HANDBOOK

COURSE STRUCTURE AND DETAILED SYLLABUS

M.Tech in Health, Safety, and Environmental Engineering

Batch 2020-22

INSTITUTE OF ENGINEERING AND TECHNOLOGY

JK LAKSHMIPAT UNIVERSITY

Near Mahindra SEZ, Mahapura, Ajmer Road, Jaipur 302 026 Ph.: +91-141-7107500/504

CONTENT

Program Education Objectives

The PG Programs at IET, JKLU are designed to prepare students for continued learning and successful careers. Our alumni are expected to:

PEO1: Apply their technical knowledge, complex problem solving and research skills in professional practice.

PEO2: Continue their intellectual development through critical thinking, self-study, apprenticeship, higher education, professional development courses, as well as participation in research groups and professional networks.

PEO3: Serve as ambassadors for engineering and sustainability by exhibiting high professional standards with a deep sense of civic responsibility.

PEO4: Effectively communicate about technical and related issues. PEO5: Embrace roles of team members and leaders in their career.

Program Outcomes

The graduates of PG Programs at IET, JKLU will have following competencies:

PO 1: ***Life-long learning:*** Demonstrate inquisitiveness, open **mindedness**, and the ability to engage in independent and life-long learning in the broadest context of technological, organizational, economic, and societal changes.

PO 2: Citizenship, Sustainability, and Professional ethics

PO 2a: Demonstrate knowledge of constitutional values of liberty, equity, justice, and fraternity with understanding of the impact of the engineering solutions in societal and environmental contexts as well as a sense of responsibility for sustainable development.

PO 2b: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural, and environmental issues and the consequent responsibilities relevant to the professional engineering practice.

PO 2c: Demonstrate commitment for professional integrity and excellence and respect for ethics, responsibilities and norms as prescribed for the engineering practice.

PO 3: Engineering knowledge and Modern tool usage

PO 3a: Demonstrate clear conceptual understanding of fundamentals of engineering specialization and cognitive flexibility to appropriately 'transfer' what has been learned in a context, to different situations.

PO 3b: Apply engineering thinking, computational thinking, and the knowledge of mathematics, natural and social sciences, engineering fundamentals, information technology, engineering specialization, and engineering management to the solution of complex engineering problems.

PO 3c: Create, select, modify, and apply appropriate techniques, best practices, standards, resources, and modern engineering and IT tools including prediction and modelling to engineering and social activities with an understanding of the limitations.

PO 4: Complex problem solving, Design and Research

PO 4a: Identify, formulate, review research literature, and analyze complex engineering problems to arrive at substantiated conclusions using critical thinking along with principles of mathematics, computing, engineering as well as natural and social sciences.

PO 4b: Use systems thinking and reflection to identify and consider underlying structures, patterns, volatility, uncertainties, complexities, ambiguities, complications, and risks to design and develop engineering solutions for complex problems to meet the specified and anticipated needs with appropriate concern for constraints, performance, sustainability, and professional ethics.

PO 4c: Use research-based knowledge and research methods including design of experiments, simulation, analysis and interpretation of data, and synthesis of the information to evaluate and improve the engineering solutions and practice.

PO 5: Individual & team work and Engineering management

PO 5a: Ability to work effectively as an individual and as a team member or leader in diverse and distributed teams, and in multidisciplinary settings.

PO 5b: Ability to apply engineering management principles to one's own and team's work to manage engineering projects and operations and in multidisciplinary environment.

PO 6: Communication: Ability to communicate effectively on complex engineering and technology activities, situations, problems, and solutions using verbal, textual, and pictorial elements with the colleagues, engineering community, users, clients, policy makers, and society at large with intellectual honesty, clarity, empathy, and compassion.

PO 7: Innovation and entrepreneurship:

PO 7a: Demonstrate enthusiasm and understanding to identify opportunities and translate research in engineering and other disciplines to conceive and design innovative engineering solutions for business, industry, and societal problems.

PO 7b: Demonstrate enthusiasm and understanding to conceive and plan technology based new ventures either as independent start-up businesses or within existing corporate structures.

Program Specific Outcomes

M.Tech. (Health, Safety and Environmental Engineering)

The Health, Safety and Environmental Engineering graduates of JKLU will be able to:

HSEPSO1: Interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces.

HSEPSO2: Collect, manage, and interpret information and data to identify hazardous conditions and practices in a variety of workplaces.

HSEPSO3: Prevent and control harm to workers, property, the environment and the general public by conceiving, designing, and implementing alternative engineering and management systems and practices in compliance with laws and/or employer policies by using principles of engineering, industrial safety, risk management, data analytics, automation, and state of the art platforms, components and tools.

HSEPSO4: Serve in fields of environmental health and safety, safety engineering, industrial hygiene, safety and occupational health in business, consultancy, industry, government, healthcare, education, research, etc.

<table>
<tr><th colspan="7">Course Structure for the M.Tech (Batch 2020-2022)
Health, Safety, and Environmental Engineering (HSEE)
M.Tech programs offer the exit option after one year with PG Diploma</th></tr>
<tr><th colspan="6">Courses</th><th>Hours & Credits</th></tr>
<tr><td colspan="7">Semester I</td></tr>
<tr><td>Statistical Data Analysis-I</td><td>Industrial Automation and Internet of Things-I</td><td>Industrial Safety Management</td><td>Elective-I</td><td>Project-I/ Research Methodology -I</td><td>Critical Thinking for Developing Perspectives</td><td>Hours: 26
Credits: 21</td></tr>
<tr><td>AS2101
(3 0 4) 5</td><td>EE2101
(3 0 2) 4</td><td>ME2101
(3 0 4) 5</td><td>(3 0 0) 3</td><td>PR2101
(2 0 0) 2</td><td>IL1101
(2 0 0) 2</td><td></td></tr>
<tr><td colspan="7">Semester II</td></tr>
<tr><td>Health, Safety, and Environment Audit</td><td>Risk and Hazard Management</td><td>Regulation for Health, Safety, and Environment Management</td><td>Elective-II</td><td>Project-II/ Research Methodology-II</td><td>Critical Thinking for Decisions at Workplace</td><td>Hours: 26
Credits: 21</td></tr>
<tr><td>IL2106
(4 0 2) 5</td><td>IL2103A
(3 0 2) 4</td><td>IL 2104
(3 0 4) 5</td><td>(3 0 0) 3</td><td>PR2102
(2 0 0) 2</td><td>CC1106
(2 0 0)2</td><td></td></tr>
<tr><td colspan="6">Internship (6- 8 weeks) PS2101</td><td>4</td></tr>
<tr><td colspan="7">Exit Option with PG Diploma</td></tr>
<tr><td colspan="7">Semester III</td></tr>
<tr><td>*Elective-III</td><td colspan="2">*Elective – IV</td><td colspan="3">Dissertation-I / Industrial Project –I / Entrepreneurial Project-I</td><td>Hours: 6+
Credits: 16</td></tr>
<tr><td>(3 0 0) 3</td><td colspan="2">(3 0 0) 3</td><td colspan="3">10</td><td></td></tr>
<tr><td colspan="7">Semester IV</td></tr>
<tr><td colspan="6">Dissertation-II / Industrial Project-II / Entrepreneurial Project-II
16</td><td>Credits: 16</td></tr>
<tr><td colspan="6">Total Credits</td><td>78</td></tr>
</table>

* These electives courses will be offered through online mode.

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M. Tech HSEE (Batch: 2020-2022)

JK Lakshmipat University

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

2 Year M. Tech Programme
(Branch: Health, Safety, and Environment Engineering)
Batch 2020-2022
SEMESTER-ONE

Detailed Syllabus
&
Scheme of Examination

Course Title and Code: Statistical Data Analysis (AS2101)		
Hours per Week	**L-T-P: 3-0-4**	
Credits	**5**	
Students who can take	M.Tech Semester-I (Batch: 2020-2022) **Core**	
Course Objective: This course aims to introduce basic concepts in descriptive and inferential statistics, as well as data exploration methods. Topics covered include probability distributions, hypothesis testing, frequency analysis, correlation, regression and design of experiments.		
After course completion, the student will be able to: 1. Frame real world analysis problems using statistical concepts and solve those using standard techniques. 2. Use professional level tools to support the study of statistics. 3. Communicate quantitative ideas to a range of audiences. 4. Apply recommended practices for data analysis.		
	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	10
4	Quiz	10
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	30
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	20
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	30
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	Nil

SYLLABUS

Principles of Statistical Data Analysis: Data Elements, Variables, and Data categorization, Levels of Measurement: Nominal, Ordinal, Interval, or Ratio, Data management and indexing, Tabular data, Measures of dispersions, Skewness – Karl Pearson and Bowley, Skewness – Kelly coefficient of Skewness and Kurtosis,

Probability Theory, Mathematical expectation, moments, probability and moment generating function, Chebyshev's inequality, Mean and Variance of a Random Variable, product moments, independence of random variables, Joint, marginal and conditional distributions, Discrete and continuous distribution function, Introduction to statistical learning using R-Programming/Python

Basic Statistical Techniques: Sampling Theory and Distributions for Normal and Non-normal Populations, Central Limit Theorem, Point and Interval Estimates, Estimator and Estimates, Sample size calculations Sample Size for Estimating Means and Proportions, Maximum likelihood test, The Central Limit Theorem, p-values and power, Parametric and Non-Parametric test of Hypothesis, Goodness of fit, Analysis of contingency tables, Non-parametric tests of location and dispersion, Statistical inference using R/Python

Analysis of Continuous and Categorical Data: Estimation Using the Regression Line, Method of Least Squares, Standard Error of Estimate, Prediction Intervals, Multi Variate regression, generalized linear models, Logistic regression, Ordinal logistic regression, Proportional odds models, Multinomial logistic regression, Poisson regression, negative binomial regression, zero-inflated models, Log linear models for (paired) tables. Procedures for stepwise building of a regression model, Introduction to random intercept models, penalized linear regression methods, Graphical and formal diagnostic methods for the inspection of residuals, Correlation Analysis, autocorrelation and cross correlation, Regression and Correlation analysis using R/Python

Design of experiments: Basic principles of experimental designs, Analysis of variance: one-way, Two-way classifications, Latin square design, Two Factorial Design.

