KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

DEPARTMENT OF MECHANICAL ENGINEERING

M. TECH
Industrial Safety Engineering
CURRICULUM AND SYLLABUS
R2018

KALASALINGAM
ACADEMY OF RESEARCH AND EDUCATION
(DEEMED TO BE UNIVERSITY)
Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade
Anand Nagar, Krishnankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

M.Tech (Industrial Safety Engineering) curriculum Structure

S.No	Course Category	Credits
1.	Core theory courses	15
2.	Lab Courses	6
3.	Supportive courses (Mathematics & Research methodology)	4
4.	Program Specific Elective courses	15
5.	Open Elective (Interdisciplinary/General Elective)	3
6.	Mini Project	2
7.	Project work	26
8.	Audit courses (2 courses)	-
	Total	71

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
Anand Nagar, Krishnankoil - 626 190
Department of Mechanical Engineering
Curriculum and Syllabi

Semester I

Course Code	Course Name	L	T	P	C
MAT18R5002	Statistics and Computational techniques	3	0	0	3
MEC18R5001	Safety Management	3	0	0	3
MEC18R5002	Occupational Health and Hygiene	3	0	0	3
MEC18Rxxxx	Program Specific Elective – I	3	0	0	3
MEC18Rxxxx	Program Specific Elective-II	3	0	0	3
Audit 1	Audit Course – 1	2	-	-	0
MEC18R5081	Industrial Safety Lab	0	0	4	2
MEC18R5082	Technical Seminar - I	0	0	4	2
	Total	17	0	8	19

Semester II

Course Code	Course Name	L	T	P	C
PGM18R5001	Research Methodology for Engineers	1	0	0	1
MEC18R5003	Regulation for Health, Safety and Environment	3	0	0	3
MEC18R5005	Fire Engineering and Explosion Control	3	0	0	3
MEC18Rxxxx	Program Specific Elective- III	3	0	0	3
MEC18Rxxxx	Program Specific Elective- IV	3	0	0	3
Audit 2	Audit Course - 2	2	-	-	0
MEC18R5083	Technical Seminar - II	0	0	3	2
MEC18R6097	Mini-Project	-	-	4	2
	Total	15	0	7	17

Semester III

Course Code	Course Name	L	T	P	C
MEC18R6007	OHSAS 18000 and ISO 14000	3	0	0	3
MEC18Rxxxx	Program Specific Elective- V	3	0	0	3
	Open Elective	3	0	0	3
MEC18R6098	Dissertation Phase – I	0	0	20	10
	Total	9	0	20	19

Semester IV

Course Code	Course Name	L	T	P	C
MEC18R6099	Dissertation Phase – II	-	-	32	16
	Total	0	0	32	16

LIST OF PROGRAM SPECIFIC ELECTIVES

Course Code	Course Title	L	T	P	C
MEC18R5004	Computer Aided Hazard Analysis	3	0	0	3
MEC18R5006	Safety In Engineering Industry	3	0	0	3
MEC18R5007	Safety in Plant Layout and Material Handling	3	0	0	3
MEC18R5009	Human Factors Engineering	3	0	0	3
MEC18R5010	Transport Safety	3	0	0	3
MEC18R5011	Fireworks Safety	3	0	0	3
MEC18R5012	Safety in On and Off Shore Drilling	3	0	0	3
MEC18R5013	Safety in Textile Industry	3	0	0	3
MEC18R5014	Industrial Noise and Vibration Control	3	0	0	3
MEC18R5015	Work Study and Ergonomics	3	0	0	3
MEC18R5016	Reliability Engineering	3	0	0	3
MEC18R5017	Probabilistic Safety Assessment	3	0	0	3
MEC18R5018	Biomechanics and Human Body Vibration	3	0	0	3
MEC18R5019	Corrosion Engineering	3	0	0	3
MEC18R5020	Risk and Reliability for offshore structure	3	0	0	3
MEC18R5021	Safety in chemical industries	3	0	0	3
MEC18R5022	Electrical safety	3	0	0	3
MEC18R5023	Environmental safety	3	0	0	3
MEC18R6001	Nuclear Engineering Safety	3	0	0	3
MEC18R6002	Safety in Mines	3	0	0	3
MEC18R6003	Dock Safety	3	0	0	3

MEC18R6004	Safety in Powder Handling	3	0	0	3
MEC18R6005	Quality Engineering	3	0	0	3
MEC18R6006	Radiographic Testing and Radiation Safety	3	0	0	3
MEC18R6008	Intelligent Industrial Systems	3	0	0	3
MEC18R6009	Safety in Petrochemical industries	3	0	0	3
MEC18R6010	Quantitative risk analysis in chemical process	3	0	0	3
MEC18R6011	Sensitivity measurement and evaluation of energetic material	3	0	0	3
MEC18R6012	Solid and Hazardous Waste Management	3	0	0	3
MEC18R6013	Maintainability Engineering	3	0	0	3
MEC18R6014	Air Pollution Control Equipment Design	3	0	0	3
MEC18R6015	Automotive Systems Safety, Quality and Reliability	3	0	0	3

OPEN ELECTIVE COURSES

Course Code	Course Title	L	T	P	C
MEC18R6051	Disaster Management	3	0	0	3
MEC18R6052	Safety in Construction	3	0	0	3
MEC18R6053	Environmental Impact Assessment	3	0	0	3

GENERAL ELECTIVES

Course Code	Course title	L	T	P	C
EEE18R5020	Soft Computing Techniques	3	0	0	3
EEE18R5021	Optimization Techniques	3	0	0	3
EEE18R6013	Evolutionary Computation Techniques	3	0	0	3
CSE18R5051	Cloud computing	3	0	0	3
CSE18R5052	IoT and Applications	3	0	0	3
CSE18R5053	Big Data Analytics	3	0	0	3

SEMESTER I

MAT18R5002	STATISTICS AND COMPUTATIONAL TECHNIQUES	L	T	P	C
		3	0	0	3

Pre – requisite:
Fundamentals in statistics.

Course Objective(s):
The purpose of this course is to acquire more knowledge in statistics and its applications to engineering fields.

Course Outcomes:
CO1: Understand the types of probability distributions and their properties
CO2: Analyse the correlation and regression
CO3:Analyse the estimation for given data
CO4: Analyse the appropriate test for given data
CO5: Distinguish various design of experiments

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												1		
CO2	2	2	2										1		
CO3	2	2	2										2		
CO4	2	2	2	3	3									2	
CO5	2	2	2	3	3										2

Unit – 1 PROBABILITY DISTRIBUTIONS (9 Hours)

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

Unit – 2 CORRELATION AND REGRESSION ANALYSIS (9 Hours)

Bivariate correlation – correlation in multivariate systems; Bivariate linear regression – statistical optimization – principle of least squares – reliability of the regression equation – reliability of point estimates of regression coefficients – confidence interval of the regression equation – correlation versus regression - Multiple Regression Analysis: Matrix solution of the standardized model - criteria for evaluating a multiple regression model – Analysis of residuals

Unit – 3 ESTIMATION THEORY (9 Hours)

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

Unit – 4 TESTING OF HYPOTHESIS (9 Hours)

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

Unit – 5 DESIGN OF EXPERIMENTS (9 Hours)

Design of Experiments: Basic Designs, Factorial Design, ANOVA

Text Books:

1. Probability and Statistics for Engineering. Freund John, E and Miller, Prentice Hall, 5th Edition, 1994.
2. Probability and Statistics for Engineering and Sciences. Jay, L. Devore, Brooks Cole Publishing Company, Monterey, California, 1982

Reference Books:

1. Probability and Statistics with Reliability, Queuing and Computer Science Applications. Trivedi, K.S.,PHI
2. Mathematical Statistics. Kapur, J.N. and Saxena, H.C, S.Chand and Co. Ltd.,18th Revised Edition,1997.

MEC18R5001	**SAFETY MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite: Basic knowledge in Documentation Process and Management system.

Objective(s): This course aims to introduce the concept of Management skills and ability to know about the various documentation systems followed in industries

Course Outcome(s)

CO1: Illustrate the basic principles of safety management.

CO2: Classify and explain various functions and activities of safety department.

CO3: Identify and implement safety audit and write audit reports effectively in auditing situations

CO4: Analyze the sources of information for safety promotion and training.

CO5: Apply and familiarize students with evaluation of safety performance.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3					3	1			2		1		
CO2	1	2		2		1	2	3			1		1		
CO3	2	3					2	3					2		

CO4		1		3		2	3				2			2	
CO5	3	3	1					3			2				2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

CONCEPTS

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

ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee - Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports- Class exercise with case study.

SAFETY EDUCATION, TRAINING AND PERFORMANCE MONITORING

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training. permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems.

PERSONAL PROTECTIVE EQUIPMENT

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

BEHAVIOUR BASED SAFETY

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

References

1. Accident Prevention Manual for Industrial Operations, N.S.C. Chicago, 1982
2. Heinrich H.W., Industrial Accident Prevention, McGraw-Hill Company, New York, 1980.
3. John V.Grimaldi and Rollin H.Simonds, Safety Management, All India Travellers Bookseller, New Delhi – 1989.
4. William Handley, "Industrial Safety Hand Book", McGraw Hill, 2nd Edition, 1969.
5. Krishnan N.V., Safety Management in Industry, Jaico Publishing House, Bombay, 1997.
6. John Ridley, Safety at Work, Butterworth & Co., London, 1983.

7. Blake R.B., Industrial Safety, Prentice Hall, Inc., New Jersey, 1973
8. Occupational Safety Manual-BHEL
9. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
10. "Safety and Good House Keeping", N.P.C., New Delhi, 1985.

MEC18R5002	OCCUPATIONAL HEALTH AND HYGINE	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Occupational Diseases and Industrial Hazards.

Objective(s): This course aims to introduce the concept of Occupational Illness and Diseases present in Industrial Workers and hazards takes place in Industries.

Course Outcome(s)

CO1: Summarize a variety of physical hazards and safety standards for hazards.
CO2: Identify suitable techniques for the evaluation of chemical standards.
CO3: Dissect the biological and ergonomical hazards and tools.
CO4: Discover the concept of occupational health and toxicology.
CO5: Categorize the parameters of measurement of occupational physiology.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1						2	3					2	1	
CO2	1	2					2	3	1	2			2	1	
CO3	1						2	3	1	3			2	1	
CO4		2					2	3	3						
CO5								3	3						

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

PHYSICAL HAZARDS

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs- vibration, types, effects, instruments, surveying procedure, permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control- remedial measures to physical hazards

CHEMICAL HAZARDS

Recognition of chemical hazards-dust, fumes, mist, vapor, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard. Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education- environmental policy

BIOLOGICAL AND ERGONOMICAL HAZARDS

Classification of Bio hazardous agents –bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design- medical safety- Ergonomics-Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain- disorders of the neck- back injuries-Ergonomical Tools-RULA-REBANIOSH LIFTING Equations.

OCCUPATIONAL HEALTH AND TOXICOLOGY

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

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 – Motivation of employees, Insurance coverage of Industrial plant & personnel-categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.

REFERENCES

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

MEC18R5081	INDUSTRIAL SAFETY LAB	L	T	P	C
		0	0	4	2

Prerequisite: Recognize the well-known about safety PPEs and safety Techniques.

Objective(s): This course helps to operate the equipment, use PPE and acquire practical knowledge related to safety problems in industry

Course Outcome(s)

CO1: Explain the importance of various equipment to bring out the safety environment in the industry.

CO2: Identify the various causes of air pollution and apply suitable measurement techniques.

CO3: Carry out the various experiments and also to find out various environmental parameters from electrical hazards

CO4: Apply the various safety protection system inside the industry.

CO5: Recognize the various problems with the use of software and hence to predict the real situations on major accidents.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3													
CO2		3													
CO3	3		3					3		3		3	3	3	3
CO4	3			3				3		2				3	3
CO5			2		2			2		2		3	2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

NOISE LEVEL AND VIBRATION MEASUREMENT AND ANALYSIS

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

FRICTION AND IMPACT SENSITIVITY TEST

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

THERMAL REACTIVITY TEST

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

EXHAUST GAS MEASUREMENT AND ANALYSIS

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

BREATHING ZONE CONCENTRATION

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

AMBIENT AIR MONITORING

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

CONSEQUENCE ANALYSIS

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

ELECTRICAL SAFETY

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

SAFETY MANGEMENT

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

STUDY OF FIRST AID, PERSONAL PROTECTIVE EQUIPMENT AND FIRE EXTINGUISHERS

Respiratory and non-respiratory – demonstration – self-contained breathing apparatus -Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, apron and leg guard. Selection and demonstration of first-aid - fire extinguishers: soda acid, foam, carbon dioxide (CO_2), dry chemical powder, halon.

RISK ANALYSIS TECHNIQUES AND ERGONOMICS ANALYSIS TECHNIQUES

Risk Assessment in Process Industries, Ergonomics Analysis using RULA, REBA, NIOSH Lifting Equations, WERA and MOST Techniques.

MEC18R5082	TECHNICAL SEMINAR-I	L	T	P	C
		0	0	4	2

OBJECTIVES

- To develop journal paper reading and understanding skill.
- To improve communication and presentation skill of students

GUIDELINES

- The students are expected to make a presentation on the state of research on a particular topic based on current journal publications in that topic.
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Students are encouraged to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

SEMESTER II

PGM18R5001	RESEARCH METHODOLOGY FOR ENGINEERS	Credits			
		L	T	P	Total
		1	0	0	1

CO1: Relate and describe the ethical obligations associated with conducting research

CO2: Interpret and evaluate the modelling feature needed for the problem solving strategy.

