

MASTER OF TECHNOLOGY
IN
INDUSTRIAL ENGINEERING & MANAGEMENT

(Applicable from the academic session 2018-2019)

MAULANA ABUL KALAM AZAD
UNIVERSITY OF TECHNOLOGY,
WEST BENGAL



Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Haringhata-741249, Nadia, West Bengal, INDIA

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

**MASTER OF TECHNOLOGY IN
INDUSTRIAL ENGINEERING & MANAGEMENT PROGRAMME**

Curriculum Structure

Semester-I							
Sl No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	Program Core I	IEM101	Work System Design	3	0	0	3
2	Program Core II	IEM102	Operations Research-I	3	0	0	3
3	Program Elective-I	IEM103 A/B/C/D	Program Elective-I	3	0	0	3
4	Program Elective-II	IEM104 A/B/C	Program Elective-II	3	0	0	3
5	Mandatory Learning Course	MLC101	Research Methodology and IPR	2	0	0	2
6	Audit Course	AC101A/B/C/D/E/F	Audit Course 1	2	0	0	0
	<i>Total Theory</i>			16	0	0	14
Practical							
1	Laboratory I	IEM191	Work System Design Laboratory	0	0	4	2
2	Laboratory II	IEM192	Simulation Laboratory	0	0	4	2
	<i>Total Practical</i>			0	0	8	4
	Total of Semester-I			16	0	8	18
Semester-II							
Theory							
1	Program Core III	IEM201	Production Planning and Control	3	0	0	3
2	Program Core IV	IEM202	Quality Design and Control	3	0	0	3
3	Program Elective-III	IEM203 A/B/C/D	Program Elective-III	3	0	0	3
4	Program Elective-IV	IEM204 A/B/C/D	Program Elective-IV	3	0	0	3
5	Audit Course	AC201A/B/C/D/E/F	Audit Course 2	2	0	0	0
	<i>Total Theory</i>			14	0	0	12
Practical							
1	Laboratory III	IEM291	Quality Design and Control Laboratory	0	0	4	2
2	Laboratory IV	IEM292	Product Development Laboratory	0	0	4	2
	<i>Total Practical</i>			0	0	8	4
Sessional							
1	Mini Project	IEM281	Mini Project with Seminar	2	0	0	2
	Total of Semester-II			16	0	8	18
Semester-III							
Theory*							
1	Program Elective-V	IEM301 A/B/C/D	Program Elective-V	3	0	0	3
2	Open Elective	OE301A/C/E/F/G/H	Open Elective	3	0	0	3
	<i>Total Theory</i>			6	0	0	6
Sessional							
1	Major Project	IEM381	Dissertation-I (Progress)	0	0	20	10
	Total of Semester-III			6	0	20	16
Semester-IV							
Sessional							
1	Major Project	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).

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List of Program Electives

❖ **Program Elective - I**

1. Discrete-Event System Simulation (IEM103A)
2. Management and Productivity (IEM103B)
3. Computer Integrated Manufacturing (IEM103C)
4. Management Information System (IEM103D)

❖ **Program Elective - II**

1. Engineering Economy and Costing (IEM104A)
2. Project Engineering and Management (IEM104B)
3. Facility Layout and Planning (IEM104C)

❖ **Program Elective - III**

1. Product Design and Development (IEM203A)
2. Human Factors Engineering(IEM203B)
3. Reliability Analysis and Prediction(IEM203C)
4. Six Sigma Fundamentals and Applications(IEM203D)

❖ **Program Elective - IV**

1. Management of Inventory Systems (IEM204A)
2. Logistics and Supply Chain Management (IEM204B)
3. Enterprise Resource Planning (IEM204C)
4. Production Design and Process Planning (IEM204D)

❖ **Program Elective - V**

1. Systems Analysis Techniques (IEM301A)
2. Operations Research-II (IEM301B)
3. Design of Experiments (IEM301C)
4. Multi-Criteria Decision Making Techniques (IEM301D)

List of Open Electives

1. Business Analytics (OE301A)
2. Cost Management of Engineering Projects (OE301C)
3. Industrial Safety (OE301D)
4. Composite Materials (OE301E)
5. Waste to Energy (OE301F)

