

**SONA COLLEGE OF TECHNOLOGY, SALEM-5**

**(An Autonomous Institution)**

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

**CURRICULUM and SYLLABI**

**[For students admitted in 2021-2022]**

**M.E / M.Tech Regulation 2019**

**Approved by BOS and Academic Council meetings**

**Sona College of Technology, Salem**  
**(An Autonomous Institution)**  
**Courses of Study for ME I Semester under Regulations 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Theory</b>							
1	P19ISE101	Occupational Health and Industrial Hygiene	3	0	0	3	45
2	P19ISE102	Principles of Safety Management	3	0	0	3	45
3	P19ISE103	Environmental Safety	3	0	0	3	45
4	P19ISE502	<b>Elective</b> -Computer Aided Hazard Analysis	3	0	0	3	45
5	P19ISE505	<b>Elective</b> - Quality Engineering in Production Systems	3	0	0	3	45
6	P19GE101	Research Methodology and IPR	2	0	0	2	30
7	P19GE701	<b>Audit Course</b> – English for Research Paper Writing	2	0	0	0	30
<b>Practical</b>							
8	P19ISE104	Industrial Safety Laboratory	0	0	4	2	60
<b>Total Credits</b>						19	

Approved by

Chairperson, 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 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Theory</b>							
1	P19ISE201	Industrial Safety, Health and Environment Acts	3	0	0	3	45
2	P19ISE202	Fire Engineering and Explosion Control	3	0	0	3	45
3	P19ISE203	Electrical Safety	3	0	0	3	45
4	P19ISE509	<b>Elective-</b> Safety in Construction	3	0	0	3	45
5	P19ISE515	<b>Elective-</b> Safety in Mines	3	0	0	3	45
6	P19GE702	<b>Audit Course</b> – Stress Management By Yoga	2	0	0	0	30
<b>Practical</b>							
7	P19ISE204	Mini Project -Hazard Assessment in Industry	0	0	4	2	60
<b>Total Credits</b>						<b>17</b>	

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**Sona College of Technology, Salem**  
**(An Autonomous Institution)**  
**Courses of Study for ME III Semester under Regulations 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Theory</b>							
1	P19ISE301	Human Factors in Industrial Safety	3	0	0	3	45
2	P19ISE517	<b>Professional Elective</b> – Plant Layout and Materials Handling	3	0	0	3	45
3	P19CEM601	<b>Open Elective</b> – Disaster Mitigation and Management	3	0	0	3	45
	P19PSE601	<b>Open Elective</b> – Smart Grid Technologies					
<b>Practical</b>							
4	P19ISE302	Project work phase - I	0	0	16	8	240
<b>Total Credits</b>						<b>17</b>	

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



**Sona College of Technology, Salem**  
**(An Autonomous Institution)**  
**Courses of Study for ME IV Semester under Regulations 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Practical</b>							
1	P19ISE401	Project Work Phase – II	0	0	28	14	420
<b>Total Credits</b>						<b>14</b>	

**Approved by**

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**Dr.S.R.R.Senthil Kumar**

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

**Sona College of Technology, Salem**  
**(An Autonomous Institution)**  
**Courses of Study for ME I Semester under Regulations 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Theory</b>							
1	P19ISE101	Occupational Health and Industrial Hygiene	3	0	0	3	45
2	P19ISE102	Principles of Safety Management	3	0	0	3	45
3	P19ISE103	Environmental Safety	3	0	0	3	45
4	P19ISE502	<b>Elective</b> -Computer Aided Hazard Analysis	3	0	0	3	45
5	P19ISE505	<b>Elective</b> - Quality Engineering in Production Systems	3	0	0	3	45
6	P19GE101	Research Methodology and IPR	2	0	0	2	30
7	P19GE701	<b>Audit Course</b> – English for Research Paper Writing	2	0	0	0	30
<b>Practical</b>							
8	P19ISE104	Industrial Safety Laboratory	0	0	4	2	60
<b>Total Credits</b>						19	

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**Dr.D.Senthilkumar**

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Copy to:-

HOD/MECH, First Semester ME ISE Students and Staff, COE

**Course Code : P19ISE101**

**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**

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	2	3	2	3	2	3	2	3	2	3	3	3	2	3
CO – 2	2	2	3	3	2	3	3	2	3	2	3	2	3	2
CO – 3	3	3	2	3	3	2	3	2	3	3	2	2	3	3
CO – 4	3	2	3	2	2	3	2	3	2	3	2	2	2	3
CO - 5	3	3	2	3	3	2	2	3	2	2	3	3	2	3

