M.Tech.
in
INDUSTRIAL ENGINEERING AND MANAGEMENT

CURRICULUM AND SYLLABI

(Applicable from 2026 admission onwards)

DEPARTMENT OF MECHANICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY CALICUT
KOZHIKODE – 673601

Vision of the Institute

International standing of the highest calibre

Vision of the Department

To impart nationally and internationally recognized education in Mechanical Engineering, leading to well-qualified engineers who are innovative contributors to the profession and successful in advanced studies and research.

Mission of the Institute

To develop high quality technical education and personnel with a sound footing on basic engineering principles, technical and managerial skills, innovative research capabilities, and exemplary professional conduct to lead and to use technology for the progress of mankind, adapting themselves to the changing technological environment with the highest ethical values as the inner strength.

Mission of the Department

To offer high quality graduate and post graduate programs in the fields of Mechanical Engineering and to prepare students for professional career and higher studies promoting excellence in teaching, research, entrepreneurship, collaborative activities with ethical values, making positive contributions to the society.

The Program Educational Objectives (PEOs) of M.Tech. in Industrial Engineering and Management

PEO1	Graduates apply their in-depth and advanced knowledge for fostering skills of analysing, formulating, defining and solving complex industrial engineering and management problems for productive and successful careers.
PEO2	Graduates demonstrate innovative and independent research work in academia/industry/R&D to enhance the knowledge base in industrial engineering and management and to disseminate the knowledge
PEO3	Graduates exhibit a high level of professionalism, integrity, social responsibility and life-long independent learning ability.

Programme Outcomes (POs)) of M.Tech. in Industrial Engineering and Management

PO1	Independently carry out research/investigation and development work to solve practical problems
PO2	Write and present a substantial technical report/document
PO3	Demonstrate mastery in industrial engineering and management at a level higher than the requirements in the appropriate bachelor program.
PO4	Acquire and share in-depth knowledge in the area of industrial engineering and management.
PO5	Analyse complex problems in the field of industrial engineering and management critically and arrive at optimal solutions.
PO6	Use modern computer/software tools to model and analyse problems related to industrial engineering and management.

M.Tech. in Industrial Engineering and Management

CURRICULUM

Total credits required for completing M.Tech. in Industrial Engineering and Management is 75.

COURSE CATEGORIES AND CREDIT REQUIREMENTS

The structure of M.Tech programme shall have the following Course Categories:

Sl. No.	Course Category	Minimum Credits
1.	Program Core (PC): Theory and Laboratory	26
2.	Program Elective (PE): General (GE) and Stream Specific (SE)	12
3.	Institute Elective (IE)	2
4.	Projects (PC)	35
	Total	**75**

Note: PC – Programme Core, PE – Programme Elective, GE – General Elective (Any elective course other than the chosen stream specific elective basket), SE – Stream Specific Elective, IE – Institute Elective

The students have to select one out of the four stream specific elective baskets (Digital Automation, Systems Engineering, Sustainability Management and Engineering Management). Two stream specific electives are to be credited from the selected stream specific elective basket. Two general electives can be any elective courses listed, other than the chosen stream specific electives or any PG level course offered in the Institute, with the approval of the programme coordinator.

The effort to be put in by the student is indicated in the tables below as follows:

- **L**: Lecture (One unit is of 50-minute duration)
- **T**: Tutorial (One unit is of 50-minute duration)
- **P**: Practical (One unit is of one-hour duration)
- **O**: Outside the class effort/self-study (One unit is of one-hour duration)

M.Tech. in Industrial Engineering and Management

CURRICULUM

Semester I

Sl. No.	Course Code	Course Title	L	T	P	O	C	Category
1	ME6102E	Statistics for Management	3	1	0	5	3	PC
2	ME6104E	Decision Modelling	3	0	2	8	4	PC
3	ME6105E	Operations Planning and Control	3	0	0	6	3	PC
4		Elective 1 - General Elective	3	0	0	6	3	PE
5		Elective 2 - Stream Specific	3	0	0	6	3	PE
6		Elective 3 - Institute Elective	2	0	0	4	2	IE
7	ME6107E	Industry Connect Seminar	1	0	0	2	1	PC
8	ME6194E	Applied Programming Laboratory	0	0	3	3	2	PC
		Total					**21**	

Semester II

Sl. No.	Course Code	Course Title	L	T	P	O	C	Category
1	ME6111E	Machine Learning and Artificial Intelligence	3	0	1	5	3	PC
2	ME6114E	Ergonomics and Work System Design	3	1	0	5	3	PC
3	ME6115E	Inventory and Supply Chain Management	3	1	0	5	3	PC
4		Elective 4 – General Elective	3	0	0	6	3	PE
5		Elective 5 – Stream Specific	3	0	0	6	3	PE
6	ME6193E	Project Phase I	0	0	0	6	2	PC
7	ME6195E	Supply Chain Management Laboratory	0	0	3	3	2	PC
8	ME6196E	Industrial Engineering Laboratory	0	0	3	3	2	PC
		Total					**21**	

Semester III

Sl. No.	Course Code	Course Title	L	T	P	O	C	Category
1	ME7194E	Project Phase II	0	0	0	9*	**3**	PC
2	ME7195E	Project Phase III	0	0	0	45	**15**	PC
		Total	**0**	**0**	**0**	**54**	**18**	

* To be completed during semester break. The number of hours is indicative only, and corresponds to a regular semester. Since the duration of the semester break is shorter, students are expected to devote more time per week. Furthermore, if Project Phase II is done as an internship, the working hours will be governed by the organization in which the internship is done.

Semester IV

Sl. No.	Course Code	Course Title	L	T	P	O	C	Category
1	ME7196E	Project Phase IV	0	0	0	45	15	PC
		Total	**0**	**0**	**0**	**45**	**15**	

ELECTIVES

List of Institute Electives

Sl. No.	Course Code	Course Title	L	T	P	O	C
1	IE6001E	Entrepreneurship Development	2	0	0	4	2
2	ZZ6002E	Research Methodology	2	0	0	4	2
3	MS6174E	Technical Communication and Writing	2	1	0	3	2

List of General Management Electives

Sl. No.	Course Code	Course Title	L	T	P	O	C
1	ME6121E	Marketing Management	3	0	0	6	3
2	ME6122E	Consumer Behaviour	3	0	0	6	3
3	ME6123E	Product Management	3	0	0	6	3
4	ME6124E	Human Resource Management	3	0	0	6	3
5	ME6125E	Organisational Behaviour	3	0	0	6	3
6	ME6134E	Product Life Cycle Management	3	0	0	6	3
7	ME6137E	Ethics and Human Values	3	0	0	6	3
8	ME6147E	Disaster Management	3	0	0	6	3
9	ME6748E	e-commerce Supply Chain Management	3	0	0	6	3
10	ME6749E	Humanitarian Supply Chain	3	0	0	6	3

Stream Specific Elective Basket - Digital Automation

Sl. No.	Course Code	Course Title	L	T	P	O	C
1	ME6126E	Forecasting Techniques and Predictive Analytics	3	0	0	6	3
2	ME6135E	Soft Computing Techniques	3	0	0	6	3
3	ME6140E	Enterprise Resource Planning	3	0	0	6	3
4	ME6141E	Decision Support and Expert System	3	0	0	6	3
5	ME6850E	Applied GIS and Spatial Data Analytics	3	0	0	6	3
6	ME6851E	Augmented Reality and Virtual Reality in Logistics	3	0	0	6	3
7	ME6852E	Business Analytics	3	0	0	6	3
8	ME6853E	Digital Innovations and Technology in Supply Chain Management	3	0	0	6	3
9	ME6854E	Fundamentals of Data Science	3	0	0	6	3
10	ME6855E	Industry 4.0 and Industrial Internet of Things	3	0	0	6	3

Stream Specific Elective Basket - Systems Engineering

Sl. No.	Course Code	Course Title	L	T	P	O	C
1	ME6127E	Facilities Layout Planning	3	0	0	6	3
2	ME6128E	Cellular Manufacturing Systems	3	0	0	6	3
3	ME6129E	Industrial Scheduling	3	0	0	6	3
4	ME6130E	Lean Production Management	3	0	0	6	3
5	ME6132E	System Modelling and Simulation	3	0	0	6	3
6	ME6756E	Cold Supply Chain	3	0	0	6	3
7	ME6757E	Shipping and Port Logistics	3	0	0	6	3
8	ME6758E	Retail Supply Chain Management	3	0	0	6	3
9	ME6759E	Air Cargo Logistics Management	3	0	0	6	3
10	ME6760E	Supply Chain Network Design	3	0	0	6	3

Stream Specific Elective Basket - Sustainability Management

Sl. No.	Course Code	Course Title	L	T	P	O	C
1	ME6131E	Sustainability Management	3	0	0	6	3
2	ME6161E	Design for Circular Economy	3	0	0	6	3
3	ME6162E	Industrial Waste Management	3	0	0	6	3
4	ME6764E	Agri-Food Supply Chain Management	3	0	0	6	3
5	ME6165E	ESG and Green Finance	3	0	0	6	3
6	ME6766E	Sustainable Supply Chain Management	3	0	0	6	3
7	ME6767E	Green Logistics	3	0	0	6	3
8	ME6168E	Design Thinking for Sustainability	3	0	0	6	3
9	ME6169E	Sustainable Mobility	3	0	0	6	3
10	ME6170E	Sustainable Organisational Development	3	0	0	6	3

Stream Specific Elective Basket - Engineering Management

Sl. No.	Course Code	Course Title	L	T	P	O	C
1	ME6146E	Investment Management	3	0	0	6	3
2	ME6163E	Negotiations and Stakeholder Management	3	0	0	6	3
3	ME6171E	Inventory Management	3	0	0	6	3
4	ME6172E	Quality Management	3	0	0	6	3
5	ME6173E	Project Management	3	0	0	6	3
6	ME6174E	Lean Service Management	3	0	0	6	3
7	ME6775E	Supply Chain Contracts	3	0	0	6	3
8	ME6144E	Management of Technology and Innovation	3	0	0	6	3
9	ME6176E	Reliability Engineering and Risk Analysis	3	0	0	6	3
10	ME6177E	Accounting and Finance for Management	3	0	0	6	3

ME6102E STATISTICS FOR MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	1	0	5	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Execute the principles of data collection, organising and description

CO2: Illustrate business problems with appropriate probability distributions and statistical terms to make better decisions

CO3: Differentiate between various statistical tests and apply an appropriate test in the context of the problem

CO4: Develop critical and integrative thinking in order to communicate the results of the analysis clearly in the context of the problem

Descriptive Statistics: Measures and application of central tendency and variation, Numerical description of data, Scales of measurement, Exploratory data analysis. Covariance, coefficient of variation. Probability distributions: Introduction to probability and random variables – Discrete Distributions, Continuous Distributions; Sampling– sampling techniques, central limit theorem; Sampling distributions - Mean and Proportion. Introducing statistical packages – working with statistical packages and data visualisation.

Statistical Inference: Confidence interval estimation for the mean and proportion, Hypothesis Testing for Single populations – about a population mean, variance and proportion. Two Populations – about difference in two means of independent and dependent samples, about two population proportions, about two variances. Chi-Square goodness of fit test, Chi-Square test of independence.

Analysis of Variance and Design of Experiments: Introduction to Design of Experiments, Fundamental assumptions of analysis of variance, Classification of ANOVA – One-way and Two-way classification, Multiple comparison test – Tukey's Honestly Significant Difference Test and Tukey-Kramer Procedure.

Simple Linear Regression – Multiple Linear Regression – Non-Parametric Statistics: Mann-Whitney U Test, Wilcoxson, Matched-pairs signed rank test, Kruskal Wallis test, Friedman test, Spearman's Rank Correlation

References:

[1] Levin, R. I., Rubin, D. S., Siddiqui, M. H., and S. Rastogi, 2017, Statistics for Management, Pearson India Education, New Delhi.

[2] Levine, D. M., Stephan, D. F., and Szabat, K. A., 2017, Statistics for Managers Using Microsoft Excel. Pearson India Education, New Delhi.

[3] Black, K., 2012, Business Statistics, John Wiley & Sons, New York.

[4] Montgomery, D.C., and Runger, G.C., 2016, Applied Statistics and Probability for Engineers, John Wiley & Sons, New York.

ME6104E DECISION MODELLING

Pre-requisites: NIL

L	T	P	O	C
3	0	2	8	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Formulate decision problems as mathematical optimization problems
CO2: Explain the solution of linear programming problems and illustrate sensitivity analysis
CO3: Solve network flow optimisation algorithms
CO4: Explain the principles and algorithms of optimisation of non-linear programming problems
CO5: Solve optimisation problems using software

Linear programming: Introduction to Linear Algebra, Formulation of optimization problems; Solution of linear programming problems: Simplex Method, Duality theory, Primal-dual relationships, Economic interpretation of dual variables and constraints, Dual simplex method, Sensitivity analysis. Karmarker's linear programming algorithm.

Integer programming: Modelling optimization problems using binary variables; Solution of integer programming problems: Branch-and-bound method, Column generation method.

Network models and solutions: Shortest route problems, Minimal spanning tree problems, Maximal flow problems, Travelling salesman problems.

Complexity of algorithms: Complexity classes, Complexity of algorithms for combinatorial optimization problems.

Non-linear programming problems: convex and concave functions, Theory of unconstrained optimization: Necessary and sufficient conditions for extrema; Theory of constrained optimization: Lagrangean method, Kuhn-Tucker conditions.

Algorithms for unconstrained optimization: Fibonacci search method, Golden section search method, Hooke and Jeeve's method, Newton-Raphson method, Cauchy's (Steepest descent) method. Algorithms for constrained optimization: Penalty function methods, Quadratic programming, Separable convex programming.

Solving optimization problems using optimization software: Mathematical modelling and solving optimization problems using solvers.

References:

[1] Rao, S. S., 2019, Engineering Optimization: Theory and Practice, John Wiley & Sons, New York.
[2] Ravindran, A., Philips, D. T., and Solberg, J. J., 1987, Operations Research: Principles and Practice, John Wiley & Sons, New York.
[3] Sarker, R. A., and Newton, C. S., 2008, Optimization Modelling: A Practical Approach, CRC Press, London.
[4] Srinivasan, G., 2017, Operations Research: Principles and Applications, PHI Learning Private Limited, New Delhi.
[5] Taha, H. A., 2019, Operations Research: An Introduction, Pearson Education, London.
[6] Winston, W. L., 2003, Operations Research: Applications and Algorithms, Cengage Learning, US.
[7] Hillier, F. S., Lieberman, G. J., Nag, B., and Basu, P., 2021, Introduction to Operations Research, McGraw Hill, New York.
[8] Arora, J. S., 2012, Introduction to Optimum Design, Elsevier Inc., USA.
[9] Hu, T. C., and Kahng, A. B., 2018, Linear and Integer Programming Made Easy, Springer, Switzerland.
[10] Ivanov, D., 2021, Supply chain simulation and optimization with anyLogistix, 5th, updated edition, Berlin School of Economics and Law
[11] Sringeswara, S., Tiwari. P., and Kumar, U.D., 2022, Data visualization - story telling using data, Wiley India Pvt. Ltd.

ME6105E OPERATIONS PLANNING AND CONTROL

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course outcomes:

CO1: Explain the operations planning and control and functional units of enterprise resource planning
CO2: Analyse forecasting models and evaluate the models
CO3: Evaluate aggregate planning and master production scheduling techniques
CO4: Apply material requirements planning and capacity requirements planning techniques
CO5: Explain operations scheduling techniques

Introduction to operations management: Operations management functions – Operations strategy formulation. Manufacturing Planning and Control (MPC): MPC systems, MPC system payoff, MPC system framework, Types of configurations of manufacturing system, Matching the MPC system with the needs of the firm.

Enterprise Information Systems: Enterprise Resource Planning (ERP), Functional units of ERP, ERP II, ERP III, Performance measures to evaluate integrated system effectiveness.

Demand Management: Demand management and MPC environment, Communicating with other MPC modules and customers, Forecasting framework; Time series analysis: Weighted moving average, Exponentially weighted moving average, Seasonal and trend adjusted exponentially weighted moving average, Economic indicators, Forecast errors, Interval estimate.

Sales and Operation Planning: Nature of sales and operation planning, Planning process, Development and evaluation of plans, Mathematical programming approaches.

Master Production Schedule (MPS): Nature of MPS, MPS techniques, Time fencing and MPS stability, Rolling through time, Order promising and available to promise, Structuring BOM, Final assembly schedule, Managing using two level MPS.

Material Requirement Planning (MRP): Nature of MRP, MRP records, MRP logic, Linking of MRP records, Determination of planning horizon; Technical Issues: safety stock and safety lead time, Low level coding, Pegging, Firm planned orders, Service parts, Rolling horizon; Using the MRP system, System Dynamics, Lot sizing methods, Buffering concepts, System nervousness. Operations scheduling - Production Activity Control: Shop floor control concepts and Techniques, Performance measures, Finite loading systems, Horizontal loading, vertical loading, Scheduling of flow shops, Scheduling of job shops, scheduling of service systems.

References:

[1] Jacobs, F. R., Berry, W. L., Whybark, D. C., and Vollmann, T. E., 2014, Manufacturing Planning and Control for Supply Chain Management, McGraw Hill Education (India) Private Limited, Chennai.
[2] Silver, E. A., Pyke, D. F., and Thomas, D. J., 2017, Inventory and Production Management in Supply Chains, CRC Press, London.
[3] Narasimhan, S. L., McLeavy, D. W., and Billington, P. J., 2000, Production Planning and Inventory Control, Prentice-Hall of India Pvt. Ltd., New Delhi.
[4] Tersine, R. J., 1985, Production/Operations Management, North Holland.
[5] Mahadevan, B., 2015, Operations Management: Theory and Practice, 3rd ed., Pearson, New Delhi.
[6] Chapman, S. N., Arnold, J. R. T., Gatewood, A. K., and Clive, L. M., 2017, Introduction to Materials Management, Pearson Education, Inc.
[7] Heizer, J., Render, B., Munson, C., and Sachan, A., 2017, Operations Management: Sustainability and Supply Chain Management, Pearson India Education Services Pvt. Ltd.
[8] Srinivasan, G., 2018, Quantitative Models in Operations and Supply Chain Management, PHI Learning.

ME6107E INDUSTRY CONNECT SEMINAR

Pre-requisites: NIL

L	T	P	O	C
1	0	0	2	1

Total Lecture Sessions: 13

Course Outcomes:

CO1: Explain contemporary industrial practices, workflows, and standards in industrial engineering and management

CO2: Identify emerging technologies, niche domains, and current challenges in industrial engineering and management from an industrial perspective.

CO3: Correlate theoretical knowledge and ongoing research with real-world industrial problems and solution strategies.

CO4: Demonstrate professional awareness and critical thinking by evaluating industry case studies, expert lectures, and interaction-based learning.

Industry experts will be invited to deliver lectures on niche domains and contemporary, industry-relevant topics in industrial engineering and management. These interactions will expose students to the current industrial practices, emerging technologies, real-world challenges, and application-driven perspectives, thereby strengthening the linkage between academic learning, research, and industrial requirements. Continuous assessment will be used for grade evaluation.