CO3: Create and demonstrate the relation between frequency distributions and other graphs.

CO4: Developing algorithms to optimize the variables and to solve the problems arising in daily life.

CO5: Apply the knowledge acquired in writing and generating the a research report

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		1	1	1									1	1	

CO2	1	2	1											1	
CO3		1	1	1	2								1		1
CO4	1	2		1									1	1	
CO5	1		1	1	1		1						1		2

INTRODUCTION

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.

QUANTITATIVE METHODS FOR PROBLEM SOLVING

Statistical modeling and analysis, time series analysis probability distributions, Fundamentals of statistical analysis and interference, multivariate methods, concepts of correlation and regression, fundamentals of time series, analysis and spectral analysis, error analysis, applications of spectral analysis.

DATA ANALYSIS

Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, relation between frequency distributions and other graphs, preparing data for analysis.

SOFT COMPUTING APPLICATION

Computer and its role in research, Use of statistical software SPSS, GRETL etc in research. Introduction to evolutionary algorithms- fundamentals of genetic algorithms, simulated annealing, and neural network based optimization, optimization of fuzzy systems.

REPORT WRITING

Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing

TEXT BOOKS

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, VishwaPrakashan, 2006
2. Donald H.McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047-0,2006

REFERENCE BOOKS

1. Donald R.Cooper, Pamela S.Schindler, Business Research Methods, 8/e, Tata McGraw Hill Co.Ltd. 2006.
2. Fuzzy Logic with Engg Applications, Timothy J.Ross, Wiley Publications, 2nd Ed[d].
3. Simulated Annealing: Theory and Applications (Mathematica and its applications, by P.J.VanLaarhoven&E.H.Aarts[e]
4. Genetic Algorithms in search, optimization and machine learning by David E Goldberg

MEC18R5003	REGULATIONS FOR HEALTH SAFETY &	L	T	P	C

	ENVIRONMENT	3	0	0	3

Prerequisite: Basic knowledge of Legal's to implement in a various industries According to the Labor Department.

Objective(s) This course aims to deals with the safety standard which has been followed in industry and helps to know about the various accidents and safety measures in industry.

Course Outcome(s)

CO1: Identify the basic knowledge about factories act and Tamilnadu factories Rules

CO2: Compare the various environmental problems and apply Environmental act and rules.

CO3: Explain about the various hazardous during transportation and import of chemicals.

CO4: Apply various safety act and rules in Industry.

CO5: Interpret the Indian standards and UK standards employed in industry.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3													
CO2		2													
CO3	3		3					3		3		3	3	3	3
CO4	3			3				3		3				2	3
CO5			2		2			2		2		3			

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

FACTORIES ACT – 1948

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

ENVIRONMENT ACT – 1986

General powers of the central government, prevention, control and abatement of environmental pollution. Latest amendment for environmental act -Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures, Latest Amendments and rules

MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989

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

OTHER ACTS AND RULES

Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other

construction workers act 1996., Petroleum rules, Gas cylinder rules Explosives Act 1983-Pesticides Act, Latest Amendments and rules

INTERNATIONAL ACTS AND STANDARDS

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

REFERENCES

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

MEC18R5005	FIRE ENGINEERING AND EXPLOSION CONTROL	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about fire hazards inside the industry

Objective(s): This course aims to provide knowledge about the science of fire, explosion and various fire and explosion prevention systems and protective equipments.

Course Outcome(s)

CO1: Identify the basic concepts of fire and explosion science.

CO2: Explain the different source of ignition and their prevention techniques.

CO3: Apply various types of fire fighting techniques to various fire

CO4: Compare the various causes of explosion and apply the prevention techniques.

CO5: Classify the various explosion protection techniques and their significances to suit the industrial requirement.

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3													
CO2		3													
CO3	3		3					3		3		3	3	3	3
CO4	3			3				3		2				3	3
CO5			2		2			2		2		3	2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

PHYSICS AND CHEMISTRY OF FIRE

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

FIRE PREVENTION AND PROTECTION

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

INDUSTRIAL FIRE PROTECTION SYSTEMS

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

BUILDING FIRE SAFETY

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

EXPLOSION PROTECTING SYSTEMS

Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO2) and halons-hazards in LPG, ammonia (NH3), sulphur dioxide (SO), chlorine (CL) etc.

Text Book

1. Derek, James, Fire Prevention Hand Book, Butterworth's and Company, London,1986.

References

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

MEC18R5083	TECHNICAL SEMINAR-II	L	T	P	C

		0	**0**	**3**	**2**

OBJECTIVE:

To enrich the communication skills of the student through presentation of topics in recent advances in Industrial safety engineering/technology

OUTCOME:

- Students will develop skills to read, write, comprehend and present research papers.
- Students shall give presentations on recent areas of research in industrial safety engineering in two cycles. Depth of understanding, coverage and quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

MEC18R6097	**MINI PROJECT** **HAZAD ASSESSMENT IN INDUSTRY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVE:

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

OUTCOME:

- It helps the students to get familiarized with respect to design standards, design calculations and analysis in designing any mechanical component or system.
- Each student is required to select any new component or an integrated mechanical system

that involves various sub components which are to be designed as per design standards and further required to be analyzed for optimum dimensions with respect to the strength and stiffness.

SEMESTER III

MEC18R6007	**OHSAS 18000 and ISO 14000**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite: Basic Knowledge about the safety standards and procedures.

Objective(s):

- The course could provide the basic knowledge on Occupational Health and Safety Management System and Environmental Management System standards.
- To inculcate the knowledge on various terms and terminologies which are used in the Occupational Health, Safety and Environmental Management system.
- To educate about the various steps to be taken for certification of Occupational Health and Safety Assessment Series (OHSAS) and ISO14001 (Environmental Management Systems) standards.
- To impart knowledge on Environment Impact Assessment (EIA), Life Cycle Assessment of product and principles of Eco labeling.

Course Outcome(s)

CO1: Explain the various standards for maintaining the Health of the employee and for the maintenance of the Environment.
CO2: Compare the basic difference between the ISO 9000 series and OHSAS 18001 and ISO 14000 standards and the various clauses which governs the system in maintaining the standard.
CO3: Illustrate the sufficient knowledge on various clauses and subsequent preparation of procedures and related documents and could be able to apply their knowledge in preparing the OHSAS manual for getting the certification from the external certifying agencies.
CO4: Identify the knowledge on various standards and provide the skill in analyzing the various clauses and its suitability and applicability on the nature of organization.
CO5: Create their own systems and procedures in accordance with the standards and able to get the certification from the certifying body in their career.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3			1		3	3			2			2	
CO2		3		1			3	3	2					2	
CO3		3			1		3	3		2					
CO4		3			1		3	3	2						3
CO5		3		1			3	3		2			2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

OHSAS STANDARD

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

OHSAS 18001 POLICY AND PLANNING

Developing OH and S policy– Guidelines – Developments - procedure - Content of OH and S policy – General principle, strategy and planning, specific goals, compliance – methodology. Planning – Guidelines, methodology steps developing action plan – Analysis and identify the priorities, objective and Targets, short term action plan, benefits and cost of each option, Development of action plan.

IMPLEMENTATION AND OPERATION, CHECKING AND REVIEW

Guidelines for structure and Responsibilities-Top Management, middle level management, coordinator and employees - Developing procedures, identifying training needs, providing training, documentation of training-Training methodology -Consultation and communications-Checking and Review; performance measurement and monitoring, Proactive and Reactive monitoring-Measurement techniques, inspections, measuring equipment - Accidents Reports, Process and procedures, recording, investigation corrective action and follow up - records and records management-Handling documentation, information, records.

ISO 14001

EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001. Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing ISO14000-General principles of Environmental Audit, Auditor, steps in audit, Audit plan.

ENVIRONMENT IMPACT ASSESSMENT

ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco labeling) – History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco labeling before company attempts for its advantages. EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits. Audit-methodology, Auditors Audit results management review-Continual improvement.

TEXT BOOK:

1. The management systems, Quality, Environment, Health & Safety ISO9001:2000,ISO-14001,OHSAS 18001

REFERENCE

1. Occupational Health and Safety Assessment Series BS (OHSAS) 18001:2007
BSI, UK, 2007.
2. OHSAS 18002, Occupational Health and Safety Management Systems
–Guide lines for the implementation of OHSAS 18001, OHSAS project group, 2008.
3. ISO 14001:2004, Environmental Management Systems- Requirements with guidance for use, ISO, 2004.
4. Dr K.C. Arora. ISO 9000 to OHSAS 18001, S. K. Kataria & Sons, 2012.
5. Guidelines on Occupational Health and Safety Management Systems (OSH-MS)
International Labor Organization: 2001.
6. BS 8800: 2004 Occupational Health and Safety Management
7. ISO 9001, ISO 14001 and OHSAS 18001 Management Systems: Integration, Costs and Benefits for Construction Companies, Taylor and Francis publishers,
Volume 48, Issue2, 2005
8. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria and Sons, Delhi.

MEC18R6098	DISSERTATION PHASE - I	L	T	P	C
		0	0	20	10

METHODOLOGY OF THE PROJECT WORK:

The Student will identify and select a problem based on comprehensive literature survey. The student should submit a proposal and get it approved by the HOD. Three reviews will conducted by Project review committee. Students will be evaluated by the committee during the review and suggestions will be offered by members. The report for PHASE -I should be submitted by the students at the end of course.

SEMESTER IV

MEC18R6099	DISSERTATION PHASE – II	L	T	P	C
		0	0	32	16

Prerequisite: Recognize the well-known all safety Techniques and Methodology.

Objective(s) :

- To develop the skill of students for analyzing safety problems to control the hazard.
- To expose the students to identify and evaluate the hazards in an industry under study
- To expose the students to assess the Compliance level of safety norms and procedures

Course Outcome(s)

CO1: Conduct hazard analysis and suggest solutions to control risks. Course would be helpful for the students

CO2: Recognize the various norms and standards for an Industry.

CO3: Illustrate the students to assess the Compliance level of safety norms and procedures

CO4: Select the suitable measures to prevent hazards by referring the literature and comprehensive hazard analysis

CO5: Plan for publish his/her work in Scopus Index Journals.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3		3		3	3						3		3
CO2	2		3										1		2
CO3	1			2			2								1
CO4		2	3	2			2							1	
CO5			3		2									3	

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

METHODOLOGY OF THE PROJECT WORK:

It is the continuation of Phase I project Three reviews will conducted by Project review committee Students will be evaluated by the committee during the review and suggestions will be offered by members. At least one paper should be published by the student in international / national conference and reputed Journals (H Index Citation). The report should be submitted by the students at the end of course

LIST OF PROGRAM SPECIFIC ELECTIVES

MEC18R5004	COMPUTER AIDED HAZARD ANALYSIS	L	T	P	C
		3	0	0	3

Prerequisite: Principles of Safety Management

Objective(s):

- Identify the knowledge on risk, hazard and their assessment techniques in Industry To understand the principles of operation of various equipment for safety application
- To know the consequences of fire, explosion and toxic release
- To know the various software available for risk quantification
- To conduct a risk assessment technique in Industries.

Course Outcome(s)

CO1: Demonstrate the risk issues in industries and various risk assessment methods.
CO2: Illustrate the safety applications of diverse instruments used in the industries.
CO3: Interpret the utilization of different software for safety applications.
CO4: Examine the possibilities of effects by analyzing quantitative information on the risk and potential hazards.
CO5: Summarize various industrial accidents and past risk assessment reports.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		1	2	2		3			2		3	2	2
CO2	2	2						2					3	2	
CO3	2		2		3			2					3	2	
CO4	3	2			1			3				2	3	3	2
CO5	2	1		3				2					2		2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

HAZARD, RISK ISSUES AND HAZARD ASSESSMENT

Introduction, hazard, hazard monitoring-risk issue, group or societal risk, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation. Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis(PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems.

COMPUTER AIDED INSTRUMENTS

Applications of Advanced Equipment's and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter(ARC), Reactive Calorimeter(RC), Reaction System Screening Tool(RSST) - Principles of operations, Controlling parameters, Applications, advantages. Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

RISK ANALYSIS QUANTIFICATION AND SOFTWARES

Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - fire explosion and toxicity index(FETI), various indices – Hazard analysis(HAZAN)- Failure Mode and Effect Analysis(FMEA)- Basic concepts of Reliability- Software on Risk analysis, CISCON, FETI, HAMGARS modules on Heat radiation, Pool fire, Jet, Explosion. Reliability software's on FMEA for mechanical and Electrical systems. Hazard evaluation software aids, Risk Phast V 6.6 (DNV), Hazard Review LEADER, HAZOP manager, HAZOP+ (Reliability workbench), PHA manager, LOPA manager, PHA- Pro, FEME-Pro, ALOHA

CONSEQUENCES ANALYSIS

Logics of consequences analysis- Estimation- Hazard identification based on the properties of chemicals- Chemical inventory analysis- identification of hazardous processes- Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout.

CREDIBILITY OF RISK ASSESSMENT TECHNIQUES

Past accident analysis as information sources for Hazard analysis and consequences analysis of chemical accident, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster(1966), Port Hudson disaster- convey report, hazard assessment of nonnuclear installation- Rijnmond report, risk analysis of size potentially Hazardous Industrial objects- Rasmussen masses report, Reactor safety study of Nuclear power plant

REFERENCES

1. Frank P. Less, Loss Prevention in Process Industries, (Vol.I, II and III) ,Butterworth-Hein UK 1990
2. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
3. Course Material Intensive Training Programme on Consequence Analysis, by Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka and CLRI, Chennai. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
4. Brown, D.B., System analysis and Design for safety, Prentice Hall, 1976.
5. Hazop and Hazom, Trevor A Klett, Institute of Chemical Engineering, 1983.
6. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety, 1992
7. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AICHE 1992.