**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
- 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 : P19ISE102**

**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.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	2	3	2	3	2	2	3	3	3	2	3	3	3	2
CO – 2	3	2	3	2	2	3	3	2	3	2	3	2	2	3
CO – 3	3	2	2	3	3	2	2	2	2	3	2	3	3	2
CO – 4	2	3	2	2	2	3	2	3	3	2	2	2	3	3
CO - 5	2	3	3	3	3	2	2	2	2	3	3	3	3	3

**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.

**Total Number of Periods: 45**

### **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, 2<sup>nd</sup> 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 : P19ISE103**

**Course Name : ENVIRONMENTAL 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 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.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO – 3	3	2	3	2	3	2	2	3	2	3	2	2	3	2
CO – 4	2	3	2	2	2	3	2	3	3	2	2	3	3	2
CO - 5	2	2	3	3	3	3	3	2	2	3	3	3	2	3

**UNIT I AIR POLLUTION**

**L 9 T 0**

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 0**

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 0**

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 0**

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.

**UNIT V POLLUTION CONTROL IN PROCESS INDUSTRIES****L 9 T 0**

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

**Total Number of Periods: 45****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 : P19ISE502**

**Course Name : COMPUTER AIDED HAZARD ANALYSIS**

Lecture	-	3 Hrs/Week	Internal Marks	50
Tutorial	-	NIL	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 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.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO – 4	3	2	3	2	3	2	2	3	3	2	3	3	2	3
CO - 5	2	2	3	3	2	2	3	3	3	2	3	3	3	3

**UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT**

**L 9 T 0**

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 0**

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).

### **UNIT III RISK ANALYSIS QUANTIFICATION AND SOFTWARES**

**L 9 T 0**

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 0**

Logics of consequences analysis- Fuzzy logic-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 0**

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 = 45**

### **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](#)

### **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 : P19ISE505**

**Course Name : QUALITY ENGINEERING IN PRODUCTION SYSTEMS**

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

Pre-requisites subject: Nil

**Upon completion of this course the students will be able to**

- C01** Explain the concept of quality loss function and use it to improve quality in any production system
- C02** Explain various process parameter variables and use them appropriately in an online quality control systems
- C03** device and use various process improvement methods for process diagnosis and adjustment.
- C04** Explain various maintenance methods and plan schedules of maintenance for minimum cost and failure
- C05** Differentiate six sigma from various other quality improvement methods and implement it in an organisation

**Course Outcomes**

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
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CO – 4	3	2	2	2	3	2	3	2	3	3	3	2	2	3
CO - 5	2	2	3	3	2	2	3	3	3	3	3	3	3	3

**UNIT I INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION L 9 T 0**

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

**UNIT II ON-LINE QUALITY CONTROL L 9 T 0**

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.

### **UNIT III ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS**

**L 9 T 0**

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

### **UNIT IV QUALITY ENGINEERING AND TPM**

**L 9 T 0**

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.

### **UNIT V SIX SIGMA AND ITS IMPLEMENTATION**

**L 9 T 0**

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

**TOTAL NUMBER OF PERIODS = 45**

### **Content beyond syllabus**

- FMS
- Throughput
- Production planning
- Reliability engineering
- Economic production quantity

### **Learning Resources**

#### **Text Book**

1. De Feo J A and Barnard W W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, NewDelhi, 2005.

### **REFERENCES**

1. Taguchi G, Elsayed E A and Hsiang, T.C., "Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, International Edition, 1989
2. Pyzdek T and Berger R W, "Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996
3. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, New Delhi, Second reprint, 2002.

**Course Code P19GE101**

L T P C

**Course Name RESEARCH METHODOLOGY AND IPR**

2 0 0 2

Pre-requisite subjects:

**Course Outcomes**

Upon completion of this course the students will be able to

<b>CO1</b>	Understand research problem formulation.
<b>CO2</b>	Analyze research related information and Follow research ethics
<b>CO3</b>	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
<b>CO4</b>	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
<b>CO5</b>	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO - 1</b>	3	2	2	3	2	2	3	3	2	2	3	2	3	2
<b>CO - 2</b>	2	3	3	2	3	3	2	2	3	2	2	3	2	3
<b>CO - 3</b>	3	3	2	3	2	3	3	3	2	3	2	3	3	2
<b>CO - 4</b>	2	2	3	2	3	2	2	3	3	3	3	2	2	3
<b>CO - 5</b>	3	2	3	3	2	2	3	2	3	2	3	3	3	3

