HAND BOOK
of
CURRICULUM STRUCTURE AND SYLLABUS
Doctor of Philosophy - IET
(Programme Code: 3101)
AY: 2021-22

Institute of Engineering and Technology

Vision

To be one of India's most innovative higher education institutions.

Mission

To realise its vision, the University will:

Practice teaching that inculcates critical thinking and problem solving,

Pursue research that leads to innovation and enhancement of real-life applications,

Offer experience that leads to all round development, and

Develop a culture that is strongly rooted in interdisciplinarity and learning by building, not just doing.

Values

Caring for people.

Integrity including intellectual honesty, openness, fairness, and trust.

Commitment to excellence.

IQAC Documentation

Document Name: Curriculum Structure and Syllabus Handbook, Doctor of Philosophy in Engineering (Session 2021-2022)

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Document Description: This document is prepared by the Institute of Engineering and Technology (IET), JKLU to serve as an information baseline for further planning and delivery of courses w.r.t Doctor of Philosophy in Engineering (Session 2021-2022).

It includes Curriculum Structure, collation of Semester wise Course Description, prepared by respective faculty members.

This document is in compliance with BoS (upto 13th meeting) and approvals of the Academic Council (upto 20th meeting).

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Basic Rules and Regulations

1. Credit Requirement in Pre PhD Course Work:

S. No.	Qualifying Examination	Credits
1.	M. Phil, M. Tech	9
2.	MBA, M. Sc., MCA, M. Com	16
3.	B. Tech	32

2. Research Methodology, Pedagogy, Academic Writing, Credit-2 each course, would be compulsory courses for Pre PhD Course work. Remaining credits can be earned through elective courses and/or MOOC courses offered by different departments/institutes.
3. Minimum CGPA requirement for passing Pre PhD Course work is 6.
4. Minimum duration of the PhD Programme would be 3 years and one can complete PhD work within 6 years (UGC Norms).

Course Structure, Detailed Syllabus & Scheme of Examination

S. No.	Course Code	Course Title	Total Contact Hours	Credits	Target Students	Core/ Elective
Common Core Courses (Engineering)						
1	IL2101	Research Methodology	2 0 0	2	Pre PhD	Core
2	IL2102	Pedagogy	2 0 0	2	Pre PhD	Core
3	IL2103	Academic Writing	2 0 0	2	Pre PhD	Core
Elective Courses in Engineering						
1	CS2202	Advanced Algorithms	3 0 2	4	Pre PhD	Elective
2	CS2101	Cloud based Big Data System-I	3 0 2	4	Pre PhD	Elective
3	AS2106	Statistical Data Analysis-I	3 0 4	5	Pre PhD	Elective
4	CS2102	Machine Learning and Data Mining	3 0 4	5	Pre PhD	Elective
5	CS2201	Large Scale Graph Analytics	3 0 2	4	Pre PhD	Elective
6	EE2104	Optimisation and Control	3 0 0	3	Pre PhD	Elective
7	EE2101	Industrial Automation and IoT-I	3 0 2	4	Pre PhD	Elective
8	EE2202	Computational Game Theory and Applications	3 0 0	4	Pre PhD	Elective
9	ME2101	Industrial Safety Management	3 0 4	5	Pre PhD	Elective
10	CE2201	Industrial Waste Management	3 0 0	4	Pre PhD	Elective
11	CE2203	Safety in Construction and Mining	3 0 0	4	Pre PhD	Elective
12	CE2205	Environmental Impact Assessment	3 0 0	4	Pre PhD	Elective
13	ME2201	Fire Engineering and Management	3 0 0	4	Pre PhD	Elective
14	ME2202	Chemical Safety	3 0 0	4	Pre PhD	Elective
15	ME1404	Mechatronics	8 Weeks	2	Pre PhD	Curated MOOC
16	IL2104	Regulation for Health, Safety, and Environment Management	4 0 2	5	Pre PhD	Elective

17	IL2201	Occupational Hygiene and Health	3 0 0	4	Pre PhD	Elective
18	CS2407	Natural Language Processing Specialization	12 Weeks	4	Pre PhD	Curated MOOC
19	CS2408	IBM Full Stack Cloud Developer Professional Certificate	12 Weeks	4	Pre PhD	Curated MOOC

CORE AND MANDATORY COURSES FOR ENGINEERING

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
IL2101	Research Methodology	20	0	0	0	2

Target Students: PhD Scholars.

Course Objectives: This course aims to familiarize the PhD students with basic elements of research thinking.

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

1. critically analyze the strengths and weaknesses of one's own and other's intellectual work and also write a literature review on a topic.
2. identify, describe, and critique the methods used for research in engineering, management, and development.
3. define research problems from a coherent analysis of gaps in existing knowledge base.
4. formulate hypotheses and/or research questions
5. write research proposals describing research questions, purpose, context, metrics, sources and methodology.
6. undertake research work making systematic use of investigation or experimentation, to discover or revise knowledge of reality.

Assessment Scheme:

Prerequisites : Nil		Research Methodology
Teaching Scheme		20+ hrs of Lecture, Seminar
Credit		2
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NA
2	Assignment	30
3	Class Participation	10
4	Quiz	NA
5	Theory Exam-I	NA
6	Theory Exam-II	NA
7	Theory Exam-III	NA
8	Report-I	30
9	Report-II	NA
10	Report-III	NA
11	Project-I	30
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I	NA
15	Lab Evaluation-II	NA

16	Course Portfolio	NA
	Total (100)	100

Course Syllabi:

Ways of knowing, nature of science and philosophy, research competencies, reasoning, critical thinking for researchers, fallacies, common errors in analysis, literature review, nature of theoretical and empirical world, research approaches, research process, research goal, basic research, applied research, empirical research, characteristics of good research, types of research results, framing research proposal, pitfalls in research proposals, ethical issues in research, data collection, sources of evidence,

Reference and Reference Sources:

1. Coursera Courses:
    a. Understanding Research Methods by University of London.
    b. Being a Researcher (In Information Science and Technology) by Politecnico di Milano
    c. Introduction to Logic and Critical Thinking by Duke University
2. Jerry Wellington et al, Succeeding with Your Doctorate, SAGE Publications, 2005
3. Holyoak, Keith J., and Robert G. Morrison, eds. The Cambridge Handbook Of Thinking And Reasoning. Cambridge University Press, 2005.
4. McNabb, David E. Research methods for political science: Quantitative and qualitative methods. Routledge, 2004, 2015.
5. Yin, R. K. 2003. Case Study Research: Design and Methods, 2d Edition. Thousand Oaks, 3rd Edition, CA: Sage Publications.
6. Patten, Mildred L. Proposing empirical research: A guide to the fundamentals. Part E, Pyrczak Pub, 2005
7. http://philosophy.hku.hk/think/arg
8. http://158.132.155.107/posh97/private/ResearchMethods/150.htm

Many more references will be provided during the courses.

Facebook Group: https://www.facebook.com/groups/641656313395600

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
IL2102	Pedagogy	20	0	0	0	2

Target Students: PhD Scholars.

