

SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

**M.E-Mechanical Engineering
(Industrial Safety Engineering)**

CURRICULUM and SYLLABI

[For students admitted in 2018-2019]

M.E / M.Tech Regulation 2015

Approved by BOS and Academic Council meetings

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME I Semester under Regulations 2015
Mechanical Engineering
Branch: M.E. Industrial Safety Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P15ISE101	Industrial Safety and Hazards Management	3	0	0	3
2	P15ISE102	Principles of Safety Management	3	0	0	3
3	P15ISE103	Environmental Safety	3	2	0	4
4	P15ISE104	Occupational Health and Industrial Hygiene	3	0	0	3
5	P15ISE105	Industrial Safety, Health and Environmental Acts	4	0	0	4
6	P15ISE505	Professional Elective -Safety in Construction	3	0	0	3
Total Credits						20

Approved by

Chairman, Mechanical Engineering BOS
Dr.D.Senthilkumar

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/MECH, First Semester ME ISE Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME II Semester under Regulations 2015
Mechanical Engineering
Branch: M.E. Industrial Safety Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P15ISE201	Fire Engineering And Explosion Control	3	0	0	3
2	P15ISE202	Computer Aided Hazard Analysis	3	2	0	4
3	P15ISE203	Electrical Safety	3	0	0	3
4	P15ISE204	Maintainablity Engineering	3	0	0	3
5	P15ISE506	Elective -Transport Safety	3	0	0	3
6	P15ISE511	Elective -Safety In Mines	3	0	0	3
Practical						
7	P15ISE205	Industrial Safety Laboratory	0	0	4	2
8	P15ISE206	Hazard Assessment In Industry – Mini Project	0	0	4	2
Total Credits						23

Approved by

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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME III Semester under Regulations 2015
Mechanical Engineering
Branch: M.E. Industrial Safety Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P15SE301	Reliability Engineering	3	2	0	4
2	P15SE513	Elective- Plant Layout and Materials Handling	3	0	0	3
3	P15SE516	Elective- Human Factors in Engineering	3	0	0	3
Practical						
4	P15SE302	Project Work Phase - I	0	0	12	6
Total Credits						16

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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME IV Semester under Regulations 2015
Mechanical Engineering
Branch: M.E. Industrial Safety Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Practical						
1	P15ISE401	Project Work Phase – II	0	0	30	15
Total Credits						15

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Copy to:-
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Sona College of Technology, Salem
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Mechanical Engineering
Branch: M.E. Industrial Safety Engineering

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Theory						
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2	P15ISE102	Principles of Safety Management	3	0	0	3
3	P15ISE103	Environmental Safety	3	2	0	4
4	P15ISE104	Occupational Health and Industrial Hygiene	3	0	0	3
5	P15ISE105	Industrial Safety, Health and Environmental Acts	4	0	0	4
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Total Credits						20

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Copy to:-
HOD/MECH, First Semester ME ISE Students and Staff, COE

Course Code : P15ISE101

Course Name : INDUSTRIAL SAFETY AND HAZARDS MANAGEMENT

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

**Course
Outcomes**

C01 Analyze the hazards potential of industrial processes and various types of explosions.

C02 Explain and use various types of preventive and protective systems from fire and explosions.

C03 Have knowledge of various hazards indices and the methods to identify and analyze them.

C04 Estimate the levels of leakage of liquids, vapour and gases and the measures of mitigation.

C05 Analyze and discuss various disastrous events occurred and give suggestions for future prevention

UNIT I FIRE AND EXPLOSION

L 9 T 0

Industrial processes and hazards potential, mechanical, electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Factories Act, 1948 and Environment (Protection) Act, 1986 and rules thereof. Shock wave propagation, vapor cloud and boiling liquid expanding vapors explosion (VCE and BLEVE), mechanical and Chemical explosion, multiphase reactions, transport effects and global rates.