MEC18R5006	SAFETY IN ENGINEERING INDUSTRY	L	T	P	C
		3	0	0	3

Prerequisite: Recognize the hazards and safety measures in engineering industry

Objective(s):

- To know the safety rules and regulations, standards and codes
- To study various mechanical machines and their safety importance
- To understand the principles of machine guarding and operation of protective devices.
- To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
- Developing the knowledge related to health and welfare measures in engineering industry

Course Outcome(s)

CO1: Extend the knowledge in safety rules, standards and codes in various mechanical engineering processes

CO2: Design machine guarding systems for various machines such as lathe, drilling, boring, milling etc.

CO3: Illustrate the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes etc.,

CO4: Infer the knowledge in testing and inspection as per rules in boilers, heat treatment operations etc.,
CO5: Outline various preventive measures in health and welfare of workers' aspects in engineering industry.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3				3		3	3				3	2	2
CO2	3		3					3	2	3	1				
CO3	2	3					3			3			2		
CO4	3	3				3		3	3	2				3	3
CO5	3		3			2	2				3		3		3

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

PRINCIPLES OF MACHINE GUARDING

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing presses- forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.

SAFETY IN WELDING AND GAS CUTTING

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders-Precautions of Welding and gas cutting

SAFETY IN COLD FORMING AND HOT WORKING OF METALS

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers press brakes.

Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries,

foundry production cleaning and finishing foundry processes, Precaution to reduce hazardous in hot working

SAFETY IN FINISHING, INSPECTION AND TESTING

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

REFERENCES

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

MEC18R5007	SAFETY IN PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		3	0	0	3

Prerequisite: Basics of Safety Management

Objective(s):

- Students will be provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which include ventilation, comfort, lighting and its effect based on various nature of work.
- To provide the skill of handling the Manual material handling and lifting techniques of various shapes of machine and heavy objects.
- To give an input of handling the hazardous materials of liquid, sol-ids and cryogenic liquids with proper packing.
- The students will be provided with expert knowledge of arriving plant locations and creating the plant layout based on nature of industries and working conditions with better experience in material handling techniques.

Course Outcome(s)

CO1: Classify the safety parameters taken in to considerations for selecting the plant location.

CO2: Examine the diverse types of plant layout for different industries in accordance with safety requirements.

CO3: Illustrate the working conditions to be provided to the workers with safety considerations for better work quality.

CO4: Demonstrate the safety procedures to be followed in manual material handling process.

CO5: Summarize the hazard prevention techniques that to be implemented in mechanical handling process for avoiding accidents in the industry.

Mapping of COs with Pos

CO/	PO	PSO

PO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3						2					3	3	
CO2	2	3	2	2				2					3	3	
CO3	2	2		2		3		3					2	2	2
CO4	3	2	2					3	1				3	1	3
CO5	3	2	2					3	1				3	1	3

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

PLANT LOCATION

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants

PLANT LAYOUT

Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers. Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works

WORKING CONDITIONS

Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S, Welfare Facilities to workers.

MANUAL MATERIAL HANDLING AND LIFTING TACKLES

Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials – problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids -shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic and safety considerations Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection - ergonomic and safety considerations, Arresting Gears.

MECHANICAL MATERIAL HANDLING

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications - ergonomic and safety considerations Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks –

man lifts, construction, brakes, inspection - ergonomic and safety considerations, Storage and Retrieval of common goods of various shapes and sizes in a general store of a big industry.

TEXT BOOKS

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

REFERENCES

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

MEC18R5009	HUMAN FACTORS ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in workers behavior and attitude assessment in Industries..

Objective(s): This course aims to introduce the concept of ergonomical hazards present in industries and manual handling problems faced by employees in Industries..

Course Outcome(s)

CO1: Identify the basic knowledge of Ergonomics.

CO2: Analyze various aspects of human behavior.

CO3: Design of equipment's for standing and seated works.

CO4: Develop the efficiency of Manual Handling task and repetitive works for human.

CO5: Determine the solution to problems resulting for human performance and control measurements of virtual environments.

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2				1		2			3	3	2	3
CO2	2	1		1			2			2					2
CO3	2						1		1			1		2	2
CO4		2	1	1											
CO5		2	1						1			2			

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

ERGONOMICS AND ANATOMY

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the sprine and pelvis related to 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

HUMAN BEHAVIOR

Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction - Management theories of motivation, Job enrichment theory. Frustration and Conflicts - Reaction to frustration, Emotion and Frustration. Attitudes - Determination of attitudes, changing attitudes - Learning, Principles of Learning, Forgetting, Motivational requirements.

ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions Human factors in transportation systems (such as automobile, aviation)and medical systems

MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND MANUAL HANDLING TASK

Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs. Machine. Ergonomics interventions in Repetitive works, handle design, key board design- measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability STORAGE

HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS

A general information-processing model of the users, cognitive system, problem solving, effectiveness. Principles for the design of visual displays- auditory displays- design of controls-combining displays and controls- virtual (synthetic) environments, research issues.

REFERENCES

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

MEC18R5010	TRANSPORT SAFETY	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in road, rail and marine related safety procedures involved in industries.

Objective(s): This course aims to introduce the concept of transportation of hazardous materials and road safety for drivers by applying the safety standards.

Course Outcome(s)

CO1: Identify basic knowledge of transportation methods followed in industries.

CO2: Analyze various types of road ways available in Industries.

CO3: Demonstrate and preach the drivers self-safety.

CO4: Identify about the road safety signs, symbols and way of loading materials.

CO5: Explain about the maintenance of transport yards.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1			1		2			1	1	2		
CO2	2	1				2			2	1	2	1			
CO3	2	2	1			2		1			1	1	1	2	
CO4	2	1													
CO5	1	1	1					2							

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

TRANSPORTATION OF HAZARDOUS GOODS

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

ROAD TRANSPORT

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

DRIVER AND SAFETY

Driver safety programme – selection of drivers – driver training-tacho-graph-driving test driver's responsibility-accident reporting and investigation procedures-fleet accident frequency-safe driving incentives-slogans in driver cabin-motor vehicle transport workers act-road transport act and rules – driver relaxation and rest pauses – speed and fuel conservation – emergency planning.

ROAD SAFETY

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per km. factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds significance of speeds-Ground

speed-Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers – street lighting and illumination-overloading-concentration of driver. Plant railway: Clearance-track-warning methods-loading and unloading-moving cars safety practices.

SHOP FLOOR AND REPAIR SHOP SAFETY

Transport precautions-safety on manual mechanical handling equipment operations-safe driving-movement of cranes-conveyors etc., servicing and maintenance equipment-grease rack operation-wash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

REFERENCES

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

MEC18R5011	FIREWORKS SAFETY	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in chemicals used to produce crackers in fireworks Industries.

Objective(s) This course aims to introduce the concept of safety precautions and safety procedures followed in matchbox and fireworks industry.

Course Outcome(s)

CO1: Identify the basic knowledge in properties of Fireworks chemicals

CO2: contrast the static friction and dust present in fireworks.

CO3: Extend the standard followed in fireworks.

CO4: Illustrate the various material handling procedures.

CO5: Identify the Transportation safety and apply waste disposal method of crackers in fireworks.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2				1		2			3	3	2	3
CO2	2	1		1			2			2					2
CO3	2						1		1			1		2	2
CO4		2	1	1											
CO5	2						1		1			1		2	2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

PROPERTIES OF FIREWORKS CHEMICALS

Fire properties – potassium nitrate (KN03), potassium chlorate (KCl03), barium nitrate (BaNO3), calcium nitrate (CaNO3), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (A1) powder-Reactions-metal powders, Borax, ammonia (NH3) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.

STATIC CHARGE AND DUST

Concept-prevention-earthing-copper plates-dress materials-static charge meter lightning, Causes-effects-hazards in fireworks factories-lightning arrestor: concept-installation earth pit-maintenance-resistance-legal requirements-case studies. Dust: size-respirable, non-respirable-biological barriers – hazards – personal protective equipment – pollution prevention.

PROCESS SAFETY

Safe-quantity, mixing-filling-fuse cutting – fuse fixing – finishing – drying at various stages-packing-storage-hand tools-materials, layout: building-distances- factories act – explosive act and rules – fire prevention and control – risk related fireworks industries.

MATERIAL HANDLING

Manual handling and automated handling – wheel barrows-trucks-bullock carts-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material movement-go down-waste pit.

TRANSPORTATION

Packing-magazine-design of vehicles for explosive transports-loading into automobiles transport restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers-loose chemicals handling and transport.

WASTE CONTROL AND USER SAFETY

Concepts of wastes – Wastes in fireworks-Disposal-Spillages-storage of residues. Consumer anxiety-hazards in display-methods in other countries-fires, burns and scalds sales outlets-restrictions-role of fire service.

REFERENCES

1. Ronald Lancaster, “Fireworks, Principles and Practice”, Chemical Publishing Company, 4th edition, 2005.
2. K.N.Ghosh, “Principles of fireworks”, H.Khatsuria, Sivakasi, 1987.
3. J.A.Purkiss, “Fire Safety Engineering”, Butterworth-Heinemann, 2nd edition, 2006.
4. Bill of Ofca, “Fireworks Safety manual: a collection of essays” B & C Products, 1991
5. John Barton C Chem. FRSC, “Dust Explosion Prevention and Protection: A Practical Guide”, Gulf Professional Publishing, 1st edition, 2002.
6. Goeff Lunn, “Guide to Dust Explosion Prevention and Protection”, Butterworth Heinemann, 2nd edition, 1992.
7. Alan St. H Brock, “A history of fireworks”, G.G. Harrap publishers, 1st edition, 1949
8. “Proceedings of National seminar on Fireworks Safety-1999”, MSEC-1999.

MEC18R5012	SAFETY IN ON AND OFF SHORE DRILLING	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Safety in Oil wells and Drilling Process.

Objective(s): This course aims to introduce the concept of Manufacturing process of petroleum products and operation hazards present in these field and erection of oil plants, storage and Extraction Process

Course Outcome(s)

CO1: Demonstrate the basic Knowledge of Manufacturing Process of Petroleum Products
CO2: Analyze the various Hazards Operations involved in on and off shore Construction activities
CO3: Examine the Drilling Equipments and its Hazards Work Functions
CO4: Determine the Safety Precautions involved in oil wells during Extraction and Transportation
CO5: Formulate the Procedure and Process involving in Oil and Gas Well Drilling Technology

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	3	3								2	2	
CO2	2	3	3	2	2						2				2
CO3	3	3	2	3	2						2		2	3	
CO4	3	3	2		3					2					
CO5	3	3		2						2	3			3	

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

PRODUCTS

Petroleum and Petroleum products – Fuels- Petroleum solvents – Lubricating oils – Petroleum wax, greases – Miscellaneous product-Physical and Chemical Behavior of Petroleum Products-Applications.

OPERATIONS AND HAZARDS

On and off shore oil operation – Construction of Installation – Pipe line Construction – Maintenance and repair activities – Safety and associated hazards-Material Used for Construction in Off-Shore Oil Operations and its Properties.

DRILLING EQUIPMENTS AND HAZARDS

Drilling oil – Technique and equipment- Work position –Working condition – safety and associated hazards- lighting and its effects –List out the Hazards and its effects-Remedial Measures for Controlling the Hazard.

EXTRACTION AND TRANSPORT

Petroleum Extraction and transport by sea – Oil field products – Operation – Transport of crude by sea – Crude oil hazards-Storage Petroleum product storage and transport –Storage equipment –Precaution –Tank cleaning-Storage process-Types of transportation Equipment used for Transport.

OIL AND GAS WELL DRILLING TECHNOLOGY

Well planning-Drilling method-Drilling rigs Rig operating systems-Drilling fluids function and properties-Drilling fluid maintenance equipment-Oil & gas well cementing operations-Drill bit types and their applications-Drill string & Casing string function, operations, selection & design-Drilling problems, their control & remedies-Directional drilling tools-Directional survey-Application of horizontal, multilateral, extended reach, slim wells.

REFERENCES

1. Encyclopedia of Occupational Health and Safety, Vol. I & II International Labour Organization, Geneva, 1985.
2. D.A. Ardus and C.D. Green, "Safety in Offshore Drilling: The Role of Shallow Gas Surveys (Advances in Underwater Technology, Ocean Science and Offshore Engineering)", Springer, 1st edition, 1990.
3. Jan-Erik Vinnem, "Offshore Risk Assessment: Principles, Modeling and Applications of QRA Studies", Springer, 1st edition, 2010.
4. Ian Sutton,"Offshore Safety Management (Second Edition) Implementing a SEMS Program, Science Direct 2013

MEC18R5013	SAFETY IN TEXTILE INDUSTRY	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in textile process and safety procedures followed in Textile mills.

Objective(s) : The course aims about the basic knowledge and the concept of process involved in textile mills, Machinery, hazards and knowledge on health and welfare activities specific to the Textile industries as per the factories act.

Course Outcome(s)

CO1: Illustrate the overall picture about the textile industries and its operations
CO2: Discover the various hazards involved in looming section.
CO3: Classify the various hazards involved in effluent treatment process.
CO4: Find the solution to problems resulting for health and welfare in textile.
CO5: Apply the factories act and rules for textile industry.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2									1			2		
CO2	2				2								2		
CO3		3	3		3					1					
CO4	2		3		2					1			2	3	
CO5					2					1			2		2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION

Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.

TEXTILE HAZARDS-I

Accident hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttles looms iii) knitting machines iv) nonwovens.

