CURRICULUM STRUCTURE AND DETAILED SYLLABI

FOR

MASTER OF TECHNOLOGY

IN

INDUSTRIAL ENGINEERING AND MANAGEMENT PROGRAM

(Applicable from the academic year 2021-2022)

Department of Industrial Engineering and Management

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Haringhata-741249, Nadia, West Bengal, India

Web: https://makautwb.ac.in

Department of Industrial Engineering and Management
Maulana Abul Kalam Azad University of Technology, West Bengal
Haringhata-741249, Nadia, West Bengal, India

Vision of the Department

To emerge as a world class center of education for building competency in the field of Industrial Engineering and Management.

Mission of the Department

As a department, we are committed to

- Provide students with state-of-the-art technologies and principles to solve global challenges in Industrial engineering and management.
- Instill ability to apply cutting edge tools and techniques involving frontier engineering devices amongst students, for sustainable development in industrial engineering and allied sectors.
- Facilitate the students to choose career in academia, industry and entrepreneurship.
- Impart legal, ethical and environmental awareness to the students for the inclusive development of the society.

Maulana Abul Kalam Azad University of Technology, West Bengal
Master of Technology in
Industrial Engineering and Management Program

Program Educational Objectives (PEOs)

Graduating Students of M. Tech in Industrial Engineering and Management program shall be able to

- **PEO 1:** Pursue advanced education and research in industrial engineering and management leading to lifelong learning.
- **PEO 2:** Succeed in their career as globally employable professionals in academia and industry.
- **PEO 3:** Emerge as ethically responsible citizens committed to social and environmental sustainability.

Program Outcomes (POs)

Graduating Students of M. Tech in Industrial Engineering and Management program will have

- **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:** Students should be able to demonstrate a degree of mastery over the area as per the industrial engineering and management program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Program Specific Outcomes (PSOs)

Graduating Students of M. Tech in Industrial Engineering and Management program will be able to:

- **PSO1:** Use modern software tools for modeling, analysis, and solution of problems in the domain of Industrial Engineering and management related to manufacturing and service systems.
- **PSO2:** Emerge as productivity and quality improvement specialists.

Maulana Abul Kalam Azad University of Technology, West Bengal
M. Tech in Industrial Engineering and Management: 2021-2022
Curriculum Structure

Sl No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Semester-I							
Theory							
1	Program Core I	PC-IEM101	Work System Design	3	0	0	3
2	Program Core II	PC-IEM102	Production Planning and Control	3	0	0	3
3	Program Elective-I	PE-IEM103 A/B/C/D	Program Elective-I	3	0	0	3
4	Program Elective-II	PE-IEM104 A/B/C/D	Program Elective-II	3	0	0	3
5	Mandatory Learning Course	MC-IEM101	Research Methodology and IPR	2	0	0	2
6	Audit Course	AC-IEM101A/B/C/ D/E/F/G/H/I	Audit Course 1	2	0	0	0
	Total Theory			**16**	**0**	**0**	**14**
Practical							
1	Laboratory I	PC-IEM191	Work System Design Laboratory	0	0	4	2
2	Laboratory II	PC-IEM192	Simulation Laboratory	0	0	4	2
	Total Practical			**0**	**0**	**8**	**4**
			Total of Semester-I	**16**	**0**	**8**	**18**
Semester-II							
Theory							
1	Program Core III	PC-IEM201	Operations Research-I	3	0	0	3
2	Program Core IV	PC-IEM202	Quality Design and Control	3	0	0	3
3	Program Elective-III	PE-IEM203 A/B/C/D	Program Elective-III	3	0	0	3
4	Program Elective-IV	PE-IEM204 A/B/C/D	Program Elective-IV	3	0	0	3
5	Audit Course	AC-IEM201A/B/C /D/E/F/G/H/I	Audit Course 2	2	0	0	0
	Total Theory			**14**	**0**	**0**	**12**
Practical							
1	Laboratory III	PC-IEM291	Quality Design and Control Laboratory	0	0	4	2
2	Laboratory IV	PC-IEM292	Design Thinking Laboratory	0	0	4	2
	Total Practical			**0**	**0**	**8**	**4**
Sessional							
1	Mini Project	PW-IEM281	Mini Project with Seminar	**2**	**0**	**0**	**2**
			Total of Semester-II	**16**	**0**	**8**	**18**
Semester-III							
Theory*							
1	Program Elective-V	PE-IEM301 A/B/C/D	Program Elective-V	3	0	0	3
2	Open Elective	OE-IEM301A/B/C/D/E	Open Elective	3	0	0	3
	Total Theory			**6**	**0**	**0**	**6**
Sessional							
1	Major Project	PW-IEM381	Dissertation-I (Progress)	0	0	20	10
			Total of Semester-III	**6**	**0**	**20**	**16**
Semester-IV							
Sessional							
1	Major Project	PW-IEM481	Dissertation-II (Completion)	0	0	32	16
			Total of Semester-IV	**0**	**0**	**32**	**16**
Total Credits for the programme							**68**

*****_Students going to Industry full time for doing their Project & Thesis work (Dissertation) may opt for completion of these courses through Massive Open Online Courses (MOOCs)._

List of Program Electives

- **Program Elective - I**
  1. Discrete-Event System Simulation (PE-IEM103A)
  2. Management and Productivity (PE-IEM103B)
  3. Automation in Production Systems and Management (PE-IEM103C)
  4. Management Information System (PE-IEM103D)
- **Program Elective - II**
  1. Product Design and Development (PE-IEM104A)
  2. Engineering Economy and Costing (PE-IEM104B)
  3. Facility Planning and Design (PE-IEM104C)
  4. Application of Optimal Control Theory in Management Science (PE-IEM104D)
- **Program Elective - III**
  1. Project Engineering and Management (PE-IEM203A)
  2. Reliability Analysis and Prediction (PE-IEM203B)
  3. Enterprise Resource Planning (PE-IEM203C)
  4. Production Design and Process Planning (PE-IEM203D)
- **Program Elective - IV**
  1. Management of Inventory Systems (PE-IEM204A)
  2. Logistics and Supply Chain Management (PE-IEM204B)
  3. Six Sigma Fundamentals and Applications (PE-IEM204C)
  4. Human Factors Engineering (PE-IEM204D)
- **Program Elective - V**
  1. Systems Analysis Techniques (PE-IEM301A)
  2. Operations Research-II (PE-IEM301B)
  3. Design of Experiments (PE-IEM301C)
  4. Multi-Criteria Decision Making Techniques (PE-IEM301D)

List of Open Electives

1. Business Analytics (OE-IEM301A)
2. Industrial Safety Engineering (OE-IEM301B)
3. Cost Management of Engineering Projects (OE-IEM301C)
4. Composite Materials (OE-IEM301D)
5. Waste to Energy (OE-IEM301E)

Audit course 1 & 2

1. Statistics & Probability with R (AC-IEM101A / AC-IEM201A)
2. English for Research Paper Writing (AC-IEM101B / AC-IEM201B)
3. Pedagogy Studies (AC-IEM101C/ AC-IEM201C)
4. Constitution of India (AC-IEM101D/ AC-IEM201D)
5. Disaster Management (AC-IEM101E/ AC-IEM201E)
6. Value Education (AC-IEM101F/ AC-IEM201F)
7. Stress Management by Yoga (AC-IEM101G /AC-IEM201G)
8. Personality Development through Life Enlightenment Skills (AC-IEM101H/ AC-IEM201H)
9. Sanskrit for Technical Knowledge (AC-IEM101I/ AC-IEM201I)

Subject Name: Work System Design	**Category:** Program Core I
Subject Code: PC-IEM101	**Semester**: First
L-T-P:3-0-0	**Credit:** 3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Explain basic productivity concepts and productivity measurement approaches of the Organizations.
CO2: Apply the various methods of Method study to Improve productivity
CO3: Apply the various techniques of work measurement in manufacturing systems.
CO4: Explain Ergonomic principles for Work Systems.
CO5: Design Work Space, Manual Material Handling Tasks and Physical Work Environment.
CO6: Estimate Physical Work Capacity and Work load of Individuals.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Overview, scope and objectives of Work System Design; *Productivity:* Introduction and Concept of Productivity, Measurement of Productivity, Productivity Measures, Productivity Measurement Models, Factors Influencing Productivity, Causes of Low Productivity, Productivity Measurement Models, Productivity Improvement Techniques, Numerical Problems on productivity, Case study on productivity.	6
2	*Work Study*: Basic Concept, Steps Involved in Work Study, Concept of Work Content, Techniques of Work Study, Human Aspects of Work Study; *Method Study*: Basic Concept, Objectives of Method Study, Procedure of Method Study, Micro-motion Study, Equipment Used for Micro-motion Study, Factors to be Considered while in Conducting Method Study, Tools of Method Study.	6
3	*Work Measurement:* Basic Concept, Techniques of Work Measurement, Steps Involved in Time Study, Time Study Equipment, Performance Rating. Performance Rating: Examples, Allowances, Computation of Standard Time, Numerical on Computation of Standard Time, Case Study. Work Sampling: Basics, Procedure of Work Sampling Study, Numerical Problems on work sampling, Introduction to Synthetic Data and PMTS, Introduction to MTM and MOST	6
4	*Ergonomics Fundamentals:* Simple and complex work systems, ergonomic aspects in workstation design and analysis, history of ergonomics, modern ergonomics. *Anthropometric Principles and Postural Analysis in Workspace Design:* Anthropometry and its uses, principles of applied anthropometry, applications of anthropometry in design, postures and body mechanics, musculoskeletal problems in sitting and standing. *Design of Manual Handling Tasks:* Anatomy and biomechanics of manual handling, design of manual handling tasks; lifting and carrying, NIOSH approach, EC guidelines. *Physiology, Workload, and Work Capacity:* Physical work capacity, factors affecting work capacity, measurement of physiological cost of work, fitness for work.	22

	Design of Physical Environment: Human thermoregulation, measuring thermal environment, measurement of light, lighting design considerations, measurement of sound, industrial noise control, vibration, principles for the design of visual displays, design of control, work organization and worksystem design.	
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Bridger, R. S., Introduction to Ergonomics, CRC Press, 4th edition, 2017.
2. Halender, M., A Guide to the Ergonomics of Manufacturing, CRC Press, 2nd edition, 2005.
3. Introduction to Human Factors and Ergonomics for Engineers. Lehto, Mark R., and Landry, Steven J., CRC Press, 2nd edition, 2013.
4. Sanders, M. S. and McCormick, E. J., Human Factors in Engineering and Design, McGraw-Hill Education, 7th edition, 1992.
5. Freivalds, A., and Niebel, B., Niebel's Methods, Standards, & Work Design, McGraw-Hill Education, 13th edition, 2013.
6. Groover, M. P., Work Systems: The Methods, Measurement & Management of Work, Pearson Education, 1st edition, 2016.
7. Geneva Indian Adaptation International Labour Office, Introduction to Work Study, Oxford & IBH Publishing Co Pvt. Ltd, 3rd edition, 2015.
8. Barnes, R. M., Motion and Time Study: Design and Measurement of Work, Wiley, 7th edition, 2009.
9. Chaffin, D. B., Andersson, G. B.J., and Martin, B. J., Wiley, Occupational Biomechanics Wiley-Interscience, 4th edition, 2006.