UNIT II RELIEF SYSTEMS

L 9 T 0

Preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation, and sprinkling, proofing, relief systems – relief valves, flares, scrubbers.

UNIT III TOXICOLOGY

L 9 T 0

Hazards identification-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).

UNIT IV LEAKS AND LEAKAGES

L 9 T 0

Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation

Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

Total Number of Periods: 45

Content beyond syllabus

- Critical Control Point
- Fault Tree Analysis
- Chemical Process Safety
- Reliability Engineering
- Risk Assessment

Learning Resources**Text book:**

1. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol. I, 3rd Ed., Butterworth-Heinemann. 2004
2. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol. II, 3rd Ed., Butterworth-Heinemann. 2004
3. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol. III, 3rd Ed., Butterworth-Heinemann. 2004

References:

1. Crowl D.A. and Louvar J.F., "Chemical Process Safety: Fundamentals with Applications", 2nd Ed., Prentice Hall. 2001

Course Code : P15ISE102

Course Name : PRINCIPLES OF SAFETY MANAGEMENT

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

**Course
Outcomes**

- C01 Evaluate safety concepts and current safety related issues
- C02 demonstrate how safety audits should be done and in what ways the findings should be analyzed.
- C03 Explain the principles of accident investigation and prevention
- C04 know the various measures of safety performance.
- C05 be familiar with present efforts of government and private agencies to create the safety awareness and training.

UNIT I CONCEPTS AND TECHNIQUES

L 9 T 0

History of Safety movement –Evolution of modern safety concept- general concepts of management – planning for safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT II SAFETY AUDIT - INTRODUCTION

L 9 T 0

Components of safety audit, types of audit, audit methodology, non conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

UNIT III ACCIDENT INVESTIGATION AND REPORTING

L 9 T 0

Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident.

UNIT IV SAFETY PERFORMANCE MONITORING

L 9 T 0

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

UNIT V SAFETY EDUCATION AND TRAINING

L 9 T 0

Importance of training-identification of training needs-training methods – programs, 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.

Content beyond syllabus

- Safety management systems
- OSHA
- Environmental protection agency
- Emergency planning and response
- Permissible exposure limits

Learning Resources

Text book:

1. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.
2. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.
3. Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2nd edition, 1990.
4. John Ridley, "Safety at Work", Butterworth and Co., London, 1983.

References:

1. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
2. Relevant India Acts and Rules, Government of India.
3. Relevant Indian Standards and Specifications, BIS, New Delhi.
4. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973.

Course Code : P15ISE103

Course Name : ENVIRONMENTAL SAFETY

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	2 Hrs/Week	External Marks	50
Practical	-		Credits	4

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

- Course Outcomes**
- C01 Explain various source of air pollution, and various types of radiation hazards.
 - C02 Analyze the various water pollutants like industrial effluents and the methods of treating and disposing them.
 - C03 Identify the options for collection treatments and disposal of various solid and radioactive wastages.
 - C04 Explain the methods, equipments for measuring and control environmental pollution.
 - C05 Recommend the ways of pollution control in various process industries.

UNIT I AIR POLLUTION

L 9 T 6

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.

UNIT II WATER POLLUTION

L 9 T 6

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.

UNIT III HAZARDOUS WASTE MANAGEMENT

L 9 T 6

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-health hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio-process dilution- standards and restrictions – recycling and reuse.

UNIT IV ENVIRONMENTAL MEASUREMENT AND CONTROL

L 9 T 6

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 like cement, paper, petroleum-petroleum products-textiles, tanneries- thermal power plants – dying and pigment industries - eco-friendly energy.

Total Number of Periods: 75

Content beyond syllabus

- Genetically modified organisms
- Polluter pays principles
- Indian wildlife protection act
- Social impact assessment
- Healthy development measurement tools

Learning Resources**Text book:**

1. Rao, CS, "Environmental pollution engineering:", Wiley Eastern Limited, New Delhi, 1992.
2. S.P.Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 1993.

