Curriculum

for

Master of Technology

in

Industrial Engineering and Management

(IEM)

Department of Production and Industrial Engineering

Delhi Technological University

Shahbad-Daulatpur, Delhi-110042

M.Tech. (Industrial Engineering and Management)

M.Tech. (Industrial Engineering & Management) course is meant for those candidates, who are aspiring of higher education in the area of Industrial Engineering & Management. The basic purpose of the course is to serve the society and the nation through teaching, research and development in the area of Industrial Engineering & Management. Our aim is to build a center of excellence to give the interdisciplinary exposure of Industrial processes to improve the organizational efficiency and effectiveness.

The primary research interests fall into three broad themed areas:

- **Decision Science and modelling in management**
- **Sustainable Development**
- **Production and Operations Management**

The overall purpose of the proposed M.Tech. Programme is to establish a cohesive and expanding base of research in Industrial Engineering & Management. It will help in the sustainable growth of the industry, excellence in integrated research and education, and increase in national and international stature and economic competitiveness of Indian industries.

Nowadays, Industrial Engineering and Management has attracted the attention of the researchers and practitioners to solve the industrial problems considering the sustainability and inclusive growth. Demand for the goods and services have been increasing day by day, but the availability of the resources is limited. Thus, It becomes important to improve the way of operations and design of the systems so that the resources can be conserved for future generation. It is important for the industry, society and nation to fulfil the need of the people without harming the ecological systems. The professional must be given a proper exposure of the sustainable growth of the economy. Considering these points, the curriculum of Industrial Engineering & Management has been designed including the recent development in the technology, industrial constraints, and need of the society. There are many recent topics that are included in the curriculum such as Industry 4.0, Circular Economy, Sustainability, Safety and Disaster Management, etc.

The students graduated in this course will be able to handle the difficult situation by proper decision making. They will get the exposure of all the major industrial processes related to the materials management, resource planning, quality management, knowledge management, shop floor management, work design and ergonomics, supply chain management, e-commerce, management information systems, etc.

University Vision

"To be a world class university through education, innovation and research for the service of humanity "

University Mission

1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.
2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.
3. To create environment of collaboration, experimentation, imagination and creativity.
4. To develop human potential with analytical abilities, ethics and integrity.
5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

Program Educational Objectives PEOs

The objectives of the M.Tech. Programme in Industrial Engineering and Management are:

PEO 1: To develop the scientific and engineering manpower of high quality to cater the need of the industries and institutes.

PEO 2: To provide a broad concept of Industrial Engineering & Management.

PEO 3: To provide a deeper understanding of the area of specialization to solve the industrial problems.

PEO 4: To create some innovations for sustainable manufacturing systems.

PEO 5: To provide a capacity to learn continually and interact with interdisciplinary groups.

PEO 6: To develop the students with a capability to cater the requirements and aspirations of the society.

Program Outcomes (PO)

PO1: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: An ability to demonstrate expertize over the area as per the specialization of the program.

Programme Specific Outcomes (PSOs)

PSO 1: Apply software skills in the field of decision making, optimization, simulation and modeling, statistics for optimal utilization of the different resources and improving the efficiency and affectiveness of the various processes in the industry.

PSO 2: Recognize the need for lifelong learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PSO 3: The student will be employable, able to develop entrepreneurship and be equipped in applying knowledge of Industrial Engineering and management in solving various real time problems and also pursue higher studies.

With these objectives in mind, the M.Tech. Programme has been designed to include courses of study, practicals/seminars and project/thesis through which a student may develop his/her concepts and intellectual skills. The procedures and requirements stated in this proposal embody the philosophy and regulations of the M.Tech. education and ensure a high standard of performance at the University and industries.

This will certainly expand the demonstrated capability of the University in the area of Industrial Engineering & Management applications and to explore research activities that broaden and expand research expertise in this field. It will definitely find appropriate opportunities for educational outreach activities and training courses for other institutes and universities near Delhi to create awareness and to stimulate interest in Industrial Engineering & Management.

Eligibility Criteria: Students with Bachelor degree (4-years degree Programs; B.Tech./B.E/B.Sc.Engg., and equivalent degree) in any branch of Engineering will be eligible to take admission in this program. This program (M.Tech. in Industrial Engineering and Management) is interdisciplinary in nature. For scholarship a valid GATE Score is mandatory.

Total Intake: 25

M. Tech (*Industrial Engineering and Management*) Scheme

Semester -I

	Courses	Credits	Type	L-T-P	Total Credits
Group A	IEM-501: Data Analytics	4	**Core**	3-0-2	
	IEM-503: Production & Operations Management	4	**Core**	4-0-0	
Group B	IEM-54XX: Elective Type 1	4	Elective	3-0-2	**17**
	IEM-53XX: Elective Type 2	3	Elective	3-0-0	
	IEM-52XX: Elective Type 3	2	Elective	2-0-0	

Semester -II

Courses		Credits	Type	L-T-P	Total Credits
Group C	IEM-502: Operations Research	4	**Core**	3-0-2	
	IEM-504: Supply Chain Management	4	**Core**	4-0-0	
Group D	IEM-54XX: Elective Type 4	4	Elective	3-0-2	**17**
	IEM-53XX: Elective Type 5	3	Elective	3-0-0	
	IEM-52XX: Elective Type 6	2	Elective	2-0-0	

Semester -III

Courses		Credits	Type	L-T-P	Total Credits
Group E	Track 1*				
	IEM-651: Research Project	12			**12**
	OR				
	Track 2				
	IEM-601: Project-1	3	Core		
	IEM-64XX: Elective Type 7	4	Elective	3-0-2	
	IEM-63XX: Elective Type 8	3	Elective	3-0-0	
	IEM-62XX: Elective Type 9	2	Elective	2-0-0	

Semester -IV

Courses		Credits	Type	L-T-P	Total Credits
Group F	Track 1*	12	Core		
	IEM-652: Research Project				**12**
	OR				
	Track 2				
	IEM-602:Project-2	12	Core		

Marks Distribution

SI.No	Type of Course	Credit	L	T	P	CWS	PRS	MTE	ETE	PRE	Total
1.	Core	4	3	0	2	15	25	20	40	-	100
2.	Elective	4	3/4	0	2/0	15/20	25/0	20/30	40/50	-	100
3.	Elective	3	3	0	0	20	-	30	50	-	100
4.	Elective	2	2	0	0	20	-	30	50	-	100

List of Electives

Semester -I		Credits & L-T-P
Group C		
Elective Type 1	IEM-5401: AI/ML in Industrial Engineering and Management IEM-5403: Modelling & Simulation IEM-5405: Decision Science Modelling IEM-5407: Product Design & Development	4(3-0-2)
Elective Type 2	IEM-5301: Enterprise Resource Planning IEM-5303: Financial Management IEM-5305: Total Quality Management IEM-5307: Innovation and Entrpreneurship	3(3-0-0)
Elective Type 3	IEM-5201: Live Industry Project IEM-5203: Management Information Systems IEM-5205: Principles of Management IEM-5207: Maintenance Management IEM-5209: Contemporary Issues in Industrial Engineering and Management	2(2-0-0)
Semester -II		
Group D		
Elective Type 4	IEM-5402: Reliability Engineering IEM-5404: Industry 4.0 & Smart Manufacturing IEM-5406: Physical and Cognitive Ergonomics IEM-5408: Supply Chain Analytics	4(3-0-2)
Elective Type 5	IEM-5302: Service Operations Management IEM-5304: International Logistics & Warehousing Management IEM-5306: Infrastructure Management IEM-5308: Industrial Economics	3(3-0-0)
Elective Type 6	IEM-5202: Value Engineering IEM-5204: Retail Supply Chain IEM-5206: Energy Management Systems IEM-5208: Industrial Waste Management IEM-5210: Contemporary Issues in Industrial Engineering and Management	2(2-0-0)