Subject Name: Production Planning and Control	**Category:** Program core II
Subject Code: PC-IEM102	**Semester:** First
L-T-P:3-0-0	**Credit:** 3
Perquisite: No perquisite	

Course Outcome:

On successful completion of the course, Students will able to:

CO1: Explain the requirement of production planning and control for manufacturing organizations.
CO2: Apply the appropriate planning and control techniques to estimate production-distribution system design.
CO3: Analyze, evaluate and make decisions for short term as well as long term organizational growth.
CO4: Predict changes in demand pattern due to external and internal factors and develop operations scheduling and control.
CO5: Design production planning and control operations for any manufacturing industry.

Course contents:

Module No.	Description Of Topic	Contact Hour
1	*Forecasting:* Long and short-term demand forecasting methods, smoothing methods, regression methods, Estimation of trend, cycle, and seasonality components, analysis of forecast error and computer control of forecasting systems	9
2	*Production-Distribution System Design:* Plant location and capacity planning	7
3	*Aggregate planning and Master Production Scheduling:* Aggregation techniques, aggregate capacity, disaggregation of aggregate plan, master production scheduling, Analytical and computer integrated solution techniques	8
4	*Operations Scheduling and Control:* Basic sequencing and scheduling techniques, priority rules, progress chasing and updating of production schedules	9
5	*Design of Production Planning and Control Systems:* System design for continuous and intermittent production systems, integration of master production, material requirements and shop scheduling Systems.	7
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Silver, E. A., Pyke, D. F., Peterson, R., Thomas, D.J., and Inventory and Production Management in Supply Chains, CRC Press, 4th edition, 2021.
2. Narasimhan, S. L., McLeavey, D. W., & Billington, P, Production Planning and Inventory Control, PHI, 2nd Edition, 1996.
3. Mahadevan, B., Operations Management: Theory and Practice Pearson; 3rd edition, 2015.
4. Makridakis, S., Wheelwright, S. C., & Hyndman, R. J., Forecasting methods and applications, Wiley, 3rd edition, 2008.
5. Holt, C. C., Modigliani, F., Muth, J. F., and Simon, H. A., Planning Production, Inventories, and Workforce, Prentice-Hall, 1960.

Subject Name: Discrete-Event System Simulation	**Category:** Program Elective – I
Subject Code:PE-IEM103A	**Semester:** First
L-T-P:3-0-0	**Credit:** 3
Perquisite: No perquisite	

Course Outcomes:

On successful completion of the course, Students will able to:

CO1: Understand the basic steps involved in discrete event simulation process.
CO2: Select the entities involved in a simulation process and construct the activity cycle diagram for each entity.
CO3: Analyze basic queuing system in which discrete event simulation is an appropriate and feasible approach in evaluating the operation of a queuing system with uncertain behaviour.
CO4: Develop logical discrete event simulation models of queuing system using simulation package and implement computational experiments.
CO5: Formulate simulation experiments, interpret the results.

Course Contents:

Module No.	Description of Topic	Contact Hours
1	Introduction to Simulation: Overview of simulation; scope of simulation; general principles, spreadsheet examples to describe overview of simulation	7
2	Simulation software: Evolution of simulation software; different features and attributes of simulation software	5
3	Statistical Models in Simulation: Review of probability terminology and concept; distribution forms; random number generation techniques; Monte-Carlo simulation process	8
4	Input Modelling: Overview of driving force of simulation; selection of appropriate input data for simulation	4
5	Verification and Validation of Simulation Models: Outline of Model Building, Verification, and Validation; verification of simulation models; Calibration of models; Input-output validation	7
6	Estimation of Absolute Performance: Types of Simulations with Respect to Output Analysis; Nature of output data; measure of performance; Output testing for Terminating Simulation; Comparison and Evaluation of Alternative System Design.	9
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Banks, J., Carson II, J. S., Automation, B., Nelson, B. L., & Nicol, D. M. Discrete-Event System Simulation Fourth EDITION.
2. Law, A. M., Kelton, W. D., & Kelton, W. D. (2000). Simulation modeling and analysis (Vol. 3). New York: McGraw-Hill.

Subject Name: Management and Productivity	**Category:** Program Elective – I
Subject Code: PE-IEM103B	**Semester**: First
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Explain what is meant by management and managerial effectiveness
CO2: Identify the roles which are fulfilled while working as a manager
CO3: Identify managerial activities that contribute to managerial effectiveness
CO4: Illustrate basic Productivity Concepts and Productivity Measurement Approaches of the Organizations.
CO5: Identify long term and short-term productive models in industry for improvement of the productivity.
CO6: Solve problems on productivity by applying the various productivity performance improvement tools and techniques.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	*Evolution of management principles and concepts*	4
2	*Function of management:* Planning-strategic, tactical and operation planning, short-medium-long term planning; organizing-different organization structure, peters principles; staffing-delegation of authority and power roles and responsibilities; leading-kinds of leaderships, motivation theories, Parkinson's law; control-fit forward and fit back control;	10
3	*Basics of productivity and performance management:* productivity cycle, performance management, classification of productivity and performance measurement tools and techniques- NPMMP including evaluation norms and systems in manufacturing and service organization, productivity planning application, productivity performance-measurement techniques, NC, surrogate measurement technique;	16
4	*Productivity performance improvement:* classification of the tools and techniques, important aspects, integrated framework, examples and case studies.	10
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Koontz, H., and Weihrich, H., Essentials of Management - An International, Innovation and Leadership Perspective, McGraw-Hill, 11th edition, 2020.
2. Buffa, E. S., and Sarin, R.K., Modern Production / Operations Management, Wiley, 8th edition, 2007
3. Scott Sink, D., Productivity Management: Planning, Measurement and Evaluation Control and Improvement, Wiley,1985.
4. Riggs, J. L., Production systems: Planning, analysis, and control, Wiley, 1987.
5. Sumanth, D. J., Productivity Engineering and Management, McGraw-Hill, 1984.

Subject Name: Automation in Production Systems and Management	**Category:** Program Elective I
Subject Code: PE-IEM103C	**Semester**: First
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Develop offline program for simulating the machining operation.
CO2: Apply the concepts of PPC and GT to the development of FMS.
CO3: Develop the structure of automated process planning system.
CO4: Explain the principle of generative and retrieval CAPP systems for automation.
CO5: Demonstrate different robotic systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Manufacturing and Production Systems	4
2	Automation in Manufacturing and Production Systems	4
3	Product Development Process and Automation	4
4	Fundamentals of NC Technology: Part-I & Part II	6
5	Flexible and Programmable Automation	4
6	Cellular Manufacturing Systems	3
7	Flexible Manufacturing Systems:	6
8	Fundamentals of Robotic Systems	3
9	Automated CAPP Part-I & Part II	6
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Groover, M P., Automation, Production Systems, and Computer Integrated Manufacturing, 4th Edition, Pearson, 2016
2. Groover, M P and Zimmers, E W Jr, CAD/CAM: Computer-aided Design and Manufacturing, Pearson, 2013

Subject Name: Management Information System	**Category:** Program Elective –I
Subject Code: PE-IEM103D	**Semester:** First
L-T-P :3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Relate the basic concepts and technologies used in the field of management information systems;
CO2: Compare the processes of developing and implementing information systems.
CO3: Outline the role of the ethical, social, and security issues of information systems.
CO4: Translate the role of information systems in organizations, the strategic management processes, with the implications for the management.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	The IS Revolution; Strategic Role of Information Systems, Organizations, and Business Processes;	6
2	Information, Management, and Decision-Making Computers and Information Processing; Information Systems Software;	6
3	Telecommunications, Networks and Wireless Technology; The Internet; Electronic Business and Ecommerce and digital markets, digital goods Developing Information systems; function-oriented design; object-oriented design; data base management systems,	10
4	Enterprise Resource Planning: Basic issues; Approach; Implementation, and the modules of ERP Project management: establishing the business value of systems and managing change Managing Knowledge: Knowledge Work and Artificial Intelligence;	10
5	Enhancing Management Decision Making. Redesigning the Organization with IS Information Systems Security and Control; Ethical and Social Impact of Information Systems.	8
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Laudon, K.C., and Laudon, J. P., Management Information Systems: Managing the Digital Firm, Pearson, 16th edition, 2020
2. Pressman, R. S., and Roger S. P., Software Engineering: A Practitioner's Approach, McGraw Hill, 8th Edition, 2019.
3. Norris, G., Hurley, J.R., Hartley, K. M., Dunleavy, J. R., and Balls, J. D., E-Business and ERP: Transforming the Enterprise, Wiley, 2008.

Subject Name: Product Design and Development	**Category:** Program Elective –II
Subject Code: PE-IEM104A	**Semester:** First
L-T-P :3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Apply the Product Design and Development Process, as a means to manage the development of an idea from concept through to production.
CO2: Analysis methodologies as it pertains to the product design process, meaning, and user experience.
CO3: Apply creative process techniques in synthesizing information, problem-solving and critical thinking.
CO4: Demonstrate and employ drafting principles to convey concepts.
CO5: Apply basic fabrication methods to build prototype models for hard-goods and soft-goods and packaging.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Product Development Process and Organization	2
2	Opportunity Identification: Establish a Charter, Generate and Sense Many Opportunities, Screen Opportunities, Develop Promising Opportunities, Select Exceptional Opportunities, and Reflect on the Results and the Process Product Planning: Identify Opportunities, Evaluate and Prioritize Projects, Allocate Resources and Plan Timing, Complete Pre-Project Planning, and Reflect on the Results and the Process	5
3	Identifying Customer Needs: The Importance of Latent Needs, Gather Raw Data from Customers, Interpret Raw Data in Terms of Customer Needs, Organize the Needs into a Hierarchy, Establish the Relative Importance of the Needs, What Are Specifications? When Are Specifications Established? Establishing Target Specifications, and Setting the Final Specifications	8
4	The Activity of Concept Generation, Clarify the Problem, Search Externally, Search Internally, Explore Systematically, Concept Screening, Concept Scoring, and Caveats Concept Testing: Define the Purpose of the Concept Test, Choose a Survey Population, Choose a Survey Format, Communicate the Concept, Measure Customer Response, Interpret the Results, and Reflect on the Results and the Process	10

5	Product Architecture Industrial Design: What Is Industrial Design? Assessing the Need for Industrial Design, The Impact of Industrial Design, The Industrial Design Process, Management of the Industrial Design Process, and Assessing the Quality of Industrial Design Design for Environment Design for Manufacturing and Supply Chain	6
6	Understanding Prototypes, Principles of Prototyping, Prototyping Technologies, and Planning for Prototypes, Robust Design, Patents and Intellectual Property, Product-Service Systems, The Service Design Process, and Downstream Development Activities in Services, Product Development Economics, and Project Management	9
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Ulrich, K. T., and Eppinger, S. G., Product Design and Development, McGraw Hill, 7th edition, 2020.
2. Rao, D. V., and Ray, P. K., Production and Process Design for Quality, Economy and Reliability, New Age International Publishers,2010.
3. Chitale, A. C., and Gupta, R. C., Product Design and Manufacture, Prentice-Hall, 6th edition, 2014.