TEXTILE HAZARDS-II

Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes. Occupational health hazards in textiles industry

HEALTH AND WELFARE

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

SAFETY STATUS

Relevant provision of factories act and rules and other statues applicable to textile industry – effluent treatment, waste disposal and Toxicity –Acute toxicity-Chronic toxicity in textile industry.

REFERENCES

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

MEC18R5014	INDUSTRIAL NOISE AND VIBRATION CONTROL	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about noise and its control in inside the industry.

Objective(s):

- To provide the student about the basic knowledge about the noise and vibration.
- To enforce the knowledge on human ear parts and acoustic noise.
- To understand the various sources of noise and propagation.
- To know about the methods of noise control and abatement.

Course Outcome(s)

CO1: Illustrate the basics of noise and vibration hazards.
CO2: Demonstrate the human ear instrumentation and auditory
CO3: Analyze the various noise sources and propagation.
CO4: Classify the noise control methods and prevention from noise hazards.
CO5: Outline about the basics of noise and vibration causes hazards.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2		2				3	1			2		
CO2	3	2		2									2		
CO3			1						3	3					
CO4	3	2	3	2	3					3			2		
CO5	3	3	2		1								2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION

Basic definitions and terminology used in Vibrations and acoustics – Mathematical concepts and degrees of freedom in vibratory systems – Natural frequencies and vibration modes – continuous systems and wave theory concept – wave equation and relation to acoustics - theory of sound propagation and terminology involved – Plane wave and spherical waves – Concepts of free field and diffuse field, near field and far field – frequency analysis and vibration and noise spectrum – Signature analysis and condition monitoring.

INSTRUMENTATION AND AUDITORY

Sensors used in vibration and measurements – Frequency and spectrum analyzers – Weighting networks – Hearing mechanism- Types of ear protection– relation between subjective and objective sounds – Auditory effects of noise and audiometric testing – Speech interference levels and its importance.

SOURCES OF NOISE AND RATINGS

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

NOISE CONTROL

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

ABATEMENT OF NOISE

Trend of abatement of noises, Noise abatement approaches, Active noise attenuators and scope for abatement of industrial noise.

TEXT BOOK

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

REFERENCES

1. Irwing B Crandall, Theory of Vibrating Systems and Sound, D. Vannostrand Company, New Jercy, 1974.
2. Cyril M. Harris, Hand Book of Noise Control, McGraw Hill Book Company, New York, 1971.
3. White R. G. Walker J. G, "Noise and Vibration", John Wiley and sons New York, 1982.
4.

MEC18R5015	WORK STUDY AND ERGONOMICS	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about human and working environment in inside the industry.

Objective(s):

- To understand the basic knowledge on working methods in Industry.
- To enable the students to learn about ergonomics.
- To enable students to learn about uses of personal protection equipment.
- To know the importance of Human Behavior in Industry

Course Outcome(s)

CO1: Interpret the role of work study and method study in workplace
CO2: Explain the importance of ergonomics in industries.
CO3: Summarize the need of various types of PPE used in Industry.
CO4: Contrast the equipment design and human safety
CO5: Outline the need of human behavior in industry.

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3							3	2					
CO2	3	3	3	3			3						2		
CO3				3				3	3	3			3	3	2
CO4	3		3	3						1	3		3	2	2
CO5	2	2	3	3			3	2			3		1		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

WORK STUDY

Study of operations – work content – work procedure – breakdown – human factors – safety and method study – methods and movements at the workplace – substitution with latest devices – robotic concepts – applications in hazardous workplaces – productivity, quality and safety (PQS),Work Measurement -Work measurement objectives, Techniques & criteria for selection of technique.

ERGONOMICS

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

PERSONAL PROTECTION

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

PROCESS AND EQUIPMENT DESIGN

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

MAN MACHINE SYSTEMS

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

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

TEXT BOOK

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

REFERENCES

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

MEC18R5016	RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about reliability of the product

Objective(s):

- To provide in depth knowledge about the concept of reliability equipment.
- To gain the knowledge on various reliability prediction modeling.
- To recognize techniques to maintain reliability in Industrial.
- To develop knowledge on risk assessment

Course Outcome(s)

CO1: Identify the various reliability concepts

CO2: Evaluate the various failure data analysis

CO3: Develop the students to effectively conduct risk assessment study by applying reliability in hazardous industries

CO4: Recognize techniques to maintain reliability in Industrial

CO5: Develop knowledge on risk assessment study

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

CO1	2	2	2	1		1	1				1		1		
CO2	3	3	3	3	1						1		2	2	
CO3	2	2	3	2	1								3	2	
CO4	2	2	2							1			2	1	
CO5	3	2	2	1					1		1			1	

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

RELIABILITY CONCEPT

Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – A priori and a posteriori concept - mortality curve – useful life – availability – maintainability – system effectiveness.

FAILURE DATA ANALYSIS

Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting. Failure severity ranking using Risk Priority Number (RPN)

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. Hazard analysis and Failure Modes Effect Analysis (FMEA)

RELIABILITY MANAGEMENT AND RISK ASSESSMENT

Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model.

Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment. Failure severity ranking using Risk Priority Number (RPN)

HUMAN RELIABILITY ANALYSIS

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

REFERENCES

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

MEC18R5017	**PROBABILISTIC SAFETY ASSESSMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite: Basic knowledge about reliability of the product

Objective(s):

- To provide in depth knowledge about the concept of Probability analysis.
- To gain the knowledge on various accident analysis methodology.
- To recognize techniques to maintain a system safety
- To apply the methodology in real Industrial applications

Course Outcome(s)

CO1: Identify the knowledge of mathematical probability analysis.
CO2: Analyze the accidental methods
CO3: Develop knowledge on risk assessment
CO4: Apply real hazardous system in Industry.
CO5: Apply the methodology in real Industrial applications

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2											1		
CO2	3	3	3		2	1									
CO3	3	3	3				3		2		2				
CO4	3	3	3		2	2		2	3	3	3			2	
CO5					2										3

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION TO PROBABILISTIC SAFETY ASSESSMENT

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

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

SYSTEM & ACCIDENT ANALYSIS METHODS

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

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

ACCIDENT CONSEQUENCE ANALYSIS

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

Nuclear Accident Consequence Analysis: -Meltdown Process -Source Terms for In-Plant Radionuclide Transport- Ex-Plant Transport of Radionuclide-Case Study-Aviation –Airplane Crash Risks

LEVELS OF PSA

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

APPLICATIONS OF PSA

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

TEXT BOOKS

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

REFERENCE

1. International Atomic Energy Agency. "Applications of probabilistic safety assessment (PSA) for nuclear power plants"-IAEA-TECDOC-1200, Vienna, Austria, February 2001
2. International Atomic Energy Agency. "Living probabilistic safety assessment (LPSA)-IAEA-TECDOC-1200, Vienna, Austria August 1999
3. Pekka Pey, Human reliability analysis methods for probabilistic safety assessment, VTT Automation, Technical research centre of Finland, December 2000
4. "Probabilistic Safety Assessment and Management" PSAM 7 –ESREL'04 June14-18 2004, Berlin Germany

MEC18R5018	BIOMECHANICS AND HUMAN BODY VIBRATION	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about biomechanics and humanbody motion in inside the industry.

Objective(s):

- To teach the fundamental principles that characterize life and bio systems
- To introduce students to cutting-edge bioengineering research method.
- To relate fundamental bioengineering approaches to health-related biomedical research.
- To teach how biology impacts engineering and bio-nanotechnology

Course Outcome(s)

CO1: Demonstrate the basic principles that characterize living system

CO2: Organize the muscular skeletal system and anthropometry in biomechanics
CO3: Examine the modern, quantitative, experimental research methods in bioengineering
CO4: Evaluate the societal impact of biomechanical models in safety engineering
CO5: Improve the fundamental bio engineering approaches to health related biomedical research.

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	2					2			3		
CO2	3	2	2	2	3					3	3			2	
CO3	3	2	2	2			2					2			2
CO4		3	2		2						2		3		
CO5	3	3	2		3		2			1		2		3	

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

VIBRATION

Basic principle-Introduction, vibration exciters, control systems, Performance specification, motion sensors and transducers-Types of vibration measuring instruments in human body and its applications.

MUSCULAR SKELETAL SYSTEM AND ANTHROPOMETRY IN BIOMECHANICS

Introduction, structure and function of musculoskeletal system - Connective Tissue, Skeletal Muscle, Joints Measurement of body segment, physical properties, Anthropometric data for biomechanical studies in industry-Methods of anthropometric data collection-Some case studies for the MSD remedial measures.

MECHANICAL WORK CAPACITY EVALUATION AND BIOINSTRUMENTATION

Joint motion, human motion analysis system, applied electromyography, intra discal pressure measurement, inter abdominal measurement, force platform system, whole body vibration measurement-Human work measuring equipment-Advantages and disadvantages-Applications on various fields.

BIOMECHANICAL MODELS

Planar static biomechanical models, static 3D modelling, dynamic biomechanical models, special purpose biomechanical models-3D modelling evaluation and data estimation-Applications.

WHOLE BODY AND SEGMENTAL VIBRATION

Vibration on human body, whole body vibration, Hand-Transmitted Vibration, segmental vibration, vibration exposure criteria- Hand transmitted vibration/Segmental Vibration recording instruments-Types, application.

REFERENCES

1. Vibration and Shock Handbook, Clarence W. De Silva, Taylor and Francis Group, 2005
2. Occupational Biomechanics, Don B. Chaffin and Gunnar B.J.Andersson, John Wiley and sons, Inc
3. Biomechanics in Ergonomics,Shrawan Kumar,CRC Press, 01-Apr-1999 - Medical.

4.Effect of Mechanical Vibrations on Human Body, Mohammad AlShabi, World Journal of Mechanics
Vol.06 No.09(2016), Article ID:70778,32 pages .
5.The Effect of Whole-Body Vibration Frequency and Amplitude on the Myoelectric Activity of Vastus, Medialis and Vastus Lateralis,Grzegorz Juras,Journal of Sports Sciene Medicine. 2011 Mar; 10(1): 169–174.Published online 2011 March.

MEC18R5019	CORROSION ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: To about the chemical composition and properties of metals.

Objective(s):

- To introduce the principles of corrosion, common corrosion forms, corrosion control methods, and material selection to reduce corrosion cost.
- Provide Fundamental understanding of aspects of electrochemistry and materials relevant to corrosion phenomena.
- Provide Methodologies for Predicting, Measuring and analyzing corrosion performance of materials.
- Identify practices for the prevention and remediation of corrosion.

Course Outcome(s)

CO1: Describe the basics principles of corrosion phenomenon.
CO2: Classify the different forms of corrosion
CO3: Illustrate the various techniques to prevent the corrosion
CO4: Infer the forms of corrosion by appropriate testing methods.
CO5: Summarize the corrosion in various industry

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2									1			2		
CO2	2				2								2		
CO3		3	3		3					1					
CO4	2		3		2					1			2	3	
CO5					2					1			2		2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

PRINCIPLES

Principles of corrosion phenomenon: Thermodynamics and kinetics: emf/galvanic series, Pourbaix diagram, exchange current density, passivity, Evans diagram, flade potential.

TYPES OF CORROSION

Different forms of corrosion: atmospheric/uniform, pitting crevice, intergranular, stree corrosion, corrosion fatigue, dealloying, high temperature oxidation-origin and mechanism with specific examples.

CORROSION PREVENTIONS

Corrosion prevention through design, coatings, inhibitors, cathodic, anodic protection, specific applications, economics of corrosion control.

CORROSION TESTING AND MONITORING

Non-Electrochemical and Electrochemical methods: weight loss method, Tafel Linear polarization and Impedance techniques, Lab, semi plant & field tests, susceptibility test.

CORROSION & ITS CONTROL IN INDUSTRIES

Power, Process, Petrochemical, ship building, marine and fertilizer industries. Some case studies-Corrosion and its control in different engineering materials: concrete structures, duplex, super duplex stainless steels, ceramics, composites and polymers. Corrosion auditing in industries, Corrosion map of India.

REFERENCES

1. Pierce R.Roberge, Hand Book of Corrosion Engineering, McGraw Hill, 2005
2. ZakiAnand, Principles of Corrosion Engineering and Corrosion Control, Oxford Press, 2006
3. R.WinstonRevie, Corrosion and Corrosion Control, John Wiley & Sons INC, 2008
4. Fontana. M.G., Corrosion Engineering, Tata McGraw Hill, 3rd Edition, 2005.
5. Jones.D.A. Principles and Prevention of Corrosion, 2nd Edition, Prentice Hall, 1996.

MEC18R5020	RISK AND RELIABILITY FOR OFFSHORE STRUCTURE	L	T	P	C
		3	0	0	3

Prerequisite: Reliability Engineering, Safety In ON & OFF Shore Drilling.

Objective(s): To understand the various types of hazards involved in ON & OFF Shore Structures that can be controlled by using the reliability concepts.

Course Outcome(s)

CO1: Identify the Environmental problems involved in Off shore structures and assess by using various Management Tools.

CO2: Develop a Risk Assessment Models using Various safety Tools and Techniques.

CO3: Examine the types of risks using the Reliability Concepts.

CO4: Identify the safety Precautions Followed in Off Shore Wells.

CO5: Apply the safety techniques to predict the various types of risk involved in Off Shore Structures.