References:

1. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

Course Code : P15ISE104

Course Name : OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

C01 Explain the concept of physical hazards like noise, sound, radiation and OSHA standards.

C02 state the concept of chemical hazards like gas, fog, fumes and industrial hygiene calculation.

C03 explain and describe biological and ergonomical hazards and bio hazards control program.

C04 know the concept of occupational health services and industrial toxicology.

C05 Explain the importance of occupational physiology and work organization.

Course Outcomes

UNIT I PHYSICAL HAZARDS

L 9 T 0

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- nonionizing 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

UNIT II CHEMICAL HAZARDS

L 9 T 0

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

UNIT III BIOLOGICAL AND ERGONOMICAL HAZARDS

L 9 T 0

Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design.

UNIT IV OCCUPATIONAL HEALTH AND TOXICOLOGY**L 9 T 0**

Concept and spectrum of health - functional units and activities of occupational health services, preemployment and post-employment medical examinations - occupational related diseases, levels of revention 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

UNIT V OCCUPATIONAL PHYSIOLOGY**L 9 T 0**

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

Total Number of Periods: 45**Content beyond syllabus**

- Preventive medicines
- Exposure assessment
- Occupational exposure limits
- World health organization
- Employment of children
- Muscular skeleton disorder

Learning Resources**Text book:**

1. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 1982

References:

1. Encyclopedia of "Occupational Health and Safety", Vol.I and II, published by International Labour Office, Geneva, 1985

Course Code : P15ISE105

Course Name : INDUSTRIAL SAFETY HEALTH AND ENVIRONMENTAL ACTS

Lecture	-	4 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	4

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

- Course Outcomes**
- C01** Explain the factory act regarding, health, safety and workers welfare.
 - C02** Explain the various aspects of the environmental act, powers and function of statutory authorities of central and state government.
 - C03** identify the list of hazardous and toxic chemical and the safety procedure to be followed.
 - C04** explain various Acts regarding boiler, motor vehicles, mines, construction workers, explosive pesticides.
 - C05** be familiar with the international acts and standards regarding occupational safety and health.

UNIT I FACTORIES ACT – 1948 L 12 T 0

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

UNIT II ENVIRONMENT ACT – 1986 L 12 T 0

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

UNIT III MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989 L 12 T 0

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.

UNIT IV OTHER ACTS AND RULES L 12 T 0

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

UNIT V INTERNATIONAL ACTS AND STANDARDS

L 12 T 0

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).

Total Number of Periods: 60

Content beyond syllabus

- Seoul declarations
- National pension scheme
- Debt bondage in India
- Employment of children (Sumangali)
- Unfair dismissal

Learning Resources

Text book:

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.

References:

1. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd. Allahabad.
2. The Mines Act 1952, Commercial Law Publishers (India) Pvt.Ltd. Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

Course Code : P15ISE505

Course Name : SAFETY IN CONSTRUCTION

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

- Course Outcomes**
- C01** Analyze and prevent the causes of accidents in a construction site and also to decide the amount of compensation
 - C02** Explain various hazards associated with a construction site and how to work safely in each type of project
 - C03** know the laws of safety to be followed when working at height and methods of preventing fall
 - C04** operate various construction equipments and to train others in safe handling those equipments
 - C05** Explain what are the safety measures to be taken during a demolition process

UNIT I ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS

L 9 T 0

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

UNIT II HAZARDS OF CONSTRUCTION AND PREVENTION

L 9 T 0

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.

UNIT III WORKING AT HEIGHTS

L 9 T 0

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.

UNIT IV CONSTRUCTION MACHINERY

L 9 T 0

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..

UNIT V SAFETY IN DEMOLITION WORK

L 9 T 0

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.