Semester -III		
Group E		
Elective Type 7	IEM-6401: Six –Sigma and Lean Manufacturing IEM-6403: Method Engineering and Work Design IEM-6405: Advanced Operations Reseach IEM-6407: Computer Integrated Manufacturing & Robotics	4(3-0-2)
Elective Type 8	IEM-6301: Human Resource Development & Industrial Psychology IEM-6303: Knowledge Management IEM-6305: Global Business Management IEM-6307: Reverse Logistics	3(3-0-0)
Elective Type 9	IEM-6201: e-Commerce IEM-6203: Safety and Disaster Management IEM-6205: Facility Planning & Design IEM-6207: Humanitarian Supply Chain IEM-6209: Contemporary Issues in Industrial Engineering and Management	2(2-0-0)

IEM-501: Data Analytics

Probability Theory: Sample Spaces- Events - Axioms – Counting - Conditional Probability and Bayes' Theorem – The Binomial Theorem – Random variable and distributions: Mean and Variance of a Random Variable-Binomial-Poisson-Exponential and Normal distributions.

Curve Fitting and Principles of Least Squares- Regression and correlation. Sampling Distributions & Descriptive Statistics: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Sampling distributions (Chi-Square, t, F, z).

Test of Hypothesis- Testing for Attributes – Mean of Normal Population – One-tailed and two-tailed tests, F-test and Chi-Square test, Analysis of variance ANOVA – One way and two-way classifications. Tabular data- Power and the computation of sample size- Advanced data handling

Multiple regression- Linear models- Logistic regression- Rates and Poisson regression

Nonlinear curve fitting. Density Estimation- Recursive Partitioning- Smoothers and Generalised Additive Models - Survivals Analysis- Analysing Longitudinal Data- Simultaneous Inference and Multiple Comparisons- Meta-Analysis- Principal Component Analysis- Multidimensional Scaling Cluster Analysis.

Introduction to R- Packages- Scientific Calculator- Inspecting Variables- Vectors Matrices and Arrays- Lists and Data Frames- Functions- Strings and Factors- Flow Control and Loops- Advanced Looping- Date and Times.

Introduction to Python Packages- Fundamentals of Python- Inserting and Exporting Data- Data Cleansing Checking and Filling Missing Data- Merging Data- Operations- Joins.

Books:

1. Richard Cotton, "Learning R", O'Reilly, 2013.

2. Dalgaard, Peter, "Introductory Statistics with R", Springer Science & Business Media, 2008.

3. Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, LLC, 2014.

4. Samir Madhavan, "Mastering Python for Data Science", Packt, 2015.

5. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 4th edition, Academic Press; 2009.

6. Paul Teetor, "R Cookbook, O'Reilly, 2011. 7. Mark Lutz," Learning Python", O'Reilly,5th Edition,2013

IEM-503: Production & Operations Management

Managing operations; planning and design of production and operations systems. Service characteristics. Facilities planning location, layout, and movement of materials. Line balancing. Analytical tools and techniques for facilities planning and design.

Production forecasting. Aggregate planning and operations scheduling, Production Planning and Control. Purchasing, Materials Management, and Inventory control and JIT Material Requirements Planning. MRPII, ERP, Optimization techniques applications.

Work-Study, Value Engineering, Total quality & statistical process control. Maintenance management and equipment policies. Network planning and control. World-class manufacturing and factories of the future, Case studies.

Books:

1. Operations Management by Jay Heizer and Berry Render, Pearson Learnings.
2. Operations Management by Russell and Taylor, John Wiley and Sons.

IEM-502: Operations Research

Linear Programming Problem, Simplex technique, Big-M and Two-phase method, Duality and Post Optimal Sensitivity Analysis.

Integer Linear Programming- Gomory's Cutting plane and Branch & Bound methods.

Network Models-Shortest Path problem, Spanning tree problem, Maximum flow problem, Travelling salesman problem.

Goal Programming, Queuing Models.

Books:

1. Operations Research by Hamdy A.Taha, 6/e, PHI
2. S. S. Rao, Optimization Techniques, Wiley Eastern
3. Operations Research by J.K.Sharma, McMillan.
4. Operations Research by Panneerselvam, PHI

IEM-504: Supply Chain Management

Role of supply chain management in Economy and Organization- Introduction to SCM, Evolution, Key concepts, Decisions, and Importance of SCM. Supply chain strategy and Performance Measures- Competitive supply chain strategies, CRM strategy, Supplier relationship strategy- Performance Measures (Financial, Productivity, Quality and cycle time). Supply chain drives- Introduction, Facilities, Inventory, Transportation, and Information. Supply chain design- Network design and operation models.

Sourcing and Transportation- Role of sourcing, Supplier selection and contracts, Procurement process, Role of Transportation, Design options for the transportation network.

Planning and Managing Inventories-Introduction, cycle/safety/seasonal stock, Inventory for short life cycle products, Multi echelon inventory, Bullwhip Effect, Risk Pooling.

Information Technology in SCM- Role of IT, E-business and future trends. Supply chain innovations- Introduction, Supply chain integration, Restructuring, Agile supply chains, Case studies.

Books:

1. Designing and Managing the Supply Chain: David Simchi-Levi, Philip Kaminsky, Edith Simchi – Levi, Ravi Shankar, Mc Graw Hill Education, 2008

2. Supply chain management text and cases: Janat Shah, Pearson Education, 2009.

3. Supply chain management strategy, planning, and operation, Sunil Chopra, Peter Meindl, PHI.

4. Supply chain management: Chopra, Pearson Education, 2009. 5. Business logistics/ Supply chain management, 5/e: Ballou, Pearson Education.

IEM-5401: AI/ML in Industrial Engineering and Management

Artificial Intelligence: Decoding Artificial Intelligence, Fundamentals of Machine Learning and Deep Learning, Machine Learning Workflow, Performance Metrics

Machine Learning Applications: Basics of Machine Learning, The Machine Learning Process, Into Machine Learning working cycle, Preparing Data, Running Experiments, Finding the Model, Training the Model, Deploying and using a Model, Machine Learning in practice (examples of existing or future applications in the field of manufacturing)

References: Refer Various Research Articles

IEM-5403: Modelling & Simulation

Introduction to systems and modelling: discrete and continuous system, Limitations of simulation, areas of application, Monte Carlo Simulation. Discrete event simulation and their applications in queueing and inventory problems.

Random number generation and their techniques, tests for random numbers Random variable generation – Analysis of simulation data, Input modelling – verification and validation of simulation models – output analysis for a single model.