Course Objectives: This course aims to familiarize the PhD students with modern approaches for teaching university level or continuing professional development courses.

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

1. Plan appropriate learning outcomes for university level or continuing professional development courses in their discipline wrt the New Education Policy or National Skill Qualification Framework.
2. Design a variety of learning activities for university level or continuing professional development courses in their discipline wrt the desired learning outcomes.
3. Design appropriate assessment schemes for university level or continuing professional development courses in their discipline wrt the desired learning outcomes.
4. Use contemporary approaches of pedagogy to transform regular university level or continuing professional development courses in their disciplines.

Assessment Scheme:

Prerequisites : Nil		**Pedagogy**
Teaching Scheme		20+ hrs. of Lecture, MOOC, and Seminar
Credit		2
Sr. No.	**Evaluation Component**	**Marks**
1	Attendance	NA
2	Assignment	30
3	Class Participation	10
4	Quiz	NA
5	Theory Exam-I	NA
6	Theory Exam-II	NA
7	Theory Exam-III	NA
8	Report-I	30
9	Report-II	NA
10	Report-III	NA
11	Project-I	30
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I	NA
15	Lab Evaluation-II	NA
16	Course Portfolio (MOOC)	NA
	Total (100)	100

Course Syllabi:

New Education Policy, NSQF, Levels of Expertise, Cognitive and Moral Development. Learning Styles, Deep learning, Bloom's Taxonomy of educational objectives, Dimensions of Learning, Solo Taxonomy of Educational Objectives, Merrill's Principles of Instruction, Deductive teaching, inductive teaching, flipped class, team-teaching, and hybrid teaching, Social learning theory, Experiential learning, Constructivism, Situated Learning, Problem/Project based learning, etc.

Reference and Reference Sources:

1. Coursera MOOC Courses:
    a. e-Learning Ecologies: Innovative Approaches to Teaching and Learning for the Digital Age by University of Illinois at Urbana-Champaign
    b. New Learning: Principles and Patterns of Pedagogy by University of Illinois at Urbana-Champaign
    c. Designing Learning Innovation by Politecnico di Milano
2. New Education Policy, 2020
3. NSQF
4. https://www.learning-theories.com/
5. https://gsi.berkeley.edu/gsi-guide-contents/
6. https://eric.ed.gov/
7. https://tomprof.stanford.edu/
8. https://www.engr.ncsu.edu/stem-resources/legacy-site/education/
9. More specific references will suggested during the coursework.

Facebook Group: https://www.facebook.com/groups/4175456125843387

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
IL2103	Academic Writing	20	0	0	0	2

Target Students: PhD Scholars.

Course Objectives: Although they follow a well-defined format, writing scientific articles and getting them ready to be published, can be a difficult task. This course focuses on practicing necessary skills to write good academic prose.

Learning Outcomes:

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

1) write a scientific article to communicate about their research
2) assess the quality of academic writing
3) prepare a scientific article for publication, using different computational tools

Prerequisites : Nil

Teaching Scheme	20+ hrs of Lecture, Seminar, and Observation of selected classes
Credit	**2**

Assessment Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	NA
2	Assignment (2)	80
3	Class Participation	10
4	Quiz	10
5	Theory Exam-I	NA
6	Theory Exam-II	NA
7	Theory Exam-III	NA
8	Report-I	NA
9	Report-II	NA
10	Report-III	NA
11	Project-I	NA
12	Project-II	NA
13	Project-III	NA
14	Lab Evaluation-I	NA
15	Lab Evaluation-II	NA
16	Course Portfolio	NA
	Total (100)	100

Course Syllabi:

The scientific paper. Sections: Title, Authors/Affiliation, Abstract, Introduction, Materials and methods, Results, Discussion, Conclusion, References, Bibliography, Footnotes, Appendix and Acknowledgements.

Tools and techniques for academic writing. Basic guidelines for text, equations, tables, figures, legends, graphs, quotes, references, captions, journal formats, etc. Using version control tools, using reference management tools.

Preparing to publish. Rewriting, final manuscript preparation, analyzing written arguments and responding to referees. Ethics in research and publication. Plagiarism checkers.

Reference and Reference Sources:

[1] E. Wager and S. Kleinert, "Responsible research publication: international standards for authors. A position statement developed at the 2nd World Conference on Research Integrity," presented at the Promoting Research Integrity in a Global Environment, 2011.
[2] S. A. Socolofsky, "How to write a research journal article in engineering and science," p. 17.
[3] M. J. Katz, From research to manuscript: a guide to scientific writing. Dordrecht, The Netherlands: Springer, 2006.
[4] Zemach Rumisek. Academic Writing, 2005. Macmillan ELT
[5] S. Bailey, Academic writing: a handbook for international students. London; New York: Routledge Falmer, 2004.
[6] I. Leki, Academic writing: exploring processes and strategies, 2. ed., 13th print. Cambridge: Cambridge Univ. Press, 2009.
[7] S. Kaye, Writing under pressure: the quick writing process. New York: Oxford University Press, 1989.
[8] E. J. Rothwell and M. J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, 1st ed. CRC Press, 2017.
[9] Silvia, P. J. 2015. Arcana and miscellany: From titles to footnotes. Write it up: Practical strategies for writing and publishing journal articles: 157-174. Washington, DC: American Psychological Association.
[10] Ballinger, G. A. & Johnson, R. E., 2015. Editor's comments: Your first AMR review. Academy of Management Review, 40(3): 315-322.
[11] Kamler, B. 2008. Rethinking doctoral publication practices: Writing from and beyond the thesis. Studies in Higher Education, 33(3): 283-294.
[12] Alvesson, M. & Sandberg, J. 2011. Generating research questions through problematization. Academy of Management Review, 36(2): 247-271.

IT Resources:

Canvas Instructure: https://canvas.instructure.com/enroll/JRJ33R

1. Coursera. Academic English: Writing. University of California, Irvine. https://www.coursera.org/specializations/academic-english

ELECTIVES IN ENGINEERING

Course Title and Code:	**Advanced Algorithms; CS2202**
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	M. Tech. Semester I

Course Objective- This course will introduce algorithms based on dynamic programming and greedy approach. We will also cover graph algorithms which will include introduction to some of the NP-hard, NP-complete problems as well. We will also understand the notion of complexity theory and complexity classes in relation to the algorithms studied.

Course Outcome:

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

CS2111.1. Analyze the computational complexity of algorithms
CS2111.2. Design algorithms based on dynamic programming and greedy approaches.
CS2111.3. Design algorithms for graphs and network flow.
CS2111.4. Explain the importance of complexity classes in theoretical computer science.
CS2111.5. Prove the complexity status of some of the well known problems.

Evaluation Scheme		
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	30
03	Class Participation	Nil
04	Quiz	Nil
05	Theory Exam-I	Nil
06	Theory Exam-II	15
07	Theory Exam-III	35
08	Report-I	Nil
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I (Continuous)	20
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	**100**

Retest

1	Theory Exam-III	35
	Total	**35**

Syllabus (Theory):

UNIT – I: Review

Basics related to growth of functions and recurrence relations. Introduction to complexity classes.

UNIT – II: Dynamic Programming and Greedy Strategies

Elements of Dynamic Programming, optimal substructure, overlapping subproblems, memoization, constructing an optimal solution. Matrix chain multiplication, Longest common subsequence, Optimal polygon triangulation. Elements of greedy strategy, greedy choice property, optimal substructure. Activity selection problem, Huffman codes. Matroids, Task scheduling problem.

UNIT – III: Graph Algorithms
Minimum spanning trees: Kruskal and Prims algorithms. Shortest path algorithms: Dijkstra's algorithm, Bellman Ford algorithm, Floyd-Warshall algorithm. Network flow algorithms: Flow networks, Ford-Fulkerson method.

UNIT – IV: NP-Completeness
The complexity class P, Polynomial time algorithms, Polynomial time verification. The complexity class NP. NP completeness and reducibility, 3-SAT, NP completeness proofs, NP complete problems: The clique problem, Vertex cover problem, The subset sum problem.

Text Books:

1. *Introduction to Algorithms,* by Thomas H. Cormen, Charles E. Leiserson, and Ronald L. Rivest

Course Title and Code:	Cloud Based Big Data System-I: CS2101
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	M.Tech. in Data Science (1st Semester)

Course Objective: This course prepares students to use the Big Data platform and methodologies in order to collect and analyze large amounts of data from different sources. The students will acquire skills in Big Data architecture, such as Apache Hadoop, Ambari, HDFS, YARN, MapReduce, ZooKeeper, Knox, Sqoop, and HBase. This course lays the foundation for the course on Cloud Based Big Data System-II.

Learning Outcomes:

After completing this course, the students should be able to understand the following topics:

2101.1 Explain Big Data technologies challenges and solutions for businesses.
2101.2 Illustrate Apache Hadoop, Ambari, Spark, HDFS, YARN, MapReduce, Pig, ZooKeeper, Knox, Sqoop, and HBase.
2101.3 Execute job on MapReduce framework.
2101.4 Demonstrate the process of add and removal nodes from Hadoop clusters, check available disk space on each node, modify configuration parameters.
2101.5 Use Hive to Access Hadoop Data.
2101.6 Organize Apache Sqoop and Flume to Move Data into Hadoop.
2101.7 Apply Pig's relational operators, evaluation functions, and math and string functions.
2101.8 Develop Data Pipelines with Apache Kafka.
2101.9 Design Hadoop ecosystem for a Big Data application.

Prerequisites		Linux, Programming, SQL
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	Nil
03	Class Participation	Nil
04	Quiz	15
05	Theory Exam-I	Nil
06	Theory Exam-II	Nil
07	Theory Exam-III	25
08	Report-I	20
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	20
15	Lab Evaluation-II	20
16	Course Portfolio	Nil
	Total	**100**
Evaluation Scheme for Retest		
01	Theory Exam-III	25
02	Lab Evaluation-II	20
	Total	**45**

Big Data Overview: Data Overview, Industry Applications, Case Studies, Understanding Big Data

Basics of Hadoop: Architecture and core components, MapReduce and the Hadoop Distributed File System (HDFS), Add and remove nodes from Hadoop clusters, check available disk space on each node, modify configuration parameters, Other Apache projects that are part of the Hadoop ecosystem, including Pig, Hive, HBase, ZooKeeper, Oozie, Sqoop, Flume, among others.

MapReduce and YARN: reliable, scalable, and cost-effective solution, MapReduce features, including Yet Another Resource Negotiator (YARN), HDFS Federation, and high availability, Controlling MapReduce framework job execution, Design and implementation of YARN.

Hadoop Operations: Apache Sqoop and Flume, Importing or loading data into HDFS from common data sources such as relational databases, data warehouses, web server logs, etc., Import/export data in and out of Hadoop, Hive, Accessing Hadoop Data Using Hive, Hive QL, Hive for Data Warehousing tasks, Apache Pig, overview of Pig's data structures, Access data using the LOAD operator, Pig's relational operators, Pig's evaluation functions, math and string functions, Big SQL

Stream Computing: Apache Kafka, Use and architecture and components, up-and-running, producing and consuming messages using both the command line tools and the Java APIs, Connect Kafka to Spark and working with Kafka Connect.

Reference Books:

1. Benjamin Bengfort and Jenny Kim. *Data Analytics with Hadoop: An Introduction for Data Scientists*. O'Reilly Media, 2016.
2. Jake VanderPlas. *Python Data Science Handbook: Essential Tools for Working with Data*. O'Reilly Media, 2016.

Suggested MOOCs:

- Big Data Essentials: HDFS, MapReduce and Spark RDD
  https://www.coursera.org/learn/big-data-essentials
- Big Data Analysis: Hive, Spark SQL, DataFrames and GraphFrames
  https://www.coursera.org/learn/big-data-analysis
- Big Data Specialization
  https://www.coursera.org/specializations/big-data

Course Title and Code: Statistical Data Analysis-I (AS2106)	
Hours per Week	**L-T-P: 3-0-4**
Credits	**5**
Students who can take	MTech Semester-I (Batch: 2021-2023) **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.

Course Outcomes: After course completion, the student will be able to:

- AS2106.1: Frame real world analysis problems using statistical concepts and solve them using standard techniques.
- AS2106.2: Use professional level tools to support the study of statistics.
- AS2106.3: Communicate quantitative ideas to a range of audiences.
- AS2106.4: Apply recommended practices for data analysis.

Prerequisites		
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	10
4	Quiz	15
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	25
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	20
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	Total (100)	100

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-

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 R Studio. https://www.youtube.com/watch?v=lL0s1coNtRk

Course Title and Code: Machine Learning and Data Mining CS2102	
Hours per Week	**L-T-P: 3-0-4**
Credits	**5**
Students who can take	M. Tech Sem I (2021-2023)

Course Objective: This course introduces the fundamental concepts and state-of-the art tools and techniques of machine learning and data mining. This course helps the students to pursue projects related to ML and data mining.

Course Outcome:

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

CS2102.1. Utilize advanced knowledge of data mining, data warehousing and KDD concepts and techniques.

CS2102.2. Organize and prepare the data needed for data mining using pre-preprocessing techniques.

CS2102.3. Generate and apply different mining techniques such as rule generation, association mining, Bayesian techniques and Frequent Itemset generation.

CS2102.4. Apply the techniques of clustering, classification, association finding, feature selection and visualization for large datasets.

CS2102.5. Explain the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

CS2102.6. Select and apply suitable machine learning techniques for a given problem.

Prerequisites		Nil
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	20
3	Class Participation	Nil
4	Quiz	10
5	Theory Exam-I	10
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	20
12	Project –II	Nil
13	Project –III	Nil
14	Lab Evaluation I (Continuous)	10
15	Lab Evaluation II (Test)	10
16	Course portfolio	Nil
	Total (100)	100

Evaluation Scheme for Retest		
1	Theory Exam-III	20
2	Lab Evaluation-II	10
	Total	**30**

Syllabus (Theory)

UNIT – I: Introduction: Data warehouse – Difference between Operational DBs and Data warehouses – Multidimensional Data Model, The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques.

UNIT – II: Techniques of Data Mining: Link analysis, predictive modeling, database segmentation, score functions for data mining algorithms, Bayesian techniques in data mining, Association Analysis: Problem Definition; Frequent Itemset generation; Rule Generation; Compact representation of frequent item-sets; Alternative methods for generating frequent item-sets

UNIT – III: Issues in Data Mining: Scalability and data management issues in data mining algorithms, parallel and distributed data mining, privacy, social, ethical issues in Knowledge Discovery in Databases (KDD) and data mining, pitfalls of KDD and data mining.

UNIT – IV: Introduction to Machine Learning, Supervised Learning: Classification: Preliminaries; General approach to solving a classification problem; Decision tree induction; Rule-based classifier; Simple and Multiple Linear Regression; Nearest-neighbor classifier, SVM, Unsupervised Learning: Clustering; K-Means, Hierarchical Clustering

UNIT – V: Model Evaluation Measures: Cross-Validation Technique, Confusion matrix for evaluation, Class probabilities and class predictions, ROC Curve, Model evaluation metrics, Fitting dataset and evaluating their performance set, Evaluation of selected features, Model evaluation metrics, making predictions on new data

Usage of AI and ML Techniques for achieving sustainable practices, NIST and IEEE standards for AI and ML libraries, tools and techniques.

Reference Books:

1. Mitchell, Tom. Machine Learning, McGraw Hill 1997.
2. Murphy, Kevin P. Machine learning: A Probabilistic Perspective. MIT press, 2012. (Electronic copy available through the Bodleian library.)
3. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006.
4. Han, Jiawei, Jian Pei, and Micheline Kamber. Data Mining: Concepts and Techniques. Elsevier, 2011.
5. Tan, Pang-Ning, Michael Steinbach, Vipin Kumar, and Anuj Karpatne. Introduction to Data Mining, Global Edition. Pearson Education Limited, 2019.
6. Witten, Ian H., Eibe Frank, Mark A. Hall, and Christopher J. Pal. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann, 2016.

CS2201: Large scale graph analytics

Course Title and Code **CS2201: Large scale graph analytics**	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	M.Tech final year

Course Objective-

Graphs are a universal construct to deal with the complex data in science, nature, and technology. With the emergence of large online social networks and broad availability of network data in various domains, real-world networks pose unprecedented challenges. This course focuses on analysis of large scale graphs and introduces recent advances in the area.

Course Outcome:

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

CS2201.1. analyze the concept of small world graph, Power law distribution, Centrality measures, Communities, modularity of large-scale graph.

CS2201.2. compute the ranking graph nodes using HITS and PageRank

CS2201.3. identify and apply the Motifs, Contagions, Viral propagations

CS2201.4. demonstrate Graph Learning and GPU computations

CS2201.5. experiment using libraries like, NetworkX, SNAPPY and GIRAPH

Prerequisites		**Programming**
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignments	20
03	Class Participation	Nil
04	Quiz	Nil
05	Theory Exam-I	Nil
06	Theory Exam-II	20
07	Theory Exam-III	20
08	Report-I	Nil
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	20
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I (Test)	10
15	Lab Evaluation-II (Test)	10
16	Course portfolio	Nil
	Total (100)	**100**

Retest

1	Lab Evaluation-II	10
2	Theory Exam-III	20
	Total	30

Syllabus

1: Introduction

General introduction to real-world networks, interdisciplinary network science field and why computer science matters in that context, review on fundamental concepts in graph theory, overview of linear algebra and matrix operations.

2: PageRank
Link analysis in networks, hubs and authorities, HITS algorithm, degree-driven metrics to determine important nodes and edges, use of PageRank in web and beyond.

3: Graph Traversal and Maximum Flow
Fundamental and practical algorithms for graph traversal, breadth-first search, depth-first search, strongly connected components, direction-optimizing BFS, maximum flows & minimum cuts.

4: Shortest Paths and Centrality
Single-source shortest paths, all-pairs shortest paths, practical algorithms for Katz, eigenvector, closeness, and betweenness centrality computations, adaptations for weighted graphs.

5: Community Detection
Graph clustering problem, community definition and detection algorithms, evaluation metrics, modularity, graph conductance, types of communities in real-world networks, overlapping communities.

6: Dense Subgraphs
Densest subgraph problem, dense subgraph models and measures, clique and quasi-cliques, connections to graph clustering and community detection, use of higher-order structures, core, truss, and nucleus decompositions.

7: Graph Partitioning
Definition of graph partitioning, applications in scientific computing and data mining, sparse matrix vector multiplication, Kernighan-Lin algorithm, load balancing, multi-level methods, streaming graph partitioning.

8: Network Motifs
Subgraph patterns, mesoscale structures, triangles and higher-order structures, motif distributions per node/edge, adaptation for directed networks, motifs on bipartite graphs and limitations, connections to subgraph isomorphism.

9: Heterogeneous and Non-traditional Networks
Directed networks and challenges, graphs with categorical and numerical node/edge labels, bipartite networks and challenges, k-partite networks and applications.

10: Temporal Graphs I.
Temporal walks, paths, and reachability, basic graph metrics in temporal graphs such as subgraphs, connectivity, and centrality, models of temporal networks, temporal network motifs. Streaming models for graph algorithms, graph sketches, incremental methods to maintain graph analytics such as centrality, community detection, pagerank, and k-core computation.

11: Machine (and Deep) Learning on Graph.
Representation learning on graphs, applications in downstream ML tasks, embedding nodes, embedding subgraphs, bipartite graph embeddings, graph neural networks.

12: Parallel Graph Analytics.
Shared-memory graph processing frameworks, GPU algorithms and frameworks for graph processing, Distributed-memory graph processing frameworks, vertex-programming model, specialized distributed graph algorithms (graph coloring, centrality, k-core computation), connections to the graph partitioning.

Text Books:

1. Networks, Crowds, and Markets, by D. Easley & J. Kleinberg.
2. Networks An Introduction, by M.E.J. Newman.

Reference Courses:

1. Networks (Daron Acemoglu and Asu Ozdaglar, MIT)
2. Analysis of Networks (Jure Leskovec, Stanford)
3. Networks (David Easley and Jon Kleinberg, Cornell)
4. Topics in Social Data (Johan Ugander, Stanford)
5. Network Theory (Mark Newman, University of Michigan)
6. Graphs and Networks (Dan Spielman, Yale)
7. Statistical Network Analysis (Jennifer Neville, Purdue)
8. Network Analysis and Modeling (Aaron Clauset, Sante Fe Institute)
9. Parallel Graph Analysis (George Slota, RPI)
10. Large-Scale Graph Mining (A. Erdem Sariyuce, University of Buffalo)
11. Mining Large-scale Graph Data (Danai Koutra, University of Michigan)
12. Data Mining meets Graph Mining (Leman Akoglu, Stony Brook)
13. Graphs and Networks (Charalampos Tsourakakis, Aalto University)
14. Large-Scale Graph Processing (Keval Vora, Simon Fraser University)

Course Title and Code:	**Optimisation and Control; EE2104**
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	MTech Automation & Robotics – 1st semester

Course Objective- This course aims at equipping students with the conceptual tools necessary to solve estimation and control problems, maximizing performance and minimizing cost.

Course Outcomes:

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

1. analyze the requirements of a given estimation and control problem
2. design and implement a solution for a given estimation and control problem
3. efficiently use Computer Aided Control Systems Design (CACSD) tools
4. assess, troubleshoot, improve and document a given estimation and control system
5. apply relevant engineering standards to meet technical, safety, regulatory, societal and market needs

Prerequisites		
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment (4)	40
03	Class Participation	Nil
04	Quiz	Nil
05	Theory Exam-I	Nil
06	Theory Exam-II	Nil
07	Theory Exam-III	30
08	Report-I	30
09	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**

Retest

1	Theory Exam	30

Syllabus (Theory):

1) Mathematics refresher: linear algebra, linear programming, nonlinear programming, dynamic systems, modelling identification and simulation, both in continuous time and discrete time.
2) Control system project planning and documentation.
3) Discrete-event control systems. Typical models, counters, and timers. State machines, Petri nets, Sequential Flow Charts.
4) Continuous control systems: Stability, time domain, frequency domain, design specifications, compensation. State variable modelling of linear continuous systems, controllability, and

5) Introduction to optimal control. Performance assessment.

Reference Books:

- R. F. Stengel (1994). Optimal control and estimation. Dover Publications.
- C.-T. Chen, Linear System Theory and Design, 3rd ed. USA: Oxford University Press, Inc., 1998.
- B. Hrúz and M. Zhoum (2007). Modeling and control of discrete-event dynamical systems: with Petri nets and other tools. London: Springer.
- D. H. Hanssen, Programmable Logic Controllers A Practical Approach TO IEC 61131-3 Using CoDeSys. Wiley, 2015.

IT Resources

https://nptel.ac.in/courses/107/106/107106081/
https://nptel.ac.in/courses/108/105/108105019/
https://nptel.ac.in/courses/112/107/112107220/
https://www.controldraw.co.uk/
https://www.codesys.com/
https://web.math.princeton.edu/~cwrowley/python-control/index.html

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

Course Objectives

The course focuses on the application of technologies to control and monitor the industrial processes. Course aims to introduce industrial automation, IoT technologies and standards. Its emphasis is on theoretical principles and applications for problem solving.

Course Outcomes:

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

EE2101.1 Analyze the link between Information Technology and Operational Technology.
EE2101.2 Specify the key components to design an Industrial automation & IoT system.
EE2101.3 Choose technologies for communication and real time data collection.
EE2101.4 Design, deploy and test a basic Industrial automation & IoT system.
EE2101.5 Apply recommended engineering practices to meet desired requirements for applications, considering sustainability, security and safety as design constraints.

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

Evaluation Scheme for Retest:

S. No.	Specifications	Marks
1	Theory Exam-III (End Term)	20
2	Lab Evaluation-II (Exam)	10
3	**Total**	**30**

Theory

UNIT1: Introduction: Classical hierarchical industrial automation model. Essential functions of each level. Elements of industrial control (sensors, actuators, transmitters, controllers, etc.). ISA 95 / ISA S88 – 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.

UNIT 3: IoT fundamentals, Architecture and protocols,

UNIT 4: Industrial IoT fundamentals. Convergence of IT and OT. Industrial communication: principles, protocols and technologies. Design methodology. Design of IoT systems for industrial safety processes.

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.

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. PLC programming.
5. Mini-project

Text Book(s)

- Krishna Kant. "*Computer-based Industrial Control*". PHI Learning Private Limited, 2010.
- Hanes, Salgueiro, Grossetete, Barton and Henry (2017). "*IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things*". Cisco Press.
- Curtis Johnson. "*Process Control Instrumentation Technology*". PHI Learning Private Limited, 2013.

Reference Book(s)

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

Web Resources

https://nptel.ac.in/courses/108/105/108105062/
https://nptel.ac.in/courses/106/105/106105195/

Online Courses:

Developing Industrial Internet of Things
https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk/browse?index=prod_enterprise_products&productId=84QbLYtsEeicuBLWaYsl_g&productType=s12n&query=industrial+iot&showMiniModal=true

Design of Internet of Things
https://nptel.ac.in/courses/108/108/108108098/

Course Title and Course Code	**Computational Game Theory and Applications (EE 2202)**
Hours per Week	**L T P: 3 0 0**
Credits	**4**
Students who can take	**M. Tech Semester-III A&R**

Course Objective:

The course focuses on areas of game theory that are relevant for engineering applications. The emphasis is both on theoretical principles and on the application of the theory to problem formulation and problem solving. The course covers a wide range of topics, from different models of non-cooperative games and related equilibrium concepts, to cooperative games.

Course Outcomes:

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

EE2202.1 Explain the key concepts of preferences, utility, and decision-making under certainty and uncertainty.

EE2202.2 Apply the key models and solution concepts of non-cooperative game theory, including both strategic form and extensive form games.

EE2202.3 Evaluate the importance of competitive and cooperative factors in a variety of decision problems.

EE2202.4 Analyse the key models and solution concepts of cooperative game theory, including TU and NTU games.

EE2202.5 Analyze games with imperfect and incomplete information.

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

Evaluation Scheme for Retest:

S. No.	Specifications	Marks
1	Theory Exam-III (End Term)	30
3	**Total**	**30**

Syllabus:

Unit-1: Introduction

Introduction to game theory, routing games and mechanism design; Strategies, costs, and payoffs; Prisoner's dilemma, Nash Equilibrium, Strategic games; Best response; Dominant strategies; Pure strategy v/s Mixed strategy.

Unit-2: Preferences, Utility, and Goals

Preference relations and their interpretation, utility as a numeric model of preference, Decision-making under uncertainty: preferences over lotteries; Von Neumann and Morgenstern utility functions; expected utility and expected utility maximisation, Paradoxes of expected utility maximisation; framing effects and prospect theory.

Unit-3: Bayesian Games

Definition of a Bayesian Game and Bayesian Nash Equilibrium, Games with incomplete information, Bayesian-Nash equilibrium, Perfect Bayesian equilibrium, Refinements of PBE, Applications to spence job-market signaling game, oligopoly games with asymmetric information etc.

Unit-4: Cooperative and Non-Cooperative Games

Noncooperative Game Theory: Strategic form games, existence of Nash equilibrium, computation of Nash equilibrium, matrix games, minimax theorem, extensive form games.

Cooperative Game Theory: Correlated equilibrium, two person bargaining problem, coalitional games, core, shapley value and its implications, Transferable utility (TU) and nontransferable utility (NTU) games.

Unit-5: Engineering Applications

Game theory based control approach for smart grid operation, power control schemes, reactive power management, demand side management, electric vehicle charging, storage management, electricity pricing etc.

MOOC Course Link:

https://www.coursera.org/learn/game-theory-1?action=enroll&courseSlug=game-theory-1&showOnboardingModal=check

https://online.stanford.edu/courses/soe-ycs0002-game-theory

Reference Books:

1. Dutta, Prajit K., “Strategies and Games : Theory and Practice” MIT Press.
2. Vladimir Mazalov, “Mathematical Game Theory and Applications” John Wiley & Sons, Ltd.
3. Ken Binmore, “Playing for Real: A Text on Game Theory” Oxford University Press.
4. Erich Prisner, “Game Theory Through Examples” The Mathematical Association of America.
5. Steven Tadelis, “Game Theory: An Introduction” Princeton University Press.

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 HSEE **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: ME2101.1 Analyse the effect of the release of toxic substances. ME2101.2 Explain the industrial laws, regulations and source models. ME2101.3 Apply the methods of prevention of fire and explosions. ME2101.4 Identified the relief and its sizing methods. ME2101.5 Explain the methods of hazard identification and preventive measures. ME2101.6 Apply standard safety procedures in an industrial environment.		
	Prerequisites	
Evaluation Scheme		
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	15
03	Class Participation	05
04	Quiz	20
05	Theory Exam-I	10
06	Theory Exam-II	Nil
07	Theory Exam-III	30
08	Report-I	10
09	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	Nil
16	Course Portfolio	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
07	Theory Exam-III	30

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;

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

T1. L.M. Deshmukh, “Industrial Safety Management” 15th edition, McGraw Hill Education (India) Pvt. Ltd.(2018).

Reference books

R1. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice-Hall, 2011.

R2. Fawcett H.H. and W.S.Wood, Safety and accident prevention in Chemical operations 2nd edition John Wiley and Sons Inc. (1982).

R3. Study materials of industrial safety from National safety council of India.

Course Title and Code: Industrial Waste Management | CE2201	
Hours per Week	**L-T-P: 3-0-0**
Credits	**4**
Students who can take	M.Tech Semester-I (Batch: 2021-2023)

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.

Course Outcome:

After course completion, the student will be able to:

CE2201.1 Analyze key sources, typical quantities generated, composition, and properties of solid and hazardous wastes.

CE2201.2. Compare effective methods of solid & hazardous wastes handling and segregation of wastes at source.

CE2201.3. Test the most common techniques for preventing, minimizing, recycling, disposing and treatment of waste and their application on-site remediation.

CE2201.4. Recognize the relevant regulations that apply for facilities used for disposal, and destruction of waste.

CE2201.5. Identify, formulate, and solve engineering problems, and an understanding of professional and ethical responsibility.

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

Evaluation Scheme for Retest			
1	Theory Exam-III	30	
	Total (30)	**30**	

Syllabus:

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

REFERENCE BOOKS:

Refer all courses related books, other than text books here.

R1: George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw- Hill, New York, 1993

R2: CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

R3: George Tchobanoglous; Frank Kreith Handbook of Solid Waste Management, Second Edition ISBN: 9780071356237 Publication Date & Copyright: 2002 .The McGraw-Hill Companies, Inc

R4: Thomas H. Christensen; Solid Waste Technology & Management, 1 & 2; First published:23 November 2010 Print ISBN:9781405175173 |Online ISBN:9780470666883 |DOI:10.1002/9780470666883; Copyright © 2011 Blackwell Publishing Ltd.

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 (HSE) I Semester, 2021-23**

Course Objective: Aim of this course is to develop knowledge and skills w.r.t. technical, managerial and legal aspects for safety and health in the construction as well as in mining sector.

Course Outcomes:

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

CE2203.1 Define key safety requirements in construction and mining sectors.
CE2203.2 Identify hazards and risks involved in construction and mines sites.
CE2203.3 Implement Effective Safety Management System.
CE2203.4 Reduce workplace injuries through incident prevention methods.
CE2203.5 Improve safety culture within an organization.
CE2203.6 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	20
7	Theory Exam-III	30
8	Report-I	20
9	Report-II	NIL
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	30

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: Safetyduring constructionworks- 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 highwayconstruction: 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 :4 -Safety 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:5- 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:	**Environmental** Impact Assessment CE2205
Hours per Week	L-T-P: 3-0-0
Credits	04
Students who can take	M.Tech Semester-III (Batch: 2020-2022) Elective
Prerequisites	Basic Knowledge of Environmental Engineering

Course **Objective:** This course aims to develop knowledge and skills for identifying, predicting,
and evaluating economic, environmental, and social impacts of development activities and alsoproviding information on the environmental consequences for decision making.

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

CE2205.1 Identify objectives of environmental impact assessment.

CE2205.2 Use the basic steps and elements of an EIA.

CE2205.3 Apply legislation and rules for EIA, EMA.

CE2205.4 Identify, assess and address environmental concerns and adopt EIA as tools for sustainable development.

CE2205.5 Conduct EIA and pollution prevention assessments and critically evaluate its outcomes.

Evaluation Scheme:

Sr. No.	Evaluation Component	Marks
1	Attendance	NIL
2	Assignment	10
3	Class Participation	10
4	Quiz	10
S	Theory Exam-I	NIL
6	Theory Exam-II	20
7	Theory Exam-III	30
8	Report-I	20
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-11	NIL
16	Course Portfolio	NIL
	Total (100)	100

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

Caee 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://environmentc1earance.nic.in/
2) http://www.environmentwb.gov.in/pdf/EIA%20Notification,%202006.pdf
3) http://www.fao.org/3/v9933e/v9933e02.htm
4) http://environmentc1earance.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-1Lp6E

Course Title and Code: Fire Engineering and Management (ME2201)		
Hours per Week	**L-T-P: 3-0-0**	
Credits	**4**	
Students who can take	**M.Tech Semester-III Elective**	
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: ME2201.1 Distinguish and select the most suitable portable and fixed fire extinguishing systems for different kinds of fire. ME2201.2 Describe the number system used by the United Nations and Department of Transportation (DOT) in classifying hazardous materials. ME2201.3 Determine the factors necessary when selecting an appropriate fire detection and controlling system for any kind of buildings. ME2201.4 Describe the suitable and effective methods for proper care and maintenance of automatic/manual and portable/ fixed fire protection systems. ME2201.5 Prepare, review, and/or approve all the applicable safe-practice methods/standards as per legislation to protect life, society, and property from fire hazards. ME2201.6 Develop and implementing the key elements of an emergency response action program. ME2201.7 Explain the development and implementation of the National Fire Incident Reporting System (NFIRS).		
	Prerequisites	
Evaluation Scheme		
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	20
03	Class Participation	05
04	Quiz	20
05	Theory Exam-I	10
06	Theory Exam-II	Nil
07	Theory Exam-III	30
08	Report-I	15
09	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		
07	Theory Exam-III	30

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

T1 Derek, James, Fire Prevention Hand Book, Butterworths and Company, London, 1986.

T2 Daniel E. Della-Giustina, Fire Safety Management Handbook, Third Edition, CRC Press, Taylor & Francis Group, 2014

References

R1 Gupta, R.S., Hand Book of Fire Technology, Orient Longman, Bombay 1977.

R2 Accident Prevention manual for industrial operations, N.S.C., Chicago, 1982.

R3 Dinko Tuhtar, Fire and explosion protection– A System Approach, Ellis Horwood Ltd, Publisher, 1989

R4 William E. Clark, "Firefighting Principles & Practices", Fire Engineering Books and Videos, 2nd edition 1991.

R5 Dennis P. Nolan, "Handbook of Fire & Explosion Protection Engineering Principles for Oil, Gas, Chemical, & Related Facilities ", William Andrew Publishers, 1997

R6 Firefighters hazardous materials reference book, Fire Prevention in Factories, a Nostrand Rein Hold, New York, 1991.

Course Title and Code: Chemical Safety (ME2202)		
Hours per Week	**L-T-P: 3-0-0**	
Credits	**4**	
Students who can take	**M.Tech Semester-III Elective**	
Course Objective: The objective of this course is to improve the skills of students to recognize chemical hazards and their preventive and corrective safety work practices during the use, storage, handling, and production of any kinds of chemicals.		
After course completion, the student will be able to: ME2202.1 Assess the severity of the consequences of incidents. ME2202.2 Identify the hazard by different techniques in a chemical processing plant. ME2202.3 Assess the level of risk for different kind of hazards in a chemical processing plant. ME2202.4 Explain the legal framework controlling process plant safety in India. ME2202.5 Analyze the root cause of accidents in chemical industry. ME2202.6 Evaluate the onsite and offsite emergency plan for chemical spill or fire.		
	Prerequisites	
Evaluation Scheme		
Sr. No	**Specifications**	**Marks**
01	Attendance	Nil
02	Assignment	20
03	Class Participation	05
04	Quiz	20
05	Theory Exam-I	10
06	Theory Exam-II	Nil
07	Theory Exam-III	30
08	Report-I	15
09	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		
07	Theory Exam-III	30

COURSE CONTENTS

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 sart-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.

Chemical Process Industry Safety: Introduction; Basic Principles; Material Hazards; Process and Plant Hazards; Hazard Analysis; Preventive and Protective Measures.

Reference Book

R1: Crowl D.A. and Louvar J.F., Chemical Process Safety: Fundamentals With Applications.
R2: Lees F.P. Lee's Loss Prevention in Process industries: Hazard Identification, Assessment and control
R3: Kletz T, What Went Wrong? Case Histories of Process Plant Disasters: How They Could Have Been Avoided
R4: "Quantitative Risk Assessment in Chemical Process Industries" American Institute of

Chemical Industries, Centre for Chemical Process safety.
R5: Fawcett, H.h. and Wood, “Safety and Accident Prevention in Chemical Operations” Wiley inters, Second Edition.
R6: “Accident Prevention Manual for Industrial Operations” NSC, Chicago, 1982.
R7: GREEN, A.E., “High Risk Safety Technology”, John Wiley and Sons,. 1984.
R8: Petroleum Act and Rules, Government of India. 6. Carbide of Calcium Rules, Government of India.

Course Title and Course Code	**Mechatronics (ME1404)**
Hours per Week	**L T P: 2 0 0**
Credits	**2**
Students who can take	**PhD (2021-22, 2nd semester)**

Course Outcomes :

ME1404.1 implementing electronics control in a mechanical system.

ME1404.2 enhancing existing mechanical design with intelligent control

ME1404.3 replacing mechanical component with an electronic solution

ME1404.4 understand basic concept of sensors and transducers, actuators and mechanisms, signal conditioning, microprocessors and microcontrollers, modeling & system response and design and mechatronics.

Prerequisites		**Basics of Engineering Drawing**
Sr. No	**Specifications**	**Marks**
1	Attendance	0
2	Assignment	25
3	Class Participation	NIL
4	Quiz	10
5	Theory Exam-I	NIL
6	Theory Exam-II	15
7	Theory Exam-III	40
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	NIL
15	Lab Evaluation-II	NIL
16	Course Portfolio	NIL
17	Presentation	10
18	VIVA	NIL
Total (100)		**100**
Evaluation Scheme for Retest		**Marks**
1	Theory-Retest	30
Total		**30**

COURSE SYLLABUS (Theory):

Introduction to Mechatronics : Introduction, Examples of Mechatronic systems, Electric circuits and components, Semiconductor Electronics, Transistor Applications

Sensors and transducers : Performance terminology of sensors, Displacement, Position & Proximity Sensors-I, Displacement, Position & Proximity Sensors-II, Force, Fluid pressure, Liquid flow sensors, temperature, light sensor, Acceleration and Vibration measurement, Semiconductor sensor and MEM, SAW

Actuators and mechanisms : Mechanical Actuation System, Hydraulic & Pneumatic Actuation System, Electrical Actuation System-I, Electrical Actuation System-II, Data Presentation system

Signal conditioning: Introduction to signal processing & Op-Amp, Op-Amp as signal conditioner, Analogue to Digital Converter, Digital to Analogue Converter, Artificial intelligence

Microprocessors and microcontrollers: Digital circuits-I, Digital circuits-II, Microprocessor Micro Controller, Programming of Microcontrollers

Modeling and system response: Mechanical system model, Electrical system model, Fluid system model, Dynamic response of systems, Transfer function and frequency response.

Closed loop controllers: P,I, PID Controllers, Digital Controllers, Program Logic Controllers, Input/output & Communication systems, Fault findings

Design and mechatronics: Project using Microcontroller-Atmega 16, Myoelectrically Controlled, Robotic Arm, Robocon-Part I, Robocon-Part II, Design of a Legged Robot

Text & Reference Books:

1. Mechatronics: Bolton, W., Longman/div
2. Introduction to Mechatronics: D.G. Alciatore & Michael B. Histand; Tata Mc Graw Hill
3. Mechatronic system Design; Shetty Dedas, Kolk and Richard
4. Mechatronic handbook: Bishop; CRC press
5. Intelligent Mechatronic Systems: Modeling, Control and Diagnosis, R. Merzouki, A. K. Samantaray, P. M. Pathak, B. Ould Bouamama, Springer, London

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	Pre-PhD, M.Tech Semester-II (Batch: 2021-2023) **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: IL2104.1 List out important legislations related to health, Safety and Environment. IL2104.2 List out requirements mentioned in factories act for the prevention of accidents. IL2104.3 Implement the health and welfare provisions as given in the factories act. IL2104.4 Explain the statutory requirements for an Industry on registration, license and its renewal. IL2104.5 Design Safety and Occupational Health Plans for different projects according to the OHSA 18001standard and the current laws IL2104.6 Evaluate and deploy appropriate control systems for air pollutants.		
	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	15
3	Class Participation	05
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	Nil
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	10
16	Course Portfolio	Nil
17	Presentation	Nil
18	Viva	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-III	30
2	Lab Evaluation-II	10
	Total	**40**

SYLLABUS

Unit-I: 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, OHS 2020.

Unit-II: 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. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards, prevention and control of air pollution and water pollution, fund, accounts and audit, penalties and procedures.

Unit-III: Manufacture, Storage and Import of Hazardous Chemical Rules 1989: 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.

Unit-IV: Other acts and rules: Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules, electricity act and rules, hazardous wastes (management and handling) rules, 1989, with amendments in 2000, the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules, Explosives Act 1983, Pesticides Act.

Unit-V: 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.

Syllabus (Practical):

1. To determine the BOD in water and waste water/ related case study.
2. To determine the COD in water and waste water/ related case study.
3. To determine the TOC in water and waste water/ related case study.
4. To determine SoX, NoX, and Particulate matters in the air / related case study.
5. To determine chemical properties of solid waste/ related case study.

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.

Course Title and Code: Occupational Hygiene and Health (IL2201)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**4**
Students who can take	M.Tech Semester-II HSE (Batch: 2020-2022) **Elective-II**

Course Objective:

This course aims to develop an 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:

IL2201.1. Apply the basic principles of occupational hygiene, including measurement, control, and evaluation.

IL2201.2 Identify various types of hazards arising out of physical, chemical, and biological agents in processes and workplaces.

IL2201.3 Evaluate the effect of occupational diseases on the various physiological functions of the human body by periodical health monitoring and suggest methods for the prevention of such diseases.

IL2201.4 Determine the effects of various toxicants in the human body and their control in the workplace.

IL2201.5. Advice on the importance of personal protective equipment (PPE) and their limitations

	Prerequisites	
Sr. No	**Specifications**	**Marks**
1	Attendance	Nil
2	Assignment	15
3	Class Participation	10
4	Quiz	20
5	Theory Exam-I	10
6	Theory Exam-II	Nil
7	Theory Exam-III	30
8	Report-I	15
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
17	Presentation	Nil
18	Viva	Nil
	Total (100)	**100**
Evaluation Scheme for Retest		
1	Theory Exam-III	30
	Total (30)	**30**

Syllabus (Theory)

Unit-I: Physical, Chemical, and Biological Hazards:

Noise, noise exposure regulation, properties of sound, occupational damage, noise control program, industrial audiometry, hearing conservation programs; vibration, types, effects, instruments, permissible exposure limit; Ionizing radiation, control programs, OSHA standard; non-ionizing radiations; cold environments, control measures; hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control; Recognition of chemical hazards: dust, fumes, mist, vapour, fog, gases, types, concentration; Exposure vs. dose, TLV; Methods of Evaluation, process or operation description, Sampling methodology, Industrial Hygiene calculations; Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling; Methods of Control: Engineering Control, Design maintenance considerations, design specifications; General Control Methods; training and education; Classification of Bio hazardous agents: examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases; Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets; carpal tunnel syndrome CTS; Tendon pain-disorders of the neck- back injuries; Musculoskeletal Injuries; 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; cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests; Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems

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 Code and Title: Natural Language Processing Specialization

Credits: 04

Course Objective: Natural Language Processing (NLP) is a subfield of linguistics, computer science, and artificial intelligence that uses algorithms to interpret and manipulate human language. This technology is one of the most broadly applied areas of machine learning and is critical in effectively analyzing massive quantities of unstructured, text-heavy data. As AI continues to expand, so will the demand for professionals skilled at building models that analyze speech and language, uncover contextual patterns, and produce insights from text and audio. By the end of this Specialization, student will be ready to design NLP applications that perform question-answering and sentiment analysis, create tools to translate languages and summarize text, and even build chatbots. These and other NLP applications are going to be at the forefront of the coming transformation to an AI-powered future. This Specialization which includes 4 courses is designed and taught by two experts in NLP, machine learning, and deep learning. Younes Bensouda Mourri is an Instructor of AI at Stanford University who also helped build the Deep Learning Specialization. Łukasz Kaiser is a Staff Research Scientist at Google Brain and the co-author of Tensorflow, the Tensor2Tensor and Trax libraries, and the Transformer paper.

Course Outcomes
After course completion, the student will be able to

- Use logistic regression, naïve Bayes, and word vectors to implement sentiment analysis, complete analogies, translate words, and use locality-sensitive hashing to approximate nearest neighbors.
- Use dynamic programming, hidden Markov models, and word embeddings to autocorrect misspelled words, autocomplete partial sentences, and identify part-of-speech tags for words.
- Use dense and recurrent neural networks, LSTMs, GRUs, and Siamese networks in TensorFlow and Trax to perform advanced sentiment analysis, text generation, named entity recognition, and to identify duplicate questions.
- Use encoder-decoder, causal, and self-attention to perform advanced machine translation of complete sentences, text summarization, question-answering, and to build chatbots

Evaluation Scheme

Sr. No	Specifications	Weightage (in percentage)
01	Attendance	Nil
02	Assignment	40
03	Class Participation	Nil
04	Quiz	40
05	Theory Exam (Mid Term I)	Nil
06	Theory Exam (Mid Term II)	Nil

07	Theory Exam	Nil
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation 1	Nil
15	Lab Evaluation 2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

Sentiment Analysis, Vector Space Models, PCA, Translation Systems, Question Answering Systems, Summarizing Texts, Chatbots, Auto-correct Algorithms, Viterbi Algorithm, POS Tagging, N-Gram Language Model, Word-2-Vec Model, GLoVe Word Embeddings, Gated Recurrent Unit Model, Recurrent Neural Networks for Named Entity recognition, Siamese LSTM Models, Encoder-Decoder model, Transformer Model, T5 and BERT Models, Reformer model

Reference Books

Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press. Online available at http://www.deeplearningbook.org/

Course Code and Title: CS2407 IBM Full Stack Software Developer Professional Certificate

Credits: 04

Course Objective: IBM Full Stack Software Developer Professional Certificate

The course objective to learn application development of Master Cloud Native and Full Stack Development using hands-on projects involving HTML, JavaScript, Node.js, Python, Django, Containers, Microservices and more.

Course Outcomes:

After course completion, the student will be able to

- Use front-end development languages and tools such as HTML, CSS, JavaScript, React and Bootstrap
- Use Program applications using back-end languages and frameworks like Express, Node.js, Python, Django, etc.
- Deploy and scale applications using Cloud Native methodologies and tools like Containers, Kubernetes, Microservices and Serverless

Evaluation Scheme

Sr. No	Specifications	Weightage (in percentage)
01	Attendance	Nil
02	Assignment	40
03	Class Participation	Nil
04	Quiz	40
05	Theory Exam (Mid Term I)	Nil
06	Theory Exam (Mid Term II)	Nil
07	Theory Exam	Nil
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation 1	Nil
15	Lab Evaluation 2	Nil
16	Course portfolio	Nil
	Total (100)	**100**

Syllabus

Overview of Cloud Computing, Cloud Computing Models, Components of Cloud computing, Emerging trends and practices in cloud computing. Introduction to Programming for the Cloud, HTML5 and CSS Overview, HTML5 elements, JavaScript Programming for Web Applications. Introduction to Cloud Native, IBM Cloud CLI, DevOps on IBM Cloud. Introduction to Server-Side JavaScript, Asynchronous I/O with Callback Programming, Express Web Application Framework, Building a Rich Front-End Application using REACT & ES6.