify the causes of accident from machineries and advise on how to prevent such accidents in future. 2. Prepare and propose accident reporting system. 3. Infer from mines accidents and its effects. 4. Understand the operation of warning sensors and gas detectors. 5. Identify and minimize hazards in tunneling. 6. Identify the electrical hazards and give remedial measures. 7. Understand the basic concepts of risk. 8. Construct fault tree for risk and arrive with cutsets. 9. Recognize accident classification and analysis. 10. Investigate accidents and draft reports. 							
<p>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.</p> <p>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.</p> <p>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 – Dust explosion – prevention personal protective equipment.</p> <p>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.</p> <p>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.</p>								
Reference(s) :								
1.	Michael Karmis ed., “Mine Health and Safety Management”, SME, 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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40 PIS E43 Transport Safety								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – IV	3	0	0	45	3	50	50	100
Objectives	The syllabus provides a clear cut idea applicable to safe and sound practices of transportation and also furnishes the particulars of statutory requirements for safer transportation finally contributing to a consequential approach of safety.							
Course outcomes	<ol style="list-style-type: none"> 1. Relate Legal requirements pertaining to transportation. 2. Conduct hazard identification and risk assessment in transportation of hazardous goods. 3. Suggest or comment on Factors for improving safety on roads. 4. Identify the Causes of accidents due to drivers and give suitable remedial measures. 5. Select and train drivers. Formulate emergency planning. 6. Formulate Accident reporting and investigation procedures. 7. Recognize factors influencing road alignment, plant road and railways lines. 8. Suggest safety measures at intersection, traffic control lines. 9. Devise and make use of House keeping practice. 10. Frame and implement Safety practice in manual and mechanical handling. 							
<p>Transportation of Hazardous Goods Legal requirements - Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries -static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures – Security Procedures – communication – hazard identification and risk assessment.</p> <p>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.</p> <p>Safety Responsibility of Drivers 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-CMVR Central Motor Vehicle Rules (1988) - driver relaxation and rest pauses – speed and fuel conservation – emergency planning and HAZMAT codes.</p> <p>Road Safety Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.- factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers – street lighting and illumination-Displays and signages-Plant road safety- overloading-concentration of driver.-Transportation of hazardous goods. Plant railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices.</p> <p>Shop Floor And Repair Shop Safety House keeping – Safe materials storage - Transport precautions-safety on manual, mechanical handling equipment operations-safe driving-fork lift truck-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- slip trip and falls.</p>								
Reference(s) :								
1.	pkes, C.A. “Traffic Control and Road Accident Prevention”, Chapman and Hall Limited, 1986.							
2.	bkov, 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.							

K.S.Rangasamy College of Technology – Autonomous							R 2014	
40 PIS E44 Artificial Intelligence and Expert Systems								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – IV	3	0	0	45	3	50	50	100
Objectives	The syllabus elaborates the concepts of artificial intelligence in the view of factory settings and also features about expert systems.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the Historical background of artificial Intelligence. 2. Make use of applications of Artificial intelligence. 3. Recognize specifics about informative and cybernetics. 4. Summarize the modes of perception. 5. Recognize the significant role of knowledge engineer. 6. Interpret representing the knowledge. 7. Understand the importance of expert systems. 8. Recognize the features of expert systems. 9. Understand specifics about neural network architecture. 10. Explain the various learning methods. 							
<p>Introduction Intelligence – Definition, types cognitive aspect approach, measuring intelligence – early efforts, IQ and AI: aspects of intelligence – learning, problem solving, creativity, behaviour and biology. Artificial intelligence: Historical background, applications of AI, objections and myths, AI languages: Introduction to PROLOG and LISP.</p> <p>Cognitive Psychology The mind – informative and cybernetics, components for thought, modes of perception – visual, auditory and other systems: memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote, parameter, method and concept: Game playing, reasoning, Artificial Vision – picture processing – identifying real objects; Vision Programmess, factory vision systems.</p> <p>Knowledge Engineering Introduction – role of knowledge engineer, knowledge representation – psychology, production rules, logic and Programme, Common sense and fuzzy logic, semantic networks, learning systems.</p> <p>Expert Systems Introduction, knowledge acquisition for Expert system, features of Expert systems –System structure, inference Engines, uncertainties, memory mechanisms, range of applications, actual expert systems – VP expert. Assignment – Development of a simple expert system.</p> <p>Introduction to Neural Networks Neural Network Architecture – Learning methods – Architecture of Back Propagation Network – Selection of parameters – Simple variations of BPN.</p>								
Reference(s) :								