Simulation languages and packages - ARENA, QUEST, VMAP - Introduction to GPSS – case studies - Simulation of manufacturing and material handling system.

Books:

1. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., NewJersey, 1984.

2. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.

3. Law, A.M. and W.D. Keltor, 'Simulation modelling analysis', McGraw Hill, 1982.9

IEM-5405: Decision Science Modelling

Decision-Making Models and Theories, Decisions Involving Multiple Objectives, Multiple Objective Decision Making Problems Through SMART and Alternative Models, Decision Making under Risk and Uncertainty, Decision Trees, Influence Diagrams and Bayesian Networks, System Dynamic Models, Group Decision-Making & Negotiations.

Application of fuzzy sets in optimization and decision-making problems,

Multi-criteria decision-making tools-AHP & ANP, Best-Worst Method, TOPSIS, ELECTRE, PROMETHEE, DEMATLE, VIKOR.

Data Envelopment Analysis: Return to scale, CCR, and BCC models.

Books:

1. Multiple Criteria Decision Making in Supply Chain Management by *Ravindran, A. Ravi, CRC Press.*
2. Decision Sciences: Theory and Practice: Dutta, Jaydeep, Gupta, Aparna, Sengupta, Raghunandan, Cengage Learning.

IEM-5407: Product Design & Development

Product definition, New product development concept, product development process, consumer behaviour, identifying customer needs. Establishing product specification, concept generation, concept selection, and product architecture. Industrial design, design for manufacturing prototyping, Economic analysis of new products. Test marketing and commercialization of new products.

Books:

1. Chitle A. K and Gupta R.C, Product Design and Manufacturing, PHI
2. Saunders, M.S.and Mc Cornic E.J., 'Human Factors in Engineering & Design', McGraw Hill.
3. Ulrich K. T and Eppinger S.D, Product Design and Development, Mc Graw Hill.

IEM-113: Enterprise Resource Planning

IEM-115: Financial Management

IEM-5301: Enterprise Resource Planning

ERP: An Overview - Benefits of ERP - ERP and Related Technologies - Business Process Reengineering (BPR).

Data Warehousing - Data Mining - On-line Analytical Processing (OLAP) - Supply Chain Management.
ERP Implementation - ERP Implementation Lifecycle - Implementation Methodology Vendors, Consultants and Users - Contracts with Vendors, Consultants and Employees Project Management and Monitoring.

Business Modules in an ERP Package - ERP Market - ERP-Present and Future – Turbo Charge the ERP System.

Enterprise Integration Applications (EIA) - ERP and E-Commerce - ERP and Internet Future Directions in ERP.

Books
1. Alexis Leon, ERP Demystified, Tata McGraw–Hill Publishing company limited, New Delhi, 2002
2. Brady, Enterprise Resource Planning, Thomson Learning, 2001
3. S.Sadagopan, ERP: A managerial Perspective, Tata McGraw-Hill publishing company Limited, New Delhi 1999

IEM-5303: Financial Management

Financial Statement: balance sheet, P&L accounts, Financial analysis, liquidity ratios, leverage ratio, profitability ratios and activity ratios.

Profit planning: Break even analysis, marginal analysis, EPS, P/E ratio, Return- on-Investment leverage.

Capital Budgeting: Nature of Capital budgeting Decisions, time value of money, Various approaches to evaluate investment proposals.

Risk and required return: Capital asset theory, weighted average required return, determination of required return, valuation of the firms common stock. Short term and long term financial decisions: Sources of short-term finance, Sources of long term financing: convertible securities, warrants, effective cost of long term debt. **Dividends policies and decisions**: Nature of dividend decision, factors affecting dividend decisions, alternative form of dividends, developing dividend policies.
Books:
1. Chandra Prasanna, Financial Management, Theory & Practice, Tata McGraw Hill.

2. Kuchal, S.C. Financial Management & Analytical and Conceptual Approach, Chitanaya Publishing House, Bombay.

3. John J. Humpton, Financial Decision-Making, Prentice Hall India.

4. I.M. Pandey, Financial Management, Vikas Publishing House.

IEM-5305: Total Quality Management

Concepts of TQM: Philosophy of TQM, Quality philosophies of Deming, Crossby. Juran Trilogy, Customer Focus, Organization, Top management commitment, Teamwork.

TQM process: QC tools, Problem-solving methodologies, New management tools, Work habits, Quality circles, Benchmarking, Strategic quality planning.

TQM systems: Quality function deployment, Standardization, Designing for quality, Manufacturing for quality, Failure Mode Effect Analysis.

Statistical Process Control; Advanced Analytical Tools Statistical Design of Experiments; Taguchi Approach; Cost of Quality; Reliability and failure analysis. FMECA, Quality Function Deployment, Benchmarking, Concurrent Engineering.

Quality system: Need for ISO 9000 system, Advantages, Clauses of ISO 9000, Implementation of ISO 9000, Quality costs, Quality auditing, Case studies.

Implementation of TQM: Steps, KAIZEN, 5S, JIT, POKA YOKE, Case studies.

Environment Management Systems: Need for proper Environment Management Systems and their economic implications. Environment Management Systems, Green Products and Strategies, Environment Assessment: Environment Protection Act, ISO 14000, Case Studies.

Text Books:

1. Total Quality Management by Besterfield et al., Pearson Education, India, 2009

2. The Essence of Total Quality Management by John Bank, PHI, 1993.

3. Total Quality Management by Rose, J.E., Kogan Page Ltd., 1993

IEM-5307: Innovation and Entrepreneurship

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioural; entrepreneurial challenges.

Entrepreneurial Opportunities: Opportunities. discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering

Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision-making process and approaches, Effectuation and Causation.

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer-focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources, and selection of venture finance options and its managerial implications. Policy Initiatives and focus; the role of institutions in promoting entrepreneurship.

Books

1. Ries, Eric(2011), The Lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.
2. Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch.
3. S. Carter and D. Jones-Evans, Enterprise and small business- Principal Practice and Policy, Pearson Education (2006)
4. T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)

IEM-5201: Live Industry Project

In this elective, the students will take a live project from the industry. The evaluation will be based on the submission of the project report and its presentation.

IEM-5203: Management Information Systems

Concepts of MIS: Global factors responsible for the growth of information systems, Types of Information Systems Evolution of information theory, Characteristics of management information System, Richard Nolan MIS Stages theory, Information Resource Management, Management information system organization functions MIS Long-range planning Meaning and role of MIS in an organization. Analysis and design of information systems;

Conceptual modelling of data and process in organizations: System development life cycle model, Methods of collection of data, tools for modelling and analysis of data: Concept of DataBase Database management systems and its functions Data flow diagram, Data dictionary, Data banks. Tools for modelling and analysis of processes: Flow charts, Decision tables, Decision trees. Transform analysis, Transaction analysis. Information systems audit. Impact of MIS on organizations. The usefulness of various industrial engineering techniques in the design of MIS.

Books:

1. Management Information Systems, Lauden and Lauden, PHI (1999)

2. Management Information Systems by Jerome kanter

3. Management Information Systems by Davis Gordon.

IEM-5205: Principles of Management

Management principles: Management functions, Roles & Skills, History of management thought - Various theories and approaches to management, Management by objectives

Formal and informal organizations: Organisation structure and design – Organization principles of line and staff authority and span of control.