**Unit I INTRODUCTION TO RESEARCH**

L 6 T 0

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**Unit II WRITING AND ASSESSMENT**

L 6 T 0

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**Unit III INTELLECTUAL PROPERTY**

L 6 T 0

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**Unit IV INTELLECTUAL PROPERTY RIGHTS**

L 6 T 0

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

## **Unit V DEVELOPMENTS IN IPR**

L 6 T 0

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**Total: 30 Hrs**

### **Learning Resources**

#### **Reference Books**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**Course Code P19GE701**

L T P C

**Course Name ENGLISH FOR RESEARCH PAPER WRITING**

2 0 0 0

Pre-requisite subjects: English

Upon completion of this course the students will be able to

<b>CO1</b>	Understand that how to improve your writing skills and level of readability
<b>CO2</b>	Learn about what to write in each section
<b>CO3</b>	Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO - 1</b>	3	2	3	2	2	2	3	3	2	2	3	3	3	3
<b>CO – 2</b>	3	3	2	3	3	3	2	3	3	3	2	3	3	3
<b>CO – 3</b>	3	3	3	3	3	3	3	3	2	3	2	3	3	3

### Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

### Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

### Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

### Unit 4

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

### Unit 5

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

### Unit 6

useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

### Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

**Total Hours:30**

<b>Course Code</b>	<b>P19ISE104</b>
<b>Course Name</b>	<b>INDUSTRIAL SAFETY LABORATORY</b>

Lecture	-0	Internal Marks	60
Tutorial	-0	External Marks	40
Practical	-4 Hrs/Week	Credits	2

Pre-requisites subject: Engineering thermodynamics and Thermal engineering.

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

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO - 1</b>	3	2	3	2	3	2	3	3	2	2	3	3	2	3
<b>CO – 2</b>	2	3	2	3	2	3	2	2	3	3	3	2	3	3
<b>CO – 3</b>	3	3	3	3	3	3	3	3	2	3	2	3	2	2

## LIST OF EXPERIMENTS

**Total Hours 60**

### 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)

Failure Mode Analysis

## **12. First-Aid**

Road safety signals and symbols

### **List of Equipment**

**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 Outcomes:**

At the end of the course, the students will be able to

- Demonstrate research writing skills both for research articles and thesis
- Frame suitable title and captions as sub-headings for articles and thesis
- Write each section in a research paper and thesis coherently
- Use language appropriately and proficiently for effective written communication
- Exhibit professional proof-reading skills to make the writing error free

**Unit – I** 6  
 Planning and preparation, word order, breaking up long sentences, organising ideas into paragraphs and sentences, being concise and avoiding redundancy, ambiguity and vagueness

**Unit – II** 6  
 Interpreting research findings, understanding and avoiding plagiarism, paraphrasing sections of a paper/ abstract.

**Unit- III** 6  
 Key skills to frame a title, to draft an abstract, to give an introduction

**Unit – IV** 6  
 Skills required to organise review of literature, methods, results, discussion and conclusions

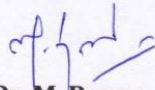
**Unit – V** 6  
 Usage of appropriate phrases and key terms to make the writing effective - proof-reading to ensure error-free writing.

**Text Books:**

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Highman N , Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book, 1998.
3. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006.
4. Goldbort R, Writing for Science, Yale University Press, 2006. (available on Google Books)

**REFERENCES**

Martin Cutts, Oxford Guide to Plain English, Oxford University Press, Second Edition, 2006



**Dr. M. Renuga**  
 BoS – Chairperson,  
 Science & Humanities  
 HOD / H&L

**Total: 30 hours**

**Sona College of Technology, Salem**  
**(An Autonomous Institution)**  
**Courses of Study for ME II Semester under Regulations 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Theory</b>							
1	P19ISE201	Industrial Safety, Health and Environment Acts	3	0	0	3	45
2	P19ISE202	Fire Engineering and Explosion Control	3	0	0	3	45
3	P19ISE203	Electrical Safety	3	0	0	3	45
4	P19ISE509	<b>Elective-</b> Safety in Construction	3	0	0	3	45
5	P19ISE515	<b>Elective-</b> Safety in Mines	3	0	0	3	45
6	P19GE702	<b>Audit Course</b> – Stress Management By Yoga	2	0	0	0	30
<b>Practical</b>							
7	P19ISE204	Mini Project -Hazard Assessment in Industry	0	0	4	2	60
<b>Total Credits</b>						<b>17</b>	

Approved by

Chairperson, 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, Second Semester ME II ISE Students and Staff, COE

Course Code : P19ISE201

Course Name : INDUSTRIAL SAFETY HEALTH AND ENVIRONMENTAL ACTS

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 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.