Audit course 1 & 2

1. English for Research Paper Writing (AC101A / AC201A)
2. Pedagogy Studies (AC101B/ AC201B)
3. Constitution of India (AC101C/ AC201C)
4. Disaster Management (AC101D/ AC201D)
5. Value Education (AC101E/ AC201E)
6. Stress Management by Yoga (AC101F /AC201F)
7. Personality Development through Life Enlightenment Skills (AC101G/ AC201G)
8. Sanskrit for Technical Knowledge (AC101H/ AC201H)

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

Course Objective: To introduce the basic concepts and issues of ergonomics and human factors engineering and its applications, method and time study techniques, for work systems and product design improvement, and the use of these concepts and techniques to select jobs and industrial situations.

Course Outline:

- 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.
- 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 work system design.
- Work Study Fundamentals:** Productivity, Definition and Scope of Motion and Time Study, History of Motion and Time Study, Work Methods Design – the Broad View and Developing a Better Method, Reducing Work Content and Ineffective Time, Human Factors in the Application of Work Study.
- Method Study:** Process Analysis, Activity Charts, Man-Machine Charts, Operation Analysis, Different Charts and Diagrams Used, Basic Procedure, Micro Motion Study, Fundamental Hand Motions, Principles of Motion Economy, Use of Films in Method Analysis.
- Work Measurement:** Its Purposes and Uses, Basic Procedure, Techniques of Work Measurement – Work Sampling, Stop-Watch Time Study, Concepts of Rating and Allowances, Setting Standard Times for Jobs, Standard Data, Predetermined Time Standards : Work-Factor, and Methods-Time-Measurement.
- Job Evaluation:** Basic Concepts, Different Methods (Objective and Subjective) and their Use, Compensation Schemes, Relationship of Work Study to Incentive Schemes, Wage Incentive Plans.

Learning Resources:

- Halender, M., A Guide to the Ergonomics of Manufacturing, East-West Press.
- Barnes, R. M., Motion and Time Study: Design and Measurement of Work, John Wiley.
- Bridger, R. S., Introduction to Ergonomics, McGraw-Hill.
- International Labor Organization, Introduction to Work Study.
- Sanders, M. S. and McCormick, E. J., Human Factors in Engineering and Design, McGraw-Hill.

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Subject Code : IEM102	Category : Program Core II
Subject Name : Operations Research-I	Semester : First
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: to introduce the basic concept, issues and techniques of operations research as they are applied in manufacturing and service organization for improve performance and design of optimized systems/sub-systems.

Course Outline:

1. **Linear Programming:** Two variable LP model, graphical method and simplex method, revised simplex method, special cases in simplex method application, comprehensive problems;
2. **Duality and Sensitivity Analysis:** Primal dual relationship and economic interpretation of duality, dual simplex method, sensitivity analysis, comprehensive problems;
3. **Transportation Model and its Variants:** Transportation algorithm, assignment model-Hungarian method, transshipment model, comprehensive problems;
4. **Integer Programming:** Branch and bound algorithm, cutting plane algorithm, comprehensive problems;
5. **Introduction to Goal Programming:** comprehensive problems;
6. **Dynamic Programming:** Forward and backward recursion-stagecoach problem, knapsack model, comprehensive problems;
7. **Classical Optimization Theory:** Unconstrained and constrained problem, comprehensive problems.

Learning Resources:

1. Hillier F S and Lieberman G J, Nag, B and Basu, P, Introduction to Operation Research, McGraw Hill.
2. Taha H A, Operation Research- An Introduction, Prentice-hall
3. Ravindran, A., Philips, D.T., and Solberg, J.J., Operations research, John Wiley and Sons.
4. Vohra, N D, Quantitative Techniques in Management, Tata McGraw Hill

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Program Elective – I

Subject Code : IEM103A	Category : Program Elective – I
Subject Name : Discrete-Event System Simulation	Semester : First
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduce the concept of simulation, the basic stages of simulation, simulation languages, statistical aspects of simulation, and the use of simulation in manufacturing and service systems.