Subject Name: Engineering Economy and Costing	**Category:** Program Elective – II
Subject Code: PE-IEM104B	**Semester:** First
L-T-P:3-0-0	**Credit:** 3
Perquisite: No Perquisite	

Course Outcome:

On successful completion of the course, Students will able to:

CO1: Explain importance of engineering economy study
CO2: Apply fundamental cost estimation technique concepts for engineering applications
CO3: Analyze problem scenario with knowledge of cost estimation techniques
CO4: Evaluate financial performance of industry
CO5: Adapt cost reduction techniques in order to improve financial performance

Course contents:

Module No.	Description of Topic	Contact Hour
1	**Foundation of Engineering Economy:** Performing an engineering economy study, Simple and compound interest, Cash flows, the rule of 72	6
2	**Time Value of Money:** How time and interest affect money, Nominal and effective interest rates, Series of cash flows, uniform series of cash flows, uniform gradient series formula	7
3	**Worth of Investment:** Present worth analysis, Annual worth analysis, Rate of return analysis	7
4	**Cost Analysis:** Estimating costing, Benefit/Cost analysis, Breakeven, sensitivity and payback analysis, Replacement and retention decision	8
5	**Effects of Inflation:** Understanding the impact of inflation, PW, FW, AW calculation adjusted for inflation	7
6	**Depreciation:** Methods of depreciation, After tax economic analysis	5
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Sullivan, W. G., Wicks, E. M., & Koelling, C. P., Engineering Economy, Pearson, 17th edition, 2018.
2. Newnan, D.G., Eschenbach T. G., Lavelle, J. P., Engineering Economic Analysis, Oxford University Press; 13th edition, 2017.
3. Blank, L., and Tarquin, A., Engineering Economy McGraw-Hill, 8th edition, 2017.
4. Panneerselvam, R., Engineering Economics, PHI, 2nd edition, 2013.

Subject Name: Facility Planning and Design	**Category:** Program Elective – II
Subject Code: PE-IEM104C	**Semester**: First
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Determine product, process, and schedule design interactions
CO2: Analyze flow, space, and activity relationships with impact to material handling and layout alternatives.
CO3: Apply quantitative facilities planning models.
CO4: Explain design and analyze material handling used in the warehousing, manufacturing and supporting operations.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Facilities planning – need and objectives of facilities planning – facilities planning process – Facilities planning strategies, Facilities Location Analysis- Single facility location models- Multi-facility location problems	10
2	Facilities Layout design- product design – process design – schedule design - Space and Area, Requirements of Facilities	10
3	Layout design procedure-Algorithmic approach – Computerized layout planning- CRAFT, ALDEP and CORELAP	6
4	Group technology - Methods of grouping – Algorithms and models for Group technology – Line balancing	6
5	Material handling design – Material handling principles - Classification of material handling equipment - Material handling models	8
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Tompkins, J A and White, J A, Facilities planning, John Wiley, 4th edition, 2010.
2. Francis, R L, McGinnis, L F and White, J A, Facilities layout and location - An analytical approach, PHI, 2nd edition 2002.
3. Apple, J M, Plant layout and Material handling, John Wiley, 3rd edition 1977.
4. Pannerselvam, R, Production and Operations management, PHI, 3rd edition 2012
5. Mahadevan, B, Operations management: Theory and Practice, Pearson education India, 3rd edition, 2015.

Subject Name: Application of Optimal Control Theory in Management Science	**Category:** Program Elective – II
Subject Code: PE-IEM104D	**Semester**: First
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Explain the basic concepts of optimal control and its significance in solving practical problems
CO2: Apply Optimal Control Principles to production and inventory, marketing and finance
CO3: Explain Stochastic Optimal Control Principles and their applications
CO4: Explain Differential Games and its applications
CO5: Apply Optimal Control Principles for Maintenance and Replacements
CO6: Apply Optimal Control Principles to Natural Resources and Economics

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Optimal Control:** Basic concepts and Definitions, Simple control models, recapitulations of few mathematical concepts--- differentiation of scalars and vectors and matrices, convex sets and convex hull, concave and convex functions, affine and homogeneous functions, saddle point, linear independence and rank of a matrix, calculus of variations and optimal control.	4
2	**Maximum Principle: Continuous time:** The Statement of the Problem, Dynamic Programming and Maximum Principle, Mixed Inequality constraints, Pure state and Mixed Ineauality Constraints, Applications to Finance, Production and Inventory, and Marketing	8
3	**Maximum Principle: Discrete Time:** Nonlinear programming problems, Lagrange Multipliers, Constraint Qualification, Theorems from Nonlinear Programming, Discrete-Time Optimal Control Problem, Discrete Maximum Principle.	6
4	**Stochastic Optimal Control:** Kalman filter, Stochastic Production Inventory Model, The Sethi Advertising Model, An Optimal Consumption-Investment Problem	6
5	**Differential Games:** Two-Person Zero-Sum Differential Games, Nash Differential Games, A Feedback Nash Stochastic Differential Game in Advertising, A Feedback Stackelberg Stochastic Differential Game of Cooperative Advertising	5
6	**Maintenance and Replacements:** Simple maintenance and Replacement model, Maintenance and Replacement for a Machine Subject to Failure, Chain of Machines and Solution by Discrete Maximum Principle.	5
7	**Further Applications:** Applications to Natural Resources, Applications to Economics	6

Learning Resources:

1. Sethi, S.P., Optimal Control Theory: Applications to Management Science and Economics, Springer,3rd edition, 2019.
2. Weber, T.A., Optimal Control Theory with Applications in Economics, MIT Press, 2011.

Subject Name: Research Methodology and IPR	**Category:** Mandatory Learning Course
Subject Code: MC-IEM101	**Semester:** First
L-T-P:2-0-0	**Credit:** 2
Perquisite: No Perquisite	

Course Outcome:

On successful completion of the course, Students will able to

CO1: Develop an understanding on different types of research problems, different steps of formulation of research problems according to their roles in real life.
CO2: Generate research questions associated with research problems.
CO3: List various sources of information for literature review and data collection
CO4: Apply different research techniques and methodologies for implementation so that research problem can be solved.
CO5: Develop an understanding on the role of Intellectual Property Rights (IPR) and its laws which can protect the researchers for promoting new and better products and in turn brings about socio-economic benefits.

Course contents:

Module No.	Description Of Topic	Contact Hour
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	5
2	Effective literature studies approaches, analysis Plagiarism, Research ethics	5
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	5
4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	6
5	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	5
	Total number of contacts (Hr.)	**26**

Learning Resources:

1. Melville, S., and Goddard, W., Research Methodology: An introduction for science and engineering students. Kenwyn: Juta & Co Ltd., 1996.
2. Goddard, W., & Melville, S., Research methodology: An introduction, Juta Academic, 2nd ed edition, 2014.
3. Alley, M., The Craft of Scientific Writing, Springer, 4th edition, 2018.
4. Kumar, R., Research Methodology: A step-by-step guide for beginners, SAGE, 5th edition, 2018.
5. Kothari, C. R., and Garg, G., Research Methodology: Methods and Techniques, New Age International Publishers; 4th edition, 2019.

Practical

Subject Name: Work System Design Laboratory	**Category:** Laboratory I
Subject Code: PC-IEM191	**Semester**: First
L-T-P:0-0-4	**Credit:**2
Pre-Requisites: No Perquisite	

Course Outcomes:

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

CO1: Measure Ergonomic variables for Short and Long Cycle Jobs

CO2: Measure Work Capacity of Individuals

CO3: Measure Anthropometric Dimensions

CO4: Analyze Work Posture of an individual while working

CO5: Analyze Human Machine Interface

CO6: Analyze tasks using Time Study Methods

Course Contents:

Laboratory experiments and exercises on Measurement of Ergonomic variables for Short and Long Cycle Jobs, Work Capacity Measurements, Anthropometry, Work Posture and Human Machine Interface Analysis, Time Study of selected Jobs and MTM applications.

Learning Resources:

1. Halender, M., A Guide to the Ergonomics of Manufacturing, CRC Press, 2nd edition, 2005.
2. Bridger, R. S., Introduction to Ergonomics, CRC Press, 4th edition, 2017.
3. Sanders, M. S. and McCormick, E. J., Human Factors in Engineering and Design, McGraw-Hill Education, 7th edition, 1992.
4. Geneva Indian Adaptation International Labour Office, Introduction to Work Study, Oxford & IBH Publishing Co Pvt. Ltd, 3rd edition, 2015.
5. Barnes, R. M., Motion and Time Study: Design and Measurement of Work, Wiley, 7th edition, 2009.

Practical

Subject Name: Simulation Laboratory	**Category:** Laboratory II
Subject Code: PC- IEM192	**Semester:** First
L-T-P:0-0-4	**Credit:** 2
Perquisite: No Perquisite	

Course Outcome:

On successful completion of the course, Students will able to

CO1: Explain the basic steps involved in discrete event simulation process by using simulation software.

CO2: Identify and examine the entities involved in a simulation process given in simulation software.

CO3: Decide the activity cycle diagram for each entity by using simulation software.

CO4: Solve simulation experiments using simulation software, estimate the results and perform sensitivity analysis to test the effects of critical model parameter.

Course Contents:

Fundamental Simulation concepts; exploring the simulation software; modelling basic operations and inputs; detailed modelling and terminating statistical analysis; intermediate modelling and steady-state statistical analysis; entity transfer; Further modelling issues and techniques; Conducting simulation studies

Learning Resources:

1. Law, A. M., Kelton, W. D., & Kelton, W. D. (2000). Simulation modeling and analysis (Vol. 3). New York: McGraw-Hill.
2. Chaturvedi, D. K. (2017). Modeling and simulation of systems using MATLAB® and Simulink®. CRC press.

Subject Name: Operations Research-I	**Category:** Program Core III
Subject Code: PC-IEM201	**Semester:** Second
L-T-P :3-0-0	**Credit:3**
Pre-Requisites: No Perquisite	

Course Outcomes:

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

CO1: Summarize the application of OR and frame a LP Problem with solution – graphical and through solver add in excel (software).
CO2: Explain the relationship between a linear program and its dual, including strong duality and complementary slackness
CO3: Formulate and solve transportation and assignment problems.
CO4: Define and solve integer linear programming problems.
CO5: Define and demonstrate the dynamic programming technique and its application in decision making.