ME6194E APPLIED PROGRAMMING LABORATORY

Pre-requisites: NIL

L	T	P	O	C
0	0	3	3	2

Total Lecture Sessions: 39

Course Outcomes:

CO1: Apply the Python language syntax including control statements, loops and functions to solve a wide variety of problems in mathematics and science.

CO2: Use the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.

CO3: Create files and perform read and write operations.

CO4: Illustrate the application of python libraries.

CO5: Handle exceptions and create classes and objects for any real time applications.

List of Experiments:

1. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
2. Scientific problems using Conditionals and Iterative loops.
3. Linear search and Binary search
4. Selection sort, Insertion sort
5. Merge sort, Quick Sort
6. Implementing applications using Lists, Tuples.
7. Implementing applications using Sets, Dictionaries.
8. Implementing programs using Functions.
9. Implementing programs using Strings.
10. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
11. Implementing real-time/technical applications using File handling.
12. Implementing real-time/technical applications using Exception handling.
13. Creating and Instantiating classes

References:

[1] Deitel, P., and Deitel, H., 2020, Python for Programmers, Pearson USA.

[2] Campesato, O., 2022, Python for Programmers, Mercury Learning and Information, USA

[3] Hunt, J., 2019, A Beginners Guide to Python 3 Programming, Springer Nature Switzerland

[4] Linge, S., and Langtangen, H.P., 2020, Programming for Computations – Python, 2nd ed., Springer Nature Switzerland

[5] Wengrow, J., 2017, A Common-Sense Guide to Data Structures and Algorithms, Pragmatic Bookshelf, Texas, USA

ME6111E MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

Pre-requisites: Basic understanding of statistics

L	T	P	O	C
3	0	1	5	3

Total Lecture Sessions: 39

Course outcomes:

CO1: Demonstrate and compare supervised machine learning algorithms for solving real-life problems using Python Language

CO2: Apply unsupervised machine learning algorithms to solve real-life problems and evaluate their performances

CO3: Apply the concept of reinforcement learning, neural network and deep learning algorithms for developing and solving engineering and management problems

Supervised machine learning: Introduction to Algorithms in Machine Learning – Supervised machine learning; Regression: linear regression, Multiple linear regression, Non-Linear Regression, Bayesian Linear Regression; Classification: Random Forest, Decision Trees, Logistic Regression, Support Vector Machines, Naïve Bayes algorithm, K-nearest neighbors algorithm, Ensemble Learning: AdaBoost, Gradient Boosting, XG Boost

Unsupervised machine learning: Unsupervised machine learning: clustering, association, and dimensionality reduction. Clustering – K-Means algorithm, DBSCAN, Agglomerative Hierarchy clustering algorithm, Gaussian Mixture Model algorithm – association: Apriori algorithm, Eclat algorithm – dimensionality reduction: Principal Component Analysis, Manifold Learning, Autoencoders – algorithms for Anomaly Detection

Artificial Intelligence: Artificial Neural Network, logical computations with Neurons, the multilayer perceptron and back propagation – Deep learning, training deep neural networks, Regularization, Convolutional neural networks – Reinforcement learning - Markov decision processes, Q-learning- Approximate Q Learning and Deep Q-learning, Long Short-Term Memory (LSTM) – Natural language processing.

References:

[1] Hastie, T., Tibshirani, R., and Friedman, J., 2008. The Elements of Statistical Learning: Data Mining, Inference and Prediction (ESL), Springer, USA.

[2] Géron, A., 2019, Hands-On Machine Learning with Scikit-Learn, Oreilly, USA.

[3] Kumar, U. D., 2021, Business Analytics, Wiley, India.

[4] Pradhan, M., and Kumar, U. D., 2019, Machine Learning using Python, Wiley, India.

[5] Muller, A., 2016, Introduction to Machine Learning with Python: A Guide for Data Scientists (Greyscale Indian Edition), Oreilly, USA.

ME6114E ERGONOMICS AND WORK SYSTEM DESIGN

Pre-requisites: NIL

L	T	P	O	C
3	1	0	5	3

Total Lecture Sessions: 39

Course outcomes:

CO1: Appraise the principles and applications of ergonomics/human factors in system design.
CO2: Perform the biomechanical analysis in a system design
CO3: Explain the concept of productivity and conduct work study techniques to improve productivity
CO4: Apply the various methods of method study and work measurement in a work space

Introduction to Human factors and Ergonomics – ergonomics, work and health, Ergonomics and productivity – productivity measurement models. Design of cognitive work - information theory – human information processing model. Engineering anthropometry, Biomechanical bases of ergonomics – static biomechanical analysis and models, Physiological responses - physical work capacity – Assessment of aerobic capacity.

Work-space design – Principles of work design – workplace, machines, tools and equipment, design for standing and seated workers. Posture and movement - postural analysis in workspace design - Evaluation of required body posture for a practical case. Lifting and handling – mechanics of lifting, NIOSH lifting guidelines.

Work design decisions – behavioural considerations, sociotechnical systems approach, physical considerations. Principles of good work design. Work Study - concept of work content.

Methods study - procedure for methods study, process analysis – exploratory tools, operation analysis. Manual Work design - principles of motion economy. Work measurement - estimation of time standards, allowances, performance rating methods, execution of time study for a practical case and determination of standard time. Pre-determined time systems – Methods Time Measurement, Maynard Operation Sequence Technique, Work sampling – planning, recording and execution for a practical case.

Work environment design – working conditions - illumination, noise, temperature, vibration, radiation. Stress, fatigue and work environment – work stress and mental workload, shift work – Work rest scheduling. Workplace and systems safety, Occupational Safety and Health Administration, Job Hazard Analysis – analysis for a practical case, General Housekeeping, 5S.

References:

[1] Sanders, M. S., and McCormick, E. J., 1993, Human Factors in Engineering and design, McGraw-Hill International.
[2] Freidvalds, A., 2013, Niebel's Methods, Standards, and Work Design, Mc-Graw Hill Education.
[3] Tayyari, F., and Smith J. L., 1997, Occupational Ergonomics: Principles and applications, Kluwer Academic Publishers.
[4] I.L.O., 2003, Introduction to Work Study: Indian Adaptation, Oxford & IBH Publishing.
[5] Barnes, R. M., 2009, Motion and Time Study: Design and Measurement of Work, John Wiley & Sons.
[6] Mital, A., Desai, A., and Mital, A., 2017, Fundamental of Work Measurements: What every engineer should know, CRC Press, London.
[7] Groover, M. P., 2014, Work Systems: The Methods, Measurement and Management of Work, Pearson Education Limited.

ME6115E INVENTORY AND SUPPLY CHAIN MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	1	0	5	3

Total Lecture Sessions: 39

Course outcomes:

CO1: Understand and assess strategic and operational frameworks used to analyse supply chains.
CO2: Demonstrate an understanding of different design concepts for supply chain networks.
CO3: Explain and illustrate the use of inventory control models in deterministic scenarios.
CO4: Analyse and evaluate appropriate inventory control systems capable of managing multiple items under various constraints.
CO5: Analyse and evaluate different methods for developing inventory control systems under probabilistic scenarios.

Building a strategic framework to analyse supply chains: Understanding the supply chains – Supply chain flows, Decision phases, Process view, Competitiveness and supply chain strategies – Strategic fit, Financial measures of performance, Drivers of supply chain performance.

Designing the supply chain network: Role of distribution, Factors influencing distribution network design, Design options, Online sales and distribution network, Designing the network, Models for facility location and capacity allocation

Independent demand inventory systems (Deterministic models): Inventory problem classification, Selective control techniques, Independent Demand Systems: Fixed order size system – Deterministic models – Economic order quantity, Economic production quantity, Quantity discounts (all units, and incremental), Sensitivity, Economic Production Quantity for multiple items, Periodic order interval systems.

Inventory system with constraints: Inventory control systems under multiple items, Inventory problems with constraints, Exchange curve (Optimal policy curve).

Independent demand inventory systems (Probabilistic models): Single order quantities – Payoff matrix – Order quantity modelling considering benefit and cost analyses; Dynamic order quantity systems (probabilistic models) - Fixed order size system – Periodic order interval systems, Safety stock modelling under known stock out costs and service levels.

References:

[1] Chopra, S., Meindl, P., and Kalra, D. V., 2018, Supply Chain Management: Strategy, Planning and Operations, Pearson Education Ltd, New Delhi.
[2] Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., and Shankar, R., 2022, Designing and Managing the Supply Chain: Concepts, Strategies and Case studies, McGraw-Hill Education, USA.
[3] Coyle, J. J., Langley, Jr. C. J., Novack, R.A., and Gibson, B.J., 2019, Supply Chain Management: A Logistics Perspective, CENGAGE Learning, USA.
[4] Tersine, R. J., 1994, Principles of Inventory and Materials Management, Prentice-Hall Inc., New Jersey.
[5] Starr, M. K., and Miller, D. W., 1986, Inventory Control: Theory and Practice, Prentice-Hall India, New Delhi.
[6] Department of Mechanical Engineering, NITC, 2017, Supply Chain Role Play Game: Instructor's Manual.
[7] Muller, M., 2019, Essentials of Inventory Management, Harper Collins Leadership, New York.

ME6193E PROJECT PHASE I

Pre-requisites: NIL

L	T	P	O	C
0	0	0	6	2

Course Outcomes:

CO1: Understand the process of reviewing and recording the literature
CO2: Understand the process of identification of the project problem
CO3: Apply the learning to define the problem and problem environment/boundary conditions
CO4: Develop a focused research learning, presentation and communication

Project Phase I is normally an initiation into the project.

Each student shall identify a topic of interest related to the core/elective courses undergone in the first semester of the M. Tech. programme. He/she shall get the topic approved by the project guide in the concerned area of specialization. The student is expected to conduct a literature survey and a systematic literature review using suitable frameworks like PICOT, SPICE, SPIDER, etc. A mid semester evaluation shall be done by the guide. At the end of the semester the student shall present the project problem and the related literature in the presence of the duly constituted evaluation committee. Grade will be awarded on the basis of the student's work and presentation.

ME6195E SUPPLY CHAIN MANAGEMENT LABORATORY

Pre-requisites: NIL

L	T	P	O	C
0	0	3	3	2

Total Practical Sessions: 39

Course Outcomes:

CO1: Create awareness on the supply chain management concept through fun roleplay game.
CO2: Identify the performance of supply chains under certain supply chain parameters.
CO3: Identify the coordination problems between supply chain members and the bullwhip effect in a supply chain.
CO4: Comprehend the need for managing the supply chain as a whole.
CO5: Appreciate the use of emerging technologies in the management of supply chains

List of Experiments

Supply chain roleplay game software package – demo of key features and performance measures

Roleplay -1: Traditional supply chain setting – lost sales

Roleplay-2: Supply chain operation simulation under lost sales shortage management

Roleplay -3: Traditional supply chain setting – backorder

Roleplay - 4: Supply chain operation simulation under backorder shortage management

Roleplay - 5: Advance demand information sharing - Supply chain operation simulation under lost sales shortage management

Roleplay - 6: Vendor Managed Inventory (VMI)-based supply chain operation simulation

Four-stage Serial Supply Chain operation simulation using P-system of inventory control: spreadsheet based simulation

Simulation of supply chains using simulation packages

References:

[1] Pillai, V.M., 2017, Supply chain role play game exercise handout, Department of Mechanical Engineering.
[2] Kurian, D.S., Pillai, V.M., and Gautham, J., Data-driven imitation learning-based approach for order size determination in supply chains. European J. of Industrial Engineering, Vol. 17, No. 3, pp. 379 – 407.
[3] Sunny, J., Pillai, V.M., Nath, H.V., Shah, K., Ghoradkar, P.P., Philip, M.J., and Shirswar, M., 2022, Blockchain-enabled beer game: a software tool for familiarizing the application of blockchain in supply chain management, Industrial Management and Data Systems, Vol. 122, No. 4, pp. 1025-1055.
[4] Sunny, J., Undralla, N., and Pillai, V.M., 2020, Supply Chain Transparency through Blockchain-Based Traceability: An Overview with Demonstration. Computers and Industrial Engineering, Vol. 150, 106895
[5] Dmitry, I., 2021, Supply chain simulation and optimization with anyLogistix.
[6] Tersine, R. J., 1985, Production/Operations Management, North Holland.
[7] Mahadevan, B., 2015, Operations Management: Theory and Practice, 3rd ed., Pearson, New Delhi.

ME6196E INDUSTRIAL ENGINEERING LABORATORY

Pre-requisites: NIL

L	T	P	O	C
0	0	3	3	2

Total Practical Sessions: 39

Course outcomes:

CO1: Develop awareness about the application of scientific methods in the practical problems related to industrial engineering

CO2: Utilize methods/techniques for solving problems related to method study, work measurement, work systems design, production planning and quality control in a practical scenario and gain hand-on experience.

CO3: Apply the principles of human factors and ergonomics engineering to aid people by improving products, systems and system interface

List of Experiments

1. Pin board assembly
2. Stop watch time study of a drill press operation
3. Experiments on development of Learning curve
4. Experiments on eye-hand coordination
5. Visual acuity test to identify and distinguish elements
6. Preparation of assembly chart and product structure
7. Fitting of Probability Distributions
8. Construction of X-bar and R chart
9. Experiments on the assessment of Light and Noise Exposure on performance
10. Measurement of maximal heart rate and maximum oxygen intake level
11. Measurement of Anthropometric Data
12. Posture Analysis using OWAS, RULA and REBA
13. Demonstration of IDEEA Minisun Gait Analysis System
14. Layout planning (Process layout design) using nitc-med_layoutplan opt software package
15. Solving OR models using optimisation packages

References:

[1] Freivalds, A., and Niebel, B. W., 2013, Niebel's Methods, Standards and Work Design, McGraw Hill, USA.

[2] Barnes, R. M.,2013, Motion and Time Study Design and Measurement of Work, John Wiley & Sons, NY.

[3] Sanders, M.S., and McCormick, E. J., 2013, Human Factors in Engineering and Design, McGraw-Hill, India

[4] I. L. O., 2011, Introduction to Work Study: Indian Adaptation, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

[5] Karwowski, W., and Marras W. S., 2019, Occupational Ergonomics: Principles of Work Design (Principles and Applications in Engineering), CRC Press, London.

[6] Grant, E., and Leavenworth, R. S., 2017, Statistical quality Control, McGraw-Hill Education, India.

ME7194E PROJECT PHASE II

L	T	P	O	C
0	0	0	9	3

Course Outcomes for ME7194E, ME7195E and ME7196E Project Phase II, III and IV

CO1: Develop a systematic procedure to solve the identified research/industrial problem (This primarily pertains to the objective of Phase 2)
CO2: Analyse and identify a suitable research methodology for solving the problem identified.
CO3: Apply the methods/tools learned to develop algorithms and solve the problem.
CO4: Analyze and interpret the results using tables and figures for visualization
CO5: Compile and construct a report by employing the techniques of academic writing critical analysis, and defend the thesis
CO6: Publish the findings in reputed journals, conferences or apply for patents

Project Phase II can be an extension of Phase I or internship outside during the summer semester break.

Students shall continue to work on the problem identified in the project phase I or undergo internship outside. Students shall identify the methodology, apply for preliminary work. The work should be suitable for communicating to a conference. The student shall submit a report. All the projects will be evaluated by a duly constituted committee.

ME7195E PROJECT PHASE III

L	T	P	O	C
0	0	0	45	15

The project work can be carried out at the institute or in an industry/research organization. Students desirous of carrying out project work in an industry or in other organizations have to fulfil the requirements as specified in the “Ordinances and Regulations for M. Tech.” The student is expected to complete the pilot study, redefine the project based on pilot study, decide on the appropriate research design, generate data/collect data, develop the algorithm and code, and obtain preliminary results in the third semester. There shall be evaluations of the project work during and at the end of the third semester by a committee constituted by the department.

ME7196E PROJECT PHASE IV

L	T	P	O	C
0	0	0	45	15

The project work will be extended to the end of the fourth semester. There shall be evaluations of the project work by a committee constituted by the department during the fourth semester. The student shall submit the thesis based on the recommendation of the departmental evaluation committee. There shall be viva-voce examination conducted by an evaluation committee with an external examiner.

The project work/thesis will be considered for awarding Grade 'S' only if a paper, based on the project work is published/accepted for presentation at least in a Scopus indexed conference or a software copyright is granted. However, in exceptional cases, where the student and the guide want to submit a journal/conference publication at a later stage and if the student is able to submit the draft version of the journal/conference paper to the evaluation committee at the time of final presentation of the project work, the student may be considered for awarding 'S' grade if the committee finds the work to be excellent and guide ensures the submission of the work for journal/conference publication"

ME6121E MARKETING MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Outline the fundamental concepts of marketing, marketing environment, marketing planning.

CO2: Comprehend segmentation and target a market with proper positioning of products and new product development

CO3: Conduct market research and consumer research and also to price the products.

CO4: Understand the concepts of consumer behaviour, advertising and sales promotion.

Introduction to Marketing: Marketing defined, Marketing Concepts, Marketing functions, Marketing Environment. Marketing Planning: Planning Process, Strategic Business Units, Evaluation of SBUs. Market Segmentation and Market Targeting: Segmentation Procedure, Market Targeting, Product Positioning. Marketing Mix: Marketing mix variables and their importance. Product Development: Idea generation, Concept development and Testing, Market Testing, Commercialization.

Marketing Research: Marketing Research Process, Research objectives, Research Plan development, Collecting information, Analysis.

Pricing Strategies: Meaning of pricing, Importance, Objectives, Factors influencing price determination, Demand market based pricing, Tender pricing, Product line pricing, Selecting the final price.

Consumer Behaviour: Factors influencing Consumer Behaviour, Decision making process in buying, Perceived risks. Marketing Communication: Marketing mix variables communicate, Steps in developing effective communication. Advertising Management: Purpose, Factors in advertising, Advertising Portfolio Selection, Deciding message or copy. Sales Promotion: Sales Promotion Tools, Consumer promotion tools, Business promotion tools, latest trends in marketing.

References:

[1] Kotler, P., Keller, K. L., Koshy, A., and Jha, M., 2018, Marketing Management, Pearson.

[2] Ramaswamy, V. S., and Namkumari, S., 2018, Marketing Management, Sage Publications.

[3] Majumdar, R., 2007, Marketing Research - Text, Applications and Case Studies, New Age International.

[4] Stanton, W. J., Etzel, M. J. and Walker, B. J., 1994, Fundamentals of Marketing, McGraw Hill International Edition.

ME6122E CONSUMER BEHAVIOUR

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Demonstrate how knowledge of consumer behaviour can be applied to marketing,

CO2: Comprehend segmentation and target a market with proper positioning of products and understand the latest trends in consumer behaviour

CO3: Identify and explain the factors which influence consumer behaviour.

CO4: Relate internal dynamics such as personality, perception, learning motivation and attitude to the choices consumers make.

CO5: To analyse personal, socio-cultural, and environmental dimensions that influence consumer decisions making.