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1		1									1	2	
CO2		2	3										3	2	
CO3		2	3											3	
CO4	3												2	1	

CO5	3	2	3										1	2	

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

ENVIRONMENTALISSUESANDMANAGEMENT

Environmental impact and management Impact of oil and gas industry in marine environment Oil hydrocarbons in marine environment Chemical disposal of offshore industry and environmental management Dispersion models and atmospheric pollution Dispersion models continued.. Hazard assessment

ACCIDENT MODELING, RISK ASSESSMENT & MANAGEMENT

Dose assessment, safety regulations Toxic releases- models and methods Chemical risk analysis Quantitative risk assessment Fire and explosion models Flammability diagrams Fire and explosion: prevention methods Event tree and fault tree analyses Process safety management Software used in HSE

RELIABILITY & TESTING METHODS.

Levels of reliability Reliability estimates FOSM, AFOSM and application problems Codes of practice of safety check Reliability bounds of structural systems Treatment of geometric variables Probabilistic methods of code calibrations

OPERATIONAL SAFETY

Introduction to HSE Safety assurance- Safety in design and operations organizing for safety Hazard classification and assessment, Hazard evaluation and control Hazop FMEA

APPLICATIONOFOFFSHORESTRUCTURES

Stochastic process Gaussian process Risk assessment Hazard identification ETA, FTA Risk modeling and Risk picture Probabilistic risk assessment

TEXTBOOKS:

1. Almond R.G. An extended example for testing graphical belief, Technical Report No. 6.1992.
2. Chakrabarti, S.K. 1990. Non-linear Method in Offshore Engineering, Elsevier Science Publisher,TheNetherlands.
3. Chakrabarti, S.K. 1994. Offshore Structure Modeling: World Scientific, Singapore.
4. Chandrasekaran, S. and Bhattacharyya, S.K. 2011. Analysis and Design of Offshore Structures. HRD Center for Offshore and Plant Engineering (HOPE), Changwon National University, Republic of Korea, pp. 285.
5. Cowell RG, Dawid AP, Lauritzen SL, Spiegelhalter DJ. Probabilistic networks and expert systems. New York: Springer; 1999.
6. Gelman A, Carlin JB, Stern HS, Rubin DB. Bayesian data analysis. London: Chapman & Hall; 1995. p. 1-526.
7. Halder, A. and Mahaderan, S., "First order and Second order Reliability Method" Probabilistic Structural Mechanics Hand Book, Edited by C. (Raj) Sundararajan, Chapman and Hall, PP. 27-52, 1995.
8. Jensen FV. Bayesian networks and decision graphs. New York: Springer; 2001.

MEC18R5021	SAFETY IN CHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Safety in Chemical Industry Process plant, commissioning, Handling, Storage and Transportation.

Objective(s): This course aims to introduce the concept of Chemical Safety in Industries and know the handling of Chemicals and storage, Transportation.

CO1: Extend the use of safety standards in designing the pressure systems.
CO2: Dissect the procedures of plant commissioning in safety industries.
CO3: Choose the concepts of planning and maintenance in emergency.
CO4: Inspect the various storage systems in chemical industries.
CO5: Adapt a suitable plant operation by following safety standards

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1								3	2						3
CO2								3	3					3	
CO3								3	2					2	
CO4								3	3					3	1
CO5								3	3					1	3

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN

Design process, conceptual design and detail design, assessment, inherently safer design- chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipment's, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system– Use of PLC to detect hazards and taking preventive actions.

PLANT COMMISSIONING AND INSPECTION

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation Plant inspection, pressure vessel, pressure piping system, nondestructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

PLANT MAINTENANCE, EMERGENCY PLANNING AND DISASTER MANAGEMENT

Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems- controls of modifications. Disaster Management- disaster planning, Emergency Planning- onsite emergency- offsite emergency, APELL

STORAGES AND TRASPORTATION

General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection- LPG storages, pressure storages, layout, instrumentation, vaporizer, refrigerated storages- LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder storage-

ware house, storage hazard assessment of LPG and LNG Hazards during transportation – pipeline transport. Cascaded N-capacities – Nuclear Chemical wastes transportation & Storage

PLANT OPERATIONS AND MANAGEMENT

Plant management-Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation, refinery units-operation of fired heaters, driers, storage- operating activities and hazards- trip systems-exposure of personnel. Multi-loop control for distillation column and boiler systems. Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petro- chemical, rubber, fertilizer and distilleries.

TEXT BOOK

1. Lees, F.P., Loss Prevention in Process Industries, Butterworth's and Company, 1996

REFERENCES

1. Guidelines for Chemical Process Quantitative Risk Analysis by Center for Chemical Process Safety (CCPS), Wiley-AIChE; 2 editions 1999
2. Fawcett, Howard H., Wood William. S., Safety and Accident Prevention in Chemical Operations, Wiley inters, Second Edition, 1984.
3. Roy E. Sanders, Chemical Process Safety - Learning from Case Histories, Elsevier Butterworth–Heinemann, USA, 2005.
4. "Accident Prevention Manual for Industrial Operations" NSC, Chicago, 1982. 5. Green, A.E., High Risk Safety Technology, John Wiley and Sons,. 1984.
6. Johnson.C.D., Process control instrumentation technology, PHI learning pvt. Ltd., New Delhi, 2010
7. Petroleum Act and Rules-1934, Government of India.
8. Carbide of Calcium Rules-1987, Government of India

MEC18R5022	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

Prerequisite: Electrical Circuits and Electronic Devices

Objective(s): This course aims to safeguard the Electrical and Electronics Equipments from the Overvoltage and Explosion hazards

Course Outcome(s)

CO1: Demonstrate the basic Knowledge of Electrical safety and Regulations employed in Electrical Inspectorate.

CO2: Analyze the causes of electrical hazards involved in electrical Equipments used in industries.

CO3: Examine the electrical Equipments from various types of safety protection systems.

CO4: Identify the selection and maintenance procedures to install a new equipment in Industries.

CO5: Categorize the various hazardous zones for an electrical hazards and suggest a suitable recommendations.

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3					2		3					3		

CO2	3							3					3		1
CO3	3			2				3					3	1	
CO4	3				2			3					3		
CO5	3			2				3					3	1	

Mapping of COs with POs

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION AND STATUTORY REQUIREMENTS

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

ELECTRICAL HAZARDS

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications- excess energy-current surges-Safety in handling of war equipment's-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity – definition, sources, hazardous conditions, control, causes of fire and explosion-ionization, spark and arc-ignition energy-Lightning, hazards, lightning arrestor, installation – earthling, specifications, earth resistance, earth bit maintenance.

PROTECTION SYSTEMS

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no-load protection-earth fault protection - earthling devices. Flame Retardant Low Smoke (FRLS) insulation-insulation and continuity test-system grounding-equipment grounding- earth leakage circuit breaker (ELCB)-cable wires maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-personal protective equipment – safety in handling hand held electrical appliance stools and medical equipment's.

SELECTION, INSTALLATION, OPERATION AND MAINTENANCE

Role of environment in selection-safety aspects in application - protection and interlock self-diagnostic features and fail safe concepts-lock out and work permit system-discharge rod -safety in the use of portable tools-cabling and cable joints- preventive maintenance.

HAZARDOUS ZONES

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

TEXT BOOK

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

REFERENCES

1. Accident prevention manual for industrial operations, National Safety Council, N.S.C., Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India.

3. Power Engineers – Handbook of TNEB, Chennai, 1989. Martin Glov., Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd., England, 1988.

MEC18R5023	ENVIRONMENTAL SAFETY	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Environmental Education and pollution in Process Industries

Objective(s): This course aims to introduce the concept of Environmental Pollution like air, Water pollution and solid hazardous waste management in Industry.

Course Outcome(s)

CO1: Identify the basic knowledge of air pollution.

CO2: Explain about the water pollution in industries.

CO3: Develop the Process of hazardous waste management in Industries.

CO4: Discover the solution to problems for environmental pollution by using measurement control actions.

CO5: Develop the control measures of various process Industries.

Mapping of COs with POs

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		1	2			3			3						
CO2				2		3	1		3	2					
CO3						3			3	2			3		
CO4			2	1		3			3		2		3		
CO5		1				3	3		3				3		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

AIR POLLUTION

Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution-hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation-ozone holes-automobile exhausts-chemical factory stack emissions-CFC.

WATER POLLUTION

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

SOLID AND HAZARDOUS WASTE MANAGEMENT

Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-processing and energy recovery – waste minimization, health hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse.

ENVIRONMENTAL MEASUREMENT AND CONTROL

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

POLLUTION CONTROL IN PROCESS INDUSTRIES

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

TEXT BOOK

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

REFERENCES

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

MEC18R6001	NUCLEAR ENGINEERING AND SAFETY	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in nuclear physics and safety concepts

Objective(s):

- The objective of this course is to make students familiar with the important concepts applicable to reactor safety methods, analysis and NRC rules and procedures.
- To introduce to the students, the various opportunities in the emerging field of Nuclear Engineering.

Course Outcome(s)

CO1: Identify the basic knowledge of Nuclear physics and nomenclature and measuring instrument.

CO2: Summarize various methods and systems used for reactor control.

CO3: Analyze various events in globe happened nuclear reactors and facilities.

CO4: Discover the various safety regulations followed by international bodies.

CO5: Apply various safety regulations followed in India during employment

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1									1	2		
CO2	2	2	1	1								1	2		
CO3	2	2	2	2	3							1	2		

CO4	2	2	1	2	3							2	2		
CO5	2	2	1	1								2	2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION

Nuclear mass and stability: Nuclear mass, nuclear structure, binding energy, Nuclear stability, mass parabolas - Deriving the semi-empirical mass formula - Radioactive decay: Alpha, beta, and gamma decay; decay schemes, internal conversion, electron capture - Decay energetic, general kinematics and the Q-equation, 99Tcm, medical imaging, positron annihilation spectroscopy (PAS), exponential decay, half-life, Successive decays, New and old Cesium source measurement– thermal utilization – criticality.

REACTOR CONTAINEMNT

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 – Passive Containment Cooling System, Containment Isolation System, Passive Core Cooling System - online central data processing system - Main Control Room Emergency Habitability System - Radiation shielding – radiation dose – dose measurements – units of exposure – exposure limits.

ADVANCED REACTOR TYPES AND HISTORY OF EVENTS IN NUCLEAR REACTORS AND FACILITIES

Advanced reactor – EPR, ABWR, ESBWR, AP-1000, Pebble Bed Reactor - INES Scale, TMI, Chernobyl, Fukushima, Wind scale, Thorp Reprocessing - Kshtym, Vandellos, Tokaimura, NRX, David Besse, Enrico Fermi, Narora Fire, Monju and FBTR Sodium Leak, Radiation over exposures in Industry and Medical applications

SAFETY OF NUCLEAR REACTORS and NUCLEAR REGULATIONS

Safety design principles – engineered safety features – site related factors – safety related systems – heat transport systems – reactor control and protection system – fire protection system – Rules of practice for domestic licensing proceedings and issuance of orders, Interpretations, Criteria and procedures for determining eligibility for access to or control over special nuclear material

SAFETY REGULATION IN INDIA

Atomic Energy Regulatory Board, functions, safety Documents, Safety Review of site, design, regulatory inspections, safety review for PFBR, Koodankulam - Regulatory review of operating plants, Licensing stages, licensing of operating personnel, Training simulator, safety up-gradation Review after TMI Chernobyl, Review after Fukushima, safety review for decommissioning, Safety Review of Radiation Facilities, medical X-ray units, Gamma irradiators.

REFERENCES

1. 1.M.M.EL.Wakil, Nuclear Power Engineering, (McGraw-Hill Series in Nuclear Engineering), McGraw-Hill Book Company, Inc., 1962
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. R.L.Murray, Introduction to Nuclear Engineering, Prentice Hall, New York, 1954.
5. K.Sri Ram, Basic Nuclear Engineering, Wiley Eastern Ltd., New Delhi, 1990.
6. Loffness, R.L., Nuclear Power Plant, Van Nostrand Publications, 1979.

7. Governmental Industrial Hygiene, USA, 1984.

MEC18R6002	SAFETY IN MINES	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Safety Management MEC5401

Objective(s): To acquire the knowledge about the handling of safety equipments in mines and accidental issues and preventive measures carried out in mines.

Course Outcome(s)

CO1: Illustrate the basic knowledge of safety in mines and mining equipments handling

CO2: Analyze the working conditions involved in underground mines

CO3: Discuss about the tunneling and accidental issues in tunnels

CO4: Evaluate and prepare the enquiry report of a mines and risk factor calculation

CO5: Analyze the major accident occurred in mines and preventive measures

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3						3					2	3	2
CO2	2	2						1	2				2	2	2
CO3	2	2	3	2				2	2				3	3	2
CO4				2		2		2		2			2	3	2
CO5	3		2	3		2		2		2			2	3	3

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

OPENCAST MINES

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

UNDERGROUND MINES

Fall of roof and sides-effect of gases-fire and explosions-water flooding-warning sensors-gas detectors-occupational hazards-working conditions-winding and transportation.

TUNNELLING

Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts) – trapping –transport-noise-electrical hazards-noise and vibration from: pneumatic tools and other machines – ventilation and lighting – personal protective equipment.

RISK ASSESSMENT

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

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. Accident case studies Benxihu Colliery Disaster (1942)–China, Courrieres Coal Mine Disaster(1906)–France, Dhanbad Coal Mine Disasters (1965 and1975)-India

REFERENCES

1. Michael Karmis ed., Mine Health and Safety Management, SME Transactions, Littleton, Co.2001.
2. Kejiriwala, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.
3. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan-DHANBAD, 2002.
4. Fred G. Bell, J. Laurance, Mining and its impact on environment, Taylor and Francis,2006.