Course contents:

Module No.	Description of Topic	Contact Hrs.
1	**Linear Programming:** Two variable LP model, graphical method and simplex method, revised simplex method, special cases in simplex method application, comprehensive problems;	6
2	**Duality and Sensitivity Analysis:** Primal dual relationship and economic interpretation of duality, dual simplex method, sensitivity analysis, comprehensive problems;	6
3	**Transportation Model and its Variants:** Transportation algorithm, assignment model- Hungarian method, transhipment model, comprehensive problems;	6
4	**Integer Programming**: Branch and bound algorithm, cutting plane algorithm, comprehensive problems;	6
5	**Introduction to Goal Programming:** comprehensive problems;	4
6	**Dynamic Programming:** Forward and backward recursion-stagecoach problem, knapsack model, comprehensive problems;	6
7	**Classical Optimization Theory:** Unconstrained and constrained problem, comprehensive problems.	6
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Hillier, F. S., and Lieberman, G. J., Nag, B., and Basu, P., Introduction to Operation Research, McGraw Hill, 10th edition, 2017.
2. Taha, H. A., Operation Research- An Introduction, Pearson Education, 10th edition, 2019.
3. Ravindran, A., Philips, D.T., and Solberg, J.J., Operations research, Wiley,2nd edition, 2007.
4. Vohra, N. D., Quantitative Techniques in Management, McGraw Hill,5th edition, 2017.

Subject Name: Quality Design and Control	**Category:** Program Core-IV
Subject Code: PC-IEM202	**Semester**: Second
L-T-P:3-0-0	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Comprehend fundamental knowledge on the basics of quality control and management of quality.
CO2: Apply statistical tools for online process control.
CO3: Design acceptance Sampling (AS) plans.
CO4: Examine reliability of complex mechanical systems.
CO5: Apply factorial design and Taguchi methods for product and process design.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**History and Evolution of Quality Control and Management.**	3
2	**Management of Quality**: Meaning of Management of Quality, Quality Engineering, Strategic Management of Quality, Management Programs for Quality, Fundamentals of Total Quality Management (TQM), Quality Loop, Quality System Standards (ISO 9000).	5
3	(a) Probability Models for Quality Control. (b) Descriptive Statistics, Sampling, and Inferences	5
4	**Statistical Process Control (SPC)**: (a) Control Chart Principles: Causes of Variation, Statistical Aspects of Control Charting, Concept of Rational Subgrouping, Detecting Patterns on Control Charts (b) Control Charts for Attributes: p, np, c, u, and U charts (c) Control Charts for Variables: R, X, S, and X charts (d) Special Control Charts: Cusum, Trend, Modified and Acceptance, Moving Average, Geometric Moving Average, and Multivariate Control Charts. (e) Specifications and Tolerances: Natural Tolerance Limits and Specification Limits, Process Capability Ratios, and Process Capability Analysis	9
5	**Acceptance Sampling**: (a) Fundamental Concepts (b) Acceptance Sampling by Attributes: Single, Double, Multiple, and Sequential Sampling Plans, MIL-STD-105E, Dodge-Romig, and ANSI-ASQC-Z1.4 Plans, Continuous Sampling Plans (c) Acceptance Sampling by Variables: Types of Plans, Plans for a Process Parameter, Plans to Control the Lot Percent Nonconforming, MIL-STD-414 and ANSI/ASQC Z 1.9	6
6	**Reliability Prediction and Life Testing**: Reliability of a System, Exponential Model in Reliability, Life Testing using Exponential and Weibull Models, Fundamentals of Maintenance Management, Concept of Total Productive Maintenance (TPM)	6

7	**Product and Process Design**: (a) Experimental Designs: Completely Randomized Design, Randomized Block Design, Latin Square Design (b) Factorial Experiments (c) Taguchi Methods in Design and Quality Improvement: Taguchi Philosophy, Loss Function, S/N Ratio and Performance Measures, Experimental Design and Parameter Design in Taguchi Methods.	6
	Total number of contacts (Hr.)	40

Learning Resources:

1. Mitra, A., Fundamentals of Quality Control and Improvement, Wiley, 3rd edition, 2013.
2. Montgomery, D C., Introduction to Statistical Quality Control, Wiley, 6th edition, 2009.
3. Grant, E L and Leavenworth, R S, Statistical Quality Control, McGraw Hill, 17th edition, 2013.
4. Banks, J., Principles of Quality Control, John Wiley, 1st edition 1989.
5. Dukkipati, R V and Ray P K., Product and Process Design for Quality, Economy and Reliability, New Age International. 1st edition 2009
6. Duncan, A J, Quality Control and Industrial Statistics, Richard D. Irwin, 5th edition, 1986.

Subject Name: Project Engineering and Management	**Category:** Program Elective – III
Subject Code: PE-IEM203A	**Semester**: First
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No Perquisite	

Course Outcomes:

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

CO1: Explain the methods for project identification & appraisal
CO2: Construct project plan through Gantt chart.
CO3: Construct the project plans through CPM and PERT
CO4: Identify resource considerations in project management
CO5: Explain monitoring schemes for project monitoring and control
CO6: Identify human factors in project management

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Define project and process, projects versus routine production, boundaries of project, Objectives and functions of Project management, characteristics and types of projects, Life cycle of a project, generation of new project ideas, brainstorming, screening of ideas	8
2	Project appraisal on various fronts: market appraisal, technical appraisal, financial appraisal, socio-economic appraisal, ecological appraisal; multi-criteria evaluation of projects	8
3	Time Management, Work Breakdown Structure (WBS), Gantt Charts, project network development, project scheduling using PERT and CPM, floats and their interpretation, project simulation, project crashing and resource aggregation, levelling and allocation.	18
4	Project monitoring and control using earned value and the concept of critical chain, human factors in project management	6
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Chandra, P., Projects: Planning, Analysis, Selection, Implementation and Review, McGraw-Hill, Ninth edition, 2019.
2. Kerzner, H., Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Wiley, 2017.
3. Kanda, A., Project Management: A Life Cycle Approach, PHI, 2010.
4. A Guide to the Project Management Body of Knowledge (PMBOK guide) and the Standard for Project Management, Project Management Institute, 7th edition, 2021.
5. Jha, K. N., Determinants of Construction Project Success in India, Springer, 2013.

Subject Name: Reliability Analysis and Prediction	**Category:** Program Elective – III
Subject Code:PE-IEM203B	**Semester**: Second
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Define the concepts of reliability, common reliability functions, parameters and methods of their modeling and prediction.
CO2: Determine reliability of system of components connected in different networks.
CO3: Estimate reliability functions and parameters of an item using life testing and hazard plotting.
CO4: Conduct failure modes effects and criticality analysis (FMEA/FMECA), fault tree analysis (FTA)

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction: Reliability definition, reliability of a system, reliability as a function of time.	5
2	Probability and Statistics for Reliability: Various probability distributions (binomial, Poisson, exponential, Weibull, Normal and Gamma). Probability plots for various distributions.	7
3	General Reliability Function: Mean time to failure (MTTF), instantaneous failures or hazard rate function. Reliability expressions for constant, increasing and decreasing hazard rates. Failure data Analysis.	8
4	System Reliability: System with components in Series, parallel, series-parallel, standby and k-out-of-m modeling.	6
5	Reliability in Design and Development: Failure Modes, Effects and Criticality Analysis (FMEA/FMECA), Fault Tree Analysis (FTA)	7
6	Reliability Testing: Reliability determination/demonstration testing, Highly Accelerated Life Testing / Stress Screening (HALT/HASS), Accelerated Reliability / Life Testing and Analysis (ALTA)	7
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Kales, P, Reliability: For Technology, Engineering, and Management, Prentice Hall, 1998
2. Dhillon, B S., Maintainability, Maintenance, and Reliability for Engineers, CRC Press, 1st edition, 2006
3. Banks, J., Principles of Quality Control, John Wiley, 1st edition 1989.
4. Dukkipati, R V and Ray P K., Product and Process Design for Quality, Economy and Reliability, New Age International. 1st edition 2009

Subject Name: Enterprise Resource Planning	**Category:** Program Elective – III
Subject Code:PE-IEM203C	**Semester:** Second
L-T-P : 3-0-0	**Credit:3**
Pre-Requisites:	

Course Outcomes:

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

CO1: Make use of Enterprise software, and its role in integrating business functions
CO2: Analyze the strategic options for ERP identification and adoption.
CO3: Design the ERP implementation strategies.
CO4: Create reengineered business processes for successful ERP implementation.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to ERP: Enterprise – An Overview Integrated Management Information, Business Modelling, Integrated Data Model, Benefits of ERP, ERP and Related Technologies, Business Process Reengineering (BPR), Data Warehousing, Data Mining, OLAP, SCM.	6
2	ERP Implementation: ERP Implementation Lifecycle, Implementation Methodology, Organizing the Implementation, Vendors, Consultants and Users, Contracts with Vendors, Consultants and Employees, Project Management and Monitoring.	10
3	ERP Modules: Business Modules- Manufacturing, Materials Management, Finance, Plant Maintenance, Quality Management, Human Resources and Marketing.	10
4	ERP Market: ERP Market Place, SAP AG, PeopleSoft, Baan, JD Edwards, Oracle, QAD, SSA, Enterprise Integration Applications (EIA), ERP and E-Commerce, ERP and Internet.	8
5	ERP Present and Future: Future Directions and Trends in ERP.	6
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Alexis Leon, “ERP demystified”, Tata McGraw–Hill publishing company Ltd., New Delhi,2002.
2. Brady, “Enterprise Resource Planning”, Thomson Learning,2001.
3. S. Sadagopan., ERP: A Managerial perspective, McGraw, New Delhi,1999.
4. Vinod Kumar Gargand Venkita krishnanNK,“EnterpriseResourcePlanning–ConceptsandPractice”, PHI, New Delhi, 2003.
5. Mary Sumner, “Enterprise Resource Planning”, Pearson Education,2007.

Subject Name: Production Design and Process Planning	**Category:** Program Elective – III
Subject Code: PE-IEM203D	**Semester:** Second
L-T-P: 3-0-0	**Credit: 3**
Perquisite: No Perquisite	

Course Outcome:

On successful completion of the course, Students will able to:

CO1: Define and explain basic principles and concepts of manufacturing systems as well as various strategies of automation in manufacturing systems.
CO2: Apply various material handling techniques in industry application.
CO3: Analyse automated flow lines and evaluate assembly systems
CO4: Design automated process plans for intended products.