Motivation Theory: Concept of Motivation, Maslow Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory, McGregor's Theory X and Theory Y and Theory Z, Motivational applications.

Decision Making: Planning process, tools, and techniques: Fundamentals of Directing, Decision-making process, approaches, and aids.

Leadership: Concept of Leadership, Leadership theories, Leadership Styles, Concept of Power and Concept of Authority and Responsibility, Delegation, decentralization, and autonomy

Communication: Concept of Communication, types of communication, aids, and Barriers in communication, Conflict, and Coordination.

Managerial control-need and principles: Role of information in control - Control methods and techniques - Managerial ethics and social responsibility.

Text Books:

1. Principles and Practice of Management by L.M. Prasad.

2 Introduction to Management by Plankett, W.R. and Attner, R.F., Kent Publishing Company.

IEM-5207: Maintenance Management

Reliability: Hazard rate, mean time to failure. Hazards models. Constant hazard Weibull model.
System Reliability: Series, parallel, and mixed configurations. k-out-of-n-structure. Economics of introducing a standby or redundancy into a production system, optimum

design configuration of a series/parallel system: maximizing reliability subject to budgetary constraint optimum level of active parallel redundancy for equipment with components subject to failure.

Maintainability: Maintainability increment Equipment and mission availability.

Replacement Decisions: Economic models block replacement policy, age replacement policy, replacement policies to minimize downtime, the economics of preventive maintenance.

Inspection Decisions: Optimal inspection frequency to profit-maximizing, minimization of downtime, and availability maximization.

Overhaul and Repair Decisions: Optimal overhaul/repair/replace maintenance policies for equipment subject to breakdown finite and infinite time horizon. Optimal repair effort of a maintenance workforce to meet fluctuating taking into subcontracting opportunities.

Spares Provisioning: Spares provisioning for single and multi-echelon systems under budgetary constraints. Maintenance Organisation: Computer application in maintenance management, MIS for maintenance.

Books:

1. Gopalakrishnan, P. and Banerji, A.K. (2009), Maintenance and Spare Parts Management, PHI Learning.

2. Srivastava, SK. (2012), Maintenance Engineering Principles, Practices and Management, S.Chand Publishers.

IEM-5209: Contemporary Issues in Industrial Engineering and Management

In this elective subject, there will be liberty to consider the contemporary issues in the industry and find the solutions.

IEM-5402: Reliability Engineering

Introduction: Concepts of quality and reliability, a brief history, terms, definitions, reliability function, MTTF, Hazard rate function, bathtub curve, conditional reliability.

Constant failure rate models: Exponential reliability, failure modes, failure modes with exponential distribution, applications, two parameters exponential distribution, Poisson process.

Time-dependent failure models: Weibull distribution, burn-in screening for Weibull, three-parameter Weibull distribution, Normal and Lognormal distributions

Reliability of systems: Series, parallel configurations, combined systems, k-out-of-n systems, complex configurations, common failure modes, minimal cuts, and minimal paths. State-dependent systems: Markov analysis, load sharing, standby systems, degraded systems

Physical reliability models: Static models- random stress and random strength, dynamic models periodic models, random loads.

Design for reliability: Reliability specification, Lifecycle costs, reliability allocation, design methods, failure analysis, FTA.

Reliability testing: Life testing, burn-in testing, acceptance testing-binomial acceptance testing. Reliability growth testing: Reliability growth process, idealized growth curve, Duane growth model.

Text Book:

1. Introduction to Reliability and Maintenance engineering by Charles E Ebeling, Tata McGraw-Hill, India.
2. Introduction to Reliability Engineering by E.E. Lewis, John Wiley& Sons, New York Reliability-based design by S.S.Rao, McGraw-Hill, New York

IEM-5404: Industry 4.0 & Smart Manufacturing

Introduction to Industry 4.0: Definition of Industry 4.0, The Various Industrial Revolutions, Digitalisation, and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services **Cyber-Physical Systems (CPS) and Cyber-Physical Production Systems (CPPS):** cyber-physical systems (Definitions, demarcation to embedded systems, ubiquitous computing, etc.), Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems, Control theory, and real-time requirements, Self-organization principles ("Self-X", autonomy, negotiations), Communication in cyber-physical systems, Design Methods for Cyber-physical Systems (Modelling, Programming, Model-Integrated Development), Applications for cyber-physical systems.

Cloud Manufacturing and the connected factory: Virtualization, Cloud Platforms, Big data in production, Cloud-based ERP and MES solutions, Connected factory applications, IT security for cloud applications.

Big Data Analytics: introduction to the technology used for Big Data analytics and applications in various fields.

3D printing: Introduction to 3D printing and its applications.

Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Related Disciplines, Cyber Security

Business issues in Industry 4.0: Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Books: (Refer various research articles)

1. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, APRESS.
2. Handbook of Industry 4.0 and SMART Systems by Diego Galar, Pascual Pasquale Daponte, Uday Kumar, CRC Press.

IEM-5406: Physical and Cognitive Ergonomics

Definition, History, and Scope of Human Factors/Ergonomics: Principles of fitting design configurations to the users; Man-machine-environment interaction system: A design perspective; Human compatibility, comfort, and adaptability;

Physical aspects of human factors: anthropometrics, human body structure, and function, posture, joint movement, and biomechanics;

Occupational stress and Musculoskeletal disorders: Safety and health issues;

Cognitive aspects of user-system interaction: perception, information processing, user behavior, error and risk perception;

Principles of human factors in visual communication: Visual display in different planes-static shape, size, font type, and dynamic characters of display;

Environmental factors influencing human performance; Participatory ergonomics aspects

Books:

1. Bridger, R., Introduction to Ergonomics, 3rd Ed., CRC Press, Taylor & Francis Group, 2009.
2. Sanders, M., McCormick, E., Human Factors in Engineering and Design, 7th Ed., McGraw-Hill International Editions: Psychology Series, 2013
3. Wicknes, C., Gordon, S., Liu, Y., and Gordon-Becker, S., An Introduction to Human Factors Engineering, Longman, New York, 2015
4. Chakrabarti, D., Indian Anthropometric Dimensions for ergonomic design practice, National Institute of Design, Ahmedabad, 1997
5. Salvendy, G. (ed.), Handbook of Human Factors and ergonomics, 4th Ed., John Wiley & Sons, Inc., 2012
6. Dul, J., Weerdmeester, B., Ergonomics for beginners, a quick reference guide, 3rd Ed., CRC Press, Taylor & Francis Group, 2008.

IEM-5408: Supply Chain Analytics

Introduction to mathematical modelling as a tool to address challenges in production logistics and supply chains. Problem formulation and choice of modelling. Linear, dynamic, non-linear, and stochastic programming. Flow and network modelling. Queueing models and Markov chains. Some analytical results and use of discrete event simulation. Monte Carlo simulation. Stochastic inventory models. Forecasting. Reliability and maintenance of the production line. Synchronization of maintenance and production activities. Models and visualization of cyber-physical systems in real-time. Decision trees. Expected Utility theory.

Books

1. Márquez Adolfo Crespo (2010) "Dynamic Modelling for Supply Chain Management: Dealing with Front-end, Back-end and Integration Issues", Springer
2. Simchi-Levi, David, Chen, Xin, Bramel, Julien (2014), "The Logic of Logistics Theory, Algorithms, and Applications for Logistics Management", Third Edition, Springer, ISBN- 978-1- 4614-9149-1
3. Tang Christopher S, Teo Chung-Piaw and Wei Kwok-Kee (Eds) (2008), "Supply Chain Analysis: A Handbook on the Interaction of Information, System and Optimization", Springer, ISBN-13: 978-0- 387-75239-6

IEM-5302: Service Operations Management

Understanding the Nature of Services: Introduction and imperatives of services, Nature, and characteristics of services, Classification of services and analyzing service operations.

Aligning Service Strategy and Service Competitiveness: - Introduction to Service Strategy, Competitive Service Strategies, Strategic Service Vision.

Service Design, Development & Automation: New service design and development, Service system design and delivery process, Technology & automation in services, Service encounter

Managing Human Resources in Services: Human resource planning & employee selection, - Managing people in Services organization, Work measurement in Services.

Service Quality: Defining Service Quality, Quality Service by Design, Service process control, Total quality management tools, Quality philosophy and performance excellence, - Service recovery and Service guarantee.

Capacity Management or Supply Management in Services: - Service Capacity Management, Yield Management, Resource and Workforce Scheduling in Services.

Service Inventory and Supply Chain Management: - Service Inventory Management, Service Supply Chains, Processes in Service Supply Chain. The Transition to Service Economies, Service Science, Service Supply Chains Versus Manufacturing Supply Chains, Service Supply Chain Models.

Quantitative Models in Managing Service Operations: Data Envelopment Analysis, Application of simulation in service operations management, Vehicle routing, and scheduling, Case studies.

Books:

1. B. Fitzsimmons, James A., and Mona J. Fitzsimmons, Service Management: Operations, Strategy, and Information Technology, 6th Ed., Irwin/McGraw-Hill, 2007.

2. C. Haksever, Render B., Russel S. R. and Murdick R. G., Service Management and Operations, 2nd Ed., Prentice-Hall, 2007.

IEM-5304: International Logistics & Warehousing Management

Globalization and International Trade: Growth in International Trade Measuring Logistics Performance, Globalisation, Outsourcing, Offshoring Failures in Outsourcing, Evaluating and Selecting Outsourcees, Outsourcer and Outsourcee Relationship Development, Supply Chain Integration, Supply Chain Collaboration

Transport in Supply Chains: Characteristics of the Different Transport Modes, Transport Operations, Distribution Centres and the Role of Factory Gate Pricing, Efficiency of Transport Services, Transport Security, Piracy, Global Transport Security Initiatives, Transport Security Technology, Fourth-Party Logistics, Selecting Logistics Service Providers and Services.

Warehousing and Materials Handling: Warehousing In Global Supply Chains, Warehouse Layout And Design, Warehouse Management Systems, Materials Handling And Storage, Work Organisation And Job Design.

Supply Chain Vulnerability, Risk, Robustness, and Resilience: Changing Times and an Uncertain World, The Shortcomings of Risk Management The Need for Holistic Approaches. **Sustainable Logistics and Supply Chain Systems**: The 'Green Revolution' and Supply Chain Redesign, The Link Between Economic Growth and Transport Growth, The Role of 'Scale' in Logistics and SCM Efficiency Solutions.

Reverse Logistics: Definition, Motivations for Reverse Logistics, Recovery Options in Reverse Logistics, Characteristics of the Remanufacturing Environment in Reverse Logistics, Factors for Successful Reverse Logistics Implementation Performance Measures in Reverse Logistics,Case Studies.

Books:

1. **Global Logistics and Supply Chain Management (2nd Edition)** Mangam, Lalwani, Butcher, & Javadpour, John Wiley & Sons, 2nd Edition, 2011
2. Logistics and Supply Chain Management, Martin Christopher, Pearson Education Limited

IEM-5306: Infrastructure Management

Definitions of infrastructure; Typical infrastructure planning steps; Planning and appraisal of major infrastructure projects; Screening of project ideas; Life cycle analysis; Multi-criteria analysis for comparison of infrastructure alternatives; Procurement strategies; Scheduling and management of planning activities;

Economic Analysis – Concepts and Applications, Principles of methodologies for economic analysis of public works, Social welfare function, indifference curves, and trade-offs, Demand curves and price elasticities; Benefit-cost ratio and internal rate of return; Shadow pricing; Accounting for risk and uncertainty;

Financial Evaluation - Time value of money, Investment criteria, Project cash flows – elements and basic principles of estimation, Financial estimates and projections, Cost of capital, Rate of return; Project risk analysis; Political and social perspectives of infrastructure planning; Case studies.

Books:

1. A. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
2. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
3. Chandra, Projects: Planning, analysis, selection, financing, implementation, and review, Tata McGraw-Hill, New Delhi, 2009.
4. J. D. Finnerty, Project financing - Asset-based financial engineering, John Wiley & Sons, New York, 1996.
5. A. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
6. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
7. L. Squire and H. G.van der Tak, Economic analysis of projects, John Hopkins University Press, London, 1975.
8. T. J. Webster, Managerial economics: Theory and practices, Elsevier, New Delhi, 2003.

IEM-5308: Industrial Economics

Introduction: Definition and Scope of Engineering Economics; Origins of Engineering Economy; Principles of Engineering Economics; Engineering Economy and Design Process; Problem solving and Decision making - Intuition and Analysis, Tactics and Strategy, Sensitivity and Sub-optimization, Accounting and Engineering Economy Studies. **Economic Theory and Managerial Economics:** Basic Economic Tools in Managerial Economics - Opportunity cost principle, Incremental Principle, Principle of time perspective, Discounting Principle and Equi- marginal Principle; Managerial Economist - Role and responsibilities.

Simultaneous Equation model.

Theory of Firm: Objectives of Business Firms- Profit as Business Objective - Accounting Profit vs. Economic Profit; Brief explanation of theories of Profit- Walker's theory, Clark's Dynamic theory, Hawley's risk theory of Profit, Knight's theory of Profit and Schumpeter's Innovation theory of Profit; A Reasonable Profit Target - Reasons and Standards; Profit as a control measure.

Theory of Production: Importance of Production function; Laws of returns to scale -phases of returns to Scale; Economies of Scale: Internal- Labor, Technical, Marketing Managerial, Financial and Economies of survival; External Economies; Advantages and Limitations of Large - Scale and Small Scale Production.

Monetary Policy: Meaning and Scope of Monetary Policy, Objectives, Central Bank and Instruments of Monetary Policy, Limitations of Monetary Policy.

Fiscal Policy: Meaning, Definition Objectives, and Instruments and limitations of Fiscal Policy.

Foreign Investment: Introduction, Types, Need for Foreign Direct Investment in Developing Countries.

Time Value of Money, Cost Accounting and Depreciation, Project comparison and selection

Books:

1. Engineering Economics by William G. Sullivan, James A. Bontaldelli and Elin M. Wicks, Pearson Education Asia, Delhi, 2001.

2. Engineering Economy and Management by Pravin Kumar, Wiley India, 2019

3. Engineering Economics**,** James L. Riggs, David D. Bed Worth and Sabah U. Randhawa**,** Tata

IEM-5202: Value Engineering

An overview of value engineering (VE) - Definition, Concepts, and approaches of value analysis and engineering – evaluation of VE.

Evaluation of function, Problem setting system, problem-solving system, setting and solving management-decision – type and services problem, evaluation of value. Results accelerators, Basic steps in using the systems Value analysis - Understanding the decision environment, Effect of value analysis on other work in the business.

VE Team, Co-ordinate, designer, different services, definitions, construction management contracts, value engineering case studies, Effective organization for value work, function analysis system techniques-FAST diagram.

Books:

1. Parker, D.E.," Value Engineering Theory", Sundaram Publishers, 1990.

2. Miles, L.D., “Techniques of Value Engineering and Analysis”, McGraw Hill Book Co., 2nd End., 1972.

3. Tufty Herald, G. Compendium on Value Engineering, The Indo American Society, 1st Edn., 1983

IEM-5204: Retail Supply Chain

Retail Supply Chain: Introduction, Definition, Types, Merchandise Replenishment and Budgeting. Retail Pricing, Drivers of Retail Supply Chain change, Retail Product Lifecycle Management, Retail Distribution and Replenishment, Retail Logistics, Retail Supplier Relationship Management, Retail customer relationship management.

Supply Chain Risk, Retail Supply Chain Metrics, Product Types—Value to the Customer. Corporate Social Responsibility, Sustainability, and the Retail Industry.

Assessing Retail SCM Skills, organizing to Improve Retail Supply Chain Performance, Collaboration with Supply Chain Partners, Demand-Driven Supply Chain, Product Tracking along Retail Supply Chains

Retail Return Loops: Types of Returns, Opportunities in Returns, Case Studies.

Books:

1. Supply chain management for Retailing by Rajesh Ray, McGraw Hill, Delhi.
2. Retail Supply Chain Management by James B. Ayers, Mary Ann Odegaard, CRC Press.

IEM-5206: Energy Management Systems

Introduction: Energy Scenario – World and India, Energy Resource Availability in India, Energy Consumption, Energy-intensive industries – an overview, Need for Energy Conservation, Role of an Energy Manager, Principles of Energy Management. Energy conservation Act 2003.

Instruments for Energy auditing: Instrument characteristics – sensitivity, readability, accuracy, precession, hysteresis, Error and Calibration, Measurement of Flow, Velocity, Pressure, Temperature, Speed, Lux, Humidity, Analysis of the stack, Water quality, Fuel quality, and Power

Energy Audit: Definition and Concepts, Types of Energy Audits – Basic Energy Concepts – Energy audit questionnaire, Data Gathering – Analytical Techniques. Energy Consultant: Need of Energy Consultant – Consultant Selection Criteria

Energy Conservation: Technologies for Energy Conservation, energy flow networks – a critical assessment of energy usage, Boilers, Thermic fluid heater, Furnaces, Waste heat recovery systems, Thermal storage systems, Steam traps, Refractories, Insulation - Optimum Thickness Synthesis of alternative options and technical analysis of options, Process integration.

Economic Analysis: Scope, Characterization of an Investment Project – Types of Depreciation – Time Value of money – budget considerations, Risk Analysis.

Methods of Evaluation of Projects: Payback – Annualized Costs, Investor's Rate of return – Present worth, Internal Rate of Return, Pros and Cons of the common methods of analysis – replacement analysis.

Books:

1. Energy Management Handbook by W.C. Turner (Ed)

2. Management by H.Koontz and Cyrill O Donnell

3. Financial Management by S.C. Kuchhal

4. Energy Management by W.R.Murthy and G.Mc Kay

5. Hamies, Energy Auditing and Conservation. Methods and Measurements, Management and Case study, Hemisphere, Washington, 1980

6. Energy Management by Trivedi, PR, Jolka KR, Commonwealth publication, New Delhi

7. Guide book for National Certificate Examination for Energy Managers and Energy Auditors (www.energymanagertraining.com)

IEM-5208: Industrial Waste Management

Introduction to waste and waste management. The concept of wastivity and its inter-relationship 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.

Books:

1. Industrial Waste Treatment Handbook, 1st Edition, Butterworth-Heinemann
2. Principles of Industrial Waste Management, Alina Covali, LAPLAMBERT Academic Publishing, Mauritiu
3. Waste Management Practices: Municipal, Hazardous, and Industrial, Second Edition, by John Pichtel

IEM-5210: Contemporary Issues in Industrial Engineering and Management

In this elective subject, there will be liberty to consider the contemporary issues in the industry and find the solutions.

IEM-6401: Six –Sigma and Lean Manufacturing

Lean & Six Sigma – Introduction, Lean - Evolution & Steps, Introduction to Lean Manufacturing, Lean - Specify Value - Quality at Source.

Total Productive Maintenance: 5S Concepts, 5S Implementation Lean - Identify Value Stream - Process Mapping, Lean - Pull - Visual Controls, Lean - Pull - Push & Pull Systems, Lean - Pull – JIT Statistics - Data & Descriptive Statistics, Statistics - Distributions,

Process Variations & Sigma, Six Sigma: Overview, Six Sigma (basics and history of the approach, methodology, and focus), the application of Six Sigma in production and service industries, Relationship of Six Sigma and Lean Management, linking Six Sigma project goals with organizational strategy; Basic description of the DMAIC methodology

Fundamental of Quality: Contribution of quality gurus, quality cost. statistical process control & process capability. Acceptance Sampling plans for attribute and variable. Taguchi quality loss function and concept of robust design. Concept of six sigma, FMEA, QFD, Poka Yoke. **ISO 9000 series of standard**, QS 9000, TQM, Quality circles. Benchmarking. Reliability.

Books:

1. Becoming Lean - Inside Stories of U.S. Manufacturers, Jeffrey K. Liker, Productivity Press, Portland, Oregon

2. The Six Sigma Handbook, Third Edition, Thomas Pyzdek & Paul Keller, McGraw-Hill

IEM-6403: Method Engineering and Work Design

Work-study: Concept of work and productivity – Productivity measurement - Methods Study Charting techniques – Elemental motions, THERBLIGS and principles of Motion Economy

Work measurement - Timing techniques - Introduction to predetermined motion time standards. Concept of standard time and benchmark jobs.

Human factors engineering: Introduction to ergonomics and human factors Engineering physiological basis of human performance - Biomechanics - Psychology of work and workload perception - Physical work environment - Basis of ergonomic problem identification - Safety.

Organization and methods: Procedure, analysis, and developing office standards - MTM application to office work - Forms design and control - Records management. Job evaluation and incentive scheme: Job description and job analysis - Job evaluation - different methods - Individual and group incentive concepts and implications - Different types of incentive schemes.

Books:

1. Introduction to Work Study, I.L.O., 3rd Revised Edn., 1986.

2. Methods, Standards and Work Design, Benjamin W. Niebel and Andris Freivalds, WCB McGraw Hill (1999).

3. Improving Productivity and Effectiveness by Mundel, Marvin, E., Prentice-Hall, 1983.

4. Human Factors Engineering & Design by Sounders, M.S. and McCormick, E.J., McGraw Hill, 1983.

5. Fitting the Task to the Man by Grandjean, E., Taylor and Francis, London, 1989.

6. Compendium on Value Engineering by Tufty, H.G., The Indo-American Society, Bombay, 1983.

7. Compensation Administration by Belchar, David, W., Prentice Hall, N.J.

IEM-6405: Advanced Operations Research

Introduction, Classification of optimization problems, Applications of optimization, concepts of design vector, Design constraints, constrain surface, objective function surfaces, and multilevel optimization.

Karmakar's method of solving L.P. problems, Quadratic programming, non-linear programming – unconstrained optimization techniques, Basics of constrained optimization.

Integer linear programming methods and applications, Introduction to integer non-linear programming,

Basics of geometric programming. Multi-objective optimization methods and applications, Formulation of problems – Separable programming and stochastic programming. Introduction to Genetic algorithms, Simulated Annealing, neural network-based optimization, and optimization of fuzzy systems.

Books

1. Kalyanmoy Deb, Optimization for Engineering design – algorithms and examples. PHI, New Delhi, 1995.
2. Singiresu S.Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1998.
3. Garfinkel, R.S. and Nemhauser, G.L., Integer programming, John Wiley & Sons, 1972

IEM-6407: Computer Integrated Manufacturing & Robotics

Information to automation & CIM, NC, CNC, DNC, PLC Manual & Computer-aided part programming Group Technology & Computer-aided process planning, Automated Guided Vehicles.

Automated material handling system, Automatic storage & retrieval system.

Robotics in Manufacturing System. Introduction to robots and robotic arms.

CAD/CAM: Solid modelling, a database for CAD/CAM, and data exchange standards.

Flexible Manufacturing System.

Books:

1. Ranky P.G. Computer Integrated Manufacturing, Prentice-Hall.

2. Mikell P.Groover, Automation, Production Systems and Computer-Integrated Mfg, Prentice Hall
3. Rao, P N, CAD/CAM, TMH

IEM-6301: Human Resource Development & Industrial Psychology

Personnel function: Its evolution, Objective principles, Philosophies, Duties, and responsibilities of the personnel management in India.

Manpower planning: Its uses and benefits - Problems and limitations - Manpower inventory: Manpower forecasting - Manpower skills analysis and practices in Indian industry

recruitment: Selection process, Psychological testing - Interviewing techniques, Transfer, Promotion and its policies - Induction placement and exit interview wage and salary administration.

Training and development: Its objective and policy planning and organizing the training department - Training manager and his job - On and off the job training - Techniques, Career planning, Objective of performance appraisal and its methods.

Industrial relations: Problems of labor-management relations - Causes for poor industrial relations - Conditions of good industrial relations - Trade union act - Objectives and advantages of trade unions - Collective bargaining - Industrial disputes act - Disciplinary action and domestic enquires - Machinery for settlement of the dispute - Grievance procedure and its handling - Counselling - Layoff, Lockouts, Strikes, Retrenchment - Labour participation in management, Joint management councils, Factories act and other social security acts relevant to the course, Case Studies.

Books:

1. Robbins, S.P., Organizational Behaviour, Concepts, Controversies, and Applications, PHI
2. Personnel Management by Monappa Arun and Saiyadain, M.S., 5th Reprint, Tata McGraw Hill, New Delhi.
3. Industrial Relations by Saiyadian, M.S., 1st Edn., Tata McGraw Hill, New Delhi, 1987. 3. The Industrial Law by Malik, P.L., 5th Edn., Eastern Book Co., 1982. 4. Personnel Management by Tripati.

IEM-6303: Knowledge Management

Overview of Knowledge Management: Introducing Knowledge Management, need for Knowledge Management, Forces Driving Knowledge Management, Issues in Knowledge Management. Cognitive Psychology, Data, Information and Knowledge, Kinds of Knowledge, Expert Knowledge, Thinking and Learning in Humans, Knowledge vs Intelligence, dumb search, Heuristic search in Knowledge-Based Systems.

Knowledge Management Systems Life Cycle: Challenges in KM Systems Development, Conventional Vs KM Systems Life Cycle(KMSLC), Key Differences, Key Similarities, KMSLC Approaches. Knowledge Creation, Nonaka's Model of Knowledge Creation & Transformation, Knowledge Architecture, Acquiring the KM System.

Knowledge Capturing Techniques: On-Site Observation (Action Protocol), Brainstorming, Electronic Brainstorming, Protocol Analysis (Think-Aloud Method), Consensus Decision Making, Repertory Grid, Nominal Group Technique (NGT), Delphi Method, Concept Mapping, Blackboarding.

Knowledge Codification: Modes of Knowledge Conversion, Codifying Knowledge, Codification Tools/Procedures Knowledge Maps, Decision Table, Decision Tree,

Frames, Production Rules, Case-Based Reasoning, Knowledge-Based Agents, Knowledge Developer's Skill Set, Knowledge Requirements, Skills Requirements.
Learning from Data: The Concept of Learning, Data Visualization, Neural Network (Artificial) as Learning Model, Supervised/Unsupervised Learning ., Applications in Business, Relative Fit with KM, Association Rules, Classification Trees.

Preserving and Applying Human Expertise: Knowledge-Based Systems: Knowledge-Based System: User's View, Developer's View, Knowledge Representation: Rules, Inference chains, Knowledge Representation: Frames, Functional attributes, Frame-Based Reasoning, Rule-Based Reasoning, forward chaining: Rule Interpretation Process, Backward chaining: Rule Interpretation Process, Backward chaining: Closed World Assumption, Knowledge engineering, Tools. Case-Based Reasoning Systems: Weaknesses of rule-based systems, Case-Based Reasoning (CBR), Case-Based Reasoning (CBR): Adaptation, Case-Based Reasoning (CBR): Successful vs failed cases, Indexing the case library: Flat Library, Indexing the case library: Shared feature networks, Indexing the case library: Redundant shared feature networks, Advantages and Disadvantages of Case-based systems.

Knowledge Elicitation: Converting Tacit Knowledge to Explicit: Basic One-On-One Interviews: Specific Problem-Solving, Knowledge-Gathering Sessions, Basic One-On-One Interviews: Knowledge Elicitation Sequence, Observational Elicitation, Observational Elicitation: Quiet on-site observation, Exercising the expert, Problem description and analysis,; Role Reversal Techniques, Team Interviewing, Team Interviewing: One-on-many, Team Interviewing: Many-on-many, Many-on-one.

Books:

1. Dalkir, K. (2011). Knowledge Management in Theory and Practice (2nd edition). Cambridge, Massachusetts: The MIT Press.
2. Hislop, D., Bosua, R., & Helms, R. (2018). Knowledge management in organizations: A critical introduction. (4th edition) Oxford: Oxford University Press.
3. Mohapatra, S., Agrawal, A., & Satpathy, A. (2016). Designing Knowledge Management-Enabled Business Strategies. Switzerland: Springer.
4. Becerra-Fernandez, I., & Sabherwal, R. (2015). Knowledge Management. Systems and Processes. (2nd edition). New York: M.E.Sharpe.
5. North, K., & Kumta, G. (2014). Knowledge management: Value creation through organizational learning. Switzerland: Springer.
6. Jashapara, A. (2011). Knowledge Management: An Integrated Approach (2nd edition). Harlow: Pearson Education Limited.

IEM-6305: Global Business Management

Key Issues in International Business. Socio-cultural, economic, and political forces facing the business. International sourcing. Understanding the determinants of competitive advantage in

international business at the national, industry, and firm-level. Global forces transforming international business. Multinational Corporation. Problems and Prospects in an International Environment, competitive and cooperative business strategy.

International Business Strategy of Indian Industry. The competitive position of key Indian Industries. Entry strategies for Indian firms: Joint Ventures, strategic/technical alliances/collaboration. Strategies employed by Indian firms to develop and sustain the international business.

Globalization Strategy. Globalization strategy, strategies of Multinational Corporation, implications for functional strategies: marketing, HR, planning, organizational structure, production, Global Information Systems, Strategy Alternatives for Global Market entry and expansion, International negotiations.

Books

1. Global Business Management: A Cross-Cultural Perspective by Abel Adekola.
2. Global Business Management, By Sanjyot P. Dunung, Flatworld.

IEM-6307: Reverse Logistics

Reverse Logistics and Supply Chain Management Relationship, Environmental Effects of Logistics, Waste Management, Understanding the Waste Hierarchy, Options in Product Recovery Management, Reverse Logistics Networks & Design, The Role of the Government, Cost-Benefit Analysis in Reverse Logistics, Sustainability, Closed-Loop Supply Chains, Sector Based Special Issues, Legal Issues.

Books:

1. Green Logistics: Improving the Environmental Sustainability of Logistics. McKinnon, A., Cullinane, S. 2001. ISBN: 9780749456788
2. Greening the Supply Chain. Sarkis, J. 2006. ISBN: 1846282985

IEM-6201: e-Commerce

E-commerce Technology: Principles, Potential, Data Warehousing, Temporal Coherency, Networking Infrastructure, Software Tools, IP, TCP HTTP, HTML, Cryptography, Consumer Interface Technologies, OALP & Data mining, Case studies.
E-commerce: Effect on job, growth, trade, international co-operation – Tax problems Application of E-commerce in different sectors, service, industry, domestic, etc., a multidisciplinary approach to E-commerce, Software, case studies.

E-commerce Management: Net Centrism, Navigation, Digital Design, Web Metrics, Business models, Hyper Markets, Intelligent Agents, Auctions, Design, Protocol, Case Studies.

Channel conflict management: Security and Encryption, Abuse and Netiquette, Internet Governance, Economics of E-Commerce, Equilibrium price, Electronic Marketing, Taxing. E-business, Road map for success, case studies.

E-commerce Legal Issues: Software Intellectual property law, Contract law for Ecommerce, Warranties and New Products, Cyberlaw issues, Privacy, and Transborder flows, Fraud, Security of Information and Risks, Electronic Highway Robbery.

Books:

1. Kalakota & Whinston, Frontiers of Electronic Commerce, Addison Wesley, 2001.
2. Efraim Turbon, Jae Lee, David King, H. Michael Chung, Electronic Commerce, A Managerial Perspective, Pearson Education Asia, 2001.
3. Napier, Judd, Rivers, and Wagner, Creating a winning E-Business, Thomson Learning, 2000.

IEM-6203: Safety and Disaster Management

Safety: Henrichs Axioms of Industrial Safety, Concepts of Safety, Organization for Safety, Organization, Definition, Need & Principles Organizing for Health, And, Environmental, Activities, Organization Structure, Function & Responsibilities

Disaster: Different Types of Disaster- Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides, etc. Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism, etc. Causes, effects, and practical examples for all disasters.

Risk and Vulnerability Analysis: Risk- Its concept and analysis, Risk Reduction, Vulnerability- Its concept and analysis, Strategic Development for Vulnerability Reduction.

Disaster Preparedness: Disaster Preparedness: Concept and Nature, Disaster Preparedness Plan, Prediction, Early Warnings and Safety Measures of Disaster, Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies. Role of IT in Disaster Preparedness, Role of Engineers on Disaster Management.

Disaster Response: Introduction, Disaster Response Plan, Communication, Participation, and Activation of Emergency Preparedness Plan, Search, Rescue, Evacuation and Logistic Management, Role of Government, International and NGO Bodies, Psychological Response and Management (Trauma, Stress, Rumor, and Panic), Relief and Recovery 8. Medical Health Response to Different Disasters.

Rehabilitation, Reconstruction and Recovery: Reconstruction and Rehabilitation as a Means of Development. Damage Assessment, Post Disaster effects and Remedial Measures, Creation of Long-term Job Opportunities and Livelihood Options, Disaster Resistant House Construction, Sanitation and Hygiene, Education and Awareness, Dealing with Victims' Psychology, Long-term Counter Disaster Planning, Role of Educational Institute.

Books:

1. Disaster Management by Mrinalini Pandey, Wiley India Pvt. Ltd.
2. Disaster Science and Management by Tushar Bhattacharya, McGraw Hill Education (India) Pvt. Ltd.
3. Disaster Management: Future Challenges and Opportunities by Jagbir Singh, K W Publishers Pvt. Ltd.
4. Disaster Management by J. P. Singhal, Laxmi Publications.

IEM-6205: Facility Planning & Design

Weberian location theory Evolution of Location including Quantitative and qualitative methods and factors affecting plant location

Introduction to the layout design process – Objectives and principles of plant layout, Process of plant layout, types of plant layout Systematic layout planning- Line Balancing - Computerized layout planning - ALDEP, CORELAP, CRAFT, Single and multi-facility location problems (with the coordinate descent method only) - Quadratic assignment location problems - Minmax layout and location problems - Discrete plant location.

Introduction to Material Handling Objectives and principles of Material handling, unit load containerization, types and classification of material handling equipment. Plant Services and Auxiliary departments and factory building

Text Books:

1. Facilities Planning, James A. Tompkins and John A. White, John Wiley

2. Facility Layout and Location- An Analytical Approach, Richard L. Francis, Leon F Mc Ginnes and John A. White, PHI (1999)

3. Plant Layout and Material Handling by G. K. Agarawal

IEM-6207: Humanitarian Supply Chain

The humanitarian context: actors, activities, and resources involved in disaster relief and logistics in developing countries; designing, managing and measuring supply chains; Donors and funding, Coordination and cooperation, Sourcing and purchasing, Distribution Infrastructure, transportation and warehousing Need Assessment, Performance, and measurement.

Pre-and Post-disaster activities, Coordination and collaboration, digitalization of the supply chain processes. Case Studies.

Books: Refer to various research articles

1. Humanitarian Logistics Cross-Sector Cooperation in Disaster Relief Management by Alessandra Cozzolino, Springer.
2. Tomasini, R & Wassenhove, L: Humanitarian logistics. INSEAD Business Press and Palgrave Macmillan, 2009, ISBN: 9780230205758.

IEM-6209: Contemporary Issues in Industrial Engineering and Management

In this elective subject, there will be liberty to consider the contemporary issues in the industry and find the solutions.