Text Book(s)

1. Prem S Mann. Introductory statistics. Wiley. Edition: 7th ed. 2010.
2. Ronald E Walpole, Raymond H Myers, Sharon L Myers and Keying Ye. Probability and statistics for engineers and scientists. 8th ed - New Delhi. Pearson. 2007.

Web Resources

1. Statistics full Course for Beginners. https://www.youtube.com/watch?v=74oUwKezFho
2. Introduction to R and RStudio. https://www.youtube.com/watch?v=lL0s1coNtRk

Course Title and Code: Industrial Automation and Internet of Things-I (EE2101)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	M.Tech Semester-I (Batch: 2020-2022) **Core**

Course Objective: Industrial automation is the application of technology to control the production and delivery of industrial products and services. On the other hand, the Internet of Things (IoT) is transforming the way we work and live, extending the power of the Internet to a whole range of objects different from computers or smartphones. This course aims to provide an introduction to industrial automation and IoT technologies and standards.

After course completion, the student will be able to:

1. Analyze the link between Information Technology and Operational Technology.
2. Explain the key components that make up an Industrial automation & IoT system.
3. Discuss protocols and standards employed at each layer of the Industrial automation & IoT stack. Choose technology for communication and real-time data collection.
4. Design, deploy and test a basic Industrial automation & IoT system.
5. Apply recommended engineering practices to meet desired requirements for applications. Consider sustainability and cybersecurity as design constraints.

	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	MID-TERM Theory Exam	10
6	END TERM Theory Exam	30
7	Theory Exam-III	Nil
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	05
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	30
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**

Syllabus (Theory)

UNIT1: Introduction. Classical hierarchical industrial automation model. Essential functions of each level. Elements of industrial control (sensors, actuators, transmitters, controllers, etc.). ISA 95 – Enterprise integration. Emergent architectures.

UNIT2: Instrumentation. Characteristics of instruments: accuracy, precision, sensitivity, etc. Units and standards. Voltage, current and electrical power measurements. Measurement of temperature, position, speed, force, pressure, light, level, humidity and other variables. Signal conditioning and transmission. Indicators, recorders. Actuators. Valves and motors.

Instrumentation symbols. Functional identification. Standards: ISA 5.1 – Instrument symbols and identification. IEC 61511 Safety Instrumented Systems.

UNIT3: IoT Fundamentals. The genesis of IoT. Digitization vs IoT. Impact. IoT architecture.

UNIT4: Industrial IoT Fundamentals. The convergence of IT and OT. 4th industrial revolution. Architecture. Design methodology. Industrial communication: principles, protocols, and technologies.

UNIT5: CASE STUDIES

Design and test a basic IIoT system involving prototyping, programming, and data analysis. Application to sustainability problems: health, energy, water, smart cities, etc.

Syllabus (Practical)

1. Characteristics of sensors. Calibration. Temperature, moisture, displacement, voltage, current, etc. Signal conditioning and processing.
2. Interfacing LEDs. Serial port. DC-motor.
3. IoT communication. Standards: MODBUS, OPC, MQTT, etc.
4. Mini-project

Text Book(s)

1. Bahga and Madisetti (2014). "Internet of Things: a hands-on approach". CreateSpace Independent Publishing Platform, 1st edition. ISBN: 978-0996025515.
2. Hanes, Salgueiro, Grossetete, Barton, and Henry (2017). "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things". Cisco Press
3. William C. Dunn. Fundamentals of Industrial Instrumentation and Process Control, Second Edition. McGraw-Hill Education, 2018

Reference Book(s)

1. Gilchrist (2016). "Industry 4.0: The Industrial Internet of Things". Apress.
2. John P. Bentley. Principles of Measurement Systems. 4th Edition, Addison Wesley Longman Ltd., UK, 2004

Web Resources: Lectures By S. Mukhopadhyay.

1. https://www.youtube.com/watch?v=oxMdDsud5vg&list=PL874F91C0180417C3

Course Title and Code: Industrial Safety Management (ME2101)	
Hours per Week	**L-T-P: 3-0-4**
Credits	**5**
Students who can take	M.Tech Semester-I HSE (Batch: 2020-2022) **Core**

Course Objective:

The goal of this course is to develop understanding about Industrial safety programs and toxicology, Industrial laws, regulations and source models. The course also aims to impart knowledge of the industrial hazard, fire and explosion, preventive methods, relief, and sizing methods.

After course completion, the student will be able to:

1. Analyse the effect of the release of toxic substances.
2. Explain the industrial laws, regulations and source models.
3. Apply the methods of prevention of fire and explosions.
4. Identified the relief and its sizing methods.
5. Explain the methods of hazard identification and preventive measures.
6. Apply standard safety procedures in an industrial environment.

	Prerequisites	Engineering Chemistry, Chemical Process Calculation, Mass Transfer, Heat Transfer
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	10
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	Nil
	Total (100)	**100**

Syllabus (Theory)

Introduction to Industrial Safety: Statutory Requirements Pertaining To OHS, Organizing For Safety, Material Handling; Electrical Safety; Fire Prevention and Protection; Machine Guarding; Work Permit System; Personal Protective Equipment; Housekeeping;

Basics of Accident Prevention: Basic Philosophy of Industrial Accidents – Causation & Prevention; Types of Hazards; Role of Supervisor in Promoting Safety & Health; Reporting & Classification of Accidents; Hazard Identification & its Techniques.

Basics of Fire Prevention & Protection: Fire & Explosion Hazards; Chemistry & Classification of Fire; Principles of Extinguishment; Portable Fire Fighting System; Fixed Fire Fighting Systems

Personal Protection Equipment: Introduction; Categories of PPE; Care, Maintenance & Effective use of PPE; Safety in Material Handling.

Industrial Hygiene & Occupational Health: An Overview; Occupational Exposure Limits; Toxicology; Workplace Monitoring; Statutory Provision Related To Industrial Hygiene

Accidents Case Studies & Case Histories

Bhopal gas tragedy, Gas-cutting a contaminated drum, tractor overturn, uncalled-for Enthusiasm, Lapse in safety organization, Lack of Procedural System and Supervision, Static Electricity, Failure of Anticipate Hazards, Malfunction and Failure of an ID Fan, Faulty Handling Equipment; Process and chemical handling; Machines and Equipment; Fire; Explosions; Electricity; Other Categories: Collapse of a factory Floor, An unplanned Operation, fall during Erection of a Pipeline, Lack of Safe Operating Procedure.

Syllabus (Practical)

1. Identified Chemical hazard in the JKLU laboratories/related case study.
2. Identified Noise hazard in the JKLU campus /related case study.
3. Identified Biological hazard in the JKLU campus /related case study.
4. Identified Fire hazard in the JKLU laboratories /related case study.
5. Identified Physical hazard in the JKLU campus /related case study.
6. Identified Ergonomic hazard in the JKLU Campus /related case study.

Main References

Textbooks

1. L.M. Deshmukh, "Industrial Safety Management" 15th edition, McGraw Hill Education (India) Pvt. Ltd.(2018).
2. NSC Study materials.

Reference books

1. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice-Hall, 2011.
2. Fawcett H.H. and W.S.Wood, Safety and accident prevention in Chemical operations 2nd edition John Wiley and Sons Inc. (1982).

Course Title and Code: **Project-I (PR-2101)**		
Hours per Week :	**L-T-P: 0 0 2**	
Credits	**02**	
Students who can take	M.Tech Semester-I HSE (Batch: 2020-2022) **Core**	
Course Objective: This course aims to develop scientific aptitude and lab skills in students and also understand the important role of solid waste management for society and industry. And apply knowledge for preparation of organic compost and generation of methane gas from bio-digester.		
After course completion, the student will be able to: 1. To identify and understand the various types of solids wastes and their sources. 2. To determine the important parameter for preparation of organic compost from solid wastes. 3. To determine the impact of different parameter on C: N ratio of organic compost. 4. Design and carry out scientific study of bio-digester for methane gas production from food waste. 5. To learn field sampling, analytical techniques and preservation of samples.		
	Prerequisites	Basics of Civil Engineering
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	NIL
3	Class Participation	NIL
4	Quiz	NIL
5	Theory Exam-I	NIL
6	Theory Exam-II	NIL
7	Theory Exam-III	NIL
8	Report-I	**10**
9	Report-II	NIL
10	Report-III	NIL
11	Project-I (Mid-term exam)	**20**
12	Project-II (Day to day observation)	**30**
13	Project-III (End term exam)	**40**
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
	Total	**100**

SYLLABUS

Types and Sources of solid wastes; Need for solid and hazardous waste management; Elements of integrated waste management; Legislations on management and handling of municipal solid wastes.

References:

Textbooks

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw- Hill, New York, 1993
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
3. Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
4. Industrial waste treatment by Nelson Leonard Nemarow

Course Title and Code: Critical Thinking for Developing Perspectives (IL1101)	
Hours per Week	L-T-P: 2-0-0
Credits	2
Students who can take	M.Tech Semester-I HSE (Batch: 2020-2022) Core

Course Objective:

The ability to clearly reason through problems and to present arguments in a logical, and compelling way, have become a key skill for survival in today's world. In this course, students will learn to dissect and evaluate the components of argument. Students will learn to raise vital questions, think from multiple perspectives, become aware of their biases, gather and assess information and come to a well-reasoned position.