Course Outline:

1. Introduction to Simulation, General Principles, Simulation Examples, Simulation Software;
2. Statistical Models in Simulation ;
3. Random Number and Random Variate Generation;
4. Input Modeling ;
5. Verification and Validation of Simulation Models;
6. Output Analysis for a Single Model;
7. Comparison and Evaluation of Alternative System Design.

Learning Resources:

1. Banks, J, Carson II, J S, Nelson, B L and Nicol, D M, Discrete-Event System Simulation, Pearson Prentice-Hall.
2. Law, A M and Kelton, W D, Simulation Modeling and Analysis, McGraw-Hill.

Subject Code : IEM103B	Category : Program Elective – I
Subject Name : Management and Productivity	Semester : First
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduces the fundamentals of management concept with its principles and practice as well as tools and techniques related to productivity engineering and management as their application in manufacturing and service organization.

Course Outline:

1. **Evolution of management principles and concepts;**
2. **Function of management:** Planning-strategic, tactical and operation planning, short-medium-long-term planning; organizing-different organization structure, peters principles ;staffing-delegation of

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authority and power roles and responsibilities; leading-kinds of leaderships, motivation theories, Parkinson's law; control-fit forward and fit back control;

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;
4. **Productivity performance improvement**: classification of the tools and techniques, important aspects, integrated framework, examples and case studies.

Learning Resources:

1. Koontz, H and O Donnel, C, Essentials of Management, McGraw-Hill
2. Dervitsiotis, K N, Operations Management, McGraw-Hill.
3. Buffa, E S, Modern Production Management, Wiley Eastern.
4. Scott Sink, D, Productivity Management: Planning, Measurement and Evaluation Control and Improvement, John Wiley.
5. Riggs, J. L., Production Systems, Planning Analysis and Control, John Wiley.
6. Sumanth, David J, Productivity Engineering and Management, McGraw-Hill.

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Subject Code : IEM103C	Category : Program Elective – I
Subject Name : Computer Integrated Manufacturing	Semester : First
L-T-P : 3-0-0	Credit :3
Pre-Requisites:	

Course Outline:

Fundamentals of Numerical Control (NC) and Computer Numerical Control (CNC);
Direct Numerical Control (DNC) NC Part Programming.
Industrial Robot Application;
Robot Programming Fundamentals;
Automated Guided Vehicle System;
Automated Storage Systems;
Flexible Manufacturing Systems (FMS); FMS Components;
Transfer Lines and Automated Manufacturing Systems Automated Assembly.
Product Design and CAD;
Computer Aided Manufacturing (CAM);
Computer Aided Process Planning (CAPP)

Learning Resources:

1. Mikell P.Groover, Automation, Production Systems and Computer Integrated Manufacturing 2nd Ed, Pearson Education.
2. Chris Mc Mahon and Jimmie Browne, CAD CAM – Principles, Practice and Manufacturing Management, 2nd Ed (Addison – Wesley), Pearson Education, Asia
3. P. Radhakrishnan, S.Subramanyam, CAD CAM CIM, New Age International Publishers.
4. Vajpayee, Principles of Computer Integrated Manufacturing, PHI

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Subject Code : IEM103D	Category : Program Elective – I
Subject Name : Management Information System	Semester : First
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: The objective of this course is to introduce the students the basic concepts and issues of management information system as they are designed and applied for developing, monitoring and control of data information and its value for ensuring timely and appropriate manufacturing and business purposes.

Course Curriculum:

Information Systems Laboratory The IS Revolution; Strategic Role of Information Systems, Organizations, and Business Processes; Information, Management, and Decision Making Computers and Information Processing; Information Systems Software; 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; database management systems, 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; Enhancing Management Decision Making. Redesigning the Organization with IS Information Systems Security and Control; Ethical and Social Impact of Information Systems.

Learning Resources:

1. Laudon, K C and. Laudon, J P, Management Information Systems: Managing the Digital Firm, Pearson Prentice Hall 2007
2. Pressman, R. S., Software Engineering: A Practicioners Approach, McGraw Hill, 5th Edition, 2001
3. Norris, G, Hurley, J R, Hartley, K M, Dunleavy, J R and Balls, J D E-Business and ERP: Transforming the Enterprise, John Wiley and Sons, 2000

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Program Elective – II

Subject Code : IEM104A	Category : Program Elective – II
Subject Name : Engineering Economy and Costing	Semester : First
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: The objective of the course is to introduce the basic concepts and issues involved and tools and techniques to be used in each of the topics to be covered for improved financial performance and cost reduction.