Course Contents:

Module No.	Description of Topic	Contact Hour
1	**Introduction**: Four concept of manufacturing – planning, control, material flow, and manufacturing process. Control loop of a manufacturing system. Basic functions of a manufacturing facility for small and medium-size production runs. Functions of a computer a manufacturing organization.	4
2	**Concurrent Engineering:** Sequential versus concurrent engineering, mathematical model for interactions between design and manufacturing, benefits of CE, characterization of CE environment, framework for integration of life-cycle phases in CE, CE techniques, difficulties associated with CE, examples.	6
3	**Automated Material Handling and Storage Systems:** Principles of MH, MH equipment, types and components of AGVS, automated storage and retrieval systems, distributed computer control architecture for AGVS and AS/RS, conveyors. Robotic Systems: Fundamentals of robotics and its technology, robot classification, robot motion analysis, robot selection and its application, economic justification of robots. Numerical Control: Conventional numerical control (NC) – basic components of an NC system, applications of NC, economics of NC, and problems with conventional NC. Computer Numerical Control (CNC), Direct Numerical Control (DNC), and combined CNC/DNC systems. NC programming.	10
4	**Process Planning:** Manufacturing environment for process planning. Generative process planning, variant process planning, and CAPP system. Computer-aided generation of process plans.	4
5	**Group Technology, CMS, and MRP: Classification methods –** OPITZ, CODE, and MICLASS systems. Master production schedule. Material Requirements Planning (MRP). Manufacturing Resources Planning (MRP-	10

	II)–capacity requirement planning, order release planning, and operations sequencing. Group scheduling in MRP-II environment. Flexible Manufacturing Systems: Types of flexibility, key characteristics, and basic features of physical components of FMS, control components of FMS, operational problems and layout considerations, simulation modelling and FMS benefits.	
6	**JIT Manufacturing Systems:** Introduction to JIT-based techniques Overview of TPS, pull versus push system, types of kanban, kanban planning and control models – deterministic and probabilistic models, signal kanban, other types of kanbans, alternative JIT systems, JIT purchasing, barriers to and benefits of JIT implementation, examples.	6
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Groover, M. P. (2016). Automation, production systems, and computer-integrated manufacturing. Pearson Education India.
2. Groover, M., & Zimmers, E. W. J. R. (1983). CAD/CAM: computer-aided design and manufacturing. Pearson Education.
3. Rembold, U., Blume, C., & Dillmann, R. (1985). Computer-integrated manufacturing technology and systems. MARCEL DEKKER, INC., NEW YORK, NY 10016(USA), 1985, 808.
4. Hyde, W. F. (1981). Improving Productivity by Classification (Vol. 5). CRC Press.
5. Noori, H, Managing the Dynamics of New Technology: Issues in Manufacturing Management, Prentice-Hall.

Subject Name: Management of Inventory Systems	**Category:** Program Elective- IV
Subject Code:PE-IEM204A	**Semester**: Second
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Explain the principles, concepts, and techniques of inventory management formulation and implementation.
CO2: Apply different methods and practices to solve inventory management problems.
CO3: Explain the important methods and approaches in purchasing, storing, distribution, value engineering/analysis, logistics and SCM for better materials control and inventory management.
CO4: Illustrate current approaches in inventory management.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Inventory and Materials Management	3
2	Selective inventory management techniques and Classification of inventory problems.	3
3	Static Inventory Problems under risk and uncertainty	4
4	Dynamic Inventory Problems under certainty, risk and uncertainty.	6
5	MRP, MRP-II and DRP	6
6	Design of Inventory Study and Decision Procedures	3
7	JIT-based Approaches for Materials Management	3
8	Theory of Constraints and Materials Management	2
9	Basics of Purchasing Management, Value Engineering/Analysis and Stores Management	6
10	Logistics and Supply Chain Management	4
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Starr, K. K., and D W Miller, Inventory Control: Theory and Practice, Prentice Hall,1962.
2. Tersine, R J., and Hays, M., Principles of Inventory and Materials ManagementPearson,4th edition, 1993.
3. Silver, E. A., Pyke, D. F., Peterson, R., Thomas, D.J., and Inventory and Production Management in Supply Chains, CRC Press; 4th edition, 2021.
4. Toomey, J. W., Inventory Management: Principles, Concepts and Techniques. Springer, 2012
5. Ptak, C., and Smith C., Orlicky's Material Requirements Planning, McGraw-Hill Education, 3rd edition, 2011.
6. Gopalakrishnan, P., and Haleem, A., Handbook of Materials Management, PHI Learning; 2nd edition ,2015.
7. Sharma, S., Inventory Parameters, Springer; 1st edition, 2017.

Subject Name: Logistics and Supply Chain Management	**Category:** Program Elective- IV
Subject Code: PE-IEM204B	**Semester:** Second
L-T-P:3-0-0	**Credit:** 3
Perquisite: No Perquisite	

Course Outcome:

On successful completion of the course, Students will able to:

CO1: Explain the importance of logistics and supply chain management in today's business environment
CO2: Develop the knowledge of computer-based supply chain optimization tools and techniques and their application
CO3: Analyzing case problems by using the current supply chain theories, practices and concepts
CO4: Select supply chain optimization tools and techniques to improve the performance of inbound and outbound logistics as well as estimate overall performance of functional systems

Course contents:

Module No.	Description of Topic	Contact Hour
1	**Introduction to logistics:** Nature and scope of logistics, Logistics environment	6
2	**Logistic decisions:** facility location, transportation, storage and material handling, Logistics information systems, Logistics audit and control. Introduction to SCM- Principles and issues;	8
3	**Inbound and outbound logistics:** Supply chain as a source of competitive advantage, Supply chain coordination- procurement, vendor development, reduced sourcing and supplier partnership, managing inventory in SCM and Risk pooling, coordinated inventory decision, co-ordinated pricing decision, coordinated product and process design	9
4	**Distribution strategies**: customer service, physical distribution planning, Material handling, Facility and warehousing decision;	7
5	**Strategic considerations for supply chain**: Porters industry analysis and value chain models, the concept of total cost of ownership, Supply chain management strategies, Logistics strategies and global supply chain management, measuring effectiveness of supply chain management, operations research models for operational and strategic issues in supply chain management, Value of information sharing in supply chain management, The Bullwhip effect and supply chain management game. E- supply chain and its performance. Case Studies in supply chain management.	10
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., & Shankar, R. (2008). Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies, McGraw-Hill, 3rd edition, 2019.
2. Gattorna, J. L., and Walters, D. W., Managing the supply chain: a strategic perspective. Palgrave, 2013.
3. Ballou, R., Business Logistics/Supply Chain Management, Pearson Education., 2014
4. Chopra, S., Meindl, P., & Kalra, D. V. (2013). Supply chain management: Strategy, planning, and operation (Vol. 232), Pearson, 7th edition, 2018.

Subject Name: Six Sigma Fundamentals and Applications	**Category:** Program Elective- IV
Subject Code: PE-IEM204C	**Semester**: Second
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Explain how DMAIC fits into the framework of the six-sigma philosophy.
CO2: Apply SQC tools for process improvement.
CO3: Apply six sigma to work problems.
CO4: Apply univariate and multivariate tools for process capability studies.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Historical background, present industrial scenario, basic concepts of Six Sigma, applications of Six Sigma, overview of Six Sigma methodology, six sigma tools and techniques.	6
2	**Variability in Production/Manufacturing Systems:** Types of production systems, production performance, capability and quality, prevention and remedial measures for improvement, methods for variability measurement and evaluation, numerical examples and short case studies.	6
3	**Six Sigma Methodology**: Detailed steps, DMAIC, DFSS, and axiomatic design.	5
4	**Six Sigma Tools and Techniques**: Univariate process capability studies: concepts, grouped/ungrouped data, measure indices and their applications, gage R&R, relationship between product and process capability, numerical examples and case studies.	6
5	**Six Sigma Tools and Techniques**: Multivariate process capability studies: background and concepts, measure indices and their applications, numerical examples and case studies.	6
6	**Six Sigma through Design Improvement**-Part-I: Process, equipment, and material, manufacturability and tolerancing, numerical examples and case studies.	6
7	**Six Sigma through Design Improvement**-Part-II: Parameter design, robust optimization, numerical examples and case studies.	5
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Evans, J R., and Lindsay, W M., An Introduction to Six Sigma & Process Improvement, South-Western College Publishing, 2nd edition, 2014.
2. Goel, P S., Gupta, P., Jain, R., and Tyagi, R K., Six Sigma for Transactions and Service, McGraw-Hill, Illustrated edition, 2005.
3. Muir, A., Lean Six Sigma Statistics: Calculating Process Efficiencies in Transactional
4. Projects, McGraw-Hill, Illustrated edition, 2005.
5. Montgomery, D C., Introduction to Statistical Quality Control, Wiley, 6th edition, 2009.
6. Breyfogle F W., Implementing Six Sigma: Smarter Solutions Using Statistical Methods, John Wiley & Sons, 2nd edition, 2003.
7. Brue G., and Howes, R., Six Sigma, Tata McGraw-Hill, 1st edition, 2005.
8. Keller, P., Six Sigma Demystified, Tata McGraw-Hill, 2nd edition.

Subject Name: Human Factors Engineering	**Category:** Program Elective- IV
Subject Code: PE-IEM204D	**Semester**: Second
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Explain the relevance of Human Factors or Ergonomics for Work Systems
CO2: Apply anthropometric Principles and Postural Analysis in Workspace Design
CO3: Estimate Physical Work Capacity and Work load of Individuals
CO4: Design of Manual Handling Tasks and Computer workstation
CO5: Design Physical Work Environment
CO6: Explain Human-centered design processes for interactive systems and human-machine interaction concept.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Introduction to Simple and Complex Work systems and Relevance of Human Factors or Ergonomics, History and Recent Trend in Human Factors, Effectiveness and cost effectiveness of ergonomics.	2
2	**Anthropometric Principles in Workspace and Equipment Design:** Basic body mechanics, Risk factors for musculoskeletal disorders, Designing for a population of users, Sources of human variability, Anthropometry and its uses in ergonomics, Principles of applied anthropometry in ergonomics, Application of anthropometry in design	4
3	**Work Capacity and Fatigue:** Muscles, structure, function, and capacity, Occupational biomechanics, Cardiovascular system, Respiratory system, Physical work capacity, Applied physiology in designing the workplace, Fitness for work	5
4	**Design of Repetitive Tasks**: Introduction to work-related musculoskeletal disorders, Injuries to the upper body at work, Tissue pathomechanics, Carpal tunnel syndrome, Lower and upper limbs	4
5	**Design of Manual Handling Tasks:** Anatomy and biomechanics of manual handling, Prevention of manual handling injuries in the workplace, Design of manual handling tasks, Lifting, carrying, and pushing, NIOSH lifting equation	5
6	**Design for Standing and Sitting:** Ergonomic approach to workstation design, Design for standing workers, Design for seated workers, Work surface design, Visual displays, Guidelines for the design of static work, Computer workstation design	5
7	**Design of the Thermal Environment:** Fundamentals of human thermoregulation, Thermoregulatory mechanisms, Measuring the thermal environment, Work in hot climates, Work in cold climates **Vision, Light, and Lighting:** Vision and the eye, Measurement of light, Lighting design considerations, Visual fatigue, eyestrain, and near work, Psychological aspects of indoor lighting	8