Introduction: Diversity in the market place, consumer research, market segmentation, Market Segmentation and Market Targeting: Segmentation Procedure, Market Targeting, Product Positioning. Consumer behaviour as discipline and Science, Ethics in marketing, influencer marketing, phygital marketing, eco-responsible behaviour.

Consumers as individuals: Consumer motivation, consumer perception, consumer learning, personality and life styles, attitudes, attitude change, communications and consumer behavior. Factors influencing Consumer Behavior, Decision making process in buying, Perceived risks.

Consumer influence and diffusion of innovations, consumer decision making- individual decision making, group influence and opinion leadership. Consumers in their social and cultural settings: Social class and consumer behavior, influence of culture, subculture and consumer behavior, income, Age, Ethnic, racial and religion subcultures.

References:

[1] Schiffman, L. G., and Kanuk, L. L., 2018, Consumer Behaviour, Pearson Education.

[2] Solomon, M. R., 2016, Consumer Behaviour, Pearson Education.

[3] Peter, J. P., and Olson,J. C., 2020, Consumer Behaviour and Marketing Strategy, Tata McGraw Hill/ Irwin.

[4] Arnould, E. J., Linda, P., and Zinkhan, G., 2004, Consumers, Tata McGraw Hill/ Irwin.

ME6123E PRODUCT MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Outline the fundamental concepts of product management, product life cycle

CO2: Comprehend Segmentation and target a market with proper positioning of products and errors in positioning

CO3: Illustrate the concepts of product innovation, adoption and diffusion

CO4: Understand the concepts of brand management, brand equity and brand positioning

Product Management: Introduction, role of product managers, product policy, product market, market potential, product market planning and demand forecasting, product life cycle, product portfolio analysis.

Target marketing, segmentation, product differentiation, product positioning, product recall/ deletion, managing product line, positioning errors.

New product innovation and development, stages, adoption process, diffusion, product pricing, new product launch, strategies. Brand Management, concept, naming, brand equity, brand extension, brand positioning, product packaging.

References:

[1] Chunawalla, S. A., 2017, Product Management, Himalaya Publishing House.

[2] Majumdar, R., 2008, Product Management, Prentice-Hall of India.

[3] Lehmann, D., and Winer, R., 2005, Product Management, Tata McGraw Hill.

[4] Crawford, C., 2014, New Product Management, Tata McGraw Hill.

ME6124E HUMAN RESOURCE MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the key terms, theories/concepts and practices within the field of Human Resource Management

CO2: Explain human resource management functions and practices including man power planning, recruitment, selection methods, training, and performance appraisal. .

CO3: Determine compensation policies based on job analysis and job evaluation.

Human Resources Management: Concepts - Trends shaping Human Resources Management (HRM) - Workforce demographics, diversity trends, trends in jobs, globalisation, economic and technology trends; Strategic HRM - HR metrics, benchmarking, data analytics - High-performance work systems - Employee engagement and performance -Important Labour Laws - HRM and Industry 4.0 - Impact of AI in HR.

Personnel Management: Workforce planning and forecasting - Recruiting - Sources of candidates, Recruiting a more workforce- Employee testing and selection - Types of tests, Work samples and simulations, Types of interviews - Training and developing employees - Orienting and onboarding, Implementing the training program, Implementing management development programs, Evaluating the training effort. Performance Management and Appraisal- Traditional tools, Rater error appraisal problems, Managing the appraisal interview, performance management.

Compensation: Factors in determining pay rates - Job evaluation methods - Creating a market competitive pay-plan - Pricing managerial and professional jobs - Competency-Based Pay, Broadbanding, Comparable Worth - Pay for Performance and Financial Incentives: Individual employee incentive and recognition programs - Team and organization-wide incentive plans; Managing Global Human Resources, Managing Human Resources in Small and Entrepreneurial Firms

References:

[1] Dessler, G., 2020, Human Resource Management, Person Education.

[2] Tarique, I., Briscoe, D. R., and Schuler, R. S., 2022, International Human Resource Management: Policies and Practices for Multinational Enterprises, Routledge (T&F), New York.

[3] Zeuch, M. (Ed.), 2016, Handbook of Human Resources Management, Springer-Verlag, Heidelberg.

[4] Brewster, C., Houldsworth, E., Sparrow, P., and Vernon, G., 2023, International Human Resource Management, Kogan Page.

ME6125E ORGANISATIONAL BEHAVIOUR

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Describe different models used to explain individual behaviour.

CO2: Analyse the behaviour of groups in organisations in terms of the key factors that influence organisational behaviour.

CO3: Recognize how a changing business environment requires organisations to adapt.

Introduction to Organisational Behaviour (OB): Management and Organizational Behavior - Systematic study in OB - Contributing disciplines in OB - Developing an OB model. The individual: Understanding Diversity - Prejudice and Discrimination in Organizations - Cross-Cultural OB - Implementing Diversity Management, Attitudes and Behavior - Emotions and moods - Personality Attributes Relevant to OB - Perception and Individual Decision Making, Motivation: Classic theories - Contemporary Theories.

Group Process: Foundations of Group Behavior - Defining and Classifying Groups - Stages of Group Development - Group Decision Making - Differences Between Groups and Teams - Types of Teams - Creating Effective Teams - Interpersonal Communication - Cross-Cultural Communication - Leadership - leadership types - power- conflict and negotiation- negotiation methods- Sources of Conflict- Types of Conflict- Conflict Management Approaches

Organisational Process: Foundations of Organisational structure - Centralization and decentralization - Common Organisational designs - New design options, Organizational Culture - Creating and Sustaining Culture - Influencing Organizational Cultures - Organizational Change - Change and employee behaviour, Resistance to change - Approaches to Managing Organizational Change.

References:

[1] Robbins, S. P., and Judge, T. A., 2023, Organisational Behavior, Pearson Education.

[2] Luthans, F., Luthans, B. C., and Luthans, K. W., 2021, Organizational Behavior: An Evidence-Based Approach, Information Age Publishing.

[3] McShane, S., and Von Glinow, M. A., 2022, Organisational Behavior, McGraw-Hill.

[4] Hersey, P., Balaschard, K. H., and Johnson, D. E., 2013, Management of Organisational Behavior, Pearson Education.

ME6134E PRODUCT LIFE CYCLE MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Define and describe the needs and importance of Product Life Cycle Management (PLM)
CO2: Analyse and evaluate different methods and approaches for implementing PLM
CO3: Describe and explain the stages and activities involved in the product launch process
CO4: Classify and categorize the different stages and characteristics of a product life cycle

Need for Product Life cycle Management (PLM), opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study, PLM visioning – PLM Strategies; Industrial strategies, strategy elements, its identification, selection and implementation, change management for PLM Product Data Management (PDM): PDM systems and importance, reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.

Product Design Engineering: Design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model – Strategies for recovery at end of life, recycling, human factors in product design; Modeling and simulation in product design.

New Product Development: Structuring new product development, building decision support system, estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program, concept of redesign of product.

Integration of technological product innovation and product development in business processes within enterprises, methods and tools in the innovation process. Product conception process: Business processes, data-process relationship, from the idea to waste disposal. Product structures: Variant management, product configuration, material master data, product description data, Data models, Life cycles of individual items, status of items.

References:

[1] John, S., 2019, Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer.
[2] Giudice, F., La Rosa, G., and Risitano, A., 2019, Product Design for the environment-A life cycle approach, Taylor & Francis.
[3] Antti, S., and Anselmi, I., 2005, Product Life Cycle Management, Springer.
[4] Grieves, M., 2005, Product Lifecycle Management: Driving the Next Generation of Lean Thinking, McGraw Hill

ME6137E ETHICS AND HUMAN VALUES

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Comprehend the importance of business ethics and its impact on individuals, organizations, and society

CO2: Articulate and communicate the importance of human values and virtues in various spheres of life

CO3: Analyse the social and ethical implications of AI technologies and contribute to the discourse on responsible AI development and use

Business Ethics: Personal ethics and professional ethics - Significance of business ethics - Values and ethics in business - Concepts and Theories of Business Ethics - Morality and law - Normative theories - Ethical theories in relation to business - Indian ethical traditions; Ethical dilemmas, Sources and their resolutions: Corporate dilemma over ethical behaviour - Sources of ethical problems - Code of personal ethics for employees - Creating ethical working environment - Resolving ethical problems and dilemmas; Ethical Decision-making in Business.

Human Values: Foundations of human values - Human values and sub-values - Morals, values and ethics - Virtues - McIntyre's list of virtues: Unity, Integrity, Honesty, Self-respect, Responsibility, Accountability; Civic Virtues, Respect for others, Living peacefully, Caring, Sharing, Courage, Valuing Time, Co-operation, Commitment, Empathy, Self-Confidence, Modesty, Generosity, Character, Spirituality.

AI Ethics: Introduction to AI - History of AI ethics - Ethical questions in AI - Comparing AI to Humans - Moral Agency, moral patiency - Privacy and data protection, Safety and security, Transparency and Explainability, Bias - Applied Ethics: Methods in applied ethics - AI in applied ethics - Normative Ethical Theory and AI Ethics - Philosophy for AI Ethics - AI in the workplace - Superintelligence, Existential Risk, and the Control Problem.

References:

[1] Fernando, A.C.,2019, Business Ethics: Indian Perspective, Pearson Education India.

[2] Gupta, A. D., 2014, Business Ethics: Texts and Cases from the Indian Perspective, Springer India.

[3] Oderberg, D. S., and Chappell, T., 2004, Human Values: New Essays on Ethics and Natural Law, Palgrave Macmillan.

[4] Kiran, D. R., 2014, Professional Ethics and Human Values, McGraw Hill Education (India) Private Limited, New Delhi.

[5] Boddington, P., 2023, AI Ethics: A Textbook, Springer Nature Singapore Pte Ltd.

[6] Coeckelbergh, M., 2020, AI Ethics, The MIT Press, London.

[7] Naagarazan, R.S., 2025, A textbook on Professional Ethics and Human Values, New Age International Publishers.

ME6147E DISASTER MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Develop understanding on science of natural and man-made disasters

CO2: Demonstrate hazard mapping, vulnerability and risk assessment using GIS

CO3: Identify the role and relationships of community, government and non-government organizations in managing phases of disasters

CO4: Apply the concepts of supply chain, and business statistics to develop the decision-making models in managing disasters

Basics of Disasters: Understanding of Natural Hazards, Disasters, vulnerability, resilience, Pressure and Release Model – Natural Disasters types, impact and science, Climate Change, and Global Warming – Manmade Disasters, types, and impact, Accidents, and E-Waste

Hazard, Risk and Vulnerability – Hazard Mapping and Vulnerability Assessment, Introduction of Geographical Information System (GIS) – Understanding Risk Concept and Elements, Risk Analysis and Risk Assessment using GIS, Risk Reduction Measures, Risk sharing – Socioeconomic Vulnerability assessment using secondary data and GIS - Community Participation in Disaster Risk Reduction - Prediction and early warning systems

Disaster Management: Disaster Management Cycle, Disaster Prevention and Mitigation, Disaster Preparedness, Disaster Response, Disaster Recovery and Rehabilitation; Disaster Management Institutions and their Role in Disaster Mitigation – Role of Government and Non-Government Organizations in Managing Disasters, damage and need assessment, scenario building, disaster resilient communities - Last mile connectivity, route optimization problems for response and recovery under chaotic environment

Humanitarian Logistics – Role of Information and Communication Technology in Disaster Prevention and Management – Education and Awareness on Disaster Management – Practical Ethics and Legal Framework in Disaster Management –National disaster management policy of India and Indian states – facility location and capacity problems- forecasting of human and relief resources

References:

[1] Tatham, P. and Christopher, M., 2018, Humanitarian Logistics: Meeting the Challenge of Preparing for and Responding to Disasters, Kogan Page, London, UK.

[2] Gupta, H. K., 2003, Disaster Management, Universities Press.

[3] Coppola, D. P., 2016, Introduction to International Disaster Management, Butterworth-Heinemann.

[4] Tomasini, R., and Van Wassenhove, L., 2009, Humanitarian Logistics, Palgrave Macmillan, London, UK.

[5] Valcik, N. A., and Tracy P. E., 2017, Case Studies in Disaster Response and Emergency Management, Routledge, USA.

[6] Diwan, P., 2010, A Manual on Disaster Management, Pentagon Press.

ME6748E E-COMMERCE SUPPLY CHAIN MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand the e-business/e-commerce models and their supply chain models
CO2: Apply tools and techniques to carry out effective decision making for e-commerce supply chain
CO3: Illustrate the correlation between supply chain parameters and customer satisfaction in ecommerce
CO4: Introduce the application of state-of-the-art technologies for e-commerce supply chain integration

E-commerce business models and supply chain design, B2C vs B2B, e-commerce supply chain, Cross- border e-commerce

E-commerce inventory management, Fulfilment centre operations, Fulfilment centre automation, robotic material handling

Returns management and reverse logistics, Visibility and Traceability in e-commerce supply chain, Information security risks and cyber-attacks, Supply and Demand Disruptions in e-commerce supply chain

E-commerce distribution network design, Last mile e-commerce delivery, 3PL and 4PL in e-commerce, Drone delivery model, Predictive shipping.

Understanding Information security risks and cyber-attacks in e-commerce supply chain and mitigating the risks, supply and demand disruptions in e-commerce supply chain.

References:

[1] Joseph, P.T. S.J., 2015, E-Commerce: An Indian Perspective, 7th ed., PHI Learning Pvt Ltd.
[2] Graham, D., Manikas, I., and Folinas, D., 2013, E-logistics and E-supply Chain Management Applications for Evolving Business, IGI Global
[3] Lacka, E., Yip, N., and Chan, H.K., 2014, E-commerce Platform Acceptance: Suppliers, Retailers, and Consumers, Springer.
[4] Chan, H., Lee, R., Dillon, T., and Chang, E., 2007, E-Commerce: Fundamentals and Applications, Wiley.
[5] Qin, Z., Wang, G., Deng, W., and Hao, Y., 2026, Introduction to E-Commerce (E-Commerce in Theory and Practice), Springer Verlag.

ME6749E HUMANITARIAN SUPPLY CHAIN

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand the logistics system and key concepts in a humanitarian and emergency situation
CO2: Design phase-wise measures for humanitarian supply chain operations
CO3: Examine the unique logistical challenges in managing disasters and analysing their solutions
CO4: Develop strategies for effective humanitarian responses for disasters and pandemics

Introduction to Humanitarian Logistics and Supply Chain, Supply Chain Management in the Humanitarian World, Key Chain Concepts & Terminology, Current trends in humanitarian logistics, humanitarian actors in action, Cutting-Edge Technologies in Relief Operations, Challenges and critical success factors in humanitarian supply chain, Lessons learned from recent disasters, exploring role of logistics and innovations in managing recent disasters

Phases of humanitarian supply chain: Preparedness, response, and recovery, Preparedness: mitigation measures, early warning systems, process management, supplier selection and route optimization, capacity building measures, evacuation planning and shelter management, network design for pre-positioning emergency relief items, Scarce resources management, Impacts of funding systems on humanitarian operations, Response: Mechanism to response, ethics and social sensitivity, last mile connectivity, swift trust in humanitarianism, mass evacuation and relocation, vehicle routing for emergency response, uses of UAV in relief distribution, accessibility to critical infrastructure, Information management in humanitarian Logistics and supply chain, knowledge management in humanitarian supply chain, Sustainability in humanitarian operation, Recovery: Damage and need assessment, preparing for in-kind and cash assistance, developing capabilities and building capacities

Agility, Adaptability, and Alignment (AAA) in humanitarian operations, Role of NGOs and international organizations, Collaboration and coordination among humanitarian organizations, Humanitarian supply chain performance measurement, Pandemic response and humanitarian logistics, Transportation strategies in humanitarian logistics, humanitarian logistics for refugee crises, importance of Public-Private Partnerships (PPP), logistics in conflict zones and war-affected areas, challenges in managing logistics for urban disasters and man-made disasters impact of climate change on humanitarian logistics

Reference:

[1] Kovács, G., Spens, K., and Moshtari, M. (eds), 2018, The Palgrave Handbook of Humanitarian Logistics and Supply Chain Management, Palgrave Macmillan, UK.
[2] Heaslip, G., and Tatham, P., 2022, Humanitarian Logistics: Meeting the Challenge of Preparing for and Responding to Disasters and Complex Emergencies, 4th Edition, Kogan Page, Wiley, UK.
[3] Sahay, B.S., Gupta, S., and Menon, V.C. (eds), 2016, Managing Humanitarian Logistics, Springer.
[4] Blecken, A., 2010, Humanitarian logistics: modelling supply chain processes of humanitarian organisations, Haupt Publisher
[5] Rahman, N. A. A., Mahroof, K., and Simarmata, J. (Eds.), 2025, Supply Chain in Humanitarian Operations: Managing Disruption Through Intervention and Innovation, Springer.

ME6126E FORECASTING TECHNIQUES AND PREDICTIVE ANALYTICS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Develop regression models for demand forecasting through the application of relevant variables and statistical techniques

CO2: Apply ARIMA model to forecast demand patterns from time series data.

CO3: Analyze and Evaluate predictive models to data from different environments.

Introduction to forecasting: Basic forecasting Tools- Forecast accuracy and error- Time series methods- Time series decomposition: Components of time series- trend- seasonal- cycle; Classical decomposition: additive and multiplicative decomposition. Regression methods: Simple linear regression- least square estimation- correlation coefficient- statistical testing of regression coefficient (f-test, t-test)- Multiple linear regression.

ARIMA models: Box-Jenkins methodology to the identification of stationary time series models- examining correlation in time series data: tests to determine the statistical properties of empirical time series- Examining stationarity of time series data- ARIMA models for time series data and forecasting.

Introduction to Predictive Analytics: Naive Bayesian Classifier- Neural Network- Segmentation and Tree Models- Sweeping to Find the Best Cutpoint Impurity Measure of a Population: Entropy and Gini Index, Chi-Square Splitting Rule; Additive Models - Boosted Tree, Least Squares Regression Boosting Tree, Binary Logistic Regression Boosting Tree; Support Vector Machine (SVM)- Wolfe Dual, Linearly Separable Problem, Linearly Inseparable Problem, Constructing Higher-Dimensional Space and Kernel; Clustering - K Means, Fuzzy C Means, Nearest Neighbor, K Nearest Neighbor (KNN).

References:

[1] Makridakis, S., Wheelwright, S. C., and McGee, V. E., 2008, Forecasting, Methods and Applications, Wiley India.

[2] Montgomery, D. C., Jennings, C. L., and Kulahci, M., 2015, Introduction to Time Series Analysis and Forecasting, John Wiley & Sons, Inc.

[3] Enders, W., 2014, Applied Econometric Time Series, John Wiley & Sons, Inc.

[4] Wooldridge, J. M., 2010, Econometric Analysis of Cross Section and Panel Data, The MIT Press.

[5] Wu, J., and Coggeshall, S., 2019, Foundations of Predictive Analytics, CRC Press, London.

[6] McCarthy, R. V., McCarthy, M. M., Ceccucci, W., and Halawi, L., 2022, Applying Predictive Analytics: Finding Value in Data, Springer.