**Course Outcomes**

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	3	3	2	3	2	2	3	3	2	3	3	3	3	3
CO - 2	2	3	3	2	3	3	2	2	3	2	2	3	2	3
CO - 3	3	2	2	3	2	3	3	2	2	3	2	2	3	2
CO - 4	2	2	3	2	3	2	2	3	3	3	3	3	2	3
CO - 5	3	3	3	3	2	2	3	3	3	2	3	2	3	2

### UNIT I FACTORIES ACT – 1948

L 9 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 9 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 9 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 9 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 9 T 0**

Occupational Safety and Health act of USA (The Williams-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: 45**

**Content beyond syllabus**

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

**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 : P19ISE202

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.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO - 1</b>	3	2	3	3	2	3	3	3	2	2	3	2	3	3
<b>CO - 2</b>	3	2	2	3	2	3	2	2	3	3	2	3	2	3
<b>CO - 3</b>	2	3	3	2	3	3	3	2	2	3	2	3	3	2
<b>CO - 4</b>	3	3	2	2	3	2	2	3	3	2	3	3	2	3
<b>CO - 5</b>	3	2	3	3	2	2	3	3	2	3	2	3	3	2

**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, Pasadena 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 – CO<sub>2</sub> 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 (CO<sub>2</sub>) and halons-hazards in LPG, ammonia (NH<sub>3</sub>), sulphur dioxide (SO<sub>3</sub>), chlorine (CL<sub>2</sub>) 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 : P19ISE203

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 equipment based on their suitability of that particular zone.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	3	2	3	3	2	2	3	3	2	2	3	3	3	2
CO – 2	3	3	2	2	3	3	2	3	3	3	2	2	2	3
CO – 3	2	3	2	3	2	3	2	2	2	3	2	2	3	2
CO – 4	3	2	3	2	3	2	3	3	3	2	3	3	2	3
CO - 5	2	3	3	3	2	2	3	3	2	3	3	3	3	3

### 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

#### **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 : P19ISE509

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

- 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

**Course Outcomes**

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	3	2	3	3	2	2	3	2	3	2	3	3	2	3
CO - 2	3	3	3	3	3	2	2	3	3	3	3	2	2	3
CO - 3	2	2	2	3	2	3	2	2	2	3	2	3	3	2
CO - 4	3	2	3	2	3	3	3	3	3	2	3	2	2	2
CO - 5	2	3	3	2	3	2	3	3	2	3	2	3	3	3

**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.

**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.

#### **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

Course Code : P19ISE515

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**

**Course Outcomes**

- 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

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	3	2	2	3	2	2	3	3	2	2	3	3	2	3
CO - 2	2	3	2	3	3	3	2	2	3	3	2	3	2	3
CO - 3	3	3	3	3	3	3	2	2	2	3	2	2	3	2
CO - 4	3	2	3	2	3	2	2	3	3	2	3	2	2	3
CO - 5	3	3	3	3	2	2	3	3	3	3	3	3	3	3

**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

P19ISE204

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.

Course  
Outcomes

Upon completion of this course the students will be able to

- 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

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome ( PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	3	2	3	2	3	2	3	3	2	2	3	3	2	3
CO – 2	2	3	2	3	3	3	2	2	3	2	2	3	3	2
CO – 3	3	3	2	3	2	3	3	3	2	3	2	2	3	3

**OBJECTIVE:**

□□It is proposed to carryout detailed analysis of real life unsafe situation and propose possible remedies without violating government norms. This helps the students to get familiar with respect to the general conditions of industrial environment and workers.

**OUTCOME:**

□□It helps the students to get familiarized with everyday problems in implementing safety standards and get the experience to solve the situations. Each student is required to study any industry and learn the practical aspects of unsafe working conditions. They are expected to submit report about the work they did to improve safety practices in an industry.