1.	Elaine R., and Kevin, “Artificial Intelligence”, 2 nd Edition, Tata McGraw Hill, 2009.							
2.	Rajasekaran .S and Vijayalakshmi Pai, G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications”, PHI, 2003.							
3.	Charnaik E., and McDermott, D., “Introduction to Artificial Intelligence”, Addison Wesley, 1985.							

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40 PIS E51 Dock Safety								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – V	3	0	0	45	3	50	50	100
Objectives	The intension of the syllabus is to supply a dive-in approach to imply safe practices in dock work, workers involved and also to meet the statutory requirements as per government norms							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the statues pertaining to dock safety. 2. Recognize the responsibilities of port authorities. 3. Identify cargo and types of cargo ships. 4. Formulate procedures to maintain safety in chipping and painting operation on ships. 5. Identify hazards in various types of lifting appliances. 6. Examine and test lifting appliances. 7. Understand facts about transporting containers. 8. Recognize the need for testing, examination and inspection of containers. 9. Draft and enact emergency action plans. 10. Devise and execute on site emergency plan and safety report. 							
<p>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, 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. Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of dock workers.</p> <p>Working On Board the Ship Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships – safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hold of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like fort-lift trucks-pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo.</p> <p>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.</p> <p>Transport Equipment The different types of equipment for transporting containers and safety in their use-safety in the use of self loading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes. Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation. Handling of different types of cargo – stacking and unstacking both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.</p> <p>Emergency Action Plan and Dock Workers (SHW) Regulations 1990 Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report. Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading & unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.</p>								
Reference(s) :								
1.	"Safety and Health in Dock work", 2 nd Edition, ILO, 1992.							
2.	"Dock Safety", Thane Belapur Industries Association, Mumbai.							
3.	Taylor D.A., "Introduction to Marine Engineering", 2 nd edition, B-H, 1996.							
4.	Srinivasan, "Harbour, Dock and Tunnel Engineering". CPH Pvt Limited, 2011.							
5.	Bindra S.R., "Course in Dock & Harbour Engineering". Dhanpat Rai Publication Limited, New Delhi, 2013							

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40 PIS E52 Safety in Petrochemical Industries								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – V	3	0	0	45	3	50	50	100
Objectives	The intention is to equip the learner with the detailed plan of the petro chemical industries and also hazards associated with it and to impart the safety measures to be carried out in each and every process of the plant.							
Course outcomes	<ol style="list-style-type: none"> 1. Recognize the need for petroleum and petroleum products. 2. Understand specifics about physical and chemical characteristics of petroleum products. 3. Recall IUPAC nomenclature and naming of hydrocarbons. 4. Understand specifics about the hazardous process. 5. Infer hazardous property of the structure of aromatic hydrocarbons and its reactivity. 6. Understand specifics about manufacture of benzene and other organic solvents. 7. Identify the risk in production and usage of halogens. 8. Identify the sources and hazards of dioxins. 9. Devise procedures for selecting and maintenance of PPE. 10. Recommend engineering and administrative control measures for petrochemical hazards. 							