Course Outline:

- Introduction
- Time value of money: Series of cash flows, uniform series of cash flows, uniform gradient series formula.
- Worth of investments: Present worth method (PW), annual worth method (AW), future worth method (FW), internal rate of return method.
- Depreciation: Sum of the years' digits depreciation, MACRS depreciation method.
- Profitability of investments
- Inflation
- Break-Even and sensitivity analysis
- Uncertainty and risk analysis
- Benefit-cost analysis

Learning Resources:

1. Taylor, G A, Managerial and Engineering Economy, Van Nostrand Reinhold Inc.
2. Sullivan, W G, Bontadelli, J A and Wicks, E M, Engineering Economy, Pearson Education Asia.
3. Baumol, W J, Economic Theory and Operations Analysis, Prentice Hall International.
4. Panneerselvam, Engineering Economics, PHI
5. Thesen & Fabrycky, Engineering Economy, 9th Ed, PHI

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Subject Code : IEM104B	Category : Program Elective – II
Subject Name : Project Engineering and Management	Semester : First
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: The objective of the course is to introduce the basic concepts, issues and tools and techniques to be used for project engineering and management so as to control specific guidelines and performance criteria for both short-term as well as long-term implications for making the projects sustainable.

Course Outline:

Project Characteristics, Project Selection, Economics, Feasibility Assessment and Evaluation, Structuring, Organizational and Work Breakdown, Scheduling, Budgeting, Life Cycle Costing, Project Control; PERT/CPM, Crashing/Time-Cost Trade-off Contracts; Resource Leveling, Limited Resource Allocation; Line of Balance.

Learning Resources:

1. Chandra, P, Projects: Planning, Analysis, Selection, Implementation & Review, McGraw Hill.
2. Kerzner, H, Project Management: A systems approach to planning and controlling, CBS Publisher, New Delhi.
3. Wiest and Levy, Management Guide to PERT/CPM: with GERT/PDM/DCPM and other networks, Prentice-Hall.
4. Kanda, A, Project Management: A Life Cycle Approach, PHI

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Subject Code : IEM104C	Category : Program Elective – II
Subject Name : Facility Layout and Planning	Semester : First
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduce of basic connects of facility layout and planning, employed in an industrial environment. Comprehension of relevant tools, techniques and methodologies as required for taking best-possible facility location decision, layout planning with material handling systems, storage and warehouses, facilities of a manufacturing or service organizations is the main purpose of introduction such a course for the students.

Course Outline:

1. **Introduction:** Nature, Significance and Scope of Facility layout and design;
2. **Facility Location:** Location analysis, Single-facility and Multi-facility location problems, Location allocation problems;
3. **Facility Layout:** Significance, Objectives, Steps in layout planning, Quantitative techniques;
4. **Material Handling:** Definition, Principles of Material Handling, Material Handling System Design, Equipment Selection;
5. **Storage and Warehousing:** Functions, Objectives and Principles, Facility Service, Design of Assembly and Production Lines;

Learning Resources:

1. Francis, White, and McGinnis, Facility Layout and Location, Prentice Hall.
2. Tompkins, White, Bozer, and Tanchoco, Facilities Planning, Wiley.
3. Apple, Plant Layout and Materials Handling, John Wiley.
4. Moore, J M, Plant Layout and Design, Macmillan
5. Muther, Systemic Layout Planning, Industrial Educational Institute, Boston.
6. Buffa, E S, Modern Production Managent, Wiley Eastern.

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Practical

Subject Code : IEM191	Category : Laboratory– I
Subject Name : Work system Design Laboratory	Semester : First
L-T-P : 0-0-4	Credit:2
Pre-Requisites:	

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, Rating Films exercises, Time Study of selected Jobs and MTM applications.