ME6135E SOFT COMPUTING TECHNIQUES

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Apply metaheuristic algorithms for solving optimization problems
CO2: Apply fuzzy logic in decision-making systems
CO3: Develop prediction models using Artificial Neural Networks

Metaheuristic Algorithms: Genetic Algorithms: - Introduction to Genetic Algorithms (GA) - Goals of optimization - Differences and similarities between genetic algorithm and traditional methods - Schemata - Terminology of GA - Strings, Structure, Parameter set - Coding - Fitness function - Data structures - GA operators - Algorithm. Multi-objective GA - Simulated Annealing: Introduction - Algorithm - Applications. Tabu Search: Introduction - Algorithm - Applications.

Fuzzy Logic: The concept of uncertainty and associated solutions - Fuzzy sets - Basic properties and characteristics of fuzzy sets - Fuzzy set operations - Fuzzy reasoning - Major components of a fuzzy logic system - Design aspects of fuzzy systems - Applications of fuzzy logic.

Artificial Neural Networks: Fundamental concepts and models of artificial neural systems – Biological and artificial neurons, Models of Artificial Neural Networks (ANN)- Feedforward and feedback network- Neural Network learning rules- Single layer perceptron classifiers- Multilayer feedforward networks - Applications of ANN in optimization. Modelling using software packages.

References:

[1] Goldberg, D. E., 2008, Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson India.
[2] Bozorg-Haddad, O., Solgi, M., and Loáiciga, H. A., 2017, Meta-Heuristic and Evolutionary Algorithms for Engineering Optimization, John Wiley & Sons, Inc.
[3] Deb, K., 2012, Optimization for Engineering Design, Prentice Hall of India.
[4] Ross, T.J., 2011, Fuzzy Logic with Engineering Applications, Wiley India.
[5] Sundareswaran, K., 2019, A Learner's Guide to Fuzzy Logic Systems, Jaico Publishing House.
[6] Zurada, J.M., 2006, Introduction to Artificial Neural Systems, Jaico Publishing House.
[7] Yegnanarayanan, B., 2012, Artificial Neural Networks, Prentice Hall of India.
[8] Schalkoff, R. J., 2011, Artificial Neural Networks, Tata McGraw Hill.

ME6140E ENTERPRISE RESOURCE PLANNING

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the features of Enterprise Resource Planning systems
CO2: Describe the benefits of ERP implementation in an organization
CO3: Analyze various success and failure factors of ERP implementation
CO4: Select and implement the appropriate ERP systems in an organization

Introduction to Enterprise Resource Planning: Business functions and Business processes, Evolution of information systems, Enterprise information systems: Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Manufacturing Execution Systems (MES), Customer Relationship Management (CRM), Product Lifecycle Management (PLM) and Business Intelligence (BI). ERP data input – ERP output capabilities, Productivity improvement through ERP.

Introduction to ERP packages – Comparison of ERP packages – Open Source ERP - Successes and failure factors of ERP, ERP strategy and implementation methodology, Implementation challenges, Roles and responsibilities of ERP consultant, ERP life cycle phases – production and materials management systems within ERP – E-commerce: e-procurement, e-auction, e-supply chain, e-market place. Introduction to Open Network for Digital Commerce.

Post implementation issues – Nature of ERP maintenance and support, client-vendor partnership, ERP vendors' policies, services, and impacts on ERP adoption, Impact of RFID, Business intelligence, mobile computing, cloud computing on ERP – Latest trends: ERP II, ERP III

References:

[1] Law, C.C., 2019. Managing enterprise resource planning adoption and business processes: A holistic approach, Cambridge Scholars Publishing.
[2] Monk, E. and Wagner, B., 2014. Concepts in enterprise resource planning, Cengage Learning.
[3] Ganesh, K., Mohapatra, S., Anbuudayasankar, S.P. and Sivakumar, P., 2014, Enterprise resource planning: fundamentals of design and implementation, Springer.
[4] Sumner, M., 2007, Enterprise resource planning, Pearson Education.
[5] Leon, A., 2019, Enterprise Resource Planning, Mc-Graw Hill Education India.
[6] Chan, H., Lee, R., Dillon, T. and Chang, E., 2007, E-commerce, fundamentals and applications, John Wiley & Sons.
[7] Joseph, P.T., 2023, E-commerce: An Indian perspective, PHI Learning Pvt. Ltd.

ME6141E DECISION SUPPORT AND EXPERT SYSTEM

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the fundamental concept and classification of decision support system

CO2: Demonstrate the applications of Knowledge-Based Expert System and Search Techniques with industry problems

CO3: Evaluate Knowledge-Based Expert System methods and models

Fundamentals of Decision Support System: Information systems, Human Information Processing, Newell and Simon model for human information processing-intelligence stage, decision stage, choice stage - Rasmussen model of judgment and choice -The Klein model Information and information value - Classification of decisions - Types of information systems, Decision support system - Decision Support Systems (DSS): Subsystems in DSS-data management subsystem, model management subsystem, dialogue management subsystem, Computer Hardware for DSS, Group Decision Support Systems (GDSS).

Knowledge-Based Expert System and Search Techniques: Knowledge-Based Expert System (KBES): Introduction, Architecture of KBES knowledge base, predicate logic, Production rules, Procedural programs, Inference mechanisms backward chaining, forward chaining, inexact reasoning, non-monotonic reasoning, reasoning based on certainty factors, expert system development shell.

Search Techniques: Introduction, Problem definition and solution process - Production systems - Search techniques-breadth first search, heuristic search, agenda-driven search, Problem decomposition and AND-OR graphs - Engineering Design Synthesis: Synthesis, Decomposition model for synthesis, building plant layout at a site-an example, Role of a synthesiser in KBES environment, An architecture for a synthesiser-a genetic tool.

Evaluation of Knowledge-Based Expert System: Criticism and Evaluation: Methodologies used in a knowledge-based environment, A framework for critiquing and evaluation-knowledge representation framework, inference mechanism, Algorithm for overall rating of a hierarchical solution. Applications of Decision Support Systems: Decision support in office information systems, Auditing, artificial intelligence and expert systems, Decision support systems for resource allocation. Process Models and Knowledge-Based Systems: Expert systems for diagnosis- understanding of domain knowledge, evolution of knowledge nets, transformation of knowledge from nets to rule base, Blackboard model of problem solving-blackboard architecture, blackboard framework, integrated engineering system, an illustrative example, Conceptual Design of a Car Body Shape.

References:

[1] Krishnamoorthy, C. S. and Rajeev, S., 1996, Artificial Intelligence and Expert Systems for Engineers, CRC Press Inc., New York.

[2] Pascual, D. G., 2020, Artificial Intelligence Tools: Decision Support Systems in Condition Monitoring and Diagnosis, CRC Press, India

[3] Sharda, R., Turban, E., and Delen, D., 2015, Decision Support and Business Intelligence Systems, Pearson Education, India

[4] Hopgood, A. A., 2021, Intelligent Systems for Engineers and Scientists: A Practical Guide to Artificial Intelligence, Taylor & Francis Ltd, India.

ME6850E APPLIED GIS AND SPATIAL DATA ANALYTICS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Acquire, manage, and preprocess spatial datasets

CO2: Demonstrate spatial analysis and geostatistical methods to develop GIS-based spatial models

CO3: Implement spatial analytics using GIS and Python to real-world problems

Introduction to GIS: components, functions, and applications, Spatial data models: raster and vector, Coordinate systems, projections, and georeferencing, Spatial data quality and metadata, Sources of geospatial data: satellite, UAV, GPS, open data, Spatial Data Acquisition and Preprocessing: Remote sensing data types and formats

Image preprocessing: radiometric, geometric corrections, Digitization and topology creation, Data cleaning and normalization, Spatial databases and geodatabases, Spatial Analysis and Geoprocessing: Buffering, overlay, proximity analysis, Network analysis, Terrain analysis: DEM, slope, aspect, watershed, Multi-criteria spatial decision analysis (MCDA).

Spatial Statistics and Geostatistics: Spatial autocorrelation: Moran's I, Geary's C, Point pattern analysis, Spatial interpolation: IDW, Kriging, Spline Variogram modeling, Hotspot analysis and cluster detection, Ordinary Least Squares (OLS) and diagnostics, Spatial lag and spatial error models, Geographically Weighted Regression (GWR), Applications in socio-economic and environmental studies, Spatial Data Analytics: Introduction to spatial data analytics, GIS with Python, Urban growth modeling, Disaster risk mapping, Climate change vulnerability analysis, Agricultural suitability and crop mapping

References:

[1] Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., 2015, Geographic Information Systems and Science, 4th ed., Wiley, United States.

[2] de Smith, M. J., Goodchild, M. F., and Longley, P. A., 2020, Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools, 6th ed., The Winchelsea Press, United Kingdom.

[3] Bivand, R. S., Pebesma, E., and Gómez-Rubio, V., 2013, Applied Spatial Data Analysis with R, 2nd ed., Springer, Germany.

[4] Wilkie, D., and Finn, J., 2020, Applied Spatial Statistics for GIS, CRC Press, United States.

ME6851E AUGMENTED REALITY AND VIRTUAL REALITY IN LOGISTICS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Analyze logistics problems suitable for immersive technology solutions
CO2: Design and apply AR/VR-based logistics for training, warehouse optimization, and simulation
CO3: Evaluate cost–benefit and operational impacts of AR/VR adoption
CO4: Integrate AR/VR with IoT, AI, and GIS for smart logistics systems

Fundamentals of Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR), Industry 4.0 and Logistics 4.0, Digital twins in logistics, Overview of hardware: headsets, sensors, wearables, warehouse management systems (WMS), AR in order picking and packing, VR in safety training and equipment handling, Layout planning and space optimization using VR, Human–machine interaction

AR/VR for Transportation and Distribution: Route visualization and planning, Fleet management simulations, Port and airport logistics applications, Last-mile delivery optimization using AR, Emergency and disaster logistics simulation, Integration with RFID, IoT, and sensors, Collaborative VR environments for supply chain planning

Integration with databases and APIs, Performance evaluation, AI-driven logistics optimization in AR/VR environments, Predictive analytics visualization, Digital twin-based logistics simulation, Real-time decision support systems, Data security and privacy, Health and safety issues in AR/VR usage, Cost–benefit analysis, Implementation challenges in Indian logistics sector, Inventory visualization and real-time stock tracking, AR dashboards for supply chain visibility

References:

[1] Schmalstieg, D., and Hollerer, T., 2016, Augmented Reality: Principles and Practice, Pearson Education India.
[2] Furht, B. (Ed.), 2011, Handbook of Augmented Reality, Springer, United States.
[3] Jung, R., Broll, W., Grimm, P., and Doerner, B., 2022, Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities, Springer, Switzerland.
[4] Craig, A. B., 2013, Understanding Augmented Reality: Concepts and Applications, Morgan Kaufmann, United States.

ME6852E BUSINESS ANALYTICS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the role of business analytics in organizational decision-making and competitive advantage
CO2: Apply descriptive analytics techniques to summarize and visualize business data
CO3: Develop and interpret predictive models for business forecasting and classification problems
CO4: Formulate and solve prescriptive analytics models using optimization and simulation techniques
CO5: Communicate analytical results effectively to support managerial decisions

Introduction to Business Analytics and Descriptive Analytics: Business Analytics: Concept, evolution, and scope, Types of analytics: Descriptive, Diagnostic, Predictive, Prescriptive- Analytics in functional areas: Marketing, Finance, Operations, HR, Supply Chain- Data types and sources: Structured vs unstructured data- Data quality, data cleaning, and preprocessing - Exploratory Data Analysis (EDA) - Data visualization principles and dashboards - Descriptive statistics for business decisions - Measures of central tendency and dispersion - Cross-tabulation and pivot tables - Descriptive analysis using Excel / Python - Business dashboards and summary reports

Predictive Analytics: Statistical and Machine Learning Models: Introduction to predictive analytics and modeling process - Regression analysis - Simple and multiple linear regression - Assumptions, diagnostics, and interpretation - Logistic regression for classification problems - Time series forecasting - Trend, seasonality, and decomposition - Moving averages and exponential smoothing - Introduction to machine learning for business analytics - k-Nearest Neighbors (k-NN) - Decision Trees - Model validation and performance metrics - RMSE, MAE, confusion matrix, ROC curve

Prescriptive Analytics and Optimization: Prescriptive analytics and decision modeling - Linear programming models - Formulation of business problems - Graphical and simplex concepts - Integer and binary optimization - Applications in: Product mix decisions, Transportation and assignment problems, Capacity planning - Introduction to simulation modeling - Monte Carlo simulation - Risk and uncertainty analysis - What-if analysis and scenario planning - Solver-based optimization (Excel / Python)

Advanced Analytics, Big Data and Managerial Applications: Analytics-driven decision-making frameworks - Big Data analytics: Concepts and ecosystem - Introduction to text analytics and sentiment analysis - Customer analytics and marketing analytics - Supply chain and operations analytics - Financial and risk analytics - Ethics, data privacy, and governance in analytics - Analytics project life cycle - Communicating insights: Data storytelling and visualization

References:

[1] Evans, J. R., 2019, Business Analytics: Methods, Models, and Decisions, Pearson.
[2] Shmueli, G., Bruce, P., Gedeck, P., 2019, Data Mining for Business Analytics, Wiley.
[3] Provost, F., Fawcett, T., 2013, Data Science for Business, O'Reilly.
[4] Davenport, T. H., Harris, J. G., 2007, Competing on Analytics: The New Science of Winning, Harvard Business School Press.
[5] Winston, W. L., 2004, Operations Research: Applications and Algorithms, Cengage.
[6] Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., and Tatham, R. L., 2006, Multivariate Data Analysis, 6th ed., Pearson.
[7] Kumar, U.D., 2021, Business Analytics: The Science of Data-driven Decision Making, 2nd ed., Wiley.

ME6853E DIGITAL INNOVATIONS AND TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

L	T	P	O	C
3	0	0	6	3

Pre-requisites: NIL

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand existing supply chain challenges
CO2: Illustrate the opportunities for supply chain transformation
CO3: Apply innovation and IT frameworks in the supply chain context
CO4: Design appropriate strategies to mitigate the cyber risk towards efficient modern supply chain

Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) Environment and Business Needs; Understanding IT challenges and integrated business processes in supply chain and logistics; Opportunity Identification for Digital Transformation; Business models and Innovation frameworks for supply chain; Enterprise Systems for Supply chain, Data Lake and Data Integration

Emerging technologies for Digital Transformation of supply chain; Application of AI, ML, IOT, Blockchain, Robotics and Automation, and Drone technologies; Platform Economy and Eco Systems. Product life cycle management for supply chain; Technology life cycle for supply chain management

Web technologies and e-SCM applications, Understanding Risk and Cyber-attacks in supply chain; Security Controls and Information Security Posture; Cryptographic Algorithms and hashing systems, Analyzing and assessing the risks; Strategies for successful implementation and use-cases.

References:

[1] Carnovale, S., and Yeniyurt, S. (Eds.)., 2021, Cyber Security and Supply Chain Management: Risks, Challenges, And Solutions, World Scientific.
[2] Delfs, H., and Knebl, H., 2007, Introduction to Cryptography: Principles and Applications. 2nd ed., Springer, 2007.
[3] Pagano, A. M., and Liotine, M., 2019, Technology in supply chain management and logistics: Current practice and future applications, Elsevier.
[4] Vyas, N., Beije, A., and Krishnamachari, B., 2019, Blockchain and the supply chain: concepts, strategies and practical applications, Kogan Page Publishers.

ME6854E FUNDAMENTALS OF DATA SCIENCE

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand and explain the fundamental concepts, data structures, and workflows of data science using programming tools.

CO2: Apply statistical and probabilistic methods to analyze, summarize, and interpret data.

CO3: Build, evaluate, and interpret basic machine learning models for predictive and descriptive analytics.

CO4: Visualize data-driven insights, communicate analytical results effectively, and address ethical and privacy issues in data science.

Introduction to Data Science and Programming Foundations: Introduction to Data Science - Evolution of data science, Data science vs statistics, data analytics, AI, and machine learning, Role of data scientists in industry, government, and research, Data-driven decision-making; Data Science Life Cycle - Problem definition and business understanding, Data acquisition and integration, Data cleaning and preprocessing, Exploratory analysis, Modeling and evaluation, Deployment and monitoring; Types of Data - Structured, semi-structured, and unstructured data; Qualitative vs quantitative data; Time-series, spatial, transactional, and streaming data; Data formats: CSV, JSON, XML, databases, APIs; Programming for Data Science - Overview of Python/R ecosystem for data science, Python basics: variables, data types, control structures, Data structures: lists, tuples, dictionaries, arrays, Introduction to NumPy and Pandas, Reading and writing datasets; Data Preprocessing - Handling missing data, Data normalization and standardization, Encoding categorical variables, Outlier detection and treatment, Data transformation and feature scaling,

Statistical Foundations for Data Science: Descriptive Statistics - Measures of central tendency, Measures of dispersion, Skewness and kurtosis, Data summarization techniques, Probability Theory, Basic probability concepts, Conditional probability and Bayes' theorem, Random variables, Probability distributions (discrete and continuous); Statistical Distributions - Binomial, Poisson, Normal distributions, Sampling distributions, Central Limit Theorem; Inferential Statistics - Sampling techniques, Hypothesis testing (parametric and non-parametric tests), Confidence intervals, t-test, chi-square test, ANOVA; Exploratory Data Analysis (EDA): Univariate, bivariate, and multivariate analysis, Correlation and covariance, Statistical insights using Python/R

Machine Learning and Predictive Analytics: Introduction to Machine Learning: Supervised vs unsupervised learning, Model building workflow, Bias–variance tradeoff; Supervised Learning Techniques - Linear regression and assumptions, Multiple and polynomial regression, Logistic regression, k-Nearest Neighbors (k-NN), Decision trees and tree pruning; Unsupervised Learning Techniques - Clustering concepts, k-means clustering, Hierarchical clustering, Dimensionality reduction: PCA; Model Evaluation and Validation - Train-test split, Cross-validation, Performance metrics: accuracy, precision, recall, F1-score, ROC curve; Overfitting and underfitting; Introduction to Feature Engineering - Feature selection methods, Feature extraction, Handling multicollinearity.

Data Visualization, Communication, and Ethics - Principles of Data Visualization - Visual perception and cognition, Choosing appropriate charts and graphs, Avoiding misleading visualizations; Visualization Tools and Libraries - Matplotlib and Seaborn (Python), ggplot2 (R), Interactive visualization concepts, Dashboards and basic reporting; Data Storytelling and Communication - Translating analysis into insights, Writing analytical reports, Presenting results to technical and non-technical audiences; Ethics in Data Science - Data privacy and confidentiality, Bias and fairness in data and algorithms, Responsible AI and explainability, Regulatory frameworks (GDPR, data protection laws)

References:

[1] Grus, J., 2015, Data Science from Scratch, O'Reilly

[2] Kalita, J.K., Bhattacharyya, D.K., and Roy, S., 2023, Fundamentals of Data Science: Theory and Practice, Elsevier, 2023

[3] VanderPlas, J., 2016, Python Data Science Handbook, O'Reilly

[4] Bruce, P., Bruce, A., and Gedeck, P., 2020, Practical Statistics for Data Scientists, 2nd ed., O'Reilly

[5] Hastie, T., Tibshirani, R., and Friedman, J., 2017, The Elements of Statistical Learning, 2nd ed., Springer

ME6855E INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the evolution, characteristics, and drivers of Industry 4.0

CO2: Analyze IoT and IIoT architectures and communication protocols for industrial systems.