MEC18R6003	DOCK SAFETY	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Regulation for Health, Safety and Environment MEC5403

Objective(s): To acquire the knowledge in learning of safety legislation related to dock activities in India

Course Outcome(s)

CO1: Identify the safety status and rules followed in dock safety

CO2: Analyze the safety process in ships and precautions to be followed in ships

CO3: Identify the process of safety followed in lifting applications

CO4: Analyze the safety in loading and unloading of goods

CO5: Evaluate the safety in ports and checking of goods in storage area

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1							2		2			1	2	3
CO2	2			3				2		1			1	3	3
CO3	1			2				3		2			1	3	3
CO4	1						2	2		2			1	2	3
CO5	1						3	1		2			1	3	3

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

HISTORY OF SAFETY LEGISLATION

History of dock safety statues in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under - manufacture,

storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989 – few cases laws to interpret the terms used in the dock safety statues.

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

WORKING ON BOARD THE SHIP

Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships – safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hole of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like fort-lift trucks-pay loaders etc.

LIFTING APPLIANCES

Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances – portainers – transtainers – top lift trucks – derricks in different rigging etc.

Use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears.

TRANSPORT EQUIPMENT

The different types of equipment for transporting containers and safety in their use-safety in the use of self loading container vehicles, container side lifter, fork lift truck, pay loaders etc., dock railways, conveyors and safety and ports.

Safe use of special lift trucks inside containers – examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation

Handling of different types of cargo – stacking and unstacking both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.

GENERAL ACTION PLAN FOR DOCK WORKERS

Dock workers (SHW) rules and regulations 1990- related to various appliances-Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of dock workers, responsible persons – authorized person etc., Emergency action Plans for fire and explosions – good storage at Port area and hazardous chemical safety – collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report.

REFERENCES

1. Safety and Health in Dock work, 2nd Edition, ILO, 1992.
2. "Dock Safety" Thane Belapur Industries Association, Mumbai.
3. Taylor D.A., "Introduction to Marine Engineering" Butterworth-Heinemann, 2nd edition, 1996
4. Srinivasan "Harbour, dock and tunnel engineering: an elementary text-book for engineering students", Charotar Books Distributors, 2003

5. S P Bindra, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi, 1993.

MEC18R6004	SAFETY IN POWDER HANDLING	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Power handling safety

Objective(s): To educate the students about the learning powder classification, properties and their handling

Course Outcome(s)

CO1: Outline the classification, synthesis, characteristics and charging of powder.

CO2: Explain the ignition of powder and dust control in various strategies.

CO3: Apply the various tests and apparatus used in dust explosion evaluation

CO4: Inspect the hazard identification and assessment of powder used in industries

CO5: Elaborate about housekeeping, role of workers and evaluation procedures and control measures for particulates

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	3	2	2				2		1	1		1	1	1
CO2	1	2	2	2				2		1	1		2	2	1
CO3	3	2						2		1			2	3	2
CO4	2	2		2				2		2	1		2	3	3
CO5	1		1	1				2		1	1		2	2	2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION

Powder classification-physical, chemical and other properties-metal powders-other non-metallic powders-handling methods-manual, mechanical, automatic-charges on powders-charge distribution-charging of powders- Pyro and agro applications.

IGNITION OF POWDERS AND DUST CONTROL

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

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

POWDER HAZARDS

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

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

HAZARD MEASUREMENT

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

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

SAFETY MEASURES

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

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

REFERENCES

1. Martin Glor, Electro Static Hazard in Powder Handling, Research studies Press Ltd., England, 1988.
2. Major hazard control, ILO Geneva, 1987.
3. Seminar on "Hazard recognition and prevention in the work place-airborne dust" Vol.I and 2, SRMC, Chennai, 4/5, Sept.2000.
4. ASM Metals hand book, Ninth edition, Vol.7, Powder Metallurgy
5. Safety considerations when handling metal powders, Journal of the Southern African Institute of Mining and Metallurgy. Johannesburg Jan.2012. Vol.112 suppl.1

MEC18R6005	QUALITY ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Total Quality Management

Objective(s): To know the quality engineering concepts in product design and development processes, control and process parameters' characteristics with feedback system, methods for production and diagnosis process improvements ISO quality systems and types of quality tools such as failure effect analysis and understand the six-sigma concepts and its implementation in engineering industries

Course Outcome(s)

CO1: Identify the loss function derivation and quality engineering in product design and development processes

CO2: Develop their knowledge in online quality control systems and process and Control parameters

CO3: Improve the process diagnosis and production process to maintain the quality

CO4: Extend the knowledge in ISO quality management systems

CO5: List the roles and responsibilities of leaders

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			3						2		1			3	2
CO2		2	3								1			3	
CO3				3							1			3	

CO4	2												2		1
CO5	2								3				1		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION

Quality value and engineering- overall quality system-quality engineering in product design - Quality engineering in design of production processes - quality engineering in production – quality engineering in service. Loss function Derivation – use-loss function for products/system- Justification of improvements-loss function and inspection- quality evaluations and tolerances-N type, S type, L type.

ON-LINE QUALITY CONTROL

On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances feedback control systems measurement error and process control parameters.

ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS

Checking intervals- frequency of process diagnosis. Production process improvement method- process diagnosis improvement method- process adjustment and recovery improvement methods..

QUALITY ENGINEERING AND TPM

Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools–fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems

SIX SIGMA AND ITS IMPLEMENTATION

Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method-roles and responsibilities –leaders, champion, black belt, green belts. Do's and don'ts - readiness of organization – planning-management role- six sigma tools – sustaining six sigma..

TEXTBOOKS:

1. Taguchi G, Elsayed E A and Hsiang, T.C.," Quality Engineering in Production Systems", McGraw-Hill
Book company, Singapore, International Edition, 1989
2. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, New Delhi, Second reprint, 2002.

REFERENCE BOOKS:

1. De Feo J A and Barnard W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, New Delhi, 2005.
2. Pyzdek T and Berger R W, "Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996

MEC18R6006	RADIOGRAPHIC TESTING AND RADIATION SAFETY	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Radiation safety

Objective(s):

- To educate the students about the learning through grounding in the principle of Radiographic Testing (RT) and
- To impart the fundamentals of material and process to the students

- To provide knowledge on identifying the suitability of RT for the material inspection

Course Outcome(s)

CO1: Explain basic principle of radiography

CO2: List the different types of industrial radiography and its entire working process.

CO3: Analyze radiographic consideration and different techniques.

CO4: Examine the testing procedures of Radiographic Techniques

CO5: Inspect the radiation hazards faced in all over the hazardous Industry and safety precautions.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2					2		1	1		2	3	2
CO2	2	2						2		1			2	3	3
CO3	2	2						2		2	1		2	3	3
CO4	1	1	1	1				2		1	1		2	2	3
CO5	2	2	2					2		1	1		2	2	2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

BASIC PRINCIPLES OF RADIOGRAPHY

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

FILM RADIOGRAPHY

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

RADIOGRAPHIC IMAGE QUALITY AND RADIOGRAPHIC TECHNIQUES:

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

SPECIAL RADIOGRAPHIC TECHNIQUES

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

RADIATION SAFETY

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

REFERENCES

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

MEC18R6008	INTELLIGENT INDUSTRIAL SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisite: To well know about the fuzzy logic and MATLAB.

Objective(s): This course aims to safeguard the Electrical and Electronics Equipments from the Overvoltage and Explosion hazards.

Course Outcome(s)

CO1: Apply various aspects of intelligence to diverse industrial situations

CO2: Illustrate the applications of expert system

CO3: Develop a simple expert system related to industrial safety Engineering.

CO4: Apply neural network concepts in safety engineering discipline

CO5: Evaluation the algorithm which is used in safety applications.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3			1		3	3			2			2	
CO2		3		1			3	3	2					2	
CO3		3			1		3	3		2					
CO4		3			1		3	3	2						3
CO5		3		1			3	3		2			2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

BASIC CONCEPTS

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

KNOWLEDGE BASED SYSTEMS

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

MATERIAL SELECTION AND PROCESS PLANNING

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

INTELLIGENT SYSTEM

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

APPLICATIONS OF AI

The role of Artificial Intelligence in the factory of the future – Intelligent systems. Contributes to AI, Real Life Applications of AI Research Areas

REFERENCES

1. Andrew Kussiak,, "Intelligent Manufacturing Systems", Prentice Hall , 1990.
2. Simons, G.L, "Introducing Artificial Intelligence", NCC Pub, 1990.
3. Rich, Elaine, and Kevin Knight. Artificial intelligence . Vol. 2. New York: McGraw-Hill, 1991.

4.Charniak, Eugene. Introduction to artificial intelligence. Pearson Education India, 1985. Volume 48,Issue2, 2005

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

MEC18R6009	SAFETY IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

Prerequisite: To know the basic knowledge in safety measures involved in Petrochemical industries

Objective(s): To become a skill person in the safety measures and analysisin the various risks and hazardous identification and able to find out theroot cause of an accident and control measures in the onsite and offsite emergency planning in petrol chemical industries.

Course Outcome(s)

CO1: Discuss the risk management involves with planning and effects it causes

CO2: Illustrate the basic knowledge in acquisition and controlling systems in petro-chemical industries.

CO3: Explain the parts and process involved in the control relief systems

CO4: Identify the hazards and toxicity involved in petro-chemical industries.

CO5: Interpret the controlling of leakages in various systems.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2						2	1			2	1	2		2
CO2	3	2													2
CO3	3	2													2
CO4	2						2	1			2	1	2		1
CO5	3	2						1					2		2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

RISK MANAGEMENT

Overall risk analysis – E and FI model– Methods for determining consequences effects: Effect of fire, Effect of explosion and toxic effect – Disaster management plan – Emergency planning – Onsite and offsite emergency planning – Risk management – Gas processing complex, refinery – First aids.

ACQUISITION AND CONTROL BASED SAFETY SYSTEMS

Control of safety systems with its characteristic and design - Control of trip, interlock and emergency shut-down systems; Programmable logic and electronic system - Knowledge acquisition and optimization - Knowledge based approaches to design mechanical parts and mechanisms and design for automated assembly.

CONTROL RELIEF SYSTEMS

Preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation, and sprinkling, proofing, relief systems – relief valves, flares, scrubbers. Design of flares, scrubbers and condensers for toxic release from chemical process industries; Design of tank farms for liquid/gaseous fuel storage.

TOXICOLOGY OF PETRO CHEMICAL INDUSTRIES

Toxicology: Hazards identification-Hazards from utilities like air, water, steam- toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

CONTROLLING OF LEAKAGES AND ASSOCIATED HAZARDS

Leaks and Leakages: Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment - Estimation of leakage through pipe lines - Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models, Effects of momentum and buoyancy, Mitigation measures for leaks and releases. Hazards Associated with Hydrocarbon and Other Chemical Products: Crude oil, natural gas, LPG, CNG, LNG, oxygenated hydrocarbons, chlorine, ammonia, hydrogen fluoride.

TEXTBOOKS:

1. Blake, R.P., "Industrial Safety", Prentice Hall; 3rd edition,ISBN-13: 978-0134631332, 2000.
2. Daniel A. Crowl , Joseph F. Louvar, "Chemical Process Safety: Fundamentals with Applications ", (Prentice Hall International Series in the Physical and Chemical Engineering Sciences) 3rd , Kindle Edition, 20 May 2011.

REFERENCE BOOKS:

1. Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, ISBN: 9780123977823, Butterworth-Heinemann. 2012.
2. Davletshina T.A. and Cheremisinoff N.P., "Fire and Explosion Hazards Handbook of Industrial Chemicals" Jaico Publication. 2003
3. Cheremisinoff N.P., "Pressure Safety Design Practices for Refinery and Chemical Operations" Noyes Publications. 1998

MEC18R6010	QUANTITATIVE RISK ANALYSIS IN CHEMICAL PROCESS	L	T	P	C
		3	0	0	3

Prerequisite: To understand the fundamentals of Quantitative risk analysis, procedure for risk assessment, gain knowledge on various tools on consequence analysis, develop the skill of risk estimation in a process plant. familiarize with international risk assessment reports like Convey report, Rijnmond report .etc.

Objective(s): To become a skill person in the safety measures and analysis in the various risks and hazardous identification and able to find out there of cause of an accident and control measures in Chemical Industries.

Course Outcome(s)

CO1: Analyze the frequency estimation using event tree analysis.
CO2: Estimate the consequences of BLEVE and Fire Ball.
CO3: Assess the risk for the given fire or dispersion scenario.
CO4: List out the data required for risk estimation..
CO5: Evaluate the data's using various QRA Techniques.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3		2							1		3		1
CO2		3		2							1		3		1
CO3		3		2							2			2	
CO4	1	2		1									3		
CO5		3									3		3		1

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION TO QUANTITATIVE RISK ANALYSIS

Definitions of Quantitative Risk Analysis –Component Techniques-System description-Hazard Identification-Incident enumeration-CPQRA Model construction – Consequence estimation Likelihood estimation-Risk estimation-Utilization risk estimation-Scope of CPQRA studies Management of incident list-Applications of CPQRA-Limitations of CPQRA Utilization of results Project management –maintenance of result.

CONSEQUENCY ANALYSIS

Source models , discharge rate models-fundamental equations –Liquid discharges-Gas discharges Two Phase discharge-Dispersion models-Wind speed –local terrain effects-Height of release above ground-momentum of material released and buoyancy-Dense gas dispersion-Vapour cloud Explosions –TNT equivalency model-TNT multi energy model-Modifier baker model –Equations for blast parameters-Damage estimate –Flash fire –Physical explosion-Projectiles-Determination of fragment velocity-BLEVE and Fire ball –Effects –Fragments-Empirical equations for fire ball diameter, duration , Height , radiation –Confined explosion-Toxic gas effect-Problems.