Subject Code : IEM192	Category : Laboratory– II
Subject Name : Simulation Laboratory	Semester : First
L-T-P : 0-0-4	Credit:2
Pre-Requisites:	

Laboratory experiments and exercises on Random Number Generation approaches, Random Variate Generation, Production shop simulations, shop scheduling, Queuing System and facility layout planning.

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Subject Code : IEM201	Category : Program Core III
Subject Name : Production Planning and Control	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduce the fundamentals of forecasting techniques, capacity planning, aggregate production planning and scheduling techniques in flow and job shops of manufacturing systems including material requirements planning and its variants. The knowledge in the topics as mentioned in the course outline is essential to achieve this objective. The course is intended to be designed for creating a knowledge-base of the state-of-the-art manufacturing systems.

Course Outline:

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;
2. **Production-Distribution System Design:** Plant location and capacity planning;
3. **Aggregate planning and Master Production Scheduling:** Aggregation techniques, aggregate capacity, disaggregation of aggregate plan, master production scheduling, Analytical and computer integrated solution techniques;
4. **Operations Scheduling and Control:** Basic sequencing and scheduling techniques, priority rules, progress chasing and updating of production schedules;
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.

Learning Resources:

1. Silver, E A, Pyke, D F and Peterson, R, Inventory Management and Production Planning and Scheduling, John Wiley.
2. Narasimhan, S L, McLeavy, D W and Billington, P J, Production Planning and Inventory Control, Prentice-Hall.
3. Makridakis, S, Wheelwright, S C and McGee, V E, Forecasting: Methods and Applications, John Wiley and Sons.
4. Holt, C C, Modigliani, F, Muth, J F and Simon, H A, Planning Production, Inventories, and Workforce, Prentice Hall, NJ.G.W. Plossi
5. Wright, O W, Production and Inventory Control, Prentice Hall, NJ.

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Subject Code : IEM202	Category : Program Core IV
Subject Name : Quality Design and Control	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduce the fundamentals of statistical process control techniques, acceptance sampling, reliability, product and process design, and the use of these concepts and techniques in manufacturing and service systems for quality control and improvement.

Course Outline:

1. History and Evolution of Quality Control and Management.

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).

3. (a) Probability Models for Quality Control

(b) Descriptive Statistics, Sampling, and Inferences

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

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. 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)

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.

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Learning Resources:

1. Mitra, A. Fundamentals of Quality Control and Improvement, Prentice-Hall,
2. Montgomery, D C, Introduction to Statistical Quality Control, John Wiley.
3. Banks, J, Principles of Quality Control, John Wiley.
4. Dukupati, R V and Pradip K Ray, Product and Process Design for Quality, Economy and Reliability, New Age International.
5. Duncan, A J, Quality Control and Industrial Statistics, Richard D. Irwin.
6. Grant, E L and Leavenworth, R S, Statistical Quality Control, McGraw Hill.

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Program Elective – III

Subject Code : IEM203A	Category : Program Elective – III
Subject Name : Product Design and Development	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: The objective of this course is to introduce the basic concepts, issues and tools and techniques to be used at different phases of product development to have an in-depth understanding and knowledge about the effect and role of technology, market conditions, manufacturing methods and quality for product development.

Course Outline:

- 1. Introduction**
- 2. Product and Process Design:** Important approaches in product development, stages in product development process, tools and techniques used in product development, technical risk management, customer needs and product development, common approaches for customer need analysis conceptual design, detailed design, test, evaluation and manufacturing
- 3. Quality Principles in Design**
- 4. Robust Design and Taguchi Method:** Taguchi Philosophy, Taguchi Methods, quality loss function, signal-to-noise ratio, orthogonal arrays, robust design, system design, parameter design, tolerance design, comparison of robust and classical design of experiments.

Learning Resources:

- Ulrich, K T and Eppinger, S G, Product Design and Development: Irwin McGraw Hill.
- Rao, D V and Ray, P K, Production and Process Design for Quality, Economy and Reliability, New Age International Publishers.
- Chitale, A C and Gupta, R C Product Design and Manufacture, Prentice-Hall.