CO3: Apply IIoT design principles, sensing, actuation, and data management techniques to industrial applications.

CO4: Design and implement secure IIoT solutions for real-world industrial use cases.

Industrial Revolution and its historical evolution. Characteristics and features of Industry 4.0. Design requirements and key drivers of Industry 4.0. Smart business perspective and characteristics of smart business models. Impacts and applications of Industry 4.0 across manufacturing and service sectors.

Baseline technologies for IoT-enabled systems, including Machine-to-Machine (M2M) communication, Cyber-Physical Systems (CPS), and the Web of Things (WoT). Introduction to the Internet of Things (IoT) and IoT architecture. IoT applications in various domains. Fundamentals of sensing and actuation. Basics of networking for IoT systems. IoT technology fundamentals including devices and gateways, data management, business processes in IoT, Everything as a Service (XaaS), role of cloud computing in IoT, and security aspects in IoT.

Introduction to Industrial Internet of Things (IIoT). Comparison between IoT and IIoT. Prerequisites for IIoT adoption. IIoT architecture, design principles, and required capabilities. Elements of IIoT including hardware components such as computing platforms (Arduino, Raspberry Pi), communication modules, sensing, actuation, and I/O interfaces. Software components including programming APIs and communication protocols such as MQTT, ZigBee, Bluetooth, CoAP, UDP, and TCP. Features of IIoT for industrial processes, future industrial architectures, and applications of IIoT.

IIoT application development and solution frameworks for IoT-based systems. Implementation of device integration, data acquisition and integration, and device data storage including unstructured data storage on cloud and local servers. Authentication and authorization of devices. Case studies and mini-projects based on IoT and IIoT applications in industrial automation, transportation, agriculture, healthcare, and home automation.

References:

[1] Misra, S., Roy, C., and Mukherjee, A., 2020, Introduction to Industrial Internet of Things and Industry 4.0, CRC Press, London.

[2] Gilchrist, A., 2016, Industry 4.0: The Industrial Internet of Things, Apress, United States.

[3] Madisetti, V., and Bahga, A., 2020, Internet of Things: A Hands-on Approach, University Press, India.

ME6127E FACILITIES LAYOUT PLANNING

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Develop understanding of plant layout, facility planning and development process of layout
CO2: Examine and analyse the computerized layout planning, their features and algorithms
CO3: Analyse and assess Facility Location-allocation Problems
CO4: Develop understanding of warehouse management system and material handling equipment

Introduction to Facility Layout and Requirement: Types of manufacturing processes, Overview of Plant Design, Plant Location – Location Factors, Location Theory, Facilities planning strategy, Layout Planning. Plant Layout: Need for Layout, Types of Layout, Layout Design Process, Layout Design Cycle, Activity Analysis, REL Diagram, Employee Requirement; Development of Layout - Block Plan, Evaluating and Selecting the Facilities Plan, Preparing, Presenting, Implementing, and Maintaining the Facilities

Layout Planning and Research Problems: Computerized Layout Planning: Construction and Improvement Algorithms, Major features of Improvement Algorithms. Major Features of Computerized Algorithms, such as ALDEP, CORELAP, CRAFT.

Formulation of Layout Problems: Quantitative, Qualitative, and multi-objective, Limitation of Computerized Layout Planning, Flow Dominance, Complexity Rating, Solution Efficiency.

Facility Location Problems and Warehouse Management Systems: Single Facility Location Problems: Rectilinear Distance Problems, Contour Lines (Iso-Cost Lines). Squared Euclidean Distance Problems and Euclidean Distance Problems Introduction to Multi-facility Location Problems: Formulation of Problems, LP formulation with rectilinear distance, squared Euclidean distance and HAP. Introduction to Quadratic assignment problem – Allocation problem – Warehousing problem, warehouse management system, Material handling equipment, factors affecting material handling.

References:

[1] Tompkins, J. A., White, J. A., Bozer, Y. A., and Tanchoco, J.M.A., 2010, Facility Planning, Wiley.
[2] Francis, R. L., McGinnis, L. F. and White, J.A.., 2015, Facility Layout and Location: An Analytical Approach, Pearson Education India.
[3] Stephens, M.P., 2019, Manufacturing Facilities Design and Material Handling, Pearson, USA.
[4] Young, P. J., 2009, Selecting, Buying, Installing and Using a Modern Warehouse Management System, Lulu, India.
[5] Groover, M. P., 2016, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson Education, India

ME6128E CELLULAR MANUFACTURING SYSTEMS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand the characteristics of cellular manufacturing system and the role of GT in production system configuration

CO2: Develop an understanding and assess various models for group formation.

CO3: Formulate and solve mathematical models for CMS design using analytical and heuristic methods

CO4: Assess development method for the creation of CMS and understand the automatic control of CMS

Introduction: Characteristics of modern production system, Ways of configuring manufacturing system

Group Technology (GT): Role of GT in Computer Aided Manufacturing (CAM) – Features of GT – Role of similarity in GT – Composite part; Coding and classification, Similarity coefficient-based clustering, Key machine approach, Binary ordering algorithm, Production flow analysis; Cell formation problem – a case study.

Models for Cellular Manufacturing System (CMS) Design: CMS design factors, Mathematical programming approaches, Model for dynamic part population, Solution procedure using genetic algorithm.

Workcell: Building blocks of workcell – Linked cell, Different types of cells, Cycle time, Workcell design; Worker assignment; Incentive plans; Issues in implementing cellular manufacturing.

Performance evaluation of CMS: Economic aspect of CM – Modelling CM performance – Experimental design for CM performance – Analysing CM performance.

Cellular manufacturing (CM) and Jidoka (autonomation): Overall equipment effectiveness for cellular manufacturing – Jidoka for ensuring OEE, Supervisory control and data acquisition (SCADA) for implementing jidoka – Case study: time-based cellular manufacturing.

Robust design of CMS: Robust design versus adaptive design – Robust design modelling – Analysing a robust design.

Networked CMS: Open systems interconnection (OSI) – layers of OSI – messages in a networked CMS – Error detection and corrections – Cycle redundancy check.

References:

[1] Wang, J.X., 2021, Cellular Manufacturing: Mitigating Risk and Uncertainty, CRC Press, London.

[2] Nicholas, J., 2001, Competitive Manufacturing Management - Continuous Improvement, Lean Production, and Customer-Focused Qualities, Tata McGraw-Hill Edition.

[3] Sing, N., and Rajamani, D., 2011, Cellular Manufacturing Systems: Design, Planning and Control, Chapman & Hall.

[4] Askin, R. G., and Standridge, C. R., 1993, Modelling and Analysis of Manufacturing Systems, John Wiley & sons. Inc.

[5] Groover, M.P., 2016, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson.

ME6129E INDUSTRIAL SCHEDULING

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand and classify scheduling problems based on characteristics and computational complexity
CO2: Formulate and solve scheduling models for single-machine shops, flow shops and job shops
CO3: Explain the scheduling of assembly lines
CO4: Illustrate scheduling of service systems

Importance of scheduling in implementation of production planning, Overview of scheduling models: Machine configurations, Processing characteristics and constraints, Objectives and performance measures, Computational complexity, NP complete and NP hard, Optimality of schedules.

Single machine sequencing with independent jobs: Scheduling without due dates, with due dates, Adjacent pair-wise interchange methods, Branch and bound approach, Neighbourhood search techniques, Random sampling, Parallel machine models.

Flow shop scheduling: Permutation schedules, Johnson's problem, Ignall and Schrage algorithm, Dominance properties for makespan problems, CDS, Palmer, Gupta heuristics, Scheduling in process industries with no waiting or work in process.

Job shop scheduling: Types of schedules, Schedule generator, Disjunctive programming and Branch and bound, Shifting bottleneck heuristic.

Dynamic job shop scheduling, Scheduling in dynamic flow systems, Use of priority disciplines. Scheduling of Flexible assembly systems; Lot sizing and scheduling; Scheduling, balancing and other aspects of design in mixed model assembly lines and flow lines. Basic principles of scheduling problems in service systems: Airline operations, Healthcare systems.

References:

[1] Pinedo, M., 2016, Scheduling: Theory, Algorithms and Systems, Springer.
[2] Baker, K.R., and Trietsch, D., 2018, Principles of Sequencing and scheduling, Wiley.
[3] French, S., 1982, Sequencing and Scheduling, Elis Horwood Ltd., Chichester, U.K..
[4] Bazargan, M., 2010, Airline Operations and Scheduling, Routledge

ME6130E LEAN PRODUCTION MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Describe and assess the impact of small lot production on the performance of a production system.
CO2: Apply and evaluate pull production control principles and techniques.
CO3: Analyse and evaluate different methods and techniques for achieving production levelling.
CO4: Analyse and assess different approaches and methodologies for achieving synchronization and balance in a production system.

Small-Lot Production: Wastes due to large lot production – Lot splitting and lot streaming – Transfer batches and performance – Lot-size reduction and competitiveness – Minimal lot-size – Facilitating small lot-size.

Setup-time reduction: Benefits of simplified setup – Setup Reduction Methodology – Techniques for Setup-Reduction – setup Reduction Projects.

Group technology: General features of group technology – Types of group layouts – Cellular manufacturing – Production flow analysis – Algorithms for cell and part family formations.

Pull Production Systems: Pull production – Determination of buffer size – Conveyance and production kanbans – Pull and Push Systems – Conditions for Pull Production Systems – How to achieve Pull Production – Signal kanbans – CONWIP system.

Workcells and Cellular Manufacturing: Linked workcells and subcells – Workcell design: cycle time, Assembly cells and machining cells.

Scheduling for Smooth Flow: Production Levelling – Levelling production with uniform schedules – Levelling the master production schedule.

Level Scheduling in Pull Production: Mixed model production (Heijunka) – Uniform load production scheduling for MTS – Modularisation and planning bills for ATO – Level scheduling for MTO.

Synchronising and Balancing Process: Synchronisation – Synchronised cycle time; Bottleneck Scheduling – Drum-buffer-rope system; Balancing – Balancing for mixed-model production – Balancing for synchronous flow.

Planning and Control in Pull Production: Centralised and decentralised planning and control systems; Adapting MRP-based production planning and control system to pull production – Flattening of BOMs – Post deduct/backflushing.

References:

[1] Nicholas, J., 2018, Lean Production for Competitive Advantage: A comprehensive Guide to Lean Methodologies and Management Practices, CRC Press, London.
[2] Nicholas, J., 2001, Competitive Manufacturing Management – Continuous Improvement, Lean Production, and Customer-Focused Qualities, Tata McGraw-Hill Edition.
[3] Askin, R. G., and Goldberg, J. B., 2007, Design and Analysis of Lean Production Systems. Wiley Student Edition.
[4] Korgaonker, M. G., 2012, Just In Time Manufacturing, Macmillan Publishers India Limited.

ME6132E SYSTEM MODELLING AND SIMULATION

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the role of important elements of system modelling and discrete event simulation
CO2: Develop simulation models using various techniques
CO3: Illustrate input data modelling for simulation
CO4: Apply tests for verification and validation of simulation models
CO5: Apply simulation modelling and analysis to various realistic situations

System Concept: Systems and system environment, Types of system study, System modelling - Types of models; System Simulation - Technique of simulation, Comparison of simulation and analytical methods, Types of system simulation, Steps in simulation study, Monte Carlo simulation: Examples - Simulation modelling and analysis of queuing systems, Inventory systems. Concepts in Discrete Event Simulation: Event scheduling/Time advance algorithm, Modelling world views; Simulation programming: Comparison and selection of simulation languages

Random Number Generation: Linear congruential method, Test for random numbers; Random Variate Generation: Inverse transformation technique, Convolution method, Acceptance-Rejection technique. Input Modelling for Simulation: Data collection, Identifying the distribution with data, Parameter estimation, Goodness of fit tests.

Verification and Validation of Simulation Models: Verification, calibration and validation of models. Estimation of Absolute Performance: Types of Simulations with respect to output Analysis, Measures of performance and their estimation, Output analysis for terminating simulations, Confidence intervals with specified precision.

Output analysis for steady state simulations: Initialisation bias, Sample size determination, Estimation of relative performance - Metamodelling: Regression models, simulation-optimization. Simulation modelling and analysis of typical manufacturing systems, Supply chains, Healthcare systems, PERT networks.

References:

[1] Altiok, T. and Melamed, B., 2014, Simulation modeling and analysis with Arena, Elsevier.
[2] Banks, J., Carson, J.S., Nelson, B. L., and Nicol, D. M., 2014, Discrete-Event System Simulation, Pearson Education.
[3] Choi B K., 2013, Modeling and Simulation of Discrete-Event Systems, John Wiley & Sons Inc.
[4] Deo, N., 1997, System Simulation with Digital Computer, Prentice Hall of India.
[5] Law, A. M., 2017, Simulation Modelling and Analysis, McGraw-Hill Education.
[6] Rossetti, M. D., 2015, Simulation Modelling and ARENA, Wiley-Blackwell.
[7] Robinson, S., 2014, Simulation: The Practice of Model Development and Use, Palgrave Macmillan.
[8] Oakshott, L., 1997, Business Modelling and Simulation, Pitman Publishing

ME6756E COLD SUPPLY CHAIN

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Design and evaluate cold storage infrastructure
CO2: Analyze refrigeration and mechanical systems
CO3: Optimize cold chain logistics and distribution
CO4: Implement monitoring and quality control frameworks

Introduction to Cold Storage and Cold Chain: Definition, significance and importance of cold chain, components of a cold chain system, overview of cold storage types, impact on product shelf life and quality, challenges in cold chain implementation.

Cold Storage Design and Infrastructure: Site selection and layout planning, types of cold storage facilities, temperature zones and classifications, insulation materials and technologies, Floor, wall, and roof construction, Loading and unloading dock design, Controlled atmosphere storage, Energy-efficient building design, Automation and smart systems in cold storage, Safety and compliance considerations.

Refrigeration systems and equipment: Basics of refrigeration cycle, types of refrigerants and their uses, vapour compression and absorption systems, Components of refrigeration systems (compressor, condenser, evaporator, expansion valve), selection of refrigeration units, Maintenance of refrigeration equipment, Refrigeration system efficiency, Natural refrigerants and eco-friendly options, safety standards.

Cold chain logistics and transportation: Types of cold chain vehicles, Reefer truck design and functioning, cold box and insulated packaging, real-time temperature monitoring devices, route planning and vehicle tracking, loading and unloading protocols, transit damage prevention methods, last-mile delivery challenges, Cold chain logistics regulations and documentation.

Storage of perishable products: Storage of fruits and vegetables, meat, poultry and seafood cold storage, dairy and milk product preservation, pharmaceutical and vaccine storage, frozen food storage practices, controlled humidity and gas storage, product compatibility and stacking, FIFO and FEFO practices, shelf-life extension techniques, packaging materials for cold storage.

Cold chain monitoring and control systems: sensors and IoT in cold storage, remote temperature and humidity monitoring, data logging and alert systems, cold chain management software, Role of AI in predictive maintenance, SCADA and PLC in cold storage automation, Blockchain for traceability, Inventory and order management systems, Regulatory compliance monitoring.

References:

[1] Gupta, A.K., 2025, Cold Storage, Cold Chain and Warehouse (With Controlled Atmosphere Storage and Rural Godowns), NPCS Board of Consultants and Engineers.
[2] Kirkpatrick, A., 2017, Introduction to Refrigeration and Air Conditioning Systems: Theory and Applications, Springer International Publishing AG.
[3] Cold Chain Facet: A Complete Practical E-Book on Cold Storage, Cold Transport and Cold Supply Chain Industry, 2020, Silver Grey Consulting Solutions.
[4] Danfoss, 2025, Application Handbook - Industrial Refrigeration Ammonia and CO_2 Application, Danfoss
[5] Khatik, S. S., 2025, Modern Cold Storage Management, Notion Press.

ME6757E SHIPPING AND PORT LOGISTICS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Analyse the structure, functioning, and economics of global shipping systems and maritime trade.
CO2: Evaluate shipping operations, vessel types, chartering practices, and freight rate mechanisms.
CO3: Examine port systems, terminal operations, cargo handling technologies, and hinterland logistics.
CO4: Apply quantitative and qualitative tools to assess port performance, efficiency, and competitiveness.
CO5: Critically assess regulatory, environmental, and sustainability issues in shipping and port logistics.

Global Shipping Systems and Maritime Economics: Introduction to Shipping and Maritime Logistics - Role of shipping in global trade, Evolution of maritime transport, Key maritime trade routes and chokepoints - Structure of the Shipping Industry - Liner, tramp, and industrial shipping, Major shipping markets and stakeholders, Shipping alliances and consortiums, Role of shipowners, operators, brokers, and agents - Maritime Economics- Demand and supply of shipping services, Shipping cycles and market volatility, Economies of scale and scope in shipping, Cost structures in shipping operations.

Shipping Operations and Maritime Management: Ship Types and Vessel Technology - Container ships, bulk carriers, tankers, Ro-Ro, LNG/LPG vessels, Ship size evolution and vessel specialization, Ship design considerations for logistics efficiency - Chartering and Commercial Operations- Voyage charter, time charter, and bareboat charter, Charter party clauses and documentation, Laytime, demurrage, and dispatch - Maritime Documentation and Contracts - Bills of Lading and sea waybills, Contracts of carriage, IMO conventions (SOLAS, MARPOL, COLREG, STCW), Ship safety management systems (ISM Code).

Port Systems and Terminal Operations: Port Systems and Governance - Port classification and functions, Landlord, tool, service, and private port models, Port authorities and regulatory frameworks, Public–Private Partnerships (PPP) in ports - Port Infrastructure and Superstructure - Port layout and planning, Berths, quays, yards, and storage facilities, Navigational infrastructure and dredging - Terminal Operations and Cargo Handling - Container terminal operations and equipment, Bulk and break-bulk terminal operations, Yard planning and gate operations, Terminal Operating Systems (TOS) - Port Performance and Productivity - Key performance indicators (KPIs), Port efficiency and benchmarking, Congestion, dwell time, and capacity analysis

Port Logistics, Hinterland Connectivity, and Sustainability: Port-centric Logistics and Supply Chains - Port-centric logistics concepts, Value-added logistics services at ports, Free Trade Zones (FTZ) and logistics parks - Hinterland Connectivity and Intermodal Transport - Road, rail, inland waterways, and coastal shipping, Dry ports and inland container depots (ICDs), Last-mile connectivity and logistics corridors.