	Hearing, Sound, Noise, and Vibration: Sound and the ear, Measurement of sound, Hearing protection, Design of the acoustic environment, Noise control, Effects of noise on task performance, Non-auditory effects of noise on health, Vibration	
8	**Human Information Processing, Skill, and Performance**: Information processing models, Cognitive systems, Problem solving	2
9	**Displays and Controls**: Human-centered design processes for interactive systems, Principles for the design of visual displays, Auditory displays, Design of controls, Combining displays and controls	2
10	**Human-machine interaction, human error, and safety:** Human error and equipment design, Mental workload in human machine interaction, Psychological aspects of human error, Characterizing human-machine interaction, Prevention of error in human-machine interaction, Accidents and safety	3
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Bridger, R. S., Introduction to Ergonomics, CRC Press, 4th edition, 2017.
2. Introduction to Human Factors and Ergonomics for Engineers. Lehto, Mark R., and Landry, Steven J., CRC Press, 2nd Edition, 2013.
3. Halender, M., A Guide to the Ergonomics of Manufacturing, CRC Press, 2nd edition, 2005.
4. Wickens, C. D., Hollands, J. G., Banbury, S., and Parasuraman, R. R., Engineering Psychology and Human Performance, Routledge, 4th edition. 2016.
5. Chaffin, D. B., Andersson, G. B.J., and Martin, B. J., Wiley, Occupational Biomechanics Wiley-Interscience, 4th edition, 2006.
6. Sanders, M. S. and McCormick, E. J., Human Factors in Engineering and Design, McGraw-Hill Education, 7th edition, 1992.
7. Salvendy, G., Handbook of Human Factors & Ergonomics, Wiley; 5th edition, 2021

Practical

Subject Name: Quality Design and Control Laboratory	**Category:** Laboratory- III
Subject Code: PC-IEM291	**Semester**: Second
L-T-P: 0-0-4	**Credit:**2
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Compute and interpret various parameter and statistic used in statistical quality control. CO2: Construct and interpret visual data displays, including the stem-and-leaf plot, the histogram, and the box plot.
CO3: Develop control charts for variables and attributes.
CO4: Design acceptance sampling plans for attributes.
CO5: Determine reliability of items connected in series and parallel network

Course Contents:

Laboratory experiments and exercises on Measurement and analysis of quality characteristics, Construction and interpretation of attribute and variable control charts, Simulation studies on acceptance sampling simulator, Process capability study, Acceptance sampling plans for variables and Reliability and life testing.

Learning Resources:

1. Mitra, A., Fundamentals of Quality Control and Improvement, Wiley, 3rd edition, 2013.
2. Montgomery, D C., Introduction to Statistical Quality Control, Wiley, 6th edition, 2009.
3. Grant, E L and Leavenworth, R S, Statistical Quality Control, McGraw Hill, 17th edition, 2013.
4. Banks, J., Principles of Quality Control, John Wiley, 1st edition 1989.
5. Dukkipati, R V and Ray P K., Product and Process Design for Quality, Economy and Reliability, New Age International. 1st edition 2009
6. Duncan, A J, Quality Control and Industrial Statistics, Richard D. Irwin, 5th edition, 1986.

Practical

Subject Name: Design Thinking Laboratory	**Category:** Laboratory- IV
Subject Code: PC-IEM292	**Semester**: Second
L-T-P:0-0-4	**Credit:** 2
Pre-Requisites: No-prerequisite	

About the Course:

Design thinking is a process-driven, human-centered approach to problem solving. The process does not have to be linear. It can jump from one phase to any other phase based on need. This course will introduce students to the tools, practices, modes of thinking, and theory of Design Thinking, with an emphasis on practical application. Students will learn to participate in and lead innovation and creativity in collaborative settings. They should be able to communicate and apply the skills mastered to real world design problems leading to lifelong learning.

Course Outcomes:

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

CO1: Explain the methods, processes, and key principles of design thinking.
CO2: Develop the capability to empathise with end-users to develop meaningful products or services.
CO3: Define problem and develop a deeper understanding of users and their interactions with the designed environment.
CO4: Participate and conduct ideation sessions with team members for new ideas and solutions.
CO5: Create and present prototype through solutions achieved.
CO6: Test solutions and work on feedback loops.

Course Contents:

Design thinking models and tenets, qualitative research methods, problem finding and framing, analysis and synthesis of research, reflective thinking, ideation and creativity techniques, experimentation and rapid prototyping, collaborative skills and technologies, concept testing, iterative design, and identifying and communicating unique points of view.

Learning Resources:

1. Tim, B., Change by Design, Harper Business, 2019.
2. Liedtka, J., and Ogilvie, T., The Designing for Growth Field Book: A Step-by-Step Project Guide, Columbia Business School Publishing, 2019.
3. Liedtka, J., and Ogilvie, T., Designing for Growth: A Design Thinking Tool Kit for Managers, Columbia Business School Publishing, 2011.
4. Lewrick, M.,Link, Patrick., and Leifer, L., The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems, Wiley, 1stedition ,2018.
5. Ulrich, K., Design: Creation of Artifacts in Society, University of Pennsylvania, 2011.
6. Ramadurai, B., Karmic Design Thinking, Self-Published, 2020

Sessional

Subject Name: Mini Project with Seminar	**Category:** Mini Project
Subject Code:PW-IEM281	**Semester**: Second
L-T-P:2-0-0	**Credit:** 2
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Select a research problem in the domain of Industrial Engineering and management

CO2: Choose an appropriate research methodology for solving the problem identified.

CO3: Apply the methods/tools learned to solve the problem.

CO4: Develop a substantial technical report on the actual work done

Course Contents:

Students will select a research problem in the domain of Industrial Engineering and management related to manufacturing and service systems by consulting a faculty member in the department. The student has to identify an appropriate methodology and solve the problem. Seminar presentation would be made by an individual student, and a report would have to be submitted by each student separately.

Subject Name: Systems Analysis Techniques	**Category:** Program Elective- V
Subject Code:PE-IEM301A	**Semester:** Third
L-T-P : 3-0-0	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Demonstrate about soft computing techniques and their applications
CO2: Analyze various neural network architectures
CO3: Apply perceptrons and counter propagation networks.
CO4: Define the fuzzy systems
CO5: Analyze the genetic algorithms and their applications.

Course contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Analysis and Design of intelligent systems using soft computing techniques. Application of soft computing; Soft Computing Methods.	8
2	Artificial Neural Network (ANN): Fundamental Model, Learning Rules Hebb Net Architecture, Algorithm, linear separability; Perceptron Networks-single and m multilayer; Adeline and Madeline Networks;	8
3	Feedback Networks – Discrete Hopfield Net – architecture, training and application algorithm, analysis (ATTAA) Feed Forward Networks (ATTAA): Back Propagation, Radial Basis	7
4	Function Self Organizing Feature Map : Kohonen SOM, LVQ	7
5	Fuzzy Systems / Logic – Fuzzy Set Theory; Fuzzy Sets Applications Hybrid : Neuro-Fuzzy Modeling	6
6	Genetic Algorithms and Theory	4
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Jang, J.S.R., Sun, C.T., and Mizutani, E., Neuro-Fuzzy & Soft Computing, Pearson, 1st edition, 2015.
2. Gurney, K., An Introduction to Neural Networks, CRC Press, 1st edition, 1997.
3. Vose, M. D., The Simple genetic Algorithm, MIT Press, 1999.
4. Engelbrecht, A. P., Computational Intelligence: An Introduction, Wiley, 2nd edition, 2007.
5. Ross, T. J., Fuzzy Logic with Engineering Applications, Wiley, 4th edition, 2016.
6. Rajasekaran, S., and Pai, G.A.V., Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI. 2nd edition, 2017.
7. Goldberg, D. E., Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley, 13th edition, 1989.

Subject Name: Operation Research-II	**Category:** Program Elective- V
Subject Code:PE-IEM301B	**Semester:** Third
L-T-P :3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Demonstrate and compute quantitative metrics of performance for queueing systems.
CO2: Apply and extend queuing models to analyze real world systems.
CO3: Demonstrate the theoretical workings of the solution methods for nonlinear programming problems and demonstrate their working by hand and solver
CO4: Demonstrate the theoretical workings of the solution method for quadratic programming problem and demonstrate its working by hand and solver

Course contents:

Module No.	Description of Topic	Contact Hrs.
1	**Queuing Systems:** Elements of queuing model, pure birth and death model, generalized Poisson queuing models, single-server models, multi-server models, other queuing models, Comprehensive problems;	13
2	**Markovian Decision Process**: Markovian Decision Problems, finite and infinite stage models, Markov chain, Comprehensive problems;	13
3	**Non-Linear Programming**: Unconstrained algorithm-direct search method, gradient method, constrained algorithm-Separable programming, quadratic programming, geometric programming, stochastic programming, linear combination method, Comprehensive problems.	14
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Hillier, F. S., and Lieberman, G. J., Nag, B., and Basu, P., Introduction to Operation Research, McGraw Hill, 10th edition, 2017.
2. Taha, H. A., Operation Research- An Introduction, Pearson Education, 10th edition, 2019.
3. Ravindran, A., Philips, D.T., and Solberg, J.J., Operations research, Wiley,2nd edition, 2007.
4. Hadley, G., Linear Programming, Addison-Wesley,1962.

Subject Name: Design of Experiments	**Category:** Program Elective- V
Subject Code:PE-IEM301C	**Semester:** Third
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: List the different types of formal experimental designs.
CO2: Identify the experimental unit and recognize issues of non-independence.
CO3: Identify formal ways of determining sample size.
CO4: Explain the fundamental principles behind the output of an ANOVA, including "blocking" and "interactions".

Course contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction: Typical applications of experimental design, basic principles, guidelines for designing experiments, experimental design fundamentals. Simple Comparative Experiments: Basic statistical concept, inferences about the differences in means, randomized designs, inferences bout the differences in means, paired comparison designs;	2
2	Experiments with a Single Factor Randomized Blocks, Latin Squares, and Related Designs	2
3	Introduction to Factorial Designs: Basic definitions and principle, the two-factor factorial design. The 2^k Factorial Design Blocking and Confounding in the 2^k Factorial Design	16
4	Two-Level Fractional Factorial Designs	10
5	Response Surface Methods and Other Approaches to Process Optimization	10
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Montgomery, D. C., Design and Analysis of Experiments, Wiley,10th edition, 2020.
2. Hinkelmann, K., Design and Analysis of Experiments, Wiley, 2008.
3. Mitra, A, Fundamentals of Quality Control and Improvement, Wiley, 4th edition ,2016

Subject Name: Multi-Criteria Decision-Making Techniques	**Category:** Program Elective- V
Subject Code: PE-IEM301D	**Semester**: Third
L-T-P: 3-0-0	**Credit: 3**
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Develop Multiple Criteria Decision Making models for problem solving.
CO2: Explain various MCDM models such as-network based, outranking, fuzzy based and goal programming models.
CO3: Apply MCDM models for problem in diverse field.
CO4: Compare and analyze solutions provided by various MCDM models.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Multi-Criteria Decision Making – An Overview – Classification of MCDM methods – Simple Additive Weighting method – Weighted Product method – Principle, steps and illustrative examples.	8
2	Network based MCDM methods – Analytic Hierarchy Process – Revised Analytic Hierarchy Process – Analytic Network Process – Principle, steps and illustrative examples.	8
3	Outranking MCDM methods – PROMETHEE, ELECTRE, TOPSIS - Compromise Ranking method - VIKOR, ORESTE – DEMATEL – Principle, steps and illustrative examples.	8
4	Fuzzy based MCDM methods – Hybrid MCDM methods – Group Decision Making- Graph Theory and Matrix approach – Principle, steps and illustrative examples.	8
5	Goal Programming – Balanced Scorecard Approach - MCDM application areas – Case studies on application of MCDM techniques.	8
	Total number of contacts (Hr.)	40

Learning Resources:

1. Belton, V., Stewart, T.J., Multiple Criteria Decision Analysis: An Integrated Approach, Kluwer Academic Publishers, 1st edition, 2002.
2. Triantaphyllou, E., Multi-Criteria Decision Making Methods: A Comparative Study, Springer, 1st edition, 2000.
3. Pedrycz, W., Ekel, P., Parreiras, R., Fuzzy Multi Criteria Decision-Making: Models, Methods and Applications, John Wiley & Sons, 1st edition 2011.
4. Kahraman, C., Fuzzy Multi-criteria Decision Making: Theory and Applications with Recent Developments, Springer, 1st edition 2008.