TOTAL NUMBER OF PERIODS = 45

Content beyond syllabus

- construction fatality rates
- Safety of non workers
- High visibility clothing
- Temporary fencing

Learning Resources

Text Book

1. Hudson, R., "Construction hazard and Safety Hand book, Butter Worth's, 1985.

REFERENCES

1. Jnathea D.Sime, "Safety in the Build Environment", London, 1988.
2. V.J.Davies and K.Thomasin "Construction Safety Hand Book" Thomas Telford Ltd., London, 1990.
3. Handbook of OSHA Construction safety and health charles D. Reese and James V. Edison

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2	P15ISE202	Computer Aided Hazard Analysis	3	2	0	4
3	P15ISE203	Electrical Safety	3	0	0	3
4	P15ISE204	Maintainablity Engineering	3	0	0	3
5	P15ISE506	Elective -Transport Safety	3	0	0	3
6	P15ISE511	Elective -Safety In Mines	3	0	0	3
Practical						
7	P15ISE205	Industrial Safety Laboratory	0	0	4	2
8	P15ISE206	Hazard Assessment In Industry – Mini Project	0	0	4	2
Total Credits						23

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Copy to:-
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Course Code : P15ISE201

Course Name : FIRE ENGINEERING AND EXPLOSION CONTROL

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

Course Outcomes

- C01** Estimate hazards potential various types of fires and discuss the real life situations of fire accidents.
- C02** Explain and use various types of fire extinguishers and about escape and rescue operations.
- C03** Have knowledge of various industrial fire protection systems like alarms and detection systems and modes of fire fighting.
- C04** Analyze various fire safety measures to be followed in buildings and the rules to be followed for certification processes
- C05** Analyze various types and dangers of explosions and the systems used for relief, venting and suppression.

UNIT I PHYSICS AND CHEMISTRY OF FIRE

L 9 T 0

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

UNIT II FIRE PREVENTION AND PROTECTION

L 9 T 0

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.

UNIT III INDUSTRIAL FIRE PROTECTION SYSTEMS

L 9 T 0

Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO₂ system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – tank farms – indices of inflammability-fire fighting systems.

UNIT IV BUILDING FIRE SAFETY

L 9 T 0

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.

UNIT V EXPLOSION PROTECTING SYSTEMS

L 9 T 0

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 (SO₃), chlorine (CL₂) etc.

TOTAL NUMBER OF PERIODS : 45 Hrs

Content beyond syllabus

Institution of fire engineers

Building service engineering

Fire modeling

Smoke control and management

Wild fire management

Learning Resources

TEXT BOOK

1. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.
2. Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977.

REFERENCES

1. "Fire Prevention and fire fighting", Loss prevention Association, India.
2. "Accident Prevention manual for industrial operations" N.S.C., Chicago, 1982.
3. Dinko Tuhtar, "Fire and explosion protection"
4. "Davis Daniel et al, "Hand Book of fire technology"
5. Fire fighters hazardous materials reference book "Fire Prevention in Factories", an Nostrand Rein Hold, New York, 1991.
6. Relevant Indian Acts and rules, Government of India.

Course Code : P15ISE202

Course Name : COMPUTER AIDED HAZARD ANALYSIS

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	2 Hrs/Week	External Marks	50
Practical	-		Credits	4

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

**Course
Outcomes**

- C01 Explain various types of risks and methodologies for assessing them and establish risk acceptance levels.
- C02 Demonstrate how to use advanced instruments to measure risk and do various sensitive tests.
- C03 Know the principles of risk analysis software and use them for checking reliability levels.
- C04 elaborate the logic of consequence analysis and to plot the affected regions.
- C05 analyze the past events to check the credibility of the risk assessment techniques.

UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT

L 9 T 6

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.

UNIT II COMPUTER AIDED INSTRUMENTS

L 9 T 6

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

UNIT III RISK ANALYSIS QUANTIFICATION AND SOFTWARES

L 9 T 6

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, HANGARS modules on Heat radiation, Pool fire, Jet, Explosion. Reliability software on FMEA for mechanical and electrical systems.

UNIT IV CONSEQUENCES ANALYSIS

L 9 T 6

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.