**TOTAL NUMBER OF PERIODS = 60**

Course Code : P19GE702

Course Name : AUDIT COURSE \_ STRESS MANAGEMENT BY YOGA

Lecture	-	2 Hrs/Week	Internal Marks	50
Tutorial	-	0 Hrs/Week	External Marks	50
Practical	-		Credits	0

Pre-requisites subject: Nil

Upon completion of this course the students will be able to

Course  
Outcomes

- C01 Develop physical and mental health thus improving social health
- C02 Increase immunity power of the body and prevent diseases
- C03 Accelerate memory power
- C04 Achieve the set goal with confidence and determination
- C05 Improve stability of mind, pleasing personality and work with awakened wisdom.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3 – Strong, 2 – Medium, 1 - Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs & PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	1	1	1	1	1	3	3	3	3	3	2	3	1	2
CO - 2	1	1	1	1	1	3	3	3	2	2	2	3	1	2
CO - 3	1	1	1	1	1	3	2	3	3	3	2	3	1	2
CO - 4	1	1	1	1	1	3	2	3	3	2	2	3	1	2
CO - 5	1	1	1	1	1	2	3	2	2	3	2	3	1	2

#### UNIT – I

6

Yoga-Introduction - Astanga Yoga- 8 parts-Yam and Niyam etc.- Do's and Don'ts in life-Benefits of Yoga and Asana- Yoga Exercise- and benefits- Pranayam Yoga- Nadisuthi, Practice and Spinal Sclearance Practice-Regularization of breathing techniques and its effects-Practice and kapalapathy practice.

#### UNIT – II

6

Neuromuscular breathing exercise and Practice- Magarasa Yoga, 14 points Acupressure techniques and practice-Body relaxation practice and its benefits- Raja Yoga- 1.Agna –explanation and practice- Activation of Pituitary- Raja Yoga-2. Santhi Yoga-Practice-Balancing of physical and mental power.

#### UNIT – III

6

Raja Yoga-3.Sagasrathara yoga –practice- Activation of dormant brain cells-Kayakalpa-theory- Kayakalpa –practice-Yogic exercise to improve physical and mental health and practice-Asanas –explanation-Practice-benefits

#### UNIT –IV

6

Sun namaskar- 12 poses-explanation and practice-Yoga –Asana-Padmasana, vajrasana,chakrasana, viruchasanaetc-Stress management with Yoga-Role of women and Yoga Equality, nonviolence, Humanity,Self- control- Food and yoga Aware of self-destructive habits Avoid fault thinking (thought analysis-Practice)-Yoga Free from ANGER (Neutralization of anger)& practice

**UNIT – V****6**

Moralisation of Desire & practice- Punctuality-Love-Kindness-CompassionEradication ofworries-Practice - Personality development, positive thinking-Good characters to lead a moral life- How to clear the polluted mind- Benefits of blessing- Five- fold culture –explanaiton- Karma Yoga Practice In Geetha- Sense of duty-Devotion, self-reliance, confidence, concentration, truthfulness, cleanliness.

**Total : 30 hours****Reference Books**

1. ‘Yogic Asanas for Group Tarining-Part-I’ Janardan Swami YogabhyasiMandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata



**Course Outcomes:**

At the end of completion of this course, students will be able to

1. Develop physical and mental health thus improving social health
2. Increase immunity power of the body and prevent diseases
3. Accelerate memory power
4. Achieve the set goal with confidence and determination
5. Improve stability of mind, pleasing personality and work with awakened wisdom

**UNIT – I****6**

Yoga-Introduction - Astanga Yoga- 8 parts-Yam and Niyam etc.- Do's and Don'ts in life- Benefits of Yoga and Asana- Yoga Exercise- and benefits- Pranayam Yoga- Nadi suthi, Practice and Spinal Sclearance Practice- Regularization of breathing techniques and its effects-Practice and kapalapathy practice.

**UNIT – II****6**

Neuromuscular breathing exercise and Practice- Magarasa Yoga, 14 points Acupressure techniques and practice- Body relaxation practice and its benefits- Raja Yoga- 1.Agna – explanation and practice- Activation of Pituitary- Raja Yoga- 2. Santhi Yoga-Practice- Balancing of physical and mental power.

**UNIT – III****6**

Raja Yoga- 3. Sagasrathara yoga –practice- Activation of dormant brain cells-Kayakalpa-theory- Kayakalpa –practice-Yogic exercise to improve physical and mental health and practice-Asanas –explanation-Practice-benefits

**UNIT –IV****6**

Sun namaskar- 12 poses-explanation and practice-Yoga –Asana-Padmasana, vajrasana,chakrasana, viruchasana etc-Stress management with Yoga-Role of women and Yoga  
Equality, nonviolence, Humanity, Self- control- Food and yoga Aware of self-destructive habits  
Avoid fault thinking (thought analysis-Practice)-Yoga Free from ANGER (Neutralization of anger)& practice

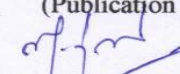
**UNIT – V****6**

Moralisation of Desire & practice- Punctuality-Love-Kindness-Compassion Eradication of worries-Practice -Personality development, positive thinking-Good characters to lead a moral life  
How to clear the polluted mind- Benefits of blessing- Five- fold culture –explanation- Karma Yoga Practice In Geetha- Sense of duty-Devotion, self- reliance, confidence, concentration, truthfulness, cleanliness.