Subject Name: Business Analytics	**Category:** Open Elective
Subject Code: OE-IEM301A	**Semester:** Third
L-T-P:3-0-0	**Credit:** 3
Perquisite: No-prerequisite	

Course Outcome:

On successful completion of the course, Students will able to:

CO1: Explain the role of business analytics within an organization.
CO2: Choose statistical and data mining techniques to analyze relationships between the underlying business processes of an organization.
CO3: Determine business problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace
CO4: Choose decision-making tools/Operations research techniques to formulate and solve the problem to support managerial decision making.

Course Contents:

Module No.	Description of Topic	Contact Hour
1	Introduction to Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	7
2	Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	7
3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.	8
4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	8
5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	6
6	Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Schniederjans, M. J., Schniederjans, D. G., and Starkey, C. M., Business analytics principles, concepts, and applications: what, why, and how, Pearson Education, 1st edition, 2014.
2. Evans, J. R., Business analytics, Pearson, 3rd edition, 2021.
3. Kumar, U. D., Business Analytics: The Science of Data- Driven Decision Making, Wiley, 2021.

Subject Name: Industrial Safety Engineering	**Category:** Open Elective
Subject Code: OE-IEM301B	**Semester**: Third
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Describe the concepts of engineering systems safety.
CO2: Identify the different hazards of occupational health in different Industries
CO3: Make use of the possible tools, techniques and methodologies to overcome the safety issues in different types of Industry
CO4: Describe the concepts of design for engineering systems safety.
CO5: Explain the various Industrial safety Acts in National and International standards.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Industrial Safety Engineering, Major Industrial accidents, Accident causation theories, Cost of accident and safety budget, Line and staff functions for safety, Planning for safety for optimization of productivity.	5
2	Introduction to hazard identification and analysis techniques, Preliminary Hazard Analysis (PHA), Failure Modes and Effects Analysis (FMEA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Hazard and Operability Analysis (HAZOP), Failure Modes Effects and Criticality Analysis (FMECA), Probabilistic Risk Assessment (PRA), Bow-Tie Tool and Management	14
3	Risk Assessment Process, Consequence Assessment, Safety Function Deployment, Systems Safety Quantification	7
4	Definition human Error, Classification and Causes of human Error, Generic error modelling system, Human Error Identification, Human Reliability Assessment	4
5	Introduction to accident/incident Investigation & Analysis, Incident Investigation process, Risk score calculation, Guidelines for investigation and team formation, Root cause analysis, Accident Data Analysis	5
6	Industrial Safety Acts, Occupational Health and Safety Management Systems and ISO 45001, Safety Performance Indicators.	5
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Clifton, A. Ericson II, Hazard Analysis Techniques for System Safety Wiley; 2nd edition, 2015.
2. Kumamoto, H., & Henley, E. J., Probabilistic Risk Assessment and Management for Engineers and Scientists, Wiley-IEEE Press, 2nd edition, 2000.
3. Goetsch, D., Occupational Safety and Health for Technologists, Engineers, and Managers, Prentice Hall, 8th edition, 2015.
4. Leveson, N. G., Engineering a Safer World: Systems Thinking Applied to Safety, MIT Press. 2016.
5. Deshmukh, L. M., Industrial Safety Management, McGraw Hill Education, 2017.
6. Benjamin, O. A., Fundamental Principles of Occupational Health and Safety, ILO 2008.

Subject Name: Cost Management of Engineering Projects	**Category:** Open Elective
Subject Code: OE-IEM301C	**Semester**: Third
L-T-P:3-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Explain the significance of cost management in engineering projects.
CO2: Describe the procedures for creating a cost management plan.
CO3: Explain categories of cost and various inputs required for estimating the cost of the project.
CO4: Use the work break down structure to estimate the cost of the project.
CO5: Describe the Project Cost Budgeting and the process of project Cost Control
CO6: Evaluate a project's performance in the context of cost.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	4
2	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process	8
3	Cost Behaviour and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.	8
4	Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	10
5	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	10
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Datar, S. M., and Rajan M. V., Horngren's Cost Accounting: A Managerial Emphasis, Pearson,16th edition, 2017.
2. Kaplan, R. S., Atkinson, A. A., Advanced Management Accounting Pearson, 3rd edition, 2015.
3. Bhattacharya, A. K., Principles & Practices of Cost Accounting, Prentice Hall, 3rd edition, 2004.
4. Vohra, N. D., Quantitative Techniques in Management, McGraw Hill,5th edition, 2017.

Subject Name: Composite Materials	**Category:** Open Elective
Subject Code: OE-IEM301D	**Semester**: Third
L-T-P: 3-0-0	**Credit: 3**
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1 Explain the mechanical behavior of composite materials.
CO2: Determine the strength of various composite materials.
CO3: Explain manufacturing of various composite materials.
CO4: Compare the manufacturing of metal matrix composite and polymer matrix composites.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	8
2	**Reinforcements:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostressconditions..	8
3	**Manufacturing of Metal Matrix Composites:** Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	8
4	**Manufacturing of Polymer Matrix Composites:** Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	8
5	**Strength:** Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	8
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Cahn, R W (ed)., Haasen, P (ed)., Kramer, E J(ed)., Chou, T-W(ed)., Materials Science and Technology: A Comprehensive Treatment, Vol. 13, Structure and Properties of Composites, Wiley-VCH, 13th edition, 1993.
2. Callister, W D Jr., Rethwisch, D G., Materials Science and Engineering, An introduction,
3. John Wiley & Sons, NY, Indian edition, 2007.
4. Lubin, G., Hand Book of Composite Materials, Springer, 1st edition, 1982.
5. Chawla, K K., Composite Materials, Springer, 3rd edition, 2012.
6. Chung D D L., Composite Materials Science and Applications, Springer, 2nd edition, 2010.
7. Gay, G., Hoa, S V., Tasi, S W., Composite Materials Design and Applications, CRC Press, 1st edition, 2002.

Subject Name: Waste to Energy	**Category:** Open Elective
Subject Code: OE-IEM301E	**Semester:** Third
L-T-P:3-0-0	**Credit:** 3
Perquisite: No Perquisite	

Course Outcome:

On successful completion of the course, Students will able to

CO1: Understand and explain the concept of Waste to Energy
CO2: Develop the concept of biomass pyrolysis and gasification.
CO3: Understand the process of biomass combustion.
CO4: Illustrate the design, construction and other features of bio energy system.

Course Contents:

Module No.	Description of Topic	Contact Hour
1	**Introduction to Energy from Waste**: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	6
2	**Biomass Pyrolysis**: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications	6
3	**Biomass Gasification:** Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating –Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	10
4	**Biomass Combustion:** Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	8
5	**Biogas:** Properties of biogas (Calorific value and composition) - Biogas plant technology and status – Bio energy system - Design and constructional features - Biomass resources and their classification – Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants –Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	10
	Total number of contacts (Hr.)	**40**

Learning Resources:

1. Khandelwal, K. C., and Mahdi, S. S., Biogas Technology: A Practical Handbook. Tata McGraw-Hill., 1988.
2. Challal, D. S., Food, Feed and Fuel from Biomass, Aspect Publications Ltd, 1991.
3. Wereko–Brobby, Y C., and Hagan, B. E Biomass Conversion and Technology, Wiley, 1996.

Sessional

Subject Name: Dissertation-I (Progress)	**Category:** Major Project
Subject Code: PW-IEM381	**Semester**: Third
L-T-P:0-0-20	**Credit:** 10
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Define research problem

CO2: Identify research gap through review of substantial current and good quality literatures

CO3: Determine the scope of present investigation and objective (s)

CO4: Plan methodology to be followed indicating all steps and tools.

Course Contents:

A Project Dissertation would be of two-semester duration and one project would be allotted to one student. The topic of research shall be in the domain of Industrial Engineering and management related to manufacturing and service systems. The Progress of project dissertation up to the end of the Third Semester would be evaluated by the concerned supervisor and a panel of examiners through a seminar presentation on the progress of dissertation followed by viva voce.

Sessional

Subject Name: Dissertation-II (Completion)	**Category:** Major Project
Subject Code: PW-IEM481	**Semester**: Fourth
L-T-P: 0-0-32	**Credit:** 16
Pre-Requisites: Dissertation-I (Progress)	

Course Outcomes:

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

CO1: Develop algorithms/ solution procedures to solve the problem.

CO2: Analyze and interpret the results using tables and figures for visualization.

CO3: Compile the problem, solution method and the findings of the project work.

CO4: Develop an extensive and independently written thesis using relevant scientific theories/ methods and defend the thesis.

Course Contents:

The project work started in the third semester will be extended to the end of the fourth semester. Final presentation and viva voce of the project will be based on the project thesis submitted. The evaluation of the thesis will be done by a panel of examiners.

Quality of the project will be measured in terms of

- Very clear and concise objectives
- Very clear methodology, articulated using technical terms indicating all steps and tools
- Cites substantial current and good quality literature
- Clarity in design/setting up of experiment.
- Interpretation of results and justification thereof and validity of the results presented.
- Overall presentation of the report.