UNIT V CREDIBILITY OF RISK ASSESSMENT TECHNIQUES

L 9 T 6

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

TOTAL NUMBER OF PERIODS = 75

Content beyond syllabus

[RTCA DO-178B](#) (Software Considerations in Airborne Systems and Equipment Certification)

[SAE ARP4761](#) (System safety assessment process)

SWIFT

[Medical Device Risk Management - ISO 14971](#)

Fault tree analysis

Learning Resources

TEXT BOOKS

1. Brown, D.B. System analysis and Design for safety, Prentice Hall, 1976.
2. Course Material Intensive Training Programme on Consequence Analysis, by Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka and CLRI, Chennai.

REFERENCES

1. Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK 1990 (Vol.I, II and III)
2. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
3. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
4. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.

Course Code : P15ISE203

Course Name : ELECTRICAL SAFETY

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

Course Outcomes

C01 know the working principles of basic electric instruments and verify whether they satisfy national and international standards.

C02 differentiate various types of electrical hazards and know various types of insulation methods to prevent those hazards.

C03 Protect against over voltage and under voltage. Safely handling hand held electrical tools.

C04 Select devices considering the role of environment and plan for maintenance

C05 Separate hazardous zones from safe area and select equipments based on their suitability of that particular zone.

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS

L 9 T 0

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).

UNIT II ELECTRICAL HAZARDS

L 9 T 0

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI.

Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS

L 9 T 0

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

UNIT IV SELECTION, INSTALLATION, OPERATION AND MAINTENANCE

L 9 T 0

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

UNIT V HAZARDOUS ZONES

L 9 T 0

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.

TOTAL NUMBER OF PERIODS = 45

Content beyond syllabus

- IEC 60335
- High voltage testing
- Double insulation
- Leakage current
- Electrical Shock

Learning Resources

TEXT BOOK:

1. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.
2. Indian Electricity Act and Rules, Government of India.

REFERENCES

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

Course Code : P15ISE204

Course Name : MAINTAINABILITY ENGINEERING

Lecture	- 3 Hrs/Week	Internal Marks	50
Tutorial	- 0 Hrs/Week	External Marks	50
Practical	-	Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

- Course Outcomes**
- C01** Explain the concept maintenance and its purpose in an industry
 - C02** Explain various maintenance models available and ways to choose among them
 - C03** know the resources required for better maintenance and ways of optimally allocating them.
 - C04** Explain the various quality measures of maintenance designing a product for easy maintenance
 - C05** Explain what are TPM and various types of losses and ways to eliminate them.

UNIT I MAINTENANCE CONCEPT

L 9 T 0

Maintenance definition –Need for maintenance –Maintenance objectives and challenges – Tero technology – Maintenance costs - Scope of maintenance department.

UNIT II MAINTENANCE MODELS

L 9 T 0

Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – PM schedule and product characteristics – Inspection models-Optimizing profit/downtime – Replacement decisions.

UNIT III MAINTENANCE LOGISTICS

L 9 T 0

Human factors – Maintenance staffing: Learning curves – Simulation – Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning and scheduling – Spare parts planning..

UNIT IV MAINTENANCE QUALITY

L 9 T 0

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

UNIT V TOTAL PRODUCTIVE MAINTENANCE

L 9 T 0

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

TOTAL NUMBER OF PERIODS = 45

Content beyond syllabus

- [Maintenance, repair, and operations](#) (MRO) Exposure assessment
- Engineering failures
- Firearm maintenance
- Reliability engineering
- Non destructive testing

Learning Resources

Text Book

1. Andrew K.S.Jardine & Albert H.C.Tsang, "Maintenance, Replacement and Reliability", Taylor and Francis, 2006.

REFERENCES

1. Bikas Badhury & S.K.Basu, "Tero Technology: Reliability Engineering and Maintenance Management", Asian Books, 2003.
2. Seichi Nakajima, "Total Productive Maintenance", Productivity Press, 1993.