References:

[1] Branch, A.E., Robarts, M., 2014, Branch's Elements of Shipping, 9th ed., Routledge.
[2] Stopford, M., 2009, Maritime Economics, 3rd ed., Routledge.
[3] Talley, W.K., 2018, Port Economics, 2nd ed., Routledge.
[4] Notteboom, T., Pallis, A., and Rodrigue, J.P., 2022, Port Economics, Management and Policy, Routledge.
[5] Song, D.W., and Panayides, P., 2015, Maritime logistics: A guide to contemporary shipping and port management, 2nd ed., Kogan Page Publishers.
[6] UNCTAD – Review of Maritime Transport (latest edition), https://unctad.org/system/files/official-document/rmt2024_en.pdf .

ME6758E RETAIL SUPPLY CHAIN MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the structure, characteristics, and strategic role of supply chains in the retail sector.
CO2: Analyse demand, inventory, and replenishment decisions to improve retail supply chain performance.
CO3: Apply logistics, distribution, and omnichannel strategies to enhance retail responsiveness and efficiency.
CO4: Evaluate the impact of digital technologies, sustainability, and risk management practices on retail supply chains.

Retail Supply Chain Fundamentals and Strategy: Introduction to retail supply chains: scope and characteristics, Evolution of retailing and supply chain integration, Retail supply chain strategy: efficiency vs responsiveness, Push, pull, and hybrid supply chains in retail, Role of demand variability and customer service levels, Retail supply chain performance drivers and metrics

Demand Forecasting, Inventory, and Replenishment in Retail: Retail demand characteristics and forecasting methods, Time-series forecasting and causal models for retail demand, Inventory management in retail: EOQ, safety stock, service levels, Multi-echelon inventory systems, Replenishment systems: Continuous vs periodic review, Vendor Managed Inventory (VMI) and Collaborative Planning, Forecasting, and Replenishment (CPFR)

Retail Logistics, Distribution, and Omnichannel Operations: Retail logistics and distribution network design, Warehousing, cross-docking, and distribution centre operations, Transportation planning and last-mile delivery, Store operations and in-store logistics, Omnichannel retailing: store, online, and fulfillment integration, Returns management and reverse logistics in retail.

Digital Technologies, Sustainability, and Risk in Retail Supply Chains: Role of information systems in retail supply chains, Sustainable retail supply chains and green logistics, Ethical sourcing and social compliance in retail, Risk management, disruptions, and retail supply chain resilience.

References:

[1] Chopra, S., and Meindl, P., 2023, Supply Chain Management: Strategy, Planning, and Operation. Pearson.
[2] Levy, M., Weitz, B. A., and Grewal, D., 2022, Retailing Management. McGraw-Hill Education.
[3] Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., 2021, Designing and Managing the Supply Chain. McGraw-Hill.
[4] Silver, E. A., Pyke, D. F., and Thomas, D. J., 2017, Inventory and Production Management in Supply Chains. CRC Press.
[5] Nahmias, S., and Olsen, T. L., 2015, Production and Operations Analysis. Waveland Press.
[6] Bowersox, D. J., Closs, D. J., and Cooper, M. B., 2019, Supply Chain Logistics Management. McGraw-Hill.
[7] Fernie, J., and Sparks, L., 2019, Logistics and Retail Management. Kogan Page.
[8] Hübner, A., Kuhn, H., and Wollenburg, J., 2016, Last-mile fulfilment and distribution in omni-channel retailing. International Journal of Retail and Distribution Management.
[9] Mangla, S. K., Sharma, Y. K., Patil, P. P., and Yadav, G., 2020, Sustainable Supply Chain Management. CRC Press.

ME6759E AIR CARGO LOGISTICS MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Demonstrate the concept of air cargo operations
CO2: Apply data analytics tools and techniques for air cargo handling and management
CO3: Identify best practices across the industry
CO4: Illustrate the application of technology in transforming traditional ways of doing business

Basics of Air Cargo Operations - Understanding basics of air cargo operations; Activity/operation of key players in air cargo service such as Shipper, Forwarder, Airline, Airports, Consignee, Coordination and contract in air cargo supply chain; Complexity in air cargo operations

Role of Analytics and Digitization in Air Cargo Management - Demand analytics, Capacity planning, Revenue management, Terminal operations and Cargo Handling, Fleet routing and flight scheduling, Decision making under risk and uncertainty, Applications of various AI/ML and optimization models in air cargo operations, Information technology and GIS for managing air cargo operations

Case Studies/ Real life applications - Cold Logistics, Heavy-lift air transportation, Humanitarian operations using Air Transport, Applications of Geospatial Technologies in Air Cargo Handling and Management.

References:

[1] Sales, M., 2016, Air cargo management: Air freight and the global supply chain. 2nd ed., Routledge
[2] Sales, M., 2016, Aviation logistics: the dynamic partnership of air freight and supply chain. Kogan Page Publishers
[3] Thompson, J. F., Brecht, P. E., and Hinsch, T., 2002, Refrigerated trailer transport of perishable products (Vol. 21615). UCANR Publications

ME6760E SUPPLY CHAIN NETWORK DESIGN

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Analyze strategic planning levels and trade-offs
CO2: Formulate and solve mathematical optimization models
CO3: Design integrated facility and logistics configurations
CO4: Apply industry best practices and ESG standards

Role of Technology, Network Modelling and Optimization - Formulating supply chain network problems using mathematical frameworks, applying linear programming, mixed-integer linear programming, and other mathematical optimization tools to find optimal solutions, applying simulation software and "what-if" scenarios to test network performance under various conditions, such as demand shifts, cost fluctuations, or disruptions.

Facility Location and Capacity Planning - Evaluating factors influencing facility location decisions, facility Types - optimal number, size, and type (e.g., factory, warehouse, cross-dock) of facilities. Capacity planning - determining the production and storage capacity needed at each location.

Greenfield and Brownfield Analysis, Inventory and Transportation in Network Design - Determining optimal inventory levels and placement across the network (raw materials, work-in-progress, finished goods) to balance holding costs and customer service levels. Transportation Planning: Selecting the most efficient transportation modes and optimizing routes and carriers to minimize freight costs and transit times. Analysing the critical trade-off between transportation costs and inventory/facility costs.

Real-life Applications and Industry Best Practices - analysing successful examples of supply chain network design from various industries, Hands-on experience or demonstrations with specialized supply chain network design and optimization software. Integrating environmental, social, and governance factors into network design

References:

[1] Watson, M., 2013, Supply chain network design: applying optimization and analytics to the global supply chain. Pearson education.
[2] Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., and Ji, J., 2000, Designing and managing the supply chain.
[3] Vyas, N., Dasgupta D., Sošic, G., 2024, Supply Chain Network Design: How to Create Resilient, Agile and Sustainable Supply Chains, Kogan Page.
[4] Ravindran, A.R., Warsing Jr., D.P., and Griffin, P.M., 2023, Supply Chain Engineering Models and Applications, CRC Press
[5] Chopra, S., and Meindl, P., 2023, Supply Chain Management: Strategy, Planning, and Operation. Pearson.

ME6131E SUSTAINABILITY MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Sensitize the business professionals on their affirmative role in sustainable development
CO2: Apply green management tools for achieving sustainability
CO3: Analyse and evaluate the sustainable supply chains
CO4: Analyse and evaluate sustainability with innovation and waste management

Management of sustainability: rationale and political trends - An introduction to sustainability management - International and Indian policies on sustainable development – Sustainable development goals (SDG/SCG) and performance measures - Corporate sustainability and shared responsibility - The corporate sustainability perimeter - The corporate sustainability institutional framework - The integration of sustainability into strategic planning and regular business practices - The fundamentals of stakeholder engagement.

Sustainability management: strategies and approaches: Corporate sustainability management and competitiveness- Sustainability-oriented corporate strategies, markets and competitiveness - Green Management between theory and practice - Sustainable Consumption and Green Marketing strategies.

Environmental regulation and strategic postures: Green Management approaches and tools - Eco- design and product development according to life-cycle thinking - Environmental Management Systems and Audit techniques according to EMAS and ISO 14001.

Green engineering: Clean technologies and innovation processes - Sustainable Supply Chain Management and Procurement - Inter-organizational alliances and public-private partnerships - Measurement and communication of environmental and social performance - Fundamentals of measuring and reporting on corporate sustainability – Sustainability reporting based on global sustainability standards board – Case studies on sustainability practices.

Product certification and labels: Environmental claims - Communication and environmental footprint - Performance indicators and reporting.

Sustainability and innovation: Socio-technical transitions and sustainability - Sustainable entrepreneurship - Sustainable pioneers in green market niches - Smart communities and smart specializations.

Sustainable management of resources, commodities and commons - Energy management - Water management - Waste management.

References:

[1] Allen, D. T. and Shonnard, D. R., 2015, Sustainability Engineering: Concepts, Design and Case Studies, Pearson Education India.
[2] Bradley, A. S., Adebayo, A.O., and Maria, P., 2016, Engineering Applications in Sustainable Design and Development, Cengage learning, 2016.
[3] Cetinkaya, B.,Cuthbertson, R., Ewer, G., Klaas-Wissing, T., Piotrowicz, W., and Tyssen, C., 2011, Sustainable Supply Chain Management: Practical Ideas for Moving Towards Best Practice, Springer-Verlag Berlin Heidelberg.
[4] Daddi, T., Iraldo, F., and Testa, F., 2015, Environmental Certification for Organizations and Products: Management Approaches and Operational Tools, Routledge.
[5] Gerwig, K., 2015, Greening Health Care, Oxford University Press.
[6] Morana, J., 2013, Sustainable Supply Chain Management, John Wiley & Sons, Inc.

ME6161E DESIGN FOR CIRCULAR ECONOMY

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain foundational concepts of Circular Economy

CO2: Explain various tools of circular economy.

CO3: Apply modelling and assessment approaches in implementing Circular economy.

Introduction to Circular Economy: Challenges in traditional practices-The limits of linear consumption-Emergence of circular economy- Key concepts - waste minimization, life cycle thinking, cradle to cradle. Key strategies, and programs – Cleaner production program, Green productivity program, 3R forum.

Circular Economy Tool box- Waste minimisation, Pollution prevention, cleaner production Audit, GHG accounting, Material flow analysis, Life cycle assessment, System dynamics modelling.

12 Rs of circular economy. Sustainability modelling of CE, Smart circularity, Closing the loop, Circular economy in select sectors-Textile, steel, Agricultural and food. Overview of circular economy business models. Barriers to circular economy.

References:

[1] Charter, M. (Ed.), 2018. Designing for the circular economy. Routledge.

[2] Tambovceva, T. and Titko, J., 2020. Introduction to circular economy. Ekonomikas un kulturas augstskola.

[3] Modak, P., 2021. Practicing circular economy. CRC Press.

[4] Stahel, W.R., 2019. The circular economy: A user's guide. Routledge.

ME6162E INDUSTRIAL WASTE MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the foundational concepts of industrial waste management
CO2: Describe various industrial waste management approaches
CO3: Discuss various interfaces of industrial waste management
CO4: Elaborate the foundational concepts of e-waste management

Introduction to waste and waste management. The concept of wastivity and its interrelationship with Productivity Quality and Flexibility. Wastivity and productivity measurement. The categories of industrial systems waste. Stages and causes of waste generation in industrial systems. Waste reduction measures and systems in the industry.

Collection and disposal system of scrap, surplus, and obsolete items. Recycling and processing of industrial waste. Industrial pollution and environment control. Management of waste in industrial and service sectors. Management of manpower waste and unemployment. Management of energy waste in the national economy. Energy recycling, Waste management, and energy conservation. Total energy concept, overall energy wastivity.

Interfaces of waste management: environment control, nature conservation, resource development, Quality and Productivity Management, Business Process Reengineering. Role of legislation and government. Waste management and national planning.

Introduction to e-waste management: Life-cycle of an e-product, hazardous and non-hazardous substances in e-products, components of e-waste management, WEEE directives, REACH, Basel Convention, sustainable development and e-waste management, extended producer responsibility.

References:

[1] Woodard, F., 2001. Industrial waste treatment handbook. Elsevier.
[2] Pichtel, J., 2005. Waste management practices: municipal, hazardous, and industrial. CRC press.
[3] Bhagat-Ganguly, V., 2021. E-Waste Management: Challenges and Opportunities in India. Routledge India.
[4] Sibyala, A. K. V., 2017. Principles of Industrial Waste Management. Lambert Academia Publishig.

ME6764E AGRI-FOOD SUPPLY CHAIN MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand the fundamentals and cross-functional perspectives of agri-food supply chain.

CO2: Apply the best practices in agri-food supply chain management for performance improvement.

CO3: Demonstrate Geospatial technology in an agri-food supply chain.

Concept of agricultural food supply chain - Introduction to agri-food supply chain management, Food production - Entities in the agriculture supply chain. Operations Management in an agri-food supply chain - agri-food silos, storage of agri-food, interdepartmental linkage, public procurement and distribution system. Food manufacturing - The importance of food processing, Changing market conditions, Food processing, Application of Geospatial Technologies for agriculture. Resource Utilization - Essentials of farm business management and sustainability.

Infrastructure development for the food sector - Food hubs, Food Logistics - Movement of food, Applications of logistics in agri-food supply chain. Digital supply chain management in the era of circular and sustainable economy - ICT future trends in agri-food logistics, Application of Geospatial Technologies to map and track Food Supply Chains, Circular economy in agri-food supply chain.

Packaging in logistics, Temperature-controlled supply chains. International food supply chains, Food security and future challenges - challenges in international food supply chains, Factors affecting the future of international food systems, Managing challenges in international food supply chains.

References:

[1] Pullman, M., and Wu, Z., 2011, Food supply chain management: Economic, Social and Environmental Perspectives, Routledge

[2] Information Resources Management Association (USA), 2017, Agri-Food Supply Chain Management: Breakthroughs in Research and Practice, IGI Global

[3] Mahapatra, S., 2021, Supply Chain Management in Agribusiness, Notion Press.

[4] Raghuram, G., and Chandrasekaran, N., 2014, Agribusiness Supply Chain Management, CRC Press.

[5] de Leeuw, S., Akkerman, R., and Romero-Silva, R., 2024, Frontiers in agri-food supply chains: Frameworks and case studies, Burleigh Dodds, UK.

[6] Cramer, F., and Transchel, S., 2024, Planning and control in agri-food supply chains, Burleigh Dodds, UK.

[7] Koubaa, M., Ammar, M.H., Dhouib, D., and Mnejja, S., 2024, Optimization in the Agri-Food Supply Chain: Recent Studies, Wiley.

ME6165E ESG AND GREEN FINANCE

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand ESG foundations and sustainability principles
CO2: Interpret Indian and global ESG reporting standards
CO3: Analyze sustainable finance products (equity, debt, SRI, impact investing)
CO4: Apply ESG metrics in corporate and financial analysis

Introduction to ESG – Evolution, Concepts, Stakeholders, ESG vs CSR vs Sustainability, ESG in India — Policy Environment, NVGs, NVG-SE, Companies Act Section 135 (CSR) and Sustainable Development Goals (SDGs), Environmental Pillar: Climate science, Paris Agreement, Social Pillar: Human rights, labour, DEI, community engagement, Governance Pillar: Board structure, ethics, compliance, whistleblowing

Introduction to ESG disclosure and materiality, Global Reporting Standards: GRI, SASB, TCFD, CDP, ISSB (IFRS S1 and S2) ESG rating methodologies (MSCI, Sustainalytics, Refinitiv, CRISIL), India-Specific ESG Disclosure: SEBI BRSR (Core and Comprehensive)

Value chain disclosures, Assurance and verification processes. Case: Reading and interpreting ESG/BRSR filings

Introduction to Sustainable Finance and ESG Integration in Investments, SRI (Socially Responsible Investing), Impact Investing, Stewardship Codes, Sustainable Debt Instruments: Green Bonds, Sustainability-Linked Bonds (SLBs), Social Bonds, Transition Finance.

Indian Regulations: SEBI ESG Debt Framework, RBI Climate Risk and Green Finance Guidelines. Sustainable Equity Instruments: ESG Mutual Funds (SEBI classification), ESG indices and ETF structures, Portfolio Construction and Risk-Return with ESG parameters. Case Studies: India green bond issuances and ESG fund performance. Digital ESG: AI, Climate Data Analytics, Blockchain Use Cases

References:

[1] Krosinsky, C., and Purdom, S., 2016, Sustainable Investing: Revolution in Theory and Practice, Routledge
[2] Jeucken, M., 2015, Sustainable Finance and Banking, Routledge
[3] PRI (UN Principles for Responsible Investment) — ESG Integration Handbook
[4] Suman, V., 2023, SG and Sustainable Investing: From Principles to Practice, Notion Press

Indian Official Publications

SEBI — BRSR Framework, ESG MF Guidelines, ESG Debt Framework

MCA — NVGs and CSR Guidelines

RBI — Climate Risk and Sustainable Finance Reports

IRDAI/PFRDA — Sustainability and Risk Guidelines

ME6766E SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand the aspects in sustainable supply chains.

CO2: Analyse performance measures to achieve sustainability in supply chain operations.

CO3: Evaluate environmental, social, and governance risks in end-to-end supply chains

CO4: Develop a diagnostic analysis of sustainability in supply chain operations using relevant policies and standards

Sustainable development frameworks - Sustainable Development Goals, other frameworks, inclusiveness and resilience in supply chain. Sustainability strategies - Cases, examples, best practices, Statement on sustainable development strategy, Policy commitments Embedding policy commitments, Processes to remediate negative impacts, Mechanisms for seeking advice and raising concerns, Compliance with laws and regulations 28 Membership associations

Sustainable logistics - Cases, examples, best practices, Activities, stakeholders, Types and Environmental Management, Concept of Green Logistics, Green Transportation, Carbon Foot print Analysis, Vehicle Routing, Tools For modelling environmental Impacts LCA. Environmental dimension - Materials, Energy, Water and Effluents, Biodiversity Emissions, Waste, Supplier Environmental Assessment. Emerging energy technologies in supply chain operations. Social (including safety) dimension - Employment, Labor/Management Relations, Occupational Health and Safety, Training and Education, Diversity and Equal Opportunity, Non-discrimination, Freedom of Association and Collective Bargaining, Child Labor, Forced or Compulsory Labor, Security Practices, Rights of Indigenous Peoples, Local Communities, Supplier Social Assessment

Governance - Governance structure and composition, Nomination and selection of the highest governance body, Chair of the highest governance body, Role of the highest governance body in overseeing the management of impacts, Delegation of responsibility for managing impacts, Role of the highest governance body in sustainability reporting, Conflicts of interest, Communication of critical concerns, Collective knowledge of the highest governance body, Evaluation of the performance of the highest governance body, Remuneration policies, Process to determine remuneration, Annual total compensation ratio. Value creation - Financial, manufactured, intellectual, human, social and relationship, natural capitals and value creation from these with the business model

References:

[1] McKinnon, A., Browne, M., Poecyk, M., and Whiteing, A., 2015, Green Logistics: Improving the Environmental Sustainability of Logistics, 3rd ed., Kogan Page Publishers, London.

[2] Modak, P., 2021, Practicing Circular Economy, CRC Press, Boca Raton.