FREQUENCY ANALYSIS

Incident frequencies from the historical records –frequency modeling techniques –Fault tree Analysis-Construction –Qualitative evaluation-Event tree analysis-logic diagram-Estimation of Probability and quantification of outcome-Common cause failure analysis-Human reliability Analysis-External event analysis-Solved problems

RISK ESTIMATION

Risk measures, Risk presentation –Risk indices-Individual and societal risk –Risk calculation for

individual and societal risk –Procedure-General approach and simplified approaches-other Individual risk measures-Average rate of death-Equivalent social cost-Fatal accident rate-Individual hazard index-Mortality index and economic loss-Problems.

DATA AND SPECIAL TECHNIQUES FOR QRA

Historical incident data –Process and plant data-plant layout , description –Ignition source data-Chemical data-Environment data-population data –Meteorological data-Geographical Topographical-Equipment reliability data-special techniques –domino effects –Unavailability Analysis of protection systems-MORT –Markov models-case studies –Convey report-Rijnmond report

TEXTBOOKS:

1. "Guidelines for Chemical process Quantitative risk analysis" Center for Chemical Process Safety CCPS- American Institute of Chemical Engineers, Wiley, 2nd edition, 1999.

REFERENCE BOOKS:

1. "Guidelines for Hazard Evaluation Procedures" Center for Chemical Process Safety CCPS-American Institute of Chemical Engineers, Wiley, 3rd edition, 2008.
2. "Guidelines for Developing Quantitative Safety Risk Criteria" Center for Chemical Process Safety CCPS- American Institute of Chemical Engineers, Wiley, 2009
3. Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2nd Edition, 1990.
4. J.S Arendt, D K.Lorenzo "Evaluating Process Safety in the Chemical Industry: A User's Guide to Quantitative Risk Analysis "Wiley, 2000

MEC18R6011	SENSITIVITY MEASUREMENT AND EVALUATION OF ENERGETIC MATERIAL	L	T	P	C
		3	0	0	3

Prerequisite: To Know about the Basic Measurement Techniques.

Objective(s): To acquire the basic concepts of sensitivity of measurement and Evaluation Techniques.

Course Outcome(s)

CO1: Outline various Energetic materials with testing methodologies.
CO2: Analyze various Mechanical measurement methods.
CO3: Infer various Thermal measurements using various Instruments.
CO4: Evaluate various kinetics of Energetic materials
CO5: Distinguish the Explosive materials and its safety.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		3		2		3			2		3		
CO2	3			1											
CO3	3										2		3		
CO4	3		2					3		2					
CO5	3			2				3			2		2		2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION-ENERGETIC MATERIAL

Energetic material-Pyrotechnics, propellant and explosives-Definitions, Distinctions, classifications, Characteristics of pyrotechnics, propellant, explosives-Combustion-Physical and chemical aspect , Deflagration, Detonation- burning to detonation, shock to detonation, propagation of the detonation shockwave, heat of reaction, heat of formation, heat of cooling, Sensitiveness, Impact Ignition, Process of Shock to Detonation Transition, The Cylinder Test

MECHANICAL SENSITIVITY ANALYSIS OF ENERGETIC MATERIAL

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.

THERMAL SENSITIVITY ANALYSIS OF ENERGETIC MATERIAL

Applications of Advanced Equipment's and Instruments, Thermo Calorimeter, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, A Timeline of solid rocket propellants development, Binders for composite solid rocket propellants, Advanced oxidizers for solid rocket propellants, Applications, advantages.

KINETICS OF UNSTABLE ENERGETIC MATERIALS

Kinetics of explosive reactions-activation energy, rate of reactions, kinetics of thermal decomposition, Measurement of kinetic parameters-Differential thermal analysis, thermo gravimetric analysis, Differential Scanning Calorimeter, Accelerated Rate Calorimeter (ARC)

EVALUATION OF EXPLOSIVE PROPERTIES

Theoretical evaluation of explosive properties, oxygen balance methods, mechanism of ignitions, initiation-initiation by heat, Friction, Flash, Percussion, Electrical, Coherent light, Blast Vibration, Peak particle velocity, Scaled Distance, Square Root Scaling, Cube Root Scaling, Coherent light

REFERENCE BOOKS

1. Test Methods for Explosives Mohamed-Suceska
2. A manual for pyrotechnic design, development and qualification- Laurence J.Bement, Morry L.Schimmel
3. Guidelines for chemical reactivity evaluation and application to process design Center for chemical process safety of the American Institute of Chemical Engineers
4. Principles of thermal analysis and calorimetry-P.J.Haines

MEC18R6012	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: To know about the environmental science and pollution control.

Objective(s):

- To understand the sources of solid and hazardous wastes
- To understand methods of solid waste disposal.
- To evaluate the health risks posed by abandoned waste sites and waste disposal Operations.
- To evaluate the legislation designed to control the production, cleanup and disposalof solid and hazardous waste disposal operations.

Course Outcome(s)

CO1: Identify the knowledge about the classification and sources of solid and hazardous waste and its characteristics
CO2: Apply knowledge in recycling/ reuse in waste management and transportation of waste.
CO3: List out various techniques for waste processing
CO4: List out the various disposal techniques for solid waste management
CO5: Develop the knowledge in Integrated Waste Management System

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1		1	3	3				1	1	1	
CO2	3	1	1	2		1	3				1	3	1	1	
CO3	3	3	2	3		1					1		1	2	
CO4	2	2	2	1				2			1		2	2	
CO5	2	2	1		3			2					1		3

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

SOLID AND HAZARDOUS WASTE

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management - Legislations on management and handling of municipal solid wastes, hazardous wastes, and biomedical wastes. Environmental impact assessment (EIA), definitions and concepts, status of EIA in India.

WASTE GENERATION

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

WASTE PROCESSING

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

DISPOSAL

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

INTEGRATED WASTE MANAGEMENT

Elements of integrated waste management- IWM as a holistic approach to waste management- Size of the IWM system- Computer models and IWM-Key drivers for implementing IWM-IWM case studies

REFERENCES

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw- Hill, New York, 1993

2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
3. Debashish Sengupta, Sudha Agrahari, Modeling Trends in Solid and Hazardous Waste Management, Springer Publications, 2017
4. M.N. Rao, Razia Sultana, Sri Harsha Kota, Anil Shah, Naresh Davergave, Solid and Hazardous Waste Management: Science and Engineering, Saint Louis: Elsevier Science 2016.

MEC18R6013	MAINTAINABILITY ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: To Know the Basic Concepts of TQM and Engineering Management.

Objective(s):

- To provide the students about the basic concept of maintainability
- Engineering and feed knowledge on various maintenance models, maintenance policies and replacement model of various equipment. To enforce the knowledge on logistics for the effective utilization of
- Existing resources and facilities availability of spares parts.

Course Outcome(s)

CO1: Classify various terms and terminologies about the maintenance concept.

CO2: Identify the various maintenance models used in Industries.

CO3: Explain about Logistics meant for the execution of various services

CO4: Apply knowledge in areas where the down time, over replacement are existing and could lead to improve the productivity and quality.

CO5: Invent the Productive Techniques in real life Industrial Scenario.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3					2								1	
CO2	3	2											2	1	
CO3	3	2	1										1	2	
CO4	3		2								2		1		
CO5	3	2	1								2	1	2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

MAINTENANCE CONCEPT

Need for maintenance – Maintenance definition – Maintenance objectives – Challenges of Maintenance management – Tero technology – Scope of maintenance department – Maintenance costs.

MAINTENANCE MODELS

Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – Optimal PM schedule and product characteristics – Optimal Inspection frequency: Maximizing profit – Minimizing downtime – Replacement models.

MAINTENANCE LOGISTICS

Human factors – Crew size decisions: Learning curves – Simulation – Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning – Maintenance scheduling – Spare parts control – Capital spare.

MAINTENANCE QUALITY

Maintenance excellence –Five Zero concept –FMECA –Root cause analysis – System effectiveness – Design for maintainability – Maintainability allocation – CMMS – Reliability Centered Maintenance.

TOTAL PRODUCTIVE MAINTENANCE

TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars –TPM implementation – Autonomous maintenance.

REFERENCE(S)

1. Andrew K.S.Jardine & Albert H.C.Tsang, "Maintenance, Replacement and Reliability", Taylor and Francis, 2006.
2. Bikas Badhury & S.K.Basu, "Tero Technology: Reliability Engineering and Maintenance Management", Asian Books, 2003.
3. Seichi Nakajima, "Total Productive Maintenance", Productivity Press, 1993.

MEC18R6014	AIR POLLUTION CONTROL EQUIPMENT DESIGN	L	T	P	C
		3	0	0	3

Prerequisite: To know about the environmental science and pollution control.

Objective(s):

- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
- To give understanding of air and water pollution and their control.
- To expose the students to the basics in hazardous waste management.
- To design emission measurement devices.

Course Outcome(s)

CO1: Illustrate and familiarize the basic concepts scope of environmental safety.

CO2: Identify the standards of professional conduct that are published by professional safety organizations and/or certification bodies.

CO3: Explain the ways in which environmental health problems have arisen due to air and water pollution

CO4: Explain the methodology of environmental sources control

CO5: classify the water pollution and its characteristics.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1									1	2		
CO2	2	2	1	1								1	2		

CO3	2	2	2	2	3							1	2		
CO4	2	2	1	2	3							2	2		
CO5	2	2	1	1								2	2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION:

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

METHODS AND TECHNIQUES:

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

PARTICULATE POLLUTION CONTROL:

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

GASEOUS POLLUTANTS:

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

HAZARDOUS WASTE MANAGEMENT AND RISK ASSESSMENT:

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

TEXT BOOKS

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

REFERENCE

1. Rao C.S. "Environmental Pollution Control Engineering," 2nd Edition, New Age International Publishers, 2006
2. A.P. Sincero and G.A. Sincero Environmental Engineering : A design Approach , Prentice Hall of India pvt Ltd, N. Delhi.1996

Noel de Nevers, Air Pollution Control Engineering, McGraw-Hill, 1999.

MEC18R6015	AUTOMOTIVE SYSTEMS SAFETY, QUALITY AND RELIABILITY	L	T	P	C
		3	0	0	3

Prerequisite: To know about the automotive process and probability analysis.

Objective(s): To know and become a skillful person in the safety management practice followed in automotive Industry and Safety system analysis.

Course Outcome(s)

CO1: Illustrate the safety management process and standards followed in automotive industry

CO2: Discuss the automotive safety control systems and expense analysis with its benefits.

CO3: Identify the hazards and risk assessment in the automotive systems.

CO4: Explain the common factors involving in the road and transport to enlighten the safe driving.

CO5: Perceive the quality and reliability in automotive safety systems.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2						2	2		1			2		
CO2	3	2											2		1
CO3	2	2					1	2					2		
CO4	2						2	2		1			1		
CO5	3												2		2

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

SAFETY MANAGEMENT PRACTICES IN AUTOMOTIVE INDUSTRIES

Need for safety - safety concepts – safety management functions – safety committee - safety audit and survey- safety inspection – safety sampling -job safety analysis - damage control - disaster control – emergency preparedness plan - accident types – causes and cost of accidents - housekeeping – safety education and training - accident reporting - accident investigation – accident prevention programs - first aid - firefighting - personal protective equipment's.

SAFETY SYSTEM ANALYSIS

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

HAZARDS AND RISKS IN AUTOMOTIVE INDUSTRIES

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

TRANSPORT SAFETY

introduction - factors for improving safety on roads - causes of accidents due to drivers and pedestrians – safety in design, selection, operation and maintenance of transport vehicles - preventive maintenance – servicing - check list - insurance - Transport emergency card (TREM)

- warning symbols- selection of driver, training of driver – slogans in drivers cabin - responsibility of driver - transport precaution- safe driving - history of legislations related to safety - safety provisions in the factory act - Indian motor vehicles act and rules - workmen compensation act - ESI act - OSHA standards – case studies

RELIABILITY AND QUALITY

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

TEXT BOOKS

1. Brown D.B., System Analysis and Design for Safety, Prentice Hall Inc., New Jersy, 2006.
2. Dale H. Bester filed, et al., Total Quality Management, Person Education, 2012.
3. Ebeling, an Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill, 2004.
4. John.V.Grimaldi and Rollin H.Simonds, Safety management, All India Travelers book seller, 1989.

REFERENCES

1. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
2. Babkov.V.F, Road conditions and traffic safety, MIR Publications, Moscow, 1986.
3. Dhillon.B.S. and Singh.C, Engineering Reliability- New Techniques and Applications, John Wiley andsons,1981.
4. Ernest J.Henley and Hiromitsu Kumamoto, Designing for reliability and safety control, Prentice Hall, 1985.
5. Ernest J.Henly and Hiromitsu Kumamoto, Reliability Engineering and Risk Assessment, Prentice Hall, 1981.
6. ILO-Major Hazard Control- A Practical Manual, ILO, Geneva, 1988.

INTERDISCIPLINARY ELECTIVE COURSES

MEC18R6051	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Disaster management

Objective(s): Impart the knowledge in disaster management and using the modern technology to analysis the disaster and policy initiatives for disaster control

Course Outcome(s)

CO1: Demonstrate the disaster management techniques using the modern tools sophisticated.

CO2: Infer the emergency measures and how to control with monitoring devices.

CO3: Illustrate the climatic change and access the environmental change

CO4: Interpret the data to analyze the earth quake disaster and to dispose the nuclear wastes.