Course Code : P15ISE506

Course Name : TRANSPORT SAFETY

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

- Course Outcomes**
- C01** explain the dangers of transporting hazardous goods and the safe procedures to be followed during transit.
 - C02** Determine the main factors contribute to the safety in road transport and implement appropriate measures to prevent accidents.
 - C03** know the methods of selecting and training drivers and teach them the safe procedures to be followed.
 - C04** Analyze the construction features of road and rails which contribute the accidents and design appropriate traffic management.
 - C05** implement the methods of keeping repair shop and off road vehicle safe and the wafer ways of servicing the vehicles.

UNIT I TRANSPORTATION OF HAZARDOUS GOODS

L 9 T 0

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

UNIT II ROAD TRANSPORT

L 9 T 0

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.

UNIT III DRIVER AND SAFETY

L 9 T 0

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- driver relaxation and rest pauses – speed and fuel conservation – emergency planning and Haz mat codes

UNIT IV ROAD SAFETY

L 9 T 0

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.- factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers – street lighting and illumination overloading-concentration of driver. Plant railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices.

UNIT V SHOP FLOOR AND REPAIR SHOP SAFETY

L 9 T 0

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

TOTAL NUMBER OF PERIODS= 45

Content beyond syllabus

- Aviation safety
- Maritime safety
- Railway safety
- Traffic management
- Safety management systems

Learning Resources

TEXT BOOKS:

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.

REFERENCES

1. Kadiyali, "Traffic Engineering and Transport Planning" Khanna Publishers, New Delhi, 1983.
2. Motor Vehicles Act, 1988, Government of India.
3. "Accident Prevention Manual for Industrial Operations", NSC, Chicago, 1982.
4. Pasricha, "Road Safety guide for drivers of heavy vehicle" Nasha Publications, Mumbai, 1999.
5. K.W.Ogden, "Safer Roads – A guide to Road Safety Engineering"

Course Code : P15ISE211

Course Name : SAFETY IN MINES

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

C01 analyze the causes of accidents in opencast mines and ways to handle them

C02 Explain various hazards which could happen in an underground mines and ways to mitigate them

C03 know the reasons for the collapse of tunnels and the necessary personal protective equipments to be worn for saving lives.

C04 Explain the basic concepts of risk assessment related to mines and do FMEA and other types of analyzes

C05 Analyze the previous accidents happened in mine and learn preventing methods by modeling them

Course Outcomes

UNIT I OPENCAST MINES

L 9 T 0

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.

UNIT II UNDERGROUND MINES

L 9 T 0

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

UNIT III TUNNELLING

L 9 T 0

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

UNIT IV RISK ASSESSMENT

L 9 T 0

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.

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT

L 9 T 0

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

TOTAL NUMBER OF PERIODS = 45

Content beyond syllabus

- Black lung diseases
- Reverberant effects
- Methane gas
- Abandoned mines

Learning Resources

Text Book

1. "Mine Health and Safety Management", Michael Karmis ed., SME, Littleton, Co.2001.

REFERENCES

1. Kejriwal, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.
2. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan-DHANBAD, 2002.

Course Code	P15ISE205
Course Name	INDUSTRIAL SAFETY LABORATORY

Lecture	-	Internal Marks	60
Tutorial	-	External Marks	40
Practical	4 Hrs/Week	Credits	2

Pre-requisites subject: Engineering thermodynamics and Thermal engineering.

Course Outcomes	Upon completion of this course the students will be able to
	CO1 Measure various levels of hazards elements present in an working environment
	CO2 Use the safety equipments and train others in it
	CO3 Use various software packages to analyze the hazards level and appropriate remedies

Total Hours 60

LIST OF EXPERIMENTS

1. NOISE LEVEL MEASUREMENT AND ANALYSIS

Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values.

2. FRICTION TEST

Explosive materials like barium nitrate, gun powder, white powder, amerces composition etc.

3. IMPACT AND BURSTING STRENGTH TEST

Explosive materials like gun powder, white powder, amerces composition etc. Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc. Auto ignition temperature test.