After course completion, the student will be able to:

1. Explain the relevance of critical thinking
2. Formulate significant questions for inquiry.
3. Evaluate information and evidence for correctness, consistency, and relevance.
4. Compose well-structured and well-reasoned arguments.
5. Recognize their own beliefs, biases, claims and assumptions by viewing the issues from multiple perspectives

	Prerequisites	
Sr. No	Specifications	Marks
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	20
4	Quiz	20
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	20
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	40
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	100

Evaluation Scheme for Retest:

S. No.	Specifications	Marks
1	Theory Exam-III	**20**
3	**Total**	**40**

SYLLABUS:

Pedagogy: This course will be an amalgamation of lectures and activity-based learning i.e. films, group discussions, debates, and case studies. The objective behind utilizing activity-based learning is for the learners to have a more hands on experience.

Topics to be covered

I. Introduction to the concept of critical thinking:

- Evolution of the concept: Philosophy and Cognitive psychology as origins of critical thinking
- Revisit Paul-Elder Critical Thinking Framework

II. Questioning for Critical Thinking

- Importance of questioning
- Models of Questioning: Questioning Circles Model, Christenbury and Kelly (1983), Webb's Depth of Knowledge (1997). Elder & Paul (2007). Socratic Questioning Taxonomy.

III. Understanding Arguments

The sessions under this topic will make use of the context of current media, social and political debates to comprehend the topics.

- Meaning and Elements of Reasoning
- Formation of Arguments: Premise and Conclusion
- Inductive –Deductive reasoning: Difference between valid and invalid arguments/ between sound and unsound arguments.
- Evaluating Arguments: Examining data and information critically
- Cognitive Biases and Fallacies: Distinguishing between fact and opinion

Reference Books:

R1. Moore, B. N., & Parker, R. (2009). Critical thinking. Boston, MA: McGraw-Hill. eBook

R2. Sinnott-Armstrong, W., & Fogelin, R. J. (2014). Cengage Advantage Books: Understanding Arguments: An Introduction to Informal Logic. Cengage Learning eBook

Readings/Video(s)

1. The Evolution of Critical Thinking (Research project by Barba Albers, Washington, State University, 2004

2. Bowker, M. H., & Fazioli, K. P. (2016). Rethinking Critical Thinking: A Relational and Contextual Approach. Pedagogy and the Human Sciences, 6(1), 1-26.

3. Bauer, N. J. (1991). Dewey and Schon: An Analysis of Reflective Thinking.

4. Nappi, J. S. (2017). The importance of questioning in developing critical thinking skills. Delta Kappa Gamma Bulletin, 84(1), 30.

5. https://cpb-us e1.wpmucdn.com/cobblearning.net/dist/6/3101/files/2018/05/The-Importance-of-Questioning-2aqkc5j.pdfBloom, B. S. (1956). Taxonomy of educational objectives. Vol. 1: Cognitive domain. New York: McKay, 20-24.

6. Paul, R., & Binker, A. J. A. (1990). Socratic questioning. Critical thinking. Center for Critical Thinking and Moral Critique.
http://www.criticalthinking.org/files/SocraticQuestioning2006.pdf

7. The Art of Asking Questions | Dan Moulthrop | TEDxSHHS
https://www.youtube.com/watch?v=hZSY0PssqH0

8. Analysing the argument - Part 1 of 2 (Video)

Course Title and Code: Industrial Waste Management (CE-2201)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	M.Tech Semester-I HSE (Batch: 2020-2022) **Elective-I**

Course Objective:

This course provides an in-depth understanding of solid and hazardous waste characteristics and management. This course also covers the principles of integrated solid waste management and provides an overview of industrial waste and hazardous waste management.

After course completion, the student will be able to:

1. Analyze key sources, typical quantities generated, composition, and properties of solid and hazardous wastes.
2. Compare effective methods of solid & hazardous wastes handling and segregation of wastes at source.
3. Test the most common techniques for preventing, minimizing, recycling, disposing and treatment of waste and their application on-site remediation.
4. Recognize the relevant regulations that apply for facilities used for disposal, and destruction of waste.
5. An ability to identify, formulate, and solve engineering problems, and an understanding of professional and ethical responsibility

	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	05
2	Assignment	10
3	Class Participation	05
4	Quiz	-
5	Theory Exam-I	15
6	Theory Exam-II	15
7	Theory Exam-III	30
8	Report-I	-
9	Report-II	-
10	Report-III	-
11	Project-I	20
12	Project-II	-
13	Project-III	-
14	Lab Evaluation-I	-
15	Lab Evaluation-II	-
16	Course Portfolio	-
	Total (100)	**100**

SYLLABUS

UNIT-1 SOLID AND HAZARDOUS WASTE: Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management - Legislations on management and handling of municipal solid wastes, hazardous wastes, and biomedical wastes.

UNIT-2 WASTE GENERATION: Waste generation rates – Composition - Hazardous Characteristics – TCLP tests – waste sampling- Source reduction of wastes – Recycling and reuse. Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations - labelling and handling of hazardous wastes.

UNIT-3 WASTE PROCESSING: Processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

UNIT-4 DISPOSAL: Disposal in landfills - site selection - design and operation of sanitary landfills- secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – landfill remediation

UNIT-5 INTEGRATED WASTE MANAGEMENT: Elements of integrated waste management

References

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

2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

Course Title and Code: Structural Health and Monitoring (ME----)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	M.Tech Semester-I HSE (Batch: 2020-2022) **Elective-I**

SYLLABUS

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

INSTRUMENTATION AND AUDITORY: Sensors used in vibration and measurements – Frequency and spectrum analyzers – Weighting networks – Hearing mechanism – relation between subjective and objective sounds – Auditory effects of noise and audiometric testing – Speech interference levels and its importance.

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

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

ABATEMENT OF NOISE: Active noise attenuators and scope for abatement of industrial noise - Methods of control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers- spectrum analysis, Anechoic chamber.

Impact of vibration in rotating equipments and remedial action .Health effects of noise and vibration. Use of protective equipments.

Reference(s)

1. V,Rao. Dukkipati and J.Srinivas, Text book of Mechanical Vibrations, Prentice-Hall of India P Ltd, New Delhi.2004
2. J.D Irwin, and E R Graf, Noise and Vibration Control, Prentice Hall Inc. New Jercy, 2003
3. John Fenton - Handbook of Automotive body Construction and Design Analysis – Professional Engineering Publishing, ISBN 1-86058-073-1998.
4. R.G White, J.G Walker, Noise and Vibration, John Wiley and sons New York, 2008.
5. Irwing Crandall, Theory of Vibrating Systems and Sound, D. Vannostrand Company, New Jercy, 2006.

Course Title and Code: Electrical Safety (EE2201)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	M.Tech Semester-I HSE (Batch: 2020-2022) **Elective-I**

Course Objective:

The goal of this course is to discuss electrical hazards, Safety standards, protection issues, identification of sensors for protection and develop understanding of the CEA regulations for Electrical safety. This course will facilitate students to find solutions of electrical hazards.

On successful completion of this course students will be able to:

1. Identify the hazards associated with electricity: shock and fire.
2. Investigative the cause of electrical accidents and fires.
3. Identify and explain how to respond to electrical emergencies.
4. Identify safe work practices when exposed to electrical hazards (including risk assessment)
5. Apply the acts in accordance with the risk and safety issues, legal obligations codes of safety practice.
6. Explain the Indian electricity safety code and rules
7. Plan and take measures to minimize hazards
8. Formulate the suitable methodologies to determine safety risks in relevant practical applications.
9. Review the design of existing electrical systems as per the standard electrical safety code.
10. Integrate the sensors for the monitoring and automation of electrical systems.

Prerequisites		Basics of Electrical Engineering,
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	-
2	Assignment	05
3	Class Participation	05
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	30
8	Report-I	05
9	Report-II	05
10	Report-III	-
11	Project-I	10
12	Project-II	10
13	Project-III	-
14	Lab Evaluation-I	-
15	Lab Evaluation-II	-
16	Course Portfolio	-
	Total (100)	100

Syllabus (Theory)

UNIT I: Concepts and Statutory Requirements

Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference –Working principles of electrical equipment -Indian electricity

act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety –first aid-cardio pulmonary resuscitation(CPR).

UNIT II: Electrical Hazards

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

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

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

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.

Reference Books:

1. Mary Capelli-Schellpfeffer, Dennis Neitzel, John Cadick, Al Winfield, “Electrical Safety Handbook” McGraw-Hill Education.
2. Mohamed A. El-Sharkawi, “Electric Safety: Practice and Standards” CRC Press.
3. Krishnan, N.V., Safety Management in Industry, Jaico Publishing House,
4. Cooper W.F., Electrical Safety Engineering, Newnes.
5. Cadick, J., et. al., Electrical Safety Handbook, McGraw Hill Education.
6. Bureau of Indian Standards, National Electrical Code 2011, Bureau of Indian Standards, New Delhi, 2011.

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

2 Year M. Tech Programme
(Branch: Health, Safety, and Environment Engineering)
Batch 2020-2022
SEMESTER-TWO

Detailed Syllabus
&
Scheme of Examination

Course Title and Code: Health, Safety, and Environment Audit (IL2106)	
Hours per Week	**L-T-P: 4-0-2**
Credits	**5**
Students who can take	M.Tech. Semester-II **(Batch: 2020-2022) Core**

Course Objective: This course introduces the fundamental concepts of health, safety, environment audit techniques and their applications in the industry.