[3] Grant, D. B., Trautrims, A., and Wong, C. Y., 2017, Sustainable Logistics and Supply Chain Management: Principles and Practices for Sustainable Operations and Management, 2nd ed., Kogan Page Publishers, London.

ME6767E GREEN LOGISTICS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain foundational concepts of Green Logistics and its role in sustainable supply chains.

CO2: Analyze environmental impacts of logistics activities, including emissions, energy use and waste.

CO3: Evaluate and design strategies and tools (e.g., green transport planning, reverse logistics) to reduce ecological footprints.

CO4: Assess regulatory frameworks, standards, and best practices for implementing green logistics in industry contexts.

Introduction to Green Logistics: Role of logistics in sustainability and global supply chains, Definitions and evolution of Green Logistics and Sustainable Logistics, Drivers for green logistics: economic, regulatory, social, environmental, Comparison: traditional vs. green logistics systems, The 4Rs in sustainable logistics: Reduce, Reuse, Recycle, Recover - Green logistics linkage with broader Green SCM concepts

Environmental Impacts and Green Practices: Carbon emissions and energy consumption in logistics, Ecological footprint of freight transport, Sustainable warehousing: energy management, renewable energy, Eco-friendly packaging and materials handling solutions, Lean logistics practices, waste minimization and continuous improvement, Green ICT tools and data for environmental performance tracking

Green Transportation and Distribution: Sustainable transportation strategies and low-carbon modes, Route optimization and modal shift planning, Electric and alternative fuel vehicles, hybrid fleets, Green distribution center design and multimodal hub planning, Emission measurement, performance indices and KPIs, Integration with network design and customer service levels

Reverse Logistics and Policy Frameworks: Reverse logistics: concepts, product returns, remanufacturing - Circular economy in logistics: closing the loop - Legal, policy and regulatory frameworks (national and international) - Standards and certifications: ISO 14001, environmental reporting, carbon accounting - Case studies of organizational implementations - Future trends: digitalization (IoT/AI), blockchain for traceability, and supply chain transparency

References:

[1] Sarkis, J. and Dou, Y., 2018, Green Supply Chain Management: A Concise Introduction, 1st ed., Routledge.

[2] Fahimnia, B., Bell, M.G.H., Hensher, D.A., and Sarkis, J. (Eds.), 2015, Green Logistics and Transportation: A Sustainable Supply Chain Perspective, Springer

[3] Majeed, M., Agarwal, K., and Tijani, A., 2025, Green Supply Chain Management, CRC Press.

[4] Paksoy, T., Weber, G., and Huber, S., 2019, Lean and Green Supply Chain Management: Optimization Models and Algorithms, Springer

[5] Maniatis, P., 2025, Sustainability in Logistics and Supply Chain Management, Cambridge Scholars Publishing

ME6168E DESIGN THINKING FOR SUSTAINABILITY

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain sustainability concepts, systems thinking, and design thinking principles in addressing complex socio-technical problems.

CO2: Apply empathy-driven research and problem-framing tools to identify sustainability challenges and opportunities.

CO3: Develop innovative and sustainable solutions using design thinking tools, prototypes, and collaborative methods.

CO4: Evaluate, refine, and communicate sustainable design solutions considering environmental, social, and economic impacts.

Foundations of Sustainability and Design Thinking: Sustainability Fundamentals - Sustainable development: concepts, evolution, and debates, Triple Bottom Line (People–Planet–Profit), Weak vs strong sustainability, Planetary boundaries and ecological limits, Sustainability in business, engineering, public systems, and communities; Systems Thinking for Sustainability - Systems thinking principles, Stocks, flows, feedback loops, leverage points, Causal loop diagrams, Socio-technical systems and sustainability transitions, Wicked problems and complexity; Design Thinking Foundations - Origins of design thinking (IDEO, Stanford d.school), Design thinking vs traditional problem-solving, Human-centered design philosophy, Design thinking process models, Role of creativity, iteration, and failure

Empathy, Systems Mapping and Problem Framing: Empathy in Sustainability Contexts - Human-centered research methods, Stakeholder identification and power–interest analysis, Interviews, observation, shadowing, ethnography, Ethics of research in vulnerable communities; Understanding Context and Ecosystems- Value chain and ecosystem mapping, Social, environmental, and institutional contexts, Policy, regulatory, and cultural influences, Equity, inclusion, and social justice considerations; Problem Definition and Framing - From symptoms to root causes, Insight generation, Problem statements and “How Might We” questions, Reframing sustainability challenges as opportunities

Ideation, Prototyping and Sustainable Innovation: Ideation for Sustainability - Divergent and convergent thinking, Brainstorming, SCAMPER, biomimicry, Nature-inspired and regenerative design, Co-creation and participatory design; Sustainable Design Strategies - Circular economy principles, Product-Service Systems (PSS), Design for environment (DfE), Sustainable business model innovation, Social innovation and frugal innovation; Prototyping and Iteration - Low-fidelity and high-fidelity prototyping, Physical, digital, and service prototypes, Rapid experimentation and feedback loops, Failure, learning, and iteration

Impact Evaluation, SDGs and Communication: Sustainability Impact Assessment - Environmental impact indicators, Social impact and stakeholder value, Economic viability and scalability, Introduction to life cycle thinking, Trade-offs and unintended consequences; Alignment with SDGs - Overview of UN SDGs and targets, Mapping solutions to SDGs, Measuring contribution to sustainability goals, Local–global sustainability linkages; Communication and Implementation - Storytelling for sustainability, Visual communication and design narratives, Pitching to policymakers, investors, communities, Implementation roadmaps and change management, Reflection and learning documentation

References:

[1] Sheffield, R., Koul, R., Bawa, S., Tee, L., Milbourn, B., and Ayoub, M., 2023, Design Thinking for Sustainability Education: Utilising the Sustainable Development Goals for Impactful Teaching and Learning, Routledge.

[2] Sherin, A., 2018, Sustainable Thinking: Ethical Approaches to Design and Design Management, Bloomsbury Publishing India Private Limited.

[3] Meadows, D. H., 2008, Thinking in Systems, Chelsea Green Publishing.

[4] Brown, T., 2009, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation – From the IDEO CEO: Creative Strategies for Business Leaders at Every Level, Harper Business.

[5] Manzini, E., 2015, Design, When Everybody Designs: An Introduction to Design for Social Innovation, MIT Press.

ME6169E SUSTAINABLE MOBILITY

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the principles of sustainability in transport systems in relation to the UN SDGs
CO2: Design and evaluate urban transport strategies for sustainable urban mobility
CO3: Assess emerging technologies for smart and sustainable cities
CO4: Conduct environmental and social impact assessments of transport systems

Foundations of Sustainable Mobility: Concept of Sustainability in Transport, Triple bottom line: environmental, economic, social dimensions, Defining sustainable mobility vs. conventional mobility, Global Challenges: Traffic congestion, urban sprawl, rising emissions, Road safety and accident statistics, Equity issues: access for vulnerable groups. SDGs and Transport: SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), Transport's role in achieving global sustainability goals

Urban Transport Planning and Policy: Land-Use and Transport Integration; Transit-oriented development (TOD); Compact city design and mixed-use planning; Public Transport Planning; Bus Rapid Transit (BRT), metro, light rail, suburban rail; Service design: frequency, coverage, reliability; Non-Motorized Transport: Pedestrian infrastructure, cycling networks, Safe Street design and complete streets concept. Policy Instruments: Congestion pricing, fuel taxes, parking management, Incentives for public transport and active mobility, Regulatory frameworks for emissions and safety.

Technology and Innovation in Mobility: Electric and Hybrid Vehicles; EV infrastructure: charging stations, grid integration, Battery technologies and lifecycle impacts. Intelligent Transport Systems (ITS): Smart traffic signals, adaptive control, Real-time traveller information systems, Shared Mobility: Ride-hailing, car-sharing, bike-sharing platforms, Impacts on congestion and emissions. Digitalization and Smart Cities, Mobility-as-a-Service (MaaS) platforms, Integration of transport apps and payment systems, Role of big data and AI in transport planning.

Environmental and Social Impact Assessment: Transport-Related Emissions: Greenhouse gases (CO_2, CH_4, N_2O), Local pollutants (NOx, PM, SO_2), Noise, Safety, and Health, Noise mapping and mitigation strategies, Road safety audits and Vision Zero approach: Public health impacts of air pollution and sedentary lifestyles, Life Cycle Assessment (LCA), Pavement and infrastructure sustainability, Tools: OpenLCA, GIS-based models. Equity and Accessibility: Transport justice: affordability, inclusivity, Accessibility for elderly, disabled, and low-income groups.

Future Directions and Case Studies: Mobility in Developing Countries: Challenges: informal transport, rapid urbanization, funding gaps. Case studies from India: Delhi Metro, Bangalore Metro, e-rickshaws. Climate Change Mitigation and Adaptation: Low-carbon transport pathways. Resilient infrastructure against floods, heatwaves, and extreme weather. Resilient Transport Systems: Disaster preparedness and recovery in transport networks, Redundancy and robustness in system design. Global Best Practices: Copenhagen cycling culture, Medellín's metro and cable cars for social inclusion, Shenzhen's electric bus fleet.

References:

[1] Black, W.R., 2010, Sustainable Transportation: Problems and Solutions, Guilford Press.
[2] Banister, D., and Button, K., 1992, Transport, the Environment and Sustainable Development, Routledge.
[3] Vasconcellos, E.A., 2014, Urban Transport, Environment and Equity: The Case for Developing Countries, Routledge.
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[6] Shaheen, S., Cohen, A., and Zohdy, I., 2016, Shared Mobility: Current Practices and Guiding Principles. U.S. Department of Transportation, Federal Highway Administration.
[7] OECD, 2020, Decarbonising Urban Mobility with Land Use and Transport Policies: The Case of Auckland, New Zealand, OECD Publishing.
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[9] UN-Habitat, 2013, Planning and Design for Sustainable Urban Mobility: Global Report on Human Settlements 2013. UN-Habitat / Routledge.

ME6170E SUSTAINABLE ORGANISATIONAL DEVELOPMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain core concepts and theories of sustainable organisational development using systems and stakeholder perspectives.

CO2: Analyse organisational strategies, structures, and cultures for sustainability and long-term value creation.

CO3: Apply leadership, human resource, and change management frameworks to sustainability-driven organisational transformations.

CO4: Evaluate organisational sustainability performance using ESG metrics, reporting frameworks, and case evidence.

Foundations of Sustainable Organisational Development: Evolution of Organisational Development (OD), Sustainability and sustainable development: concepts and challenges, Triple Bottom Line (TBL), Shared Value, Doughnut Economics, Systems thinking and organisations as socio-technical systems, Stakeholder theory and organisational legitimacy, Sustainable Development Goals (SDGs) and organisational alignment

Sustainable Strategy, Governance, and Organisational Design: Sustainability-driven organisational strategy, Sustainable and resilient business models, Organisational structures for sustainable performance, Corporate governance, ethics, and accountability, Embedding sustainability in vision, mission, and culture, Regulatory and institutional influences on organisations

Human Capital, Leadership, and Sustainable Change: Sustainable Human Resource Management (SHRM), Green HRM and employee engagement, Organisational culture and sustainability values, Leadership for sustainability and ethical decision-making, Change management models (Lewin, Kotter, ADKAR), Managing resistance to sustainability-oriented change

Digital Transformation, ESG, and Sustainability Performance: Digital transformation and organisational sustainability, Role of AI, IoT, and analytics in sustainable organisations, Circular economy and regenerative organisational models, Sustainability performance measurement and KPIs, ESG frameworks and reporting standards (GRI, SASB, TCFD), Organisational resilience, risk management, and future trends

References:

[1] Cummings, T. G., and Worley, C. G., 2020, Organization Development and Change. Cengage.
[2] Elkington, J., 1997, Cannibals with Forks: The Triple Bottom Line of 21st Century Business. Capstone.
[3] Senge, P. M., 2006, The Fifth Discipline. Doubleday.
[4] Porter, M. E., and Kramer, M. R., 2011, Creating shared value. Harvard Business Review.
[5] Lozano, R., 2018, Sustainable Business Models. Springer.
[6] Galbraith, J. R., 2014, Designing Organizations. Jossey-Bass.
[7] Cameron, K. S., and Quinn, R. E., 2011, Diagnosing and Changing Organizational Culture. Jossey-Bass.
[8] Beer, M., and Nohria, N., 2000, Cracking the code of change. Harvard Business Review.
[9] Renwick, D. W. S., Redman, T., and Maguire, S., 2013, Green human resource management. International Journal of Management Reviews.
[10] Kane, G.C., Palmer, D., Phillips, A.N., Kiron, D., and Buckley, N., 2015, Strategy, not technology, drives digital transformation. MIT Sloan Management Review.
[11] Epstein, M. J., and Buhovac, A. R., 2014, Making Sustainability Work. Berrett-Koehler.
[12] Lacy, P., and Rutqvist, J., 2015, Waste to Wealth. Palgrave Macmillan.

ME6146E INVESTMENT MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand the roles and functions of the stock market
CO2: Conduct Macro economic analysis and Estimate the risks of investments
CO3: Evaluate the investment instruments to optimize the portfolio
CO4: Understand and evaluate the derivatives as an investment instrument

Investment Management: An overview; Investment environment: - securities and market, investment process – Financial instruments: Money market instruments, capital market instruments.

Primary Market: Role and functions, Modes of raising funds - Secondary Market: Role and functions - Trading and Settlement Procedures, Leading Stock Exchanges in India. Stock Market Indicators- Types of stock market Indices, Indices of Indian Stock Exchanges.

Macro Economic analysis: Fundamental analysis – Company Analysis - Technical Analysis: Concept, Theories: Dow Theory, Eliot wave theory - Charts-Types, Trend and Trend Reversal Patterns. Mathematical Indicators – Moving averages, ROC, RSI, and Market Indicators

Modern Portfolio theory

Types of Risk: Systematic risk, Unsystematic risk, Calculation of Risk and returns of individual security,

Portfolio analysis: Markowitz Model, Portfolio Selection, Opportunity set, Efficient Frontier - Capital Asset pricing model: CAPM Equation, Security Market line, Capital market line, SML VS CML.- Arbitrage pricing theory: Arbitrage, Equation, Assumption, Equilibrium, APT AND CAPM

Portfolio Management: Diversification, Investment objectives, Risk Assessment, Selection of asset mix, Risk, Return and benefits from diversification. Portfolio Management Strategies: Active and Passive Portfolio Management strategy. Portfolio Revision: Portfolio Revision Strategies – Objectives, Performance plans. Portfolio Evaluation: Holding period's returns, Measures of portfolio performance. Sharpe's, Treynor's and Jenson's.

Investment evaluation and Derivatives

Fixed income securities: - Types, Bond valuations, Bond analysis and portfolio management, Mutual

Funds – Call and Put options (American and European), Black-Scholes option pricing model – Derivatives: Forward contracts, Future contracts, Payoff for futures - International investing.

References:

[1] Khan M.Y., and Jain P. K., 2019, Financial Management, Tata McGraw Hill.
[2] Chandra, P., 2008, Financial Management; Tata McGraw Hill, New Delhi.
[3] Reilly, F. K., and Brown, K. C., 2011, Investment Analysis and Portfolio Management, Cengage Learning.
[4] Sharpe, W. F., Alexander, G. J., and Bailey, J. V., 2019, Investments, Prentice Hall.
[5] Fabozzi, F. J., and Peterson, P. P., 2003, Financial Management and Analysis, Wiley.

ME6163E NEGOTIATIONS AND STAKEHOLDER MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Apply advanced knowledge of negotiation strategies to identify high-priority issues, trade-offs, aspirations

CO2: Understand and evaluate core strategies of influence and persuasion

CO3: Critically apply stakeholder management frameworks to classify key stakeholders, synthesize stakeholder analyses

Foundations of Advanced Negotiation: Distributive vs. Integrative vs. Compatible Negotiations. Best Alternative To a Negotiated Agreement (BATNA), Zone of Possible Agreement (ZOPA), Reservation Price and Walk-Away Points, Multi-issue trade-offs and Pareto Efficiency. Identifying High-Priority Issues and Trade-Off Structures: Issue mapping and negotiation scorecards, Aspiration setting vs. satisficing, Value creation vs. value claiming.

Psychological Dynamics in Negotiation: How assumptions, heuristics, emotions affect negotiation, Attribution errors and emotional contagion, Self vs. counterpart emotional, cultural dimensions, regulation. Obstructing vs. Facilitating Negotiation Behaviours: Hardball tactics, aggression, anchoring, misinformation, Trust-building, reframing, problem-solving dialogue. Ethics in Negotiation: Ethical dilemmas across cultures and organisations, Transparency vs. confidentiality constraints

The Science of Influence and Persuasion: Core persuasion frameworks (Cialdini, Aristotle, Conger, etc.), Formal authority vs. informal influence. Cognitive Biases and Decision-Making Under Uncertainty: Confirmation bias, loss aversion, status-quo bias, Endowment effect, framing, anchoring, Debiasing strategies for negotiators. Communication Effectiveness in High-Stakes Negotiations: Dialogue models, active listening, signalling and messaging, Managing silence, pacing, and credibility

Stakeholder Identification and Classification: Power–Interest matrix, Salience model (Power–Legitimacy–Urgency), Influence networks and informal coalitions. Stakeholder Analysis Commercial Contexts: OEMs, Tier-1 suppliers, alliances, Industry ecosystems and diplomatic actors. Building Rapport, Trust and Coalitions: Reputation, reciprocity and social capital, Trust diagnostics and restoration techniques, Coalition-building and maintenance strategies. Linking Stakeholder Analysis to Negotiation Strategy: Matching stakeholder type to negotiation tactic, Alignment of financial and relational outcomes. Negotiation Plan Development: Agenda setting, Issue packaging and sequencing, Multi-round negotiation planning, Contingency planning and escalation protocols

Applied Simulations: Multi-party negotiation simulation, Reflection and critical behavioural analysis

References:

[1] Lewicki, J., Saunders, D.M., and Barry, B., 2025, Negotiation, 8th ed., McGraw Hill

[2] Shell, G. R., 2006, Bargaining for Advantage Negotiation Strategies for Reasonable People, Penguin USA

[3] Cialdini, R., 2021, Influence: The Psychology of Persuasion, Harper Business

[4] Freeman, R.E., Harrison, J.S., and Zyglidopoulos, S., 2018, Stakeholder Theory: Concepts and Strategies, Cambridge University Press

ME6171E INVENTORY MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the concept of inventory and inventory control techniques.
CO2: Apply inventory control models in deterministic scenarios.
CO3: Apply inventory control models in probabilstic scenarios.
CO4: Compare and contrast different collaboration methods used to enhance supply chain performance.
CO5: Analyse and interpret the causes and consequences of the bullwhip effect in supply chains.

Fundamentals of Inventory Management: Stocks and Inventories, Reasons for holding inventory, Types of inventory, Functions of inventory, properties of inventory, Strategic role of inventory, Inventory costs, Approaches to inventory control, Inventory problem classification, Selective control techniques.