4. EXHAUST GAS MEASUREMENT AND ANALYSIS

Measurement of Sox, Nox, Cox, hydrocarbons.

5. ENVIRONMENTAL PARAMETER MEASUREMENT

Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, wind flow and effective corrective effective. Particle size Measurement. Air sampling analysis

6. TRAINING IN USAGE AND SKILL DEVELOPMENT

Personal protective equipment:

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, anti static and conducting plastics/rubber materials, apron and leg guard.

7. Fire extinguishers and its operations

Water Co2
Foam
Carbon dioxide (Co2)
Dry chemical powder

8. **Static charge testing** on plastic, rubber, ferrous and non-ferrous materials.

9. **Illumination testing** - by lux meter and photo meter.

10. Electrical safety

Insulation resistance for motors and cables

Estimation of earth resistance

Earth continuity test

Sensitivity test for ELCB

11. Software Usage

Accident Analysis

Safety Audit Packages

Consequence Analysis (CISCON)

Fire, Explosion and Toxicity Index (FETI)

Reliability Analysis for Mechanical system and Electrical System

Failure Mode Analysis

12. First-Aid

Road safety signals and symbols

List of Equipments

1. Noise level meter : 1 No

2. Friction tester : 1 No

3. Bursting Strength Tester : 1 No

4. Exhaust gas analyzer: 1 No

5. High volume sampler : 1 No

6. PPE Set : 1 No

7. Fire extinguisher set : 1 No

8. Static charge tester : 1 No

9. First aid kit : 1 No

10. Software : CISCON, FETI and Failure Mode analysis

Course Code | **P14ISE206**

Course Name | **HAZARD ASSESSMENT IN INDUSTRY – MINI PROJECT**

Lecture	-	Internal Marks	60
Tutorial	-	External Marks	40
Practical	4 Hrs/Week	Credits	2

Pre-requisites subject: Nil.

Upon completion of this course the students will be able to

Course Outcomes	CO1	Use their theoretical knowledge for understanding real situations
	CO2	Use their skills to design safe systems
	CO3	Use various software packages to analyze the hazards levels in risky situations and recommend appropriate remedies

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.

TOTAL NUMBER OF PERIODS = 60

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME III Semester under Regulations 2015
Mechanical Engineering
Branch: M.E. Industrial Safety Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P15SE301	Reliability Engineering	3	2	0	4
2	P15SE513	Elective- Plant Layout and Materials Handling	3	0	0	3
3	P15SE516	Elective- Human Factors in Engineering	3	0	0	3
Practical						
4	P15SE302	Project Work Phase - I	0	0	12	6
Total Credits						16

Approved by

Chairman, Mechanical Engineering BOS
Dr.D.Senthilkumar

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/MECH, Third Semester ME ISE Students and Staff, COE

Course Code : P15ISE301

Course Name : RELIABILITY ENGINEERING

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	2 Hrs/Week	External Marks	50
Practical	-		Credits	4

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

**Course
Outcomes**

- C01 Explain how failure occurs and model them as a function
- C02 know how to use various mathematical distributions to plot hazard data.
- C03 explain the principles various reliability prediction models and analyze real data using them.
- C04 Calculate the cost of reliability in a products life cycle and know the ways of keeping them in control.
- C05 analyze the risk level using various risk analysis techniques and apply reduction resources.

UNIT I RELIABILITY CONCEPT

L 9 T 6

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

UNIT II FAILURE DATA ANALYSIS

L 9 T 6

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

UNIT III RELIABILITY PREDICTION MODELS

L 9 T 6

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.