Subject Name: Statistics & Probability with R	**Category:** Audit Course
Subject Code:AC-IEM101A / AC-IEM201A	**Semester**: First/ Second
L-T-P:2-0-0	**Credit:**3
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Demonstrate the language and core concepts of probability theory.
CO2: Apply basic principles of statistical inference.
CO3: Make use of programming language R to do statistics.
CO4: Apply, examine, and conclude statistical information.
CO5: Develop skills for further coursework or on-the-job study.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Basic Statistical Concepts: Populations and Samples; Some Sampling Concepts; Random Variables and Statistical Populations; Basic Graphics for Data Visualization; Proportions, Averages, and Variances; Medians, Percentiles, and Boxplots; Comparative Studies; The Role of Probability; and Approaches to Statistical Inference	5
2	Introduction to Probability: Sample Spaces, Events, and Set Operations; Experiments with Equally Likely Outcomes; Axioms and Properties of Probabilities; Conditional Probability; and Independent Events Random Variables and Their Distributions: Describing a Probability Distribution, Parameters of Probability Distributions, Models for Discrete Random Variables, and Models for Continuous Random Variables Jointly Distributed Random Variables: Describing Joint Probability Distributions, Conditional Distributions, Mean Value of Functions of Random Variables, Quantifying Dependence, and Models for Joint Distributions	9
3	Some Approximation Results: The LLN and the Consistency of Averages, Convolutions, and The Central Limit Theorem Fitting Models to Data: Some Estimation Concepts, Methods for Fitting Models to Data, and Comparing Estimators: The MSE Criterion Confidence and Prediction Intervals: Introduction to Confidence Intervals, CI Semantics: The Meaning of "Confidence", Types of Confidence Intervals, The Issue of Precision, and Prediction Intervals Testing of Hypotheses: Setting Up a Test Procedure, Types of Tests, and Precision in Hypothesis Testing Comparing Two Populations: Two-Sample Tests and CIs for Means, The Rank-Sum Test Procedure, Comparing Two Variances, and Paired Data Comparing k > 2 Populations: Types of k-Sample Tests, Simultaneous CIs and Multiple Comparisons, and Randomized Block Designs; Two-Factor Designs, Three-Factor Designs, and 2^r Factorial Experiments	10
4	Polynomial and Multiple Regression: The Multiple Linear Regression Model, Estimation, Testing, and Prediction, and Additional Topics Statistical Process Control: The $\overline{X}$ Chart, The S and R Charts, The p and c Charts, and CUSUM and EWMA Charts	4
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Michael, A., Probability & Statistics with R for Engineers and Scientists, Pearson, 2015.
2. Gupta, B. C., Guttman, I., and Jayalath, K. P., Statistics and Probability with Applications for Engineers and Scientists Using MINITAB, R and JMP, Wiley, 2020.

Subject Name: English for Research Paper Writing	**Category:** Audit course
Subject Code:AC-IEM101B / AC-IEM201B	**Semester**: First/ Second
L-T-P: 2-0-0	**Credit:**0
Pre-Requisites: No-prerequisite	

Course Objectives:

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

CO1: Understand that how to improve your writing skills and level of readability
CO2: Learn about what to write in each section
CO3: Understand the skills needed when writing a Title
CO4: Construct the good quality of paper at very first-time submission

Course contents:

Module No.	Description Of Topic	Contact Hour
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	6
4	Key skills needed when writing a Title; key skills needed when writing an Abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.	5
5	Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions.	5
6	Useful phrases, how to ensure paper to be good for it to be possibly the first-time submission.	4
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Goldbort, R., Writing for Science, Yale University Press (available on Google Books), 2006.
2. Day, R., How to Write and Publish a Scientific Paper, Cambridge University Press, 2006.
3. Highman, N., Handbook of Writing for the Mathematical Sciences, SIAM, 1998.
4. Wallwork, A., English for Writing Research Papers, Springer, New York, 2011.

Subject Name: Pedagogy Studies	**Category:** Audit Courses
Subject Code:AC-IEM101C/ AC-IEM201C	**Semester**: First/ Second
L-T-P:2-0-0	**Credit:** 0
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: To explain overall concept of Pedagogy
CO2: To explain learning theories
CO3: To analyze different components of curriculum and their implementation
CO4: To explain Outcome Based Education and it implementation
CO5: To explain role of Technology in Pedagogy and it implementation
CO6: To explain importance of Research in relation to Pedagogy

Course Outline:

Module No.	Description Of Topic	Contact Hour
1	**Introduction and Methodology:** • Aims and rationale, Policy background, Conceptual framework and terminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions. • Overview of methodology and Searching	6
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education	4
3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? • Theory of change. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogic theory and pedagogical approaches. • Teachers' attitudes and beliefs and Pedagogic strategies.	6
4	• Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes	6
5	• Research gaps and future directions • Research design • Contexts • Pedagogy	6

	• Teacher education • Curriculum and assessment • Dissemination and research impact	
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Ackers, J., Hardman, F., Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261, 2001.
2. Agrawal, M., Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379, 2004.
3. Akyeampong, K., Teacher training in Ghana- does it count? Multi-site teacher education research project (MUSTER) country report 1, DFID, London, 2003.
4. Akyeampong, K., Lussier, K., Pryor, J., Westbrook, J., Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282, 2013.
5. Alexander, R.J., Culture and pedagogy: International comparisons in primary education, Blackwell, Oxford and Boston, 2001.
6. Chavan, M., Read India: A mass scale, rapid, 'learning to read' campaign, 2003.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Subject Name: Constitution of India	**Category:** Audit Courses
Subject Code:AC-IEM101D/ AC-IEM201D	**Semester**:First/ Second
L-T-P:2-0-0	**Credit:** 0
Pre-Requisites: No-prerequisite	

Course Outcome:

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

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4: Discuss the passage of the Hindu Code Bill of 1956.

Course Outline:

Module No.	Description Of Topic	Contact Hour
1	❖ **History of Making of the Indian Constitution:** • History • Drafting Committee, (Composition& Working)	4
2	❖ **Philosophy of the Indian Constitution:** • Preamble • Salient Features	4
3	❖ **Contours of Constitutional Rights & Duties:** • Fundamental Rights • Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies • Directive Principles of State Policy • Fundamental Duties.	6
4	❖ **Organs of Governance:** • Parliament • Composition • Qualifications and Disqualifications • Powers and Functions • Executive • President • Governor • Council of Ministers • Judiciary, Appointment and Transfer of Judges, Qualifications • Powers and Functions	4

5	❖ **Local Administration:** • District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. • Pachayati raj: Introduction, PRI: Zila Pachayat. • Elected officials and their roles, CEO Zila Pachayat: Position and role. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointed officials, • Importance of grass root democracy	6
6	❖ **Election Commission:** • Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women	4
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Busi, S.N., B.R. Ambedkar Framing of Indian Constitution, 1st Edition, 2015.
3. Jain, M.P., Indian Constitution Law, 7th Edition, Lexis Nexis, 2014.
4. Basu, D.D., Introduction to the Constitution of India, Lexis Nexis, 2015.

Subject Name: Disaster Management	**Category:** Audit Courses
Subject Code:AC-IEM101E/ AC-IEM201E	**Semester**: First/ Second
L-T-P:2-0-0	**Credit:**0
Pre-Requisites: No-prerequisite	

Course Outcome:

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

CO1: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4: Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Course Outline:

Module No.	Description Of Topic	Contact Hour
1	**Introduction** Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	4
2	**Repercussions of Disasters and Hazards**: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	5
3	**Disaster Prone Areas in India** Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.	4
4	**Disaster Preparedness and Management** Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.	6
5	**Risk Assessment** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	5

6	**Disaster Mitigation** Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.	4
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Nishith, R., Singh, A.K., Disaster Management in India: Perspectives, Issues and Strategies, New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.), Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.
3. Goel, S.L., Disaster Administration and Management Text and Case Studies, Deep & Deep Publication Pvt. Ltd., New Delhi.

Subject Name: Value Education	**Category:** Audit Courses
Subject Code:AC-IEM101F/ AC-IEM201F	**Semester**: First/ Second
L-T-P :2-0-0	**Credit:** 0
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Have knowledge of self-development.
CO2: Learn the importance of Human values.
CO3: Develop the overall personality.

Course Outline:

Module No.	Description Of Topic	Contact Hour
1	• Values and self-development- Social values and individual attitudes. • Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgments	4
2	• Importance of cultivation of values. • Sense of duty, Devotion, Self-reliance. Confidence, Concentration, Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism. Love for nature, Discipline	8
3	• Personality and Behaviour Development- Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	8
4	• Character and Competence- Holy books vs. Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Non violence, Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	8
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress, New Delhi

Subject Name: Stress Management by Yoga	**Category:** Audit Courses
Subject Code:AC-IEM101G /AC-IEM201G	**Semester**: First/ Second
L-T-P:2-0-0	**Credit:** 0
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: Develop healthy mind in a healthy body thus improving social health also
CO2: Improve efficiency

Course Outline:

Module No.	Description Of Topic	Contact Hour
1	• **Definitions of Eight parts of yog. (Ashtanga)**	8
2	• **Yam and Niyam:** Do's and Don'ts in life. i. Ahinsa, satya, astheya, bramhacharya and aparigraha ii. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	10
3	• **Asan and Pranayam:** i. Various yog poses and their benefits for mind & body ii. Regularization of breathing techniques and its effects- Types of pranayam.	10
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Yogic Asanas for Group Training- Part-I, Janardan Swami Yogabhyasi Mandal, Nagpur.
2. Vivekananda, S., Rajayoga or Conquering the Internal Nature, Advaita Ashrama (Publication Department), Kolkata.

Subject Name: Personality Development through life Enlightenment skills	**Category:** Audit Courses
Subject Code:AC-IEM101H/ AC-IEM201H	**Semester**: First/ Second
L-T-P: 2-0-0	**Credit:** 0
Pre-Requisites: No-prerequisite	

Course Outcomes:

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

CO1: develop his personality and achieve the highest goal in life
CO2: lead the nation and mankind to peace and prosperity
CO3: help in developing versatile personality of students

Course Outline:

Module No.	Description Of Topic	Contact Hour
1	**Neetisatakam-Holistic development of personality:** • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (don'ts) • Verses- 71,73,75,78 (do's)	9
2	• Approach to day to day work and duties. • Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35. • Chapter 18-Verses 45, 46, 48.	9
3	• Statements of basic knowledge. • Shrimad Bhagwad Geeta : Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 • Personality of Role model. Shrimad Bhagwad Geeta : • Chapter2-Verses 17,Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	10
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Gopinath, P., Bhartrihari's Three Satakam (Niti-sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Subject Name: Sanskrit for Technical Knowledge	**Category:** Audit Courses
Subject Code:AC-IEM101I/ AC-IEM201I	**Semester**: First/ Second
L-T-P: 2-0-0	**Credit:** 0
Pre-Requisites: No prerequisite	

Course Outcome:

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

CO1: Understanding basic Sanskrit language

CO2: Ancient Sanskrit literature about science & technology can be understood

CO3: Being a logical language will help to develop logic in students

Course Outline:

Module No.	Description Of Topic	Contact Hour
1	• Alphabets in Sanskrit, • Past/ Present/ Future Tense, • Simple Sentences	10
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	10
3	• Technical concepts of Engineering- Electrical, Mechanical, Architecture, Mathematics	8
	Total number of contacts (Hr.)	**28**

Learning Resources:

1. Vishwas, Abhyaspustakam, Samskrita-Bharti Publication, New Delhi.
2. Vempati K., Teach Yourself Sanskrit, Prathama Deeksha- Rashtriya Sanskrit Sansthanam, New Delhi Publication.
3. Soni, S., India's Glorious Scientific Tradition, Ocean books (P) Ltd., New Delhi.