Independent demand systems: Deterministic models - Fixed order size system – Economic order quantity, Economic production quantity, Quantity discounts (all units, and incremental), Sensitivity, Economic Production Quantity for multiple items, Fixed order interval systems.

Discrete Demand Systems: Deterministic Models - Lot-for-Lot Ordering, Periodic Order Quantity, Wagner-Whitin Algorithm, Silver-Meal Algorithm, Part-Period Algorithm, Incremental Part-Period Algorithm, Implications for Discrete Lot Sizing.

Independent demand systems: Probabilistic models- Safety Stock, Known Stockout Costs- Constant Demand and Constant Lead Time, Variable Demand and Constant Lead Time, Constant Demand and Variable Lead Time, Variable Demand and Variable Lead Time Service Levels; Fixed Order Interval Systems.

Vendor Managed Inventory (VMI) and collaborative supply chain: Concept of Vendor Managed Inventory (VMI), Operational simulation for analyzing effect of VMI in supply chain, Statistical and multi-criteria analyses, Blockchain-based secure information sharing platform for supply chain management, Demonstration of blockchain based operation simulation.

Inventory management in supply chain: Concepts of inventory distribution management in supply chains, Inventory costs, Inventory management under certainty and risk, Simulation of a serial supply chain under P-system of inventory control using Excel, supply chain as a multi-agent system, AI/ML application in supply chain order management and coordination.

Performance analysis of inventory models in supply chains: Variants of periodic inventory models, Parameter setting for performance analysis under different inventory models in serial and divergent supply chains, Performance analysis using software packages for different supply chain structures.

References:

[1] Pillai, V. M., 2017, Supply Chain Role Play Game (SCRPG) exercise handout and user manuals of SCRPG and VMI-SCRPG, Department of Mechanical Engineering.
[2] Pillai, V. M., 2022, Supply chain management game: revealing implied demand uncertainty, white paper, Department of Mechanical Engineering.
[3] Pillai, V. M., 2016, Performance analysis of a four-echelon supply chain under order up-to policy using SCIPA software package, Department of Mechanical Engineering.
[4] Tersine, R. J., 1994, Principles of Inventory and Materials Management, Prentice-Hall Inc., New Jersey.
[5] Kurian, D. S., Pillai, V. M., and Gautham, J., 2023, Data-driven imitation learning-based approach for order size determination in supply chains, European Journal Industrial Engineering, 17(3), pp. 379 – 407.
[6] Sunny, J., Pillai, V. M., Nath, H. V., Shah, K., Ghoradkar, P. P., Philip, M. J., and Shirswar, M., 2022, Blockchain-enabled beer game: a software tool for familiarizing the application of blockchain in supply chain management, Industrial Management and Data Systems, 122(4), pp. 1025-1055.

ME6172E QUALITY MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Analyse the link between quality and cost and assess the impact of quality costs on an organization.

CO2: Design and interpret control charts for variables and attributes for controlling and improving the quality of products, processes and services.

CO3: Design different acceptance sampling plans and analyse the risks related to quality aspects while using them

CO4: Develop house of quality for product quality improvement.

Principles of Quality Management: Introduction to Quality Management, Evolution of Quality Management, definitions of quality and related terms as per ASQ and ISO, Concepts of Product and Service Quality, Dimensions of Quality, Deming's, Juran's, Crosby's Quality Philosophy, Quality Cost, TQM framework; customer satisfaction: customer perception of quality, voice of customer; continuous process improvement.

Process Quality Improvement: Introduction to Process Quality, Process variation and sources, Graphical and statistical techniques for Process Quality Improvement, 7 QC tools, use of control charts, statistical basis of the control charts, derivation and choice of control limits, construction and interpretation of control charts for variables and attributes, rational sub groups, control chart sensitivity, OC curve, average run length, phase I and phase II control chart application; Process failure mode and effect analysis (PFMEA), Six sigma for Process Improvement, ISO 9001 and QS 9000, Quality Audit, Quality Circles

Sampling, sampling distribution, and hypothesis Testing: The acceptance-sampling problem, lot formation and sampling, guidelines for using acceptance sampling, type A and type B OC curve, binomial nomograph, rectifying inspection, average outgoing Quality limit (AOQL), average total inspection, double, multiple, and sequential sampling, ASN curve, sampling systems, MIL STD 105E, switching rules, Dodge–Romig plans; Process capability analysis Measurement system analysis; Analysis of Variance (ANOVA); Design and Analysis of Experiment (DOE)- Robust Design and Taguchi Method

Product Quality Improvement: Quality Function Deployment, Design Failure Mode and Effect Analysis, Product Reliability Analysis, Six Sigma in Product Development

References:

[1] Montgomery, D.C., 2018, Statistical Quality Control- A Modern Introduction, 6th ed. Wiley-India, New Delhi.

[2] Juran, J.M., and Gryna, F.M., 1995, Quality Planning and Analysis, 3rd ed. Tata McGraw-Hill, New Delhi.

[3] Grant, E.L., and Leavenworth, R.S., 2000, Statistical Quality Control, 7th ed. Tata McGraw-Hill, USA.

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[6] Krishnamoorthi, K.S., and Krishnamoorthi. P.V., 2019, A First Course in Quality Engineering, CRC Press

[7] Edward, G.S., and Dean, V.N. 2017, Acceptance Sampling in Quality Control, CRC Press, Boca Raton.

ME6173E PROJECT MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Describe types of projects, project life cycle, and various methodologies of project management.
CO2: Perform project economic analysis
CO3: Apply tools and techniques for scheduling the project under resource constraints
CO4: Apply techniques to monitor, control and close the project

Project Planning: Introduction to project management, Project life cycle, Triple constraints in PM, Project management approaches, Cost of project, Learning curves in cost estimation, Capital budgeting techniques in project management, NPV, IRR, MIRR, Social cost benefit analysis, UNIDO approach, Net benefit in terms of economic prices, Measurement of impact on distribution, Savings impact and its value, Income distribution impact, Adjustment for merit and demerit goods, Little Mirrlees approach, Shadow prices.

Project Implementation: Development of project network, Dummy activities, Activity on node networks, Cyclic network, Forward pass and Backward pass computations, Algorithm for critical path, Total slacks, free slacks and their interpretations. Time-cost Trade off Procedure: Schedule related project costs, Time cost trade off, Lowest cost schedule. PERT Network: Three time estimates for activities, Estimation of mean and variance of activity times, Event oriented algorithm for critical path, Probability of meeting a schedule date.

Linear Programming Formulation of Network Problems: A flow network interpretation for determination of critical paths, Time cost trade off and maximal flow, Chance constrained linear programming for probabilistic durations of activities in PERT network. Project Scheduling with Limited Resources: Complexity of project scheduling with limited resources, Levelling the demands on key resources, A simple heuristic program for resource allocation. Integer programming formulation.

Project Review and Administrative Aspects: Initial review, Project risk analysis, Performance evaluation, Abandonment analysis, Project organization, Matrix organization, Project control, Variance analysis approach, Performance analysis.

References:

[1] Pinto, J. K., 2015, Project Management: Achieving Competitive Advantage, Pearson.
[2] Weist, J. D., and Levy, F. K., 1994, A Management Guide to PERT/CPM, Prentice Hall of India, New Delhi.
[3] Larson, E W., Gary, C. F., and Joshi, R., 2021, Project Management: The Managerial Process, 8th ed., McGraw Hill.
[4] Chandra, P., 2019, Projects: Planning, Analysis, Selection, Financing, Implementation, and Review, McGraw Hill Education (India).
[5] Chapman, C., and Ward, S., 2003, Project Risk Management: Processes, Techniques and Insights, John Wiley and Sons Ltd.
[6] Hillson, D. A., and Murray-Webster, R., 2007, Understanding and Managing Risk Attitude, Gower Publications Ltd.
[7] A guide to the Project Management Body of Knowledge, 2017, Project Management Institute.

ME6174E LEAN SERVICE MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain Lean principles, value, and waste concepts
CO2: Analyze processes using Lean tools and performance metrics
CO3: Apply Lean methods such as 5S, Kanban, Kaizen, and JIT
CO4: Evaluate Lean implementation, leadership, and improvement strategies

Introduction- History of Lean: The Toyota Production System, Lean manufacturing vs lean service operations, Lean Thinking, Organizing human activities, Five Principles of Lean

Value- The Value Stream, Flow, Pull, Perfection, Types of Waste- Tangible vs intangible waste, Value-added versus non-value-added activities in work, Eight types of waste in service operations, Using the wrong metrics to measure waste, Measuring Performance, Observing processes, Understanding the key aspects of a KPI, Time as a critical factor, Systems Thinking

Managing for the future, Deming's systems thinking in service industries, Preparing the Enterprise for Lean, Lean processes, The continuous improvement cycle, Realigning metrics, Overcoming resistance, Pilot projects, Implementing Lean in Your Organization

Organizing the teams, applying technology and tools, Developing people and partners, Tracking work with Kanban, Kaizen workshops, Process Mapping, Using workflow diagrams, Order-to-delivery cycle, Value Stream Mapping, Lean measurements, Creating current and future state maps, Value Stream Analysis

The 5 S methodology, Just-in-time, Built-in-quality, Promoting Lean Thinking across the Enterprise, Tools + culture change, Coaching, Developing communication and feedback channels, Focus on long-term learning, Being data-driven, Assessing the Results of Lean

Lean maturity matrix, Tracking performance, Benchmarking against other companies, Developing Lean Leaders, Setting up a Lean leadership team, Creating a succession system, Complimentary Methodologies, Agile and Scrum, Six Sigma

References:

[1] Bertagnolli, F., 2022, Lean Management - Introduction and In Depth Study of Japanese Management Philosophy, Springer
[2] Womack, J. P., and Jones, D. T., 2003, Lean Thinking: Banish Waste and Create Wealth in Your Corporation. Simon and Schuster.
[3] Liker, J. K., 2014, The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer. McGraw-Hill.
[4] Radnor, Z. J., and Holweg, M., 2018, Lean in Healthcare: The Unseen Agenda, CRC Press
[5] Dennis, P., and Baines, T., 2018, Essentials of Services Marketing, Routledge
[6] Liker, J. K., and Franz, D. M., 2018, The Toyota Way to Service Excellence: Lean Transformation in Service Organizations, McGraw-Hill Education
[7] Poksinska, B., 2017, Lean Thinking for Healthcare, Springer
[8] Found, P., 2018, Lean Higher Education: Increasing the Value and Performance of University Processes, Palgrave Macmillan
[9] Liker, J. K., 2017, The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, McGraw-Hill Education
[10] Sobek II, D. K., and Smalley, A., 2018, Understanding A3 Thinking: A Critical Component of Toyota's PDCA Management System, CRC Press

ME6775E SUPPLY CHAIN CONTRACTS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Understand the legal and strategic foundations of supply contracts and their role in supply chain dynamics.

CO2: Identify and differentiate various types of supply contracts and their applications in different supply chain contexts.

CO3: Apply negotiation techniques and risk mitigation strategies to design and manage effective supply relationships.

CO4: Evaluate contractual performance, dispute resolution mechanisms, and governance practices aligned with supply chain objectives.

Foundations of Supply Chain Contracts: Introduction to Contracts in Supply Chain Management, Role and importance of contracts in SCM, Contract law basics (offer, acceptance, consideration, enforceability), Contract lifecycle management, Legal and Ethical Considerations, Legal environment and compliance, Ethical issues in contract management, Regulatory frameworks impacting supply contracts

Types and Structures of Supply Contracts: Standard Contract Types, Fixed-price, cost–plus, time and materials, and incentive contracts, Long-term vs. short-term contracts, Service Level Agreements (SLAs), Framework Agreements, Advanced Contract Arrangements, Revenue sharing, gain/pain sharing, Contractual terms for capacity, quality, delivery, penalties - Digital contracts and smart contracts (emerging trends)

Contract Negotiation and Risk Management: Negotiation Strategies and Tactics, Preparation, bargaining, closing techniques, Multi-party negotiations in supply networks, Risk Identification and Mitigation, Contract risks: price, delivery, quality, performance - Incentive alignment and risk allocation, Dispute resolution and remedies

Contract Performance and Governance: Performance Measurement and Compliance, KPIs in supplier performance, Contract compliance systems, Contract Governance and Relationship Management, Supplier relationship management, Continuous improvement and renegotiation, Case studies of contractual success and failure

References:

[1] Sieke, M., 2008, Supply Chain Contract Management: A Performance Analysis of Efficient Supply Chain Contracts, Springer Fachmedien Wiesbaden.

[2] Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., and Ji, J., 2022, Designing and managing the supply chain: Concepts, Strategies, And Case Studies, 4th ed., Mc Graw Hill

[3] Shah, J., 2009, Supply Chain Management: Text and cases, Pearson Education India.

[4] Zhao, Y., Meng, X., Wang, S., and Cheng, T. C.E., 2016, Contract Analysis and Design for Supply Chains with Stochastic Demand, Springer

[5] Jané, J., and de Ochoa, A., 2006, The Handbook of Logistics Contracts: A Practical Guide to a Growing Field, Palgrave Macmillan UK

[6] Macbeth, D.K., 2019, Supply ecosystems: interconnected, interdependent and cooperative operations, supply and contract management, World Scientific Publishing Company

ME6144E MANAGEMENT OF TECHNOLOGY AND INNOVATION

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Develop an understanding of the "state of the art" of the strategic management of technology and innovation in both large and small firms.

CO2: Develop a conceptual framework for assessing and auditing the innovative capabilities of a business organization.

CO3: Consider all three aspects of innovation: creativity, implementation and marketing and to have an understanding of Design Thinking

CO4: Understand the directions of Intellectual Property Rights and how to take advantage of opportunities for IP-based innovation

Understanding Management of Technology, key concepts, critical factors in managing technology – creativity factor, timing factor, technology-price relationship, managing change – Process of technological change: Technology life cycles (supply side) - Diffusion (market side), methods of diffusion – technology and competition

Formulation of strategy – Methods used in strategic analysis: Product evaluation matrix, BCG matrix, X-Y coordinate positioning, M-by-N matrix, technology evaluation for adoption decision, SWOT matrix – Formulation of technology strategy: Technology and core competence, linking technology and business strategies, creating the product-technology-business connection. Technology planning: Technology forecasting, technology audit models, technology roadmap matrix, planning based on technology life cycles, B-Tech approach to planning – case discussion.

Design thinking process - New product development process: strategic and operational phase – Approaches to speeding product development: Internal organizational mechanisms, intra-organizational mechanisms, external organizational mechanisms: acquisition and deployment of technology, methods of acquiring technology, exploitation of technology – Case discussion.

Deployment of technology in value chain – Intellectual property strategy: Mechanisms for Intellectual property protection- Technology evaluation and financing – changing role of R and D

References:

[1] Burgelman, R. A., Christensen, C. M., and Wheelwright, S. C., 2009, Strategic Management of Technology and Innovation, McGraw-Hill/Irwin.

[2] Khalil, T., and Shankar, R., 2017, Management of Technology: The key to competitiveness and wealth creation, McGraw Hill Education.

[3] Narayanan, U. K., 2001, Managing Technology and Innovation for competitive Advantage, Pearson Education, Asia.

[4] White, M. A., and Burton, G. D., 2011, The Management of Technology and Innovation: A strategic approach, Cengage Learning.

ME6176E RELIABILITY ENGINEERING AND RISK ANALYSIS

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Analyze failure data and hazard models to estimate reliability measures such as failure rate, MTTF, and system reliability.

CO2: Evaluate the reliability of engineering systems using series, parallel, k-out-of-m, mixed, and Markov-based reliability models.

CO3: Apply fault tree, event tree, redundancy, maintenance, and availability models to improve system reliability and performance.

CO4: Assess economic trade-offs in reliability engineering and use reliability data for effective reliability management decisions.

Failure data analysis: Failure data, mean failure rate, Mean time to failure (MTTF), Mean time between failure, MTTF in terms of failure density; Hazard models: Constant hazard, Linearly increasing hazard, Weibull model, gamma model, nonlinear hazard model – Derivation of reliability function using Markov model.

System reliability models: Systems with components in series, system with parallel components, k-out of-m systems, non-series-parallel systems, system with mixed mode failures, fault tree techniques; Redundancy techniques in system design: Component versus unit redundancy, mixed redundancy, standby redundancy, redundancy optimization, double failures and redundancy.

Fault-tree analysis: Fault tree construction, calculation of reliability from fault tree, Event-tree analysis - Maintainability and availability concepts, two unit parallel system with repair; Preventive maintenance, k-out-of-m systems.

Economics of reliability engineering: Economic issues, reliability achievement cost models, reliability utility cost models, availability-cost model for parallel systems Reliability Management by objectives – reliability data acquisition and analysis.

References:

[1] Balagurusamy, E., 2017, Reliability Engineering, McGraw Hill Education India P Ltd.

[2] Srinath, L.S., 2016, Reliability Engineering, East West Press, Reprint.

[3] Birolini, A., 2007, Reliability Engineering Theory and Practice, Springer

ME6177E ACCOUNTING AND FINANCE FOR MANAGEMENT

Pre-requisites: NIL

L	T	P	O	C
3	0	0	6	3

Total Lecture Sessions: 39

Course Outcomes:

CO1: Constructing, analysing and evaluating the financial statements
CO2: Understanding, applying and estimating the product and process costs for evaluating the decisions
CO3: Analyse and evaluate the time value of money and thereby the capital investments
CO4: Analyse and evaluate the tradeoffs involved in capital investment theories

Introduction to Accounting: Forms of ownership, Conceptual basis of accounting – Financial statements: Components, Construction of profit and loss and balance sheet – Working with financial statements, ratio analysis, DuPont analysis.

Cost Management Concepts: Concepts of cost, cost behavior and cost-volume-profit (CVP) relationships, cost functions, semi-variable cost measurement, applications - Activity based costing – Variable and absorption costing – Process costing – Cost variances analysis.

Time value of money: stock valuation, bond valuation. Capital budgeting: traditional techniques, identifying relevant cash flows (effect of depreciation, working capital effect, single proposal), discounted cash flow techniques. Measurement of Cost of capital: cost of debt, cost of preference shares, cost of equity capital, computation of overall cost of capital. Short-term financial planning: computation of working capital requirement.

Financial and operating and combined leverage - Capital structure theories: Net Income approach, Net operating income approach Modigliani-Miller approach.

References:

[1] Ramachandran, N., and Kakani, R. K., 2013, Financial Accounting for Management, McGraw Hill Education.
[2] D'Souza, D., 2023, Indian Accounting Standards. Snow White Publication.
[3] Khan, M. Y., and Jain, P. K., 2019, Financial Management, Tata McGraw Hill.
[4] Khan, M. Y., and Jain, P, K.,2008, Management Accounting, Tata McGraw Hill Delhi.
[5] Chandra, P., 2022, Financial Management: Theory and Practice, Tata McGraw Hill.
[6] Horngren, C. T., Sundem, G. L., Elliott, J. A., and Philbrick, D. R., 2018, Introduction to Financial Accounting, Pearson Education.
[7] Horne, V., 2015, Fundamentals of Financial Management, Pearson Education.