**Reference Books**

1. 'Yogic Asanas for Group Tarining-Part-I' Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

**Total: 30 hours**

  
Dr. M. Renuga  
BoS – Chairperson,  
Science & Humanities  
HOD / H&L

**Sona College of Technology, Salem**  
**(An Autonomous Institution)**  
**Courses of Study for ME III Semester under Regulations 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Theory</b>							
1	P19ISE301	Human Factors in Industrial Safety	3	0	0	3	45
2	P19ISE517	<b>Professional Elective</b> – Plant Layout and Materials Handling	3	0	0	3	45
3	P19CEM601	<b>Open Elective</b> – Disaster Mitigation and Management	3	0	0	3	45
	P19PSE601	<b>Open Elective</b> – Smart Grid Technologies					
<b>Practical</b>							
4	P19ISE302	Project work phase - I	0	0	16	8	240
<b>Total Credits</b>						<b>17</b>	

Approved by

Chairperson, 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 II ISE Students and Staff, COE

**Course Code : P19ISE301**

**Course Name : HUMAN FACTORS IN INDUSTRIAL 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**

**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**

CO / PO, PSO Mapping														
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	2	3	2	2	3	3	3	2	3	2	3	2	3
CO – 2	2	3	2	3	2	3	2	3	2	2	2	3	3	2
CO – 3	2	3	2	3	3	3	3	2	3	3	3	2	2	3
CO – 4	3	2	3	3	2	3	2	3	3	2	2	2	3	3
CO - 5	2	3	3	3	2	3	2	3	3	3	2	3	3	2

## 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 skeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the workplace, 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 = 45 PERIODS**

### **Content beyond syllabus**

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

### **Learning Resources**

### **TEXTBOOKS**

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

Course Code P19ISE302

L T P C

Course Name PROJECT WORK PHASE - I

- - 16 8

Pre-requisite subjects: Principles of safety management, Environmental safety, industrial safety, health and environment acts

### Course Outcomes

Upon Completion of this course the students will be able to

CO1	Use their theoretical knowledge for understanding real situations
CO2	Use their skills to analyze the root causes of the problems
CO3	Use their creativity to design / fabricate safe systems

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	2	3	3	2	3	2	3	3	3	3	2	3	3
CO – 2	2	3	2	2	3	2	3	2	2	3	3	2	3	3
CO – 3	2	2	2	2	3	3	2	3	3	2	2	3	2	3

### OBJECTIVE:

It is expected take preliminary data and analyze the situation for possible solutions. This helps the students to understand real problems in industries and possible causes for the regular problems.

### OUTCOME:

Each student should find a suitable problem in any of the industries where safety is a main requirement and do preliminary work there. This could be continued in the phase two of the project if necessary. A minimum level of finding possible solution is expected.

**TOTAL = 240 PERIODS**

**Course Code : P19ISE517**

**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**

- 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 equipment used for material handling and select the suitable ones for any specific application.

**Course Outcomes**

CO / PO, PSO Mapping														
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO - 1	3	2	3	2	2	2	3	3	3	3	2	3	2	2
CO - 2	3	2	3	3	3	3	2	2	2	3	3	3	3	2
CO - 3	2	3	2	2	3	2	3	2	2	3	3	2	2	3
CO - 4	2	3	2	3	2	3	3	3	3	2	2	3	2	3
CO - 5	2	3	3	2	3	2	2	2	3	2	2	2	3	2

## **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 expansion, 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, operator 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

Unit load concept

The NIOSH (National Institute for Occupational Safety and Health)

## **Learning Resources**

### **TEXTBOOKS:**

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



**Sona College of Technology, Salem**  
**(An Autonomous Institution)**  
**Courses of Study for ME IV Semester under Regulations 2019**  
**Mechanical Engineering**  
**Branch: M.E. Industrial Safety Engineering**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
<b>Practical</b>							
1	P19ISE401	Project Work Phase – II	0	0	28	14	420
<b>Total Credits</b>						<b>14</b>	

**Approved by**

**Chairperson, 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, Fourth Semester ME ISE Students and Staff, COE