CO5: Summarize risk and disaster assessment processes including standards, and national policies

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2		2				3	1			2		
CO2	3	2		2									2		
CO3			1						3	3					
CO4	3	2	3	2	3					3			2		
CO5	3	3	2		1								2		

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

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. Refugee operations during disasters, Human Resettlement and Rehabilitation issues during and after disasters, Inter-sectoral coordination during disasters, Models in Disasters.

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-Software's on emergency controls-Monitoring devices for detection of gases in the atmosphere-Right to know act

SUSTAINABLE DEVELOPMENT

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

OFFSHORE AND ONSHORE DRILLING

Control of fires-Case studies-Marine pollution and control-Toxic, hazardous & Nuclear wastes-state of India's and Global environmental issues-carcinogens-complex emergencies-Earthquake disasters- the nature-extreme event analysis-the immune system-proof and limits-

ENVIRONMENTAL EDUCATION AND POLICY

Population and community ecology-Natural resources conservation-Environmental protection and law-Research methodology and systems analysis-Natural resources conservation-Policy initiatives and future prospects-Risk assessment process, assessment for different disaster types-Assessment data use, destructive capacity-risk adjustment-choice-loss acceptance-disaster aid-public liability insurance-stock taking and vulnerability analysis-disaster profile of the country-national policies-objectives and standards- physical event modification-preparedness, forecasting and warning, land use planning.

REFERENCES

1. Gilbert, M. Masters, Introduction to Environmental Engineering and Science, Prentice Hall, 2005

2. G. Tyler Millerand Scott Spool man, "Environmental Science: Principles, Connections and Solutions", Brooks Cole, 12th edition, 2007
3. G. Tyler Miller, "Environmental Science: Sustaining the Earth (Environmental Science: Working with the Earth)", Wadsworth Publishing Company, 3rd edition, 1991.
4. Mackenzie Leo Davis and Susan J. Masten, "Principles of Environmental Engineering and Science", McGraw Hill Higher Education, 2nd edition, 2008

MEC18R6052	SAFETY IN CONSTRUCTION	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in construction hazards, process and prevention control.

Objective(s): This course aims to introduce the concept of construction management system, construction machinery used in industries and erection, demolition work in construction industry.

Course Outcome(s)

CO1: Identify the basic knowledge of construction management system.

CO2: Analyze various construction hazards and control measures.

CO3: Explain the procedures and rules of height work.

CO4: Perceive the various construction machinery used in Industries.

CO5: Explain about safety in erection and demolition work.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	3			1		2			2	1	2		
CO2	2	3				2			2		2	1			
CO3	1	1	2			2		1			2	1	1		
CO4	2	1													
CO5	1	3	1					2							

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – quality assurance in construction - compensation – Black Spot Identification-Recording of accidents and safety measures – Education and training

HAZARDS OF CONSTRUCTION AND PREVENTION

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

WORKING AT HEIGHTS

Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, height pass – accident case studies.

CONSTRUCTION MACHINERY

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

SAFETY IN DEMOLITION WORK

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods – interesting experiences at the construction site against the fire accidents. Understand basic physics related to crash reconstruction

REFERENCES

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

MEC18R6053	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Prerequisite: To know about the environmental science and pollution control.

Objective(s):

- To provide the in depth knowledge on Environment and Its impact on the surroundings when a major project is being carried out in a location.
- To provide the basic knowledge on Environmental impact assessment (EIA) and its legal requirements.
- To understand about the various terms and terminologies relating to EIA
- To know the implications of EIA in maintaining the global environmental management plan.

Course Outcome(s)

CO1: Explain the basic things about Environmental Impact assessment and its relevance to the Legal and regulatory aspects.

CO2: Categorize the various EIA components involved in maintaining the environment in balanced way.

CO3: Discuss about EIA and frame guideline for monitoring the Safety system.
CO4: Apply and practice the EIA with the proper guideline and evaluation criteria.
CO5: Design the concept, implement the process and to excel Environmental Impact assessment procedure in carrying out the major project in their career.

Mapping of COs with Pos

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3			1			2						1		
CO2	3	1					3						2		
CO3	3						2				2		3		
CO4	3			1			2							2	
CO5	1		3				3						2		1

3 – Strong correlation, 2 – Medium correlation, 1 – Low correlation

Course Topic(s)

INTRODUCTION

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

METHODOLOGIES

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

PREDICTION AND ASSESSMENT

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

ENVIRONMENTAL MANAGEMENT PLAN

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

EIA CASE STUDIES

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

TEXT BOOKS

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

REFERENCES

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

GENERAL ELECTIVES

EEE18R5020	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the basic concepts of soft computing techniques
CO2: To solve real world problems using neural network
CO3: To analyse the functioning of recurrent neural network
CO4: To apply genetic algorithm to solve the optimization problem
CO5: To develop fuzzy logic controller and ANN for the given system

INTRODUCTION AND FEEDFORWARD NEURAL NETWORK

Introduction to soft computing -soft computing vs hard computing-various types of soft computing techniques-applications of soft computing-Neuron-Nerve structure and synapse-Artificial Neuron and its model-activation functions-Neural network architecture-single layer and multilayer feed forward networks-McCullochPitts neuron model-perceptron model -Adaline and Madaline-multilayer perception model-back propagation learning algorithm- Implement back propagation learning algorithm using Matlab Toolbox.

RECURRENT NEURAL NETWORKS

Counter propagation network-architecture-functioning & characteristics of counter-Propagation network-Hopfield/ Recurrent network-configuration-stability constraints-associative memory-and characteristics-limitations and applications-Hopfield v/s Boltzman machine-Adaptive Resonance Theory-Architecture-classifications-Implementation and training-Associative Memory- Design of multilayer feed forward network using MATLAB Toolbox.

FUZZY LOGIC SYSTEM

Introduction to crisp sets and fuzzy sets-basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-Fuzzification-inferencing and defuzzification-Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control-Fuzzy logic control for nonlinear time delay system-Development of Neuro fuzzy system using MATLAB tool box.

GENETIC ALGORITHM

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm-Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems-Implementation of optimization problem using MATLAB Toolbox.

APPLICATIONS

GA application to power system optimization problem-Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural Network interconnection systems-Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Stability analysis of fuzzy control systems.

TEXT BOOK(S):

1. S.N. Sivanandam, S.N.Deepa, “Principles of Soft Computing” 2nd Edition, Wiley, 2011.
2. Fakhreddine O. Karray and Clarence De Silva, “Soft Computing & Intelligent System: Theory, Tools and Applications”, First edition, Pearson Education, 2009.

REFERENCE(S):

1. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education. 2004
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India., 2010.

EEE18R5021	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

INTRODUCTION

Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.

LINEAR PROGRAMMING (LP)

Simplex method of solving LPP, revised simplex method, duality, constrained optimization Theorems and procedure, Linear programming, mathematical model, solution technique, duality.

NON LINEARPROGRAMMING

Steepest descent method, conjugates gradient method, Newton’s Method, Sequential quadratic programming, Penalty function method, augmented Lagrange multiplier method.

DYNAMIC PROGRAMMING (DP)

Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm

GENETIC ALGORITHM

Int’roduction to genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.

Reference(s):

1. Computational methods in Optimization, Polak, Academic Press, 1971.
2. Optimization Theory with applications, Pierre D.A.,WileyPublications, 1969.
3. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi ,2002.
4. S.S.Rao,”Optimization–Theoryand Applications”,Wiley-Eastern Limited, 1984.
5. G.Luenberger,” Introduction of Linear and Non-Linear Programming”,Wesley

Publishing Company, 2011

EEE18R6013	EVOLUTIONARY COMPUTATION TECHNIQUES	L	T	P	C
		3	0	0	3

Course Outcome(s):

After successful completion of course, the students will be able,

CO1 - To classify the working principle of evolutionary computation.

CO2 - To apply Genetic Algorithm to solve optimization problems.

CO3 - To recognize the powerfulness of EC Techniques and the ability to apply EC algorithms to solve optimization problem.

CO4 - To compute the principle of PSO and to solve optimization problems.

CO5 - To explain the principle of ACO and to solve optimization problems.

EVOLUTIONARY COMPUTATION (EC): THE BACKGROUND

Outline of Evolutionary Algorithms (EA) – EA Terminologies – Robust adaptation and Machine Intelligence – Principles of Evolutionary Processes – Principles of Genetics – No-free Lunch theorem for EA – Advantages of EA over other approaches.

GENETIC ALGORITHM (GA)

Binary GA – genetic operators – Tournament, Proportionate and Ranking Selection – Single point, two-point and uniform crossover – Elitism – Real Parameter GA – Linear, naïve, blend and Simulated Binary Crossover – Random, Non-uniform, Normally distributed and Polynomial Mutation – Constraint Handling Techniques in GA.

EVOLUTIONARY STRATEGIES (ES) & EVOLUTIONARY PROGRAMMING (EP)

Non-Re combinative ES – Re combinative ES – Self Adaptive ES – Connection between RGA and Self adaptive ES – Evolutionary Programming(EP) – EP and ES: Similarities and Differences – Genetic Programming (GP) – Population size and Dynamics – Convergence and Stopping Criteria – Exploration and Exploitation.

PARTICLE SWARM OPTIMIZATION (PSO)

Concepts and formulation – Simulating the Social behavior – PSO algorithm – Topology – Parameter Selection and Improvements for Convergence – Maximum Velocity – Acceleration Constants - Constriction factor - Inertia weight – Advantages of PSO.

ANT COLONY OPTIMIZATION (ACO)

Ants' ForagingBehavior – Stigmergy – Double Bridge Experiment – Real Ants to Artificial Ants – Behavioral Differences – Properties of Artificial Ants – ACO Algorithms – Ant System - MAX−MIN Ant System – Ant Colony System (ACS) – Advances of ACO.

TEXT BOOK(S):

3. S.N. Sivanandam, S.N.Deepa, "Principles of Soft Computing" 2nd Edition, Wiley, 2011.

4. Fakhreddine O. Karray and Clarence De Silva, "Soft Computing & Intelligent System: Theory, Tools and Applications", First edition, Pearson Education, 2009.

REFERENCE(S):

1. Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", 3rd Edition, John Wiley & Sons, 2008.
2. Thomas Back, David BFogel and ZbigniewMichalewicz, "Evolutionary Computation 1 &2 : Basic/advanced Algorithms and Operators", Institute of Physics Publishing, 2000.
3. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", MIT Press, 2004.
4. JurgenBranke, Kalyanmoy Deb, KaisaMiettinen and Roman Slowinski (Eds.), "MultiObjective Optimization: Interactive and Evolutionary Approaches", Springer-Verlag, 2008.

CSE18R5051	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

UNIT-1

Introduction Cloud Computing: Nutshell of cloud computing, Enabling Technology, Historical development, Vision, feature Characteristics and components of Cloud Computing. Challenges, Risks and Approaches of Migration into Cloud. Ethical Issue in Cloud Computing, Evaluating the Cloud's Business Impact and economics, Future of the cloud. Networking Support for Cloud Computing. Ubiquitous Cloud and the Internet of Things

UNIT-2

Cloud Computing Architecture: Cloud Reference Model, Layer and Types of Clouds, Services models, Data center Design and interconnection Network, Architectural design of Compute and Storage Clouds. Cloud Programming and Software: Fractures of cloud programming, Parallel and distributed programming paradigms-MapReduce, Hadoop, High level Language for Cloud. Programming of Google App engine,

UNIT-3

Virtualization Technology: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor VMware, KVM, Xen. Virtualization: of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of data-center

UNIT-4

Securing the Cloud: Cloud Information security fundamentals, Cloud security services, Design principles, Policy Implementation, Cloud Computing Security Challenges, Cloud Computing Security Architecture. Legal issues in cloud Computing.
Data Security in Cloud: Business Continuity and Disaster Recovery, Risk Mitigation, Understanding and Identification of Threats in Cloud, SLA-Service Level Agreements, Trust Management

UNIT-5

Cloud Platforms in Industry: Amazon web services Google App Engine, Microsoft Azure Design, Aneka Cloud Application Platform -Integration of Private and Public Clouds Cloud applications: Protein structure prediction, Data Analysis, Satellite Image Processing, CRM and E ,Social networking . Cloud Application- Scientific Application, Business Application. Advance Topic in Cloud Computing: Federated Cloud/Inter Cloud, Third Party Cloud Services.

TEXT/REFERENCE BOOKS:

1. Distributed and Cloud Computing " By Kai Hawang , Geofrey C.Fox, Jack Dongarra Pub: Elservier
2. Cloud Computing, Principal and Paradigms, Edited By Rajkumar Buyya, Jemes Broberg, Goscinski, Pub.- Wiley
3. Kumar Saurabh, "Cloud Computing" , Wiley Pub
4. Krutz , Vines, "Cloud Security " , Wiley Pub
5. Velte, "Cloud Computing- A Practical Approach" ,TMH Pub

CSE18R5052	IOT AND APPLICATIONS	L	T	P	C
		3	0	0	3

UNIT 1

IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT 2

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT 3

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views

UNIT 4

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT 5

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

REFERENCE BOOKS:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013
3. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1.

CSE18R5053	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

INTRODUCTION TO DATA ANALYTICS

Data analytics process – roles, stages in data science project – working with data from files – working - with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL

MODELING METHODS

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

INTRODUCTION TO R

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.

MAP REDUCE

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

DELIVERING RESULTS

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot () function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph - using graphics parameters. Case studies.

REFERENCES

1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
2. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
3. 3. Mark Gardener, “Beginning R - The Statistical Pr ogramming Language”, John Wiley & Sons, Inc., 2012.
4. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
5. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd., 2014.
6. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011.
7. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
8. http://www.johndcook.com/R_language_for_programmers.html
9. http://bigdatauniversity.com/
10. http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction