INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

1. **Name of the Academic Unit: Industrial and Systems Engineering (ISE)**

2. **Subject Name: Safety and Risk Analytics, L-T-P: 3-1-0, Credits:4**

3. **Pre-requisites: NIL**

4. **Syllabus and reference books:**

Syllabus: Basics of safety and risk, safety and risk database, data quality assessment and preprocessing, descriptive safety and risk analytics, safety performance evaluation and monitoring, analysis of safety reports and narratives, risk quantification, predictive safety and risk analytics, prescriptive safety and risk analytics, behavioral safety analytics and injury epidemiology, and case studies.

Text and Reference Books:

(i) Probabilistic Risk Assessment and Management for Engineers and Scientists, by H Kumamoto and E J Henley, IEEE Press.

(ii) An Introduction to Statistical Learning by James, G., Witten, D., Hastie, T., and Tibshirani, R., Springer.

(iii) Introduction to data mining by Tan, P. N., Steinbach, M., & Kumar, V. (2016). Pearson Education India.

(iv) Text mining: predictive methods for analysing unstructured information, by Weiss S M, Indurkhya N, Zhang T and Damerau F J, Springer.

(v) Pattern Recognition and Machine Learning by Christopher M Bishop, Springer.

(vi) NPTEL, IIT Kharagpur, https://archive.nptel.ac.in/courses/110/105/110105160/

5. **Lecture-wise break-up:**

Sl. No.	Topic	No. of lectures (in hours)
1.	Basics of safety and risk: Introduction to safety and risk management, Hazard triangle, Safety ontology, Qualitative risk assessment, Quantitative risk assessment	**4**
2.	Creation of safety database: Hazard and risk data, Incident investigation data, Inspection and audit data, Behavioral & organizational safety data	**3**
3.	Safety data quality assessment and preprocessing: Data dimensions and information quality (Info-Q), Missing data handling, Data transformation (qualitative to quantitative), Data reduction (dimensionality reduction)	**7**
4.	Descriptive safety analytics: Probability distributions, Sample and statistics, Safety data visualization tools, Safety data exploration	**5**
5	Safety performance evaluation and monitoring: Safety performance indicators and their measurement, Control charts, Safety capability	**5**

	analysis, Case study	
6	Analysis of safety reports and narratives: Safety reports and use of text analytics, Preprocessing of text data, Topics modeling, Text classification, Case study	**6**
7	Risk quantification: Bow-tie construction, Bow-tie quantification with qualitative information, Bow-tie quantification with probabilistic information	**5**
8	Predictive safety and risk analytics: Introduction to predictive safety and risk analytics, Logistic regression with application, Classification and regression tree (CART) with application, Support vector machines (SVM) with application, Association rule mining (ARM) with application	**8**
9	Prescriptive safety analytics: Statistical measures of safety program effectiveness, Risk based decision-making (MCDM) with case study, Risk control systems	**5**
10	Behavioral safety analytics and injury epidemiology: Introduction to behavioral safety, Causal modeling, Injury epidemiology	**5**
Total number of hours		**51**