UNIT IV RELIABILITY MANAGEMENT

L 9 T 6

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

UNIT V RISK ASSESSMENT

L 9 T 6

Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

TOTAL NUMBER OF PERIODS = 75

Content beyond syllabus

Safety factor

Fault tolerant systems

Failure mechanisms

Availability of machines

Root cause analysis

Learning Resources

TEXT BOOKS

1. Srinath L.S, “Reliability Engineering”, Affiliated East-West Press Pvt Ltd, New Delhi, 1998.

REFERENCE BOOKS

1. Modarres, “Reliability and Risk analysis”, Maral Dekker Inc.1993.
2. John Davidson, “The Reliability of Mechanical system” published by the Institution of Mechanical Engineers, London, 1988.
3. Smith C.O. “Introduction to Reliability in Design”, McGraw Hill, London, 1976.

Course Code : P15ISE513

Course Name : PLANT LAYOUT AND MATERIALS HANDLING

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

- Course Outcomes**
- C01** Select a suitable location for constructing a factory or storing explosive materials.
 - C02** Design a safe layout for various kind of industries and supporting facilities.
 - C03** Suggest good working conditions which will improve productivity in a safe manner.
 - C04** Design material handling systems which will minimize manual handling of hazardous materials.
 - C05** Explain the principles of various industrial equipments used for material handling and select the suitable ones for any specific application.

UNIT I PLANT LOCATION

L 9 T 0

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

UNIT II PLANT LAYOUT

L 9 T 0

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

UNIT III WORKING CONDITIONS

L 9 T 0

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.

UNIT IV MANUAL MATERIAL HANDLING AND LIFTING TACKLES

L 9 T 0

Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and

tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations

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

UNIT V MECHANICAL MATERIAL HANDLING

L 9 T 0

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.

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.

TOTAL: 45 PERIODS

Content beyond syllabus

Industrial robot

Automation

Human factors and ergonomics

Unit load concept

The NIOSH (National Institute for Occupational Safety and Health)

Learning Resources

TEXT BOOKS:

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. APPLE M. JAMES “Plant layout and material handling”, 3rd edition, John Wiley and sons.

REFERENCES

1. Spivakosky, “Conveyors and related Equipment”, Vol.I and II Peace Pub. Moscow, 1982.
2. Rudenko, N., “Material handling Equipments”, Mir Publishers, 1981.
3. Reymond, A.Kulwice, “Material Handling Hand Book - II”, John Wiley and Sons, New York, 1985.
4. “Safety and good housekeeping”, N.P.C. New Delhi, 1985.
5. “Industrial ventilation (A manual for recommended practice), American conference of Governmental Industrial Hygiene, USA, 1984

Course Code : P15ISE516

Course Name : HUMAN FACTORS IN ENGINEERING

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	3

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

C01 Analyze how body posture affects the health of the workers and lead to degenerative diseases

C02 Explain accident proneness of humans and how to cure them or prevent them and others from accidents

C03 Relate the principles of anthropometry to the design of workplace both for standing and sitting conditions

C04 Explain how repetitive works affect humans and where to introduce machines or when to intervene to prevent damage to human systems

C05 Apply the principles of visual displays for the best benefits of workers and improve working comfort

Course Outcomes

UNIT I ERGONOMICS AND ANATOMY

L 9 T 0

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions

UNIT II HUMAN BEHAVIOR

L 9 T 0

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.

UNIT III ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS

L 9 T 0

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

UNIT IV MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND MANUAL HANDLING TASK

L 9 T 0

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 musculo skeltal 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.

UNIT V HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS

L 9 T 0

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.

TOTAL NUMBER OF PERIODS = 45

Content beyond syllabus

- International ergonomics association
- Carpal tunnel syndrome
- Cognitive ergonomics
- Participatory design

Learning Resources

Text Book

1. Human factors in engineering and design, MARK S.SANDERS
2. The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson

REFERENCES

1. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis
2. Ergonomic design for organizational effectiveness, Michael O'Neill

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME IV Semester under Regulations 2015
Mechanical Engineering
Branch: M.E. Industrial Safety Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Practical						
1	P15ISE401	Project Work Phase – II	0	0	30	15
Total Credits						15

Approved by

Chairman, Mechanical Engineering BOS
Dr.D.Senthilkumar

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

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