Learning Outcome:

On successful completion of this course, the students should be able to:

1. Conduct environmental audits and critically evaluate its outcomes.
2. Apply standards and rules for environmental audits.
3. Carry out a safety audit and prepare a report for the audit.
4. Assess organization's fire safety management system & supportive arrangements and identify potential fire hazards against the requirements of National Building Code (NBC) 2016, Bureau of Indian Standards (BIS) regulations & Industry best practices
5. Evaluate fire safety management systems that adhere to the prescribed legal requirements as well as safety policies and objectives set by the organization
6. Provide sound and convincing recommendations and offer a structured approach for continual improvement with regards to fire safety management

Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	15
3	Class Participation	Nil
4	Quiz	15
5	Theory Exam I	10
6	Theory Exam	Nil
7	Theory Exam (End Term)	25
8	Report-1	15
9	Report-2	Nil
10	Report-3	Nil
11	Project -1	Nil
12	Project -2	Ni
13	Project -3	Nil
14	Lab Evaluation1	10
15	Lab Evaluation2	10
16	Course portfolio	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-III	25
2	Lab Evaluation2	10
	Total (40)	**35**

Course Syllabi (Theory):

Unit-I: Elements of a Good Safety, Health and Environmental System; Management Systems; Auditing the Principles: Management Audits. Specialist Audits; Operational Audits; Purpose and Benefits; the Standard or Requirement; Preparation; Protocols and Checklists; the Entry Meeting; Area Familiarisation; Audit Observation Skills; The

Importance of Verification and the Audit Trail; Conformity; Documentary Review; Audit Uniformity and Credibility; Auditor Training; Managing Auditee Expectations;

Unit-II: Auditing and Its Relevance to Regulatory Compliance; Reporting Quantitative and Qualitative Assessment; Follow-Up; Choosing the Audit Process; Audit Team Composition; EHS Aspects of Due Diligence Audits; International EHS Auditing Standards; Process Safety Audits; Fire Life Safety Audit; Occupational Health and Safety Audits.

Unit-III: Definition of Environment Audit and its importance for industries. Types of audits, General audit methodology and basic structure of audit. Elements of an audit process and its importance, Urban Environment Audit.

Unit-IV: Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986, Definitions of Signatory, Consumption Audit, Pollution audit, Hazardous audit, Solid waste audit, Disposal audit, Cost audit, Investment audit, Voluntary. Introduction to ISO 14001 series, OHSAS 18001, ISO 45001 2018; case studies.

Unit-V: Transformers, HT/LT distribution panels, Diesel generator and its availability, Lightning protection system, Emergency power distribution system, Grounding & earthing, CEA Regulations 2010 Compliance Review, Emergency control procedures, Training competence evaluation, Systems and document review, Contractor management.

Unit-VI: Electrical Energy Management, energy conservation in industries and buildings, energy conservation in motors, Pumps and fan systems, energy efficient motors, Adoption to sustainable resources, process and technologies, Identification and Techno-economic Analysis of Energy Conservation Measures, outlines of Energy Audit Report Format.

SYLLABUS (Practical):

1. Fire Safety Audit of JKLU Campus / related case study
2. Occupational health and safety audit of JKLU/related case study
3. Environmental Auditing of JKLU campus/Related Case study
4. Electrical safety audit of JKLU campus/related case study.

References

1. Simon Watson Pain, Safety, Health and Environmental Auditing “A Practical Guide”, Second Edition, CRC Press.
2. Albert Thumann, Terry Niehus, William J. Younger, Handbook of Energy Audits, CRC Press.
3. Sonal Desai, Handbook of Energy Audit, McGraw Hill Education (India) Private Limited New Delhi

Course Title and Code: Risk and Hazard Management (IL2103A)		
Hours per Week	**L-T-P: 3-0-2**	
Credits	**4**	
Students who can take	M.Tech Semester-II (Batch: 2020-2022) **Core**	
Course Objective: The goal of this course is to introduce the student into the process for conducting a hazard/risk analysis and developing a hazard/risk management plan to support safety requirements as per safety standards. The course also aims to equip students with an understanding of basic electrical safety, identify, electrical hazards, plan & precautions to avoid injury at the workplace.		
After course completion, the student will be able to: 1. Identify hazards in chemical and petrochemical workplace activities using hazard identification techniques and hazard assessment process. 2. Plan preventive actions needed to minimize hazards in chemical and petrochemical workplace activities 3. Assess health risks at different workplaces by integrating relevant data from a variety of sources. 4. Take appropriate corrective action in emergency situations, i.e., fire, explosion, and accident. 5. Assess risk and vulnerability for the electrical system considering both natural and manmade failures. 6. Plan restoration stages for integrated power systems considering multiple contingencies.		
	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	10
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam-I	15
6	Theory Exam-II	15
7	Theory Exam-III	30
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-III	30
2	Lab Evaluation-II	10
	Total (40)	**40**

Syllabus (Theory)

Physical, Chemical & Biological Hazards: Noise, Ionizing radiation, non-ionizing radiations, cold environments, hot environments, Recognition of chemical hazards, Exposure vs. dose,

TLV-Methods of Evaluation, Classification of Biohazardous agents, General Control Methods; training and education, employee health program. Control measures, OSHA standard. (09)

Hazard, Risk Issues, And Hazard Assessment: Introduction, hazard, hazard monitoring-risk issue, group or societal risk, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation. Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems, Failure Mode and Effect Analysis (FMEA), fire explosion and toxicity index (FETI). (12)

Credibility of Risk Assessment Techniques: Past accident analysis as information sources for Hazard analysis and consequences analysis of chemical accident, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster (1966), Port Hudson disaster; convey report, hazard assessment of non- nuclear installation; Rijnmond report, risk analysis of size potentially Hazardous Industrial objects; Rasmussen masses report, Reactor safety study of Nuclear power plant. (09)

Electrical risk management: Risk Management Process, Identify the hazards, Assess the risks, Control the risks, Review the control measures, Specific hazards and risk control of electrical equipment installations at the workplace, risk controls – energized electrical work, low voltage isolation, and access, risk Controls– energized electrical work, risk controls – working near energized electrical parts.(10)

Syllabus (Practical)

1. To identify the different classes of hazards in the JKLU Campus.
2. To study HAZOP and Hazid analysis of petrochemical industries.
3. To study a quantitative risk analysis of one refinery.
4. Design of earthling system for HV/EHV substation
5. To study electrical safety hazards awareness on the basic rule(s) for all electrical work as per OSHA regulation

Reference Book(s)

1. Frank P. Less, Loss Prevention in Process Industries, (Vol.I, II and III), Butterworth-Hein UK 1990.
2. Methodologies for Risk and Safety Assessment in Chemical Process Industries, commonwealth Science Council, UK.
3. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process Safety, AIChE 1992
4. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
5. Trevor A Klett, "HAZOP and HAZOM," Institute of Chemical Engineering, 1983
6. Fordham Cooper, W., Electrical Safety Engineering, Butterworth and Company, London, 1986.
7. Accident prevention manual for industrial operations, National Safety Council, N.S.C., Chicago, 1982.
8. Indian Electricity Act and Rules, Government of India.
9. Moja SJ, Van Zuydam CS, Mphephu (2016) Hazard and Risk Assessment in Electricity Sector: A Case of Swaziland Electricity Company. J Geogr Nat Disast S6.
10. Health and Safety. Executive. Electricity at work. Safe working practices. HSG85 (Third edition). Published 2013.

Course Title and Code: Regulation for Health, Safety, and Environment Management (IL2104)		
Hours per Week	**L-T-P: 4-0-2**	
Credits	**5**	
Students who can take	M.Tech Semester-II (Batch: 2020-2022) **Core**	
Course Objective: This course aims to develop understanding of the regulatory standards and acts for applying policies, procedures, and occupational safety and health principles, and best practices for ensuring health and safety at workplace and protect environment.		
After course completion, the student will be able to: 6. Explain the Guidelines of major occupational health safety (OHS) legislation and various Act. 7. Implement appropriate OHS legislation at different workplaces. 8. Prepare a work safety analysis, applying the concepts of danger, hazard and preventive measures in any activity at different workplaces. 9. Design Safety and Occupational Health Plans for different projects according to the OHSA 18001standard and the current laws. 10. Assess workplace conditions against relevant standards and regulations. 11. Evaluate and deploy appropriate control systems for air, noise and heat pollutants.		
	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	10
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	25
8	Report-I	15
9	Report-II	Nil
10	Report-III	Nil
11	Project-I (Case Study	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	10
15	Lab Evaluation-II	10
16	Course Portfolio	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-III	25
2	Lab Evaluation-II	10
	Total (35)	**35**

SYLLABUS

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

Environment Act–1986: General Powers of the central government, prevention, control and abatement of environmental pollution, Biomedical waste (Management and Handling Rules, 1989, the noise pollution (Regulation and Control) Rules, 2000, The Batteries (Management and Handling Rules) 2001, No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards, prevention and control of air pollution and water pollution, fund, accounts and audit, penalties and procedures.

Manufacture, Storage and Import of Hazardous Chemical Rules 1989: Definitions, duties of authorities, responsibilities of the 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.

Environmental Measurement and Control: Sampling and analysis, dust monitor, gas analyzer, particle size analyzer, lux meter, pH meter, gas chromatograph, atomic absorption spectrometer. Gravitational settling chambers, cyclone separators, scrubbers, electrostatic precipitators, 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, and petroleum, petroleum products, textile, tanneries, thermal power plants, dying and pigment industries, eco-friendly energy.