<p>Petrochemicals Introduction to Petroleum and Petroleum products – Definitions of boiling point, flash point, pour point, API Gravity, Static Electricity, octane number, Cetane number, Flammability levels –Exothermicity and Endothermicity, Toxicity, Dose – response, fossil fuel – Exploration and production of petroleum oil and natural gas – Petroleum Distillation – upstream, mid-stream and downstream activities of refineries - safety in storage and transportation of petroleum products – refrigerated and mounted storage - transportation.</p> <p>Aliphatic Hydro Carbons IUPAC nomenclature – Naming of hydrocarbons – Structure of Aliphatic Hydrocarbons and its reactivity – Feed stock for aliphatic hydrocarbons – Olefins – Hazardous processes: demethanizer, deethanizer, hydroforming, hydrocracking, Isomerization, Alkylation and Catalyst regeneration – Production and applications of Ethylene, butylene, ethylene oxide and LPG –safety storage and transportation.</p> <p>Aromatic Hydrocarbons Benzene ring – cyclic hydrocarbons – BTX and its significance – Structure of Aromatic Hydrocarbons and its reactivity - manufacture of benzene and other organic solvents – Haematotoxic effects of benzene – Leukemia – safety with organic solvents – Built-in fire fighting measures for solvent storage.</p> <p>Halogenated Hydrocarbons Production, Usage and hazards of Halogens: Chlorinated hydrocarbons, Fluorinated hydrocarbons, Chlorofluorocarbons (CFC), Polychlorinated Biphenyls(PCBs), Ethylene Dichloride and Polyvinyl Chloride(PVC) Dioxin sources and hazards. Polymerization – Different types of plastics and polymers: LDPE, HDPE, PVA, Polypropylene and Polystyrene – Phenol formaldehyde Resins – Epoxy resin hazards.</p> <p>Petrochemical Industries Production and hazards of Fertilizers, pharmaceuticals and Pesticides : Ammonium nitrate, Ammonia, Urea, Methylisocyanate, Acrolein – detergents – degreasers – reducing agents – selection and maintenance of personal protective equipments – engineering and administrative control measures – emergency preparedness for petrochemical disasters - APELL.</p>								
Reference(s) :								
1.	James G.Speight, "Petroleum Chemistry and refining", Taylor & Francies, 1997.							
2.	James H.Gary, Glen.E.Handwork , "Petroleum Refining" , 2001 .							
3.	Encyclopedia of Occupational Safety and Health published by ILO, Geneva. Vol I and II, 1985							
4.	Health and Safety Executive Guide by,I M S O, London.							
5.	Perry's Chemical Engineers' Hand book,8 th edition,2007							
6.	Fire Prevention Handbook, Butterworth-Heiman, UK,1986							

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40 PIS E53 Industrial Noise and Vibration control								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – V	3	0	0	45	3	50	50	100
Objectives	To make students understand the health impacts of Industrial Noise and to know how to measure noise level and conduct noise surveys. To emphasize their knowledge over the ill-effects of vibration and to know how to control vibration in industrial environment.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand specifics about industrial noise. 2. Recall the Permissible exposure levels under the factories act 1948 and the Tamilnadu factories rules 1950. 3. Identify the existence of noise problem and suggest control measures. 4. Understand specifics of the severity of the noise problems and their impact. 5. Recognize the need for the techniques involving minimal noise modification. 6. Understand the significance of techniques requiring equipment redesign. 7. Recognize the need for noise absorption materials. 8. Understand specifics about damping materials and its usage. 9. Assess the potential vibration hazards in industrial tools and operations. 10. Assess specifics about Hand- Arm vibration and recommends suitable remedial measures. 							
<p>Noise Pollution Sound and its propagation - Noise – Industrial Noise – Workers exposure level – Noise Level measurement - Decibel – Sound level meter – Permissible exposure levels under the Factories Act 1948 and Tamil Nadu Factories Rules 1950 – Occupational Deafness as Notifiable Disease – Use of sound level meter and other means to determine noise exposure.</p> <p>Noise mapping Identification of the existence of noise problems – Severity of noise problems and their impacts over health – Noise source diagnosis – summary of Diagnostic approaches – Noise Mapping- Case study of noise problem in Engineering Industry – Noise survey procedure.</p> <p>Noise control Measures Techniques involving minimal noise modification – Techniques requiring equipment to be added to the existing machinery – Techniques requiring equipment redesign – Use of personal protective equipments – Attenuation levels of different types of PPE – Motivation and communication measures. Noise Control Materials -Noise absorption materials – Transmission Loss materials – Damping materials – Material selection – Comparison of noise reduction methods as applied to a particular noise producing machine.</p> <p>Vibration Vibration - Industrial Vibration - Whole body Vibration – Standards -Vibration isolating materials – Vibration monitoring.</p> <p>Vibration Risks And Their Control Potential Hazards of Industrial Tools and operations that produce vibration – Daily Vibration Dose – measurement Technique – Hand – Arm Vibration (HAV) – Injuries from HAV – Back pain Risks from mobile machine operations – Ergonomics of Vibrating Tools – Right Tool for the Job in the right way (Ergonomics) – Tool design and maintenance – Keeping hands warm – Multiple shift breaks – Job rotation and maintenance.</p>								
Reference(s) :								
1.	C.M.Harris et al, 'Hand – Book of Noise Control', McGraw Hill Publications, New York.							
2.	L.L.Beranick, 'Noise and Vibration Control', McGraw Hill Publications, New York.							
3.	Guidelines issued by Industrial Noise and Vibration Control Centre, U.S.A.							
4.	A.P.G.Peterson & EE.Brosh, "Hand – Book of Noise measurement", 7 th Edition..							
5.	W.A.Rosenlith and K.N.Stevens, "Hand - Book of acoustic Noise Control".							
6.	S.A.Petru Sewicz & D.K.Longmar, "Noise and Vibration Control for Industrials".							

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40 PIS E54 Nuclear Engineering and Safety								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Elective – V	3	0	0	45	3	50	50	100
Objectives	To know – how the concepts of nuclear reactors, its radiations and control methods. The syllabus facilitates the pupil in the areas relevant to nuclear power station, nuclear chemical plants, decommissioning defense nuclear facilities, nuclear safety research and startage.							
Course outcomes	<ol style="list-style-type: none"> 1. Understand radioactivity and its basic concepts. 2. Learn alpha, beta and gamma rays radioactive decay. 3. Recognize the significance of control requirements in reactor design. 4. Identify operational problems with control and shut down rods. 5. Classify and compare various types of reactors and hazards. 6. Compare direct and dual cycle power plants. 7. Understand specifics about safety design principles for reactors. 8. Design fire protection system for industrial needs. 9. Understands specifics about radiation dose and dose measurements. 10. Recommend and implement control measures for radiation exposure to plant personnel. 							
<p>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.</p> <p>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.</p> <p>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.</p> <p>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. Accident Case studies- Three Mile island & Chernobyl accident.</p> <p>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.</p>								
Reference(s) :								
1.	M.M.E.L.Wakil, "Nuclear Power Engineering", International Text Book Co.							
2.	Sterman 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.	M.M.E.L.Wakil, "Nuclear Energy Conversion", International Text Book Co.							
5.	R.L.Murray, "Introduction to Nuclear Engineering", Prentice Hall.							

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40 PIS SE1 Safety in Nano Technology								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Special Elective	1	0	0	20	1	50	50	100
Objectives	The primary objective of this course is to develop awareness about nano science and technology and to adhere adequate safety measures to be taken for nano pollution							
Course outcomes	1. Describe the ethical and societal impact of nanotechnology, 2. Analyze measures to be taken for nano pollution 3. Inculcate Public participation 4. Learns Fundamental concepts in sustainable nanotechnology 5. Understands the nature and development of nanotechnology							
<p>Introduction</p> <p>Definition- nanotechnology – ethics in nanotechnology – perspective – societal dimensions in nano technology</p> <p>Nano Toxicology</p> <p>Health impacts due to nano particles-process and technology issues</p> <p>Nano Pollution</p> <p>Nano particles in the environment-environmental fate and transport-potential ecological hazards-Methodologies for Evaluating Hazards and their Limitations.- Recommendations for Managing the Risks of Future Nanomaterials and their production</p> <p>Public Perception And Participation</p> <p>Public Interaction Research - Communicating Nanotechnological Risks - A Proposal to Advance Understanding of Nanotechnology's Social Impacts</p> <p>Nanotechnology in the Media</p> <p>A Preliminary Analysis - Public Engagement with Nanoscale Science and Engineering - Nanotechnology: Moving Beyond Risk - Communication Streams and Nanotechnology: The (Re)Interpretation of a New Technology - Nanotechnology:Societal Implications — Individual perspectives</p>								
Reference(s) :								
1.	Mihail C. Roco and William Sims Bainbridge Nanotechnology: Societal Implications II-Individual Perspectives , Springer (2007).							
2.	Darcy J. Gentleman, Nano and the Environment: Boon or Bane?" Environmental Science and technology, Vol. 43, (2009)							

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40 PIS SE2 Non Destructive Testing								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Special Elective	1	0	1	20	1	50	50	100
Objectives	The course makes the student understand the basic principles of various NDT methods, fundamentals, discontinuities in different product forms, importance of NDT, applications, limitations of NDT methods and techniques and codes, standards and specifications related to non-destructive testing technology.							
Course outcomes	<ol style="list-style-type: none"> 1. Differentiates between the properties and structure of materials and justifies the selection of materials in engineering applications. 2. Determines suitable properties, uses and applications of materials, components and processes in engineering. 3. Understands the importance of NDT applications. 4. Compare the limitations of NDT methods and techniques and codes. 5. Recognize standards and specifications related to non-destructive testing technology. 							
<p>Introduction Non destructive testing- types- methods- application</p> <p>Manufacturing processes Visual inspection,Liquid penetrant testing,Magnetic particle testing,Acoustic monitoring,X Ray testingUltrasonic testingDigital technology-Internet Resources</p> <p>Types Discontinuities associated with manufacturing processes -I Basics of Visual Testing - Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Visual Testing Basics of Liquid Penetrant Testing: Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Liquid Penetrant testing</p> <p>Types Discontinuities associated with manufacturing processes -II Basics of Magnetic Particle Testing: Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Magnetic Particle testing Basics of Ultrasonic Testing: Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Ultrasonic Testing ,Basics of Radiographic Testing: Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Radiography</p> <p>Standard Standards- legal norms- code of regulations</p>								
Reference(s) :								
1.	. Non-Destructive Testing Hand Book: Radiography and Radiation Testing, Vol.3, 2nd" ed, Columbus, OH, American Society for Non-Destructive Testing, 1985.							
2.	American Metals Society. Non-Destructive Examination and Quality Control : Metals Hand Book, Vol, 17, 9th Ed, Metals Park, 1989.							
3.	Guidelines for mechanical integrity of systems: centre for chemical process safety/AICHE: Wiley, 2006.							

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40 PIS SE3 Food Industry Safety								
M.E.(ISE)								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
Special Elective	1	0	0	20	1	50	50	100
Objectives	The course will make the candidates understand the format of food safety legislation as it relates to the management of food safety in a manufacturing business .this course also outline the safety procedures and food quality testing							
Course outcomes	<ol style="list-style-type: none"> 1. Understand the application and key aspect of regulations. 2. Describe the role of industry guides and codes of practice. 3. State how legislation is applied, actions that may be taken by enforcement officers and the consequences of non-compliance ,quality testing and safety procedures 4. State the responsibilities of proprietors, managers, supervisors and food handlers towards food safety. 5. Explain the importance of communicating food safety to staff 							
<p>Introduction</p> <p>Organization and management; quality, quality assurance, quality control, total quality management; good manufacturing practices, safety, hazards, risk</p> <p>HACCP</p> <p>Principles of HACCP, overview of biological, chemical and physical hazard in foods, designing safety into food and processes; FSSAI-grades and standard of identity, Codex Alimentarius,</p> <p>Other standards</p> <p>ISO:9000 series and ISO:14000 series, national laws and regulations: PFA, FPO, BIS and Agmark and international laws and regulations, Food Safety Act;</p> <p>Testing</p> <p>Quality testing – objective analysis, sensory assessment, rapid microbiological techniques; acceptance sampling; operational characteristics, risks, attributes sampling plan, variables sampling plan, administration of acceptance sampling; adulteration of food; identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits;</p> <p>Safety Procedures</p> <p>Sanitation in food processing facilities; definition, important and application; laws and regulation governing sanitation; establishment of SOPs; personal hygiene and hygienic food handlings, employee health, cleaning compounds; choosing of cleaning compounds, handling and storing of cleaning compounds, sanitization methods; waste disposal; solid and liquid; waste control; quality control aspect of processing plant for milk, meat, fish, poultry, foods, vegetables and cereals; customers service; complaint handling, product recall.</p>								
Reference(s) :								
1.	Ali, Food Quality Assurance: Principles and Practices, CRC Press, 2003							
2.	M. Pearson and T.R. Dutson, Kluwer HACCP in Meat, Poultry and Fish Processing, Academic Publishers, 1995							
3.	J. P. F. D'Mello, Food Safety Contaminants and Toxins, Oxford University Press, 2003							