International Acts, Standards and Rules: Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules, electricity act and rules, hazardous wastes (management and handling) rules, 1989, with amendments in 2000, the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules, Explosives Act 1983, Pesticides Act. Occupational Safety and Health act of USA (The Williams, Steiger Act of 1970), Health and safety work act (HASAWA 1974, UK), OSHAS 18000, OHSAS 18001, ISO 14000, and American National Standards Institute (ANSI). ILO Conventions; The Workmen's Compensation Act, ESIC Act., The Bio-Medical Waste Rules; Mines Act.1952 & Mines Rules, 1955; Water (Prevention & control of pollution) Act, 1974 and Rules; Air (Prevention & control of pollution) Act, 1981 and Rules.; Environment protection Act 1986 (Amended) and Rules; The Dock Workers (Safety, Health, and Welfare) Act, 1986 and the Regulations 1990 framed thereunder.

Syllabus (Practical):

Characterization physical, chemical and biological properties of water, wastewater, air and solid wastes.

References

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd, New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law Publishers (India) Pvt. Ltd. New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt. Ltd, New Delhi.

5. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd, Allahabad.
6. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd, Allahabad.
7. The manufacture, storage, and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
8. Explosive Act, 1884 and Explosive rules, 1883 (India), (2002), Eastern Book Company, Lucknow, 10th Edition
9. ISO 9000 to OHSAS P18001, Dr. K.C. Arora, S.K. Kataria & Sons, Delhi
10. Rao, CS, Environmental pollution engineering, Wiley Eastern Limited, New Delhi, 1992.
11. H. S. Peavy, D. R. Rowe, G. Tchobanoglous Environmental Engineering - McGraw- Hill Book Company, New York, 1987.
12. H.Ludwig, W.Evans, Manual of Environmental Technology in Developing Countries, International Book Company, Absecon Highlands, N.J., 1991.
13. Arcadio, P. Sincero and G. A. Sincero, Environmental Engineering – A Design Approach, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
14. G. Masters Introduction to Environmental Engineering and Science, Prentice Hall of India Pvt Ltd, New Delhi, 2003.
15. S.P. Mahajan, Pollution control in process industries, Tata McGraw Hill Publishing Company, New Delhi, 1993
16. Varma and Braner, Air pollution equipment, Springer Publishers, Second Edition

Course Title and Code: **Project-II (PR2102)**		
Hours per Week :	**L-T-P: 0 0 2**	
Credits	**02**	
Students who can take	M.Tech Semester-II (Batch: 2020-2022) **Core**	
	Prerequisites	Basics of Civil Engineering
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	NIL
3	Class Participation	NIL
4	Quiz	NIL
5	Theory Exam-I	NIL
6	Theory Exam-II	NIL
7	Theory Exam-III	NIL
8	Report-I	NIN
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	50
12	Project-II	50
13	Project-III	NIL
14	Lab Evaluation-I (Continuous Evaluation)	NIL
15	Lab Evaluation-II (Lab Examination)	NIL
16	Course Portfolio	NIL
	Total	**100**

**Retest is not applicable for PR2102. If student fails, he/she has to repeat the course in next semester

References:

Textbooks

1. Environmental engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
2. Environmental engineering: Wastewater engineering, SK Garg, Khanna Publishers
3. Water supply and sanitation engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd.
4. Water Supply Engineering, Dr. B.C. Punmia Laxmi Publications Pvt. Ltd.
5. Water and wastewater engineering, Metcalf and Eddy, McGraw Hill
6. Standard Handbook of Environmental Engineering, by Robert A. Corbitt, McGraw-Hill Professional publication.
7. Industrial waste treatment by Nelson Leonard Nemarow

E-books

1) Textbook Of Environmental Engineering by by P. Venugopala Rao
2) Environmental Engineering by D. Srinivasan.

Video Lectures

1) NPTEL >> Civil Engineering >> Water and Waste Water Engineering (Video) >>
2) Civil Engineering - Environmental Air Pollution >> NPTEL videos

Websites (related to the course)

1) http://www.cpcb.nic.in/
2) http://www.rpcb.rajasthan.gov.in
3) http://www.bis.org.in/
4) http://www.who.int/en/
5) http://www.moef.gov.in/
6) http://www.greentribunal.gov.in/
7) https://nptel.ac.in/courses/105/104/105104099/

Course Title and Code: Critical Thinking for Decisions at Workplace (CC1106)

Course Description: In today's world, the idea of right and wrong is being challenged by businesses, use of technology, economic conditions, and norms of societies. The relevance of a well-reasoned decision is crucial. This course intends to make students take better decisions keeping in mind purpose, context, and ethics.

Learning Outcomes

The students will be able to:

1. Apply techniques of critical thinking to analyse organisational problems through positive inquiry
2. Describe and analyse appropriate problem-solving and ethical decision-making processes
3. Choose the most effective and logical decision among multiple alternatives
4. Evaluate solutions and anticipate likely risks based on purpose, context and ethics

Prerequisites		**N/A**
Hours per Week		**L-T-P: 2-0-0**
Credits		**2**
Sr. No	**Specifications**	**Weightage**
		Original
01	Attendance	Nil
02	Assignment	20
03	Class Participation	20
04	Quiz	Nil
05	Theory Exam-II	20
06	Theory Exam-III	30
	Presentation	20
	Total (100)	100

References for Readings:

1. Lehrer, J. (2010). *How we decide*. Houghton Mifflin Harcourt.
2. Heath, C., & Heath, D. (2013). *Decisive: How to make better choices in life and work*. Random House.
3. Hammond, J. S., Keeney, R. L., & Raiffa, H. (2015). *Smart choices: A practical guide to making better decisions*. Harvard Business Review Press.
4. Cases and scenario will be shared in the class.

Course Title and Code: Occupational Hygiene and Health (IL2201)		
Hours per Week	**L-T-P: 3-0-0**	
Credits	**3**	
Students who can take	M.Tech Semester-II HSE (Batch: 2020-2022) **Elective-II**	
Course Objective: This course aims to develop understanding of the broad principles in occupational hygiene as the basis for anticipation, recognition, evaluation, and control of hazards that can be encountered at the workplace.		
After course completion, the student will be able to: 1. Identify the health hazard and the importance of occupational hygiene. 2. Explain the role of the occupational hygienist in the workplace. 3. Apply the Hazard recognition techniques and use Methods of controlling exposure. 4. Identify Ergonomic & psychosocial Hazards in the workplace. 5. Apply the basic principles for measurement, control, and evaluation of occupational hygiene. 6. Interpret data and apply recommendations of occupational hygiene reports. 7. Characterize the common hazards in a wide range of production processes found in India.		
	Prerequisites	N/A
Sr. No	**Specifications**	**Marks**
1	Attendance	05
2	Assignment	10
3	Class Participation	05
4	Quiz	10
5	Theory Exam-I	15
6	Theory Exam-II	15
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-III	30
	Total (30)	**30**

Syllabus (Theory)

Overview of Occupational Health: Present status of occupational health; Nationally and Internationally including public health & social welfare, strategy and programme of health protection; role of National and International Organizations, Government, employer, safety committee, trade union & employees.; Occupational Health Policy in India; Occupational

Health Surveillance and Health Service at work place; Workplace Health Monitoring, maintenance of health register & records; Prevention of Occupational Health Hazards; Occupational health audit and occupational Health Survey.; in the field of occupational health. ; OHS its principles & functions. First aid centre, first aid box and industrial hospitals. Diagnosis of Occupational Diseases.; Occupational health hazards and its preventive measures.

Occupational Diseases & its Diagnosis: (Notifiable Occupational Diseases in India as per Factories Act, 1948.)- Occupational Lung Diseases like Silicosis, Asbestosis, Coal Worker's Pneumoconiosis, Mixed Dust Fibrosis.; Occupational Asthma(i.e. Bysinosis) & Extrinsic Allergic Alveolitis (like Bagassosis).; Occupational Health related other diseases (i.e. Anorexia, Hemoptysis, Rales, Sarcoidosis, Emphysema, Bronchitis, Scleroderma); Musculoskeletal Injuries; Biological hazards (Bacterial, Viral, Fungi, Moulds, rickettsial and chlamydial agents).; Occupational Zoonotic Disease.; ILO list of Occupational Diseases globally; Hospital Waste management.

Ergonomics & Psychosocial Hazards : Introduction to Ergonomics, application of ergonomics in industry, Stress and performance, anthropometry and work physiology, physical fitness test in industry, VO2Max, workload. Psychosocial Hazards in Occupation and application of industrial psychology in occupational health, occupational health disorders of psychological origin, principle of behavioral toxicology, parameters of measurements for evaluation of physiological (categorization of job, heaviness , work organization and work load, stress & strain, fatigue , rest pauses and shift work , personal hygiene).

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

Main References

1. Toxicology Fundamentals, Target organs, and Risk Assessment, 2nd edition, Hemisphere Publishing Corps, 1991Lu, Frank C, Basic,
2. The Basic Science of Poisons Amdur M. Doull, J and Klassen, C.D.
3. Handbook of Occupational Safety & Health Lawrance Slote,
4. U S Department of Labor, Occupational Outlook Handbook
5. Industrial toxicology Philip L. Williams and James L. Burson,
6. Inhalation Toxicology Research Methods, Applications and Evaluationm, Harry Salem
7. Industrial hygiene & Toxicology, Volume –2, Frank a. Petty
8. Occupational Safety & Health Management –Thomas J Anton2. Safety Professional's reference & study guide –W David Yates3. Fundamental Principles of Occupational Health & Safety –Benjamin.O.Alli

Course Title and Code: Safety in Construction and Mining (CE2203)	
Hours per Week :	**L-T-P: 3-0-0**
Credits	**03**
Students who can take	M.Tech Semester-II HSE (Batch: 2020-2022) **Elective-II**

Course Objective: Objective of this course is to apply skills on technical, managerial and legal framework for safety and health in the construction as well as in mining sector.

On successful completion of this course students will be able to:

1) Define key safety requirements in construction and mining sectors.
2) Identify hazards and risks involved in construction and mines sites.
3) Implement Effective Safety Management System.
4) Reduce workplace injuries through incident prevention methods.
5) Improve safety culture within an organization.
6) Apply Indian Standards for safety in Construction and mining at work place.

	Prerequisites	Basics of Civil Engineering
Sr. No	**Specifications**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	Theory Exam-I	NIL
6	Theory Exam-II	15
7	Theory Exam-III	25
8	Report-I	15
9	Report-II	15
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I(Continuous Evaluation)	NIL
15	Lab Evaluation-II(Lab Examination)	NIL
16	Course Portfolio	NIL
	Total	**100**

Evaluation Scheme for Retest		
Sr. No	**Specifications**	**Marks**
1	Theory Exam-III	25

Course Syllabi (Theory):

Unit:1Safety management and regulatory framework: Importance and current situation on safety in construction, safety actions & planning, Construction Project: General features, key

tasks, safety planning, personal safety equipment, worker participation, hazard identification and assessment, hazard prevention and control, education and training, program.
The building and other construction workers, (Regulation of employment and conditions of service) acts, 1996, The building and other construction workers, (Regulation of employment and conditions of service) central rules, 1998, labor laws.

Unit 2: Safety during construction works- Basic terminology in safety, types of injuries, safety pyramid, planning for safety budget, safety culture. Safety practice during construction - Earthwork, masonry and concrete construction, railway line construction, sewer construction. Safety during demolition and dismantling of structures.

Unit:3: Safety in highway construction: Introduction, Components of the construction zone, Traffic control devices, Traffic management practices, Planning and implementation of safety measures during construction/maintenance of roads as per guidelines of IRC: SP:55, Road safety audit during construction as per IRC: SP 88.

Unit-04Safety and Health in Mining: Occupational hazards of mining and diseases; accidents and their classification; frequency rates and severity rates of accidents; cause-wise analysis; basic causes of accident occurrence; investigations into accidents and accident reports; Cost of Accidents. Emergency measures and emergency organization, Disaster Management Plans for major disasters of explosions, Measures for improving safety in mines, risk assessment.

Unit-05 Mining regulations and laws: Development of mining laws in India. Sources of legislations, mining laws of India. General provisions of Mines and Minerals (Regulation and Development Act 1957, Mineral Concession Rules 1960, Salient features of Mines Act 1952, Mines Rules 1955, General provisions of Coal Mines Regulations 1957.

References:

1. Tang, S.L., Ahmed, S.M., Aoieong, Raymond T. and Poon, S.W. (2005), Construction quality management, Hong Kong University Press, Hong Kong.*
2. Poon, S.W., Tang, S.L. and Wong, Francis K.W. (2008), Management and economics of construction safety in Hong Kong, Hong Kong University Press.*
3. International Journal of Quality and Reliability Management. (Emerald's journal)
4. The TQM Journal (Emerald's journal)
5. Safety Science (Elsevier's journal)
6. IRC:SP:55-2001 "Guidelines on safety in road construction zones, The Indian Road Congress, New-Delhi.
7. Building & other construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (BOCWA)
8. Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998 (BOCWR)
9. OSHA Field Safety and Health Manual
10. Hudson, R., Construction hazard and Safety Handbook, Butterworth's Publication, 1985.
11. JnatheaD.Sime, Safety in the Build Environment, London, 1988.
12. V.J.Davies and K.Thomasin, Construction Safety Hand Book, Thomas Telford Ltd., London, 1990.
13. Handbook of OSHA Construction safety and health, Charles D. Reese and James V. Edison
14. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982

15. Fulman, J.B., Construction Safety, Security, and Loss Prevention, John Wiley and Sons, 1979.
16. Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad
17. NIOSH Publications
18. DGMS Circulars by L.C.Kaku
19. Safety in Mines : A survey of accidents, their causes and prevention by Prof. Kejriwal

Course Title and Code: Statistical Data Analysis-II(AS_____)	
Hours per Week	**L-T-P: 3-0-4**
Credits	**5**
Students who can take	M.Tech Semester-II HSE (Batch: 2020-2022) **Elective-II**

Syllabus:

Bayesian Statistics: Bayesian concepts: Bayesian versus frequentist probability, exchangeability and the likelihood principle, choice of prior distributions, the likelihood function, summarizing the posterior distribution, conjugate priors, and Markov Chain Monte Carlo methods: Gibbs sampler, Metropolis-Hastings, slice, sampling, etc. Bayesian estimation: (multivariate) linear regression, choice models: logit, probit, multinomial, longitudinal data analysis, Bayesian hypothesis testing, Bayesian variable selection, Bayesian decision theory

Experimental Design: General concepts: randomization, adaptive randomization, blocking and stratification, bias, confounding, Sample size calculation: exact and approximation methods using simulation, Designs for ANOVA: screening design, block experiments, full and fractional factorial designs (aliasing and confounding), multiple comparisons, designs with randomization restrictions, orthogonal designs, Design of experiments using R/Python

Data Estimation and Forecasting: Density Estimation, Recursive Partitioning, Smoothers and Generalized Additive Models, Survivals Analysis, Analyzing Longitudinal Data, Principal Component Analysis, Multidimensional Scaling, Cluster Analysis, Introduction and Objectives of time series Identification of trend Variation in Time series, Secular Variation, Cyclical Variation Seasonal Variation and Irregular Variation Methods of Estimating Trends Choosing Appropriate Forecasting Model, Reliability and hazard rate, Failure time distribution, reliability of series and parallel systems, exponential model in reliability and life testing, Data analysis using R/Python

Course Title and Code: Industrial Automation and Internet of Things-II (EE____)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	M.Tech Semester-II HSE (Batch: 2020-2022) **Elective-II**

Syllabus:

UNIT1: INTRODUCTION TO INDUSTRIAL CONTROLLERS (PLC) History, structure, operation, state of the art. Standard IEC 61131.

UNIT2: INTRODUCTION TO PLC PROGRAMMING: Number systems, digital logic, and sequential control. Program structure, common language elements, functions and functions blocks.

UNIT 3: LADDER DIAGRAM (LD): AND/OR Conditions, Set/Reset Coils, Edge Detecting Contacts, Order of Execution, Labels and Jumps. Use of Standard Functions in LD, Development and Use of FBs in LD, Structured Programming in LD.

UNIT 4: STRUCTURED TEXT (ST): Standard Functions and Operators, Assignment, Calling FBs, Flank Detection and Memories, Timers, Counters, IF Statements, CASE Statements, ST Code Based upon State Diagrams, Loops

UNIT 5: SEQUENTIAL FUNCTION CHART (SFC): Graphic Symbols, Alternative Branches, Parallel Branches, Steps, Transitions, Actions

UNIT6: IIoT AND SCADA SYSTEMS: Elements of IIoT and SCADA systems. Architecture. Life cycle. Standards.

Unit 7: DATA ANALYTICS FOR IIoT: Basic concepts and methods. Applications to sustainability problems: health, energy, water, smart cities, etc.

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

2 Year M. Tech Programme
(Branch: Health, Safety, and Environment Engineering)
Batch 2020-2022
SEMESTER-THREE

Detailed Syllabus
&
Scheme of Examination

Course Title and Code: Fire Engineering and Management (ME2201)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	M.Tech Semester-III HSE (Batch: 2020-2022) **Elective-III**

Course Objective:

The goal of this course is to impart knowledge of the Fire Chemistry, Major Organizations in the Field of Fire Safety, Fire Detection Systems, Care, Maintenance, and Inspection, Legal Aspects, Organization, and Legislation, Emergency Response Planning for Safety Professionals, and Fire Codes and Standards.

After course completion, the student will be able to:

1. Identify agency resources for fire service operations and aid students with information based on the Fire Protection.
2. Determine organizational patterns for fire service operations.
3. Describe the uses and operations of various types of fire control equipment.
4. Determine and identify materials considered hazardous.
5. Recognize the training and educational experiences needed for fire service personnel.
6. Ascertain the components of fire service communications and dispatching.
7. Demonstrate accepted management practices needed to establish and improve fire service operation.

	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	05
2	Assignment	10
3	Class Participation	05
4	Quiz	10
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	10
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**

SYLLABUS

PHYSICS AND CHEMISTRY OF FIRE: Fire properties of solid, liquid and gases, fire spread, toxicity of products of combustion, theory of combustion and explosion, vapour clouds, flash fire, jet fires, pool fires, unconfined vapour cloud explosion, shock waves, auto-ignition, boiling liquid expanding vapour explosion; Understanding & Implementing Standards

National Fire Protection Act 1407 and 1021. Case studies: Flixborough, Mexico disaster, Pasedena Texas, Piper Alpha, Peterborough, and Bombay Victoria dock ship explosions.

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

INDUSTRIAL FIRE PROTECTION SYSTEMS: Sprinkler, hydrants, standpipes, special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards, alarm and detection systems. Other suppression systems, CO system, foam system, dry chemical powder (DCP) system, halon system; the need for halon replacement, smoke venting. Portable extinguishers, flammable liquids, tank farms, indices of inflammability, firefighting systems.

BUILDING FIRE SAFETY: Objectives of fire-safe building design, Fire load, fire-resistant material and fire testing, structural fire protection, structural integrity, the concept of egress design, exists, width calculations; fire certificates, fire safety requirements for high rise buildings, snooker.

EXPLOSION PROTECTING SYSTEMS: Principles of explosion, detonation and blast waves, explosion parameters; Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure, explosion venting, inert gases, plant for generation of inert gas, rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO_2) and halons, hazards in LPG, ammonia (NH_3), sulphur dioxide (SO), chlorine (Cl) etc.

Text Book

1. Derek, James, Fire Prevention Hand Book, Butterworths and Company, London, 1986.
2. Daniel E. Della-Giustina, Fire Safety Management Handbook, Third Edition, CRC Press, Taylor & Francis Group, 2014

References

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

Course Title and Code: Transportation Safety Engineering (CE_____)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	M.Tech Semester-III HSE (Batch: 2020-2022) **Elective-III**

Syllabus:

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

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

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

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

Shop Floor and Repair Shop Safety: Transport precautions-safety on manual mechanical handling equipment operations, safe driving, and 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.

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 Title and Code: Green Building Technology (CE____)		
Hours per Week	**L-T-P: 3-0-0**	
Credits	**3**	
Students who can take	M.Tech Semester-III HSE (Batch: 2020-2022) **Elective-III**	
Course Objective:		
After course completion, the student will be able to:		
	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	Theory Exam-I	Nil
6	Theory Exam-II	20
7	Theory Exam-III	30
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	20
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	Nil
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**

Syllabus

Unit I: Introduction of green building, Concept of green building, History of green building, Need of green building in present scenario, Importance of green building Merits and demerits, Classification of green building, Assessment methods Global assessment and certification, Local assessment, LEED India GRIHA (Green Rating for Integrated Habitat Assessment)

Unit II: Principles and elements of design of green building; Sustainability: concept and reality, Climate responsive process of design: Climatic zones, design sequence, shelter or form, landform, vegetation, water bodies, street widths, open spaces, ground character, plan form, orientation, roof form Shading devices and their effect.

Unit III: Thermal comfort inside the building: Factors affecting, indices, cooling and heating requirement, Heat transmission through building sections, thermal performance of building sections, simple calculation for U value and insulation thickness, Day lighting, Ventilation.

Unit IV: Water conservation: 3 R's for water conservation, Rainwater harvesting, low flow fixtures, grey water recycling, Material conservation: concept of embodied energy, low energy materials, sustainable materials, alternative materials Concept of carbon emission and its reduction.

Unit V: Bureau of energy efficiency: Functions, policies, guidelines, Energy Conservation Building Code, Study of existing green buildings, Introduction to Energy efficiency, carbon calculators, Indoor air quality management during construction & post-occupancy.

Text books:

1. Climate responsive architecture (A design handbook for energy efficient buildings), Arvind Krishnana,
Simos Yannas, Nick Baker, S V Szokolay, McGraw hill Education, Seventh reprint, 2013
2. Renewable Energy and Environment -A Policy Analysis for India, H, Ravindranath, K Usha Rao,
B Natarajan, P Monga, Tata McGraw Hill, 2000
3. Energy and the Environment, JM Fowler, McGraw Hill, New York, 2nd Edition, 1984
4. Green Building Through Integrated Design by Jerry Yudelson , McGraw-Hill Professional, 2009.

Reference Books:

1. Handbook on functional requirements of buildings (SP41), BIS, New Delhi, 1987
2. Energy Conservation building code (ECBC), Bureau of energy efficiency, 2011
3. "Green Building Illustrated" by Francis D. K. Ching and Ian M. Shapiro, Publisher: John Wiley & Sons; Ill edition (8 April 2014).
4.IGBC Green Schools Rating System published by Confederation of Indian Industry CII-Indian Green Building Council (IGBC)

Course Title and Code: Chemical Safety (ME2202)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	M.Tech Semester-III HSE (Batch: 2020-2022) **Elective-IV**

Course Objective:

The objective of this course is to improve the skills of participants in recognizing hazards and preventive safety work practices in relation of the production and use of chemicals, improve the skills of information retrieval and convey information to workers, employers and government officials.

On successful completion of this course students will be able to:

1. Distinguish the typical sources of risk in a process plant by;
2. Assess the severity of the consequences of incidents;
3. Undertake a Hazard and Operability Study (HAZOP);
4. Explain the legal framework controlling process plant safety in India;
5. Analyze the root cause of accidents in chemical industry.

Prerequisites		Occupational Health and Safety
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NIL
2	Assignment	10
3	Class Participation	5
4	Quiz	5
5	Theory Exam-I	10
6	Theory Exam-II	10
7	Theory Exam-III	40
8	Report-I	NIL
9	Report-II	NIL
10	Report-III	NIL
11	Project-I	20
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
	Total (100)	100

SYLLABUS:

Introduction of Chemical Safety: Chemical Safety is good for business; HAZCOM; Employ training: Initial orientation Training, job specific training, annual refresher training, and immediate on-the Spot training; Non-Routine Tasks, routine tasks: safety inspection, daily inspection, annual inspection; tasks evaluation; chemical storage; container labels; emergency and spills; housekeeping; chemical waste disposal.

Statutory Provisions: the factories Act, 1948 (amended 2001) and other relevant state factories rules; the environment (protection) Act, 1986 (amended 1991); the environment (protection) rules, 1986 (amended 2010); the water (prevention & Control or pollution) act,

1974 (amended 1988); The air (prevention & Control of Pollution) Act,1981 (Amended 1987); The manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 (Amended 2000); the hazardous wastes (management, Handling and transboundary Movement) Rule, 2008 (amended 2010); The petroleum Act, 1934; The petroleum Rules,2002 (amended 2011); The explosive Act,1884 (amended 1983); The explosive Rules, 2008; The static & Mobile Pressure Vessels (Unfired) Rules, 1981 (amended 2002); The Gas Cylinder Rules,2004; The Indian Boiler, Act 1923 (Amended2007); The Indian Boiler Regulation, 1950 (Amended 2010); other applicable Acts and rules: The Public liability Insurance Act, 1991 (amended 1992); The Public Liability Insurance Rules, 1991 (Amended 1993); The Chemical Accidents (Emergency Planning, Preparedness & Response) Rules, 1996.

Basic Principals of Accident Prevention: Basic Philosophy of Industrial Accidents-causation & Prevention, reporting of Near-miss and learning lessons; safety & health policy, physical hazards, chemical hazards, electrical hazards, mechanical hazards, bio-chemical hazards, radiological hazards; role of supervisor in promoting safety & Health (with special reference to chemical industry); accident and root cause analysis.

Chemical Hazards & Control Measures: Storage of hazardous chemicals (in bulk), handling of hazardous/ dangerous chemicals, transportation of hazardous chemicals, process safety-an overview; work permit system; safety in start-up and shut-down procedures; instrumentation for safe operating plant procedures (SOPs); personal hygiene (and health awareness); Industrial classification of labelling; chemical safety data sheet, housekeeping (sand safety); personal protective equipment.

Fire & Explosion hazards : Fire & explosion Hazards, chemistry& Classification of fire, flash point and explosive limit; portable firefighting system-first aid firefighting appliance, fixed firefighting systems, health hazards due to fire and explosion; classification of hazards area and safety aspects including flameproof electrical equipment; Dow index, fire and explosion index.

Health Hazards due to chemical exposure: Factors contributing to hazardous situation, threshold limit values; routes of entry of chemicals to cause health hazards; concentration and types of exposures; work environment monitoring-techniques & procedures; toxic effects of chemicals, health monitoring.

Techniques of identification of hazards by risk management: Techniques of identification of hazards; plant safety inspection; accident investigation; job safety analysis (JSA); Fault tree analysis (FTA); Failure Modes and effects analysis (FEMA); Hazards and operability (HAZOP) study; Risk and risk management.

Control of hazards by Industrial Hygiene: Industrial Hygiene control methods; substitution-a control technique of industrial hygiene; Dilution-a control techniques; segregation- a control techniques; isolation-a control techniques; Enclosure-a control techniques; Barricading-a control technique.

Management of Safety Health & Environment by Chemical Emergency Procedures & Tool Box Talk and Safety Audit,: On-Site Emergency Plan: appointment of Key Personnel And fixing Their Responsibilities, The Alarms system, Control Room (Emergency Control

Centre), Evacuation; Assembly points; Rehearsals, Rehabilitation, other action in the plan; off-site emergency plan; medical response in chemical emergency; safety audit; Occupational Health and Safety Assessment Series (OHSAS); Environmental management System (EMS); Training Cycle; training techniques; tool box talk.

Reference:

1. "Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
2. Fawcett, H.h. and Wood, "Safety and Accident Prevention in Chemical Operations" Wiley inters, Second Edition.
3. "Accident Prevention Manual for Industrial Operations" NSC, Chicago, 1982.
4. GREEN, A.E., "High Risk Safety Technology", John Wiley and Sons,. 1984.
5. Petroleum Act and Rules, Government of India. 6. Carbide of Calcium Rules, Government of India.
6. NSC Documents

Course Title and Code:	Environmental Impact Assessment
Hours per Week	L-T-P: 3-0-0
Credits	03
Students who can take	M.Tech Semester-III HSE (Batch: 2020-2022) **Elective-IV**
Prerequisites	Basic Knowledge of Environmental Engineering

Course Objective: Identifying, predicting, and evaluating economic, environmental, and social impacts of development activities. Providing information on the environmental consequences for decision making.

Learning Outcomes: On successful completion of this course, students will be able to:
1) Identify objectives of an environmental impact assessment and environmental audits.
2) Use the basic steps and elements of an EIA
3) Apply legislation and rules for EIA, EMA, and EA.
4) Identify, assess and address environmental concerns and adopt EIA & EA as tools for sustainable development.
5) Conduct EIA and pollution prevention assessments and critically evaluate its outcomes.

Evaluation Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	NIL
2	Assignment	20
3	Class Participation	10
4	Quiz	20
5	Theory Exam-I	NIL
6	Theory Exam-II	NIL
7	Theory Exam-III	30
8	Report-I	10
9	Report-II	10
10	Report-III	NIL
11	Project-I	NIL
12	Project-II	NIL
13	Project-III	NIL
14	Lab Evaluation-I	NIL
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
Total (100)		**100**

Evaluation Scheme for Retest

Sr. No	Specifications	Marks
1	Theory Exam-III	30

Course Syllabi (Theory):

Introduction: Environmental Assessment process, objectives of EIA, Terminology, and Hierarchy in EIA, Historical Review of EIA, and Concepts related to EIA, Basic data collection for EIA, Strategic environmental assessment (SEA)

Legislation and Procedures: National Environmental Policy Act and Implementation, EIA legislative requirements and administrative procedures in India/Indian States, EIA notification 2006.

Techniques and Methodology: Description of the environmental setting, Methods of Impact Analysis, Environmental risk assessment, baseline data collection for EIA
Public Participation in environmental decision making, regulatory requirement, techniques, advantages and disadvantages of public participation.
Preparation and writing of EIA report.
Prediction and Assessment of Impacts on Air, Water, Noise, Biological, Cultural and socio-economic Environment, Mining, blasting
Case studies of EIA for Industries like Oil, Petrochemical, iron and steel, fertilizer, sugar and distillery, projects of road/dams and housing etc.

Text Book(s)/ Reference Book(s)

1. Larry W. Canter," Environment Impact Assessment", McGraw-Hill Book Company, New York

2. G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.

3. Vijay Kulkarni and T V Ramchandra. “Environmental management” Capital Publishing Co

4. Mhaskar A.K., “Environmental Audit" Enviro Media Publications.

5. S.K. Dhameja, "Environmental Engineering and Management" S.K. Kalaria and Sons Publishers

Web Resources:

1) http://environmentclearance.nic.in/
2) http://www.environmentwb.gov.in/pdf/EIA%20Notification,%202006.pdf
3) http://www.fao.org/3/v9933e/v9933e02.htm
4) http://environmentclearance.nic.in/writereaddata/EIA%20Notifications.pdf
5) https://www.youtube.com/watch?v=3fbEVytyJCk
6) https://www.youtube.com/watch?v=nmeYMF2pdVs
7) https://www.youtube.com/watch?v=6NrzThAObpM
8) https://www.youtube.com/watch?v=0RZhK-lLp6E

Course Title and Code: Biomechanics for Ergonomics (ME_____)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	M.Tech Semester-III HSE (Batch: 2020-2022) **Elective-IV**

SYLLABUS

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

MUSCULARSKELETAL SYSTEM AND ANTHROPOMETRY IN BIOMECHANICS: Introduction, structure and function of musculoskeletal system - Connective Tissue, Skeletal Muscle, Joints Measurement of body segment, physical properties, Anthropometric data for biomechanical studies in industry.

MECHANICAL WORK CAPACITY EVALUATION AND BIOINSTRUMENTATION: Joint motion, human motion analysis system, applied electromyography, intradiscal pressure measurement, intrabdominal measurement, force platform system, whole body vibration measurement.

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

WHOLE BODY AND SEGMENTAL VIBRATION: Vibration on human body, whole body vibration, Hand-Transmitted Vibration, segmental vibration, vibration exposure criteria.

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

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

ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS: Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness. Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions

MAN - MACHINE SYSTEMAND REPETITIVE WORKS AND MANUAL HANDLING TASK: Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine. Ergonomics interventions in

Repetitive works, handle design, key board design- measures for preventing in work related musculoskeltal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability

HUMAN SKILL & PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS: A general information-processing model of the users, cognitive system, problem solving, effectiveness. Principles for the design of visual displays- auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues. Personal protective equipments (different types, specifications, standards, testing procedures, and maintenance).

References

1. Vibration and Shock Handbook, Clarence W. De Silva, Taylor and Francis Group, 2005
2. Occupational Biomechanics, Don B. Chaffin and Gunnar B.J.Andersson, John Wiley and sons,Inc
3. McCornick, E.J., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.
4. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
5. Introduction to Ergonomics, R.S. Bridger, Taylor & Francis
6. Ergonomic design for organizational effectiveness, Michael O'Neill
7. Human factors in engineering & design, MARK S.SANDERS
8. The Ergonomics manual, Dan McLeod, Philip Jacobs & Nancy Larson
9. Fitting the task to the human, Fifth edition,K.H.E.Kroemer and E.Grandjean

Course Title and Code: Industrial Project-I (PR2104)	
Hours per Week	**3 to 4 months**
Credits	**10**
Students who can take	M.Tech Semester-III (Batch: 2020-2022) **Core**

Course Objective:

The purpose of the Industry Project is to give students the opportunity to gain an insight into the operation of their field of study and develop an understanding of their profession in a professional context. By enabling students to observe the day-to-day operations of an organization and to prepare a research project based on these observations, with the guidance of a work place and academic supervisor, students will develop a critical perspective of their profession. Students will attend pre and post placement classes to guide the development of their research project, the sourcing of their host organization and the protocols associated with the placement.

After course completion, the student will be able to:

1. Identify skills and capabilities that intersect effectively with the needs of industry.
2. Apply and practice good communication skills in the workplace setting.
3. Reflect and evaluate on experiences that might lead to future employment.
4. Report research findings in written and verbal forms.
5. Demonstrate and apply research skills to complete a project.

Evaluation Scheme:

Expert Evaluation	**Evaluation Component**	**Mid-Term**	**Final Term**
Industry Expert	Industry Expert Feedback	15	50
Panel of Examiner	Synopsis	15	NA
	Report Content & Presentation	15	60
Internal Mentor	Reporting Activity Fortnightly	10	20
IP-II Coordinator	IP-2 Coordinator Feedback	5	10
Total		**60**	**140**

Syllabus:

Dissertation-I/ Industrial Project-I/ Entrepreneurial Project-I, Research and development projects based on problems of practical and theoretical interest. Students may choose a project based on any subject of Health, safety and Environmental Engineering. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. Evaluation will be based on student seminars, written reports, and evaluation of the developed system and/or theories.

Operation Procedure

- Student has to devote full semester for Dissertation-I/ Industrial Project-I/ Entrepreneurial Project-I.
- Student has to report to the Supervisor regularly.

- Seminars evaluation has to be carried out in the presence of a two member Committee comprising.
- Experts in the relevant area constituted by the Supervisor.
- Final Dissertation-I/ Industrial Project-I/ Entrepreneurial Project-I Report to be submitted has to be in formal hard bound cover bearing of the Institute emblem.

Reference Books and Tools:

Based on literature survey to be done with peer reviewed journals and magazines and relevant tools required to build the project.

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

2 Year M. Tech Programme

(Branch: Health, Safety, and Environment Engineering)

Batch 2020-2022

SEMESTER-FOUR

Detailed Syllabus

&

Scheme of Examination

Course Title and Code: Industrial Project-II (PR2107)	
Hours per Week	4 to 6 months
Credits	**16**
Students who can take	M.Tech Semester-IV (Batch: 2020-2022) **Core**

Course Objective:

The purpose of the Industry Project is to give students the opportunity to gain an insight into the operation of their field of study and develop an understanding of their profession in a professional context. By enabling students to observe the day-to-day operations of an organization and to prepare a research project based on these observations, with the guidance of a work place and academic supervisor, students will develop a critical perspective of their profession. Students will attend pre and post placement classes to guide the development of their research project, the sourcing of their host organization and the protocols associated with the placement.

After course completion, the student will be able to:

1. Identify skills and capabilities that intersect effectively with the needs of industry.
2. Apply and practice good communication skills in the workplace setting.
3. Reflect and evaluate on experiences that might lead to future employment.
4. Report research findings in written and verbal forms.
5. Demonstrate and apply research skills to complete a project.

Evaluation Scheme:

Expert Evaluation	**Evaluation Component**	**Mid-Term**	**Final Term**
Industry Expert	Industry Expert Feedback	15	50
Panel of Examiner	Synopsis	15	NA
	Report Content & Presentation	15	60
Internal Mentor	Reporting Activity Fortnightly	10	20
IP-II Coordinator	IP-2 Coordinator Feedback	5	10
Total		**60**	**140**

Course Syllabi:

Dissertation-II/ Industrial Project-II/Entrepreneurial Project-II - The students who work on a project are expected to work towards the goals and milestones set in Dissertation-II / Industrial Project-II/ Entrepreneurial Project-II. The problem can be extension of Dissertation-I/ Industrial Project-I /Entrepreneurial Project-I or a new problem. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. At the end there would be a demonstration of the solution and possible future work on the same problem. The student will have to present the progress of the work through seminars and progress reports.

Operation Procedure

- Student has to devote full semester for Dissertation/Industrial Project/Entrepreneurial Project.
- Student has to report to the Supervisor regularly.
- Dissertation-II/ Industrial Project-II/Entrepreneurial Project-II evaluation has to be carried out in the presence of a two member Committee comprising.
- Experts in the relevant area constituted by the Supervisor.
- Final Seminar Report to be submitted has to be in formal hard bound cover bearing of the Institute emblem.

Reference Books and Tools:

Based on literature survey to be done with peer reviewed journals and magazines and relevant tools required to build the project.