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Subject Code : IEM203B	Category : Program Elective – III
Subject Name : Human Factors Engineering	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduce the basic concepts of the important issues, related to theory and application, in ergonomics and human factors engineering for worksystem performance and product design improvement, and the use of these concepts and techniques to select jobs and situations in industries.

Course Outline

Introduction to Simple and Complex Work systems and Relevance of Human Factors or Ergonomics; History and Recent Trend in Human Factors; Anatomy, Posture, and Body Mechanics; Anthropometric Principles in Work system Design; Design of Manual Handling Tasks and Hand Tools; Workload, Work Capacity and Fitness for Work; Measuring Work by Physiological Methods; Choice of Work Posture; Fatigue Measurement and Evaluation; Physical Work and Heat Stress, Noise Exposure and Hearing Loss, Design of Thermal, Auditory, and Lighting in Physical Environment; Industrial Product Design; Illumination at Work; Whole Body Vibration; Design of VDT Work Station.

Learning Resources:

1. Halender, M., A Guide to the Ergonomics of Manufacturing, East-West Press (Taylor and Francis).
2. Bridger, R. S., Introduction to Ergonomics, McGraw-Hill.
3. Sanders, M. S. and McCormick, E. J., Human Factors in Engineering and Design, McGraw-Hill

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Subject Code : IEM203C	Category : Program Elective – III
Subject Name : Reliability Analysis and Prediction	Semester : Second
L-T-P : 3-0-0	Credit :3
Pre-Requisites:	

Course Objective: To introduce the basic concepts, issues and tools and techniques used for reliability analysis and its estimation for products, processes and systems with varied configurations, conditions and constraints including identification of reliability improvement alternatives.

Course Curriculum:

1. **Introduction:** Reliability definition, reliability of a system, reliability as a function of time.
2. **General Reliability Function:** Mean time to failure (MTTF), instantaneous failures or hazard rate function.
3. **Constant Failure Rate (CFR) Models**
4. **Time-Dependent Failure Models**
5. **System Reliability:** System with components in series, system with components in parallel, systems with standby components.
6. **Operating Characteristic Curves;**
7. **Reliability and Life Testing Plans:** Failure-terminated test, time-terminated test, sequential reliability testing, standard life testing plans using Handbook H-108.

Learning Resources:

1. Mitra, A, Fundamentals of Quality Control and Improvement, Prentice-Hall.
2. Rao, D V and Ray, P K, Production and Process Design for Quality, Economy and Reliability, New Age International Publishers.
3. Banks, J, Principles of quality control, Wiley.

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Subject Code : IEM203D	Category : Program Elective – III
Subject Name : Six Sigma Fundamentals and Applications	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Objective of the Course: The objective of this course is to introduce basic concepts of ‘six-sigma ‘and methods employed for its application in an industrial environment. Comprehension of relevant tools, techniques and methodologies as required for achieving and sustaining performance and capability at ‘six-sigma’ level for activities and/or resources at different levels of a manufacturing organization is the main purpose of introducing such a course for the students.

Course Outline:

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.
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.
3. **Six Sigma Methodology:** Detailed steps, DMAIC, DFSS, and axiomatic design.
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.
5. **Six Sigma Tools and Techniques:** Multivariate process capability studies: background and concepts, measure indices and their applications, numerical examples and case studies.
6. **Six Sigma through Design Improvement-Part-I:** Process, equipment, and material, manufacturability and tolerancing, numerical examples and case studies.
7. **Six Sigma through Design Improvement-Part-II:** Parameter design, robust optimization, numerical examples and case studies.

Learning Resources:

1. Evans J R and Lindsay W M, An Introduction to Six Sigma & Process Improvement, Thomson South-Western.
2. Goel, P S, Praveen Gupta, Rajeev Jain, and Rajesh K. Tyagi, Six Sigma for Transactions and Service, McGraw-Hill.
3. Muir, Alastair, Lean Six Sigma Statistics: Calculating Process Efficiencies in Transactional Projects, McGraw-Hill
4. Breyfogle F W Implementing Six Sigma: Smarter Solutions Using Statistical Methods, John Wiley & Sons, 2nd edition.
5. Brue G and Howes R, Six Sigma, Tata McGraw-Hill.
6. Keller P, Six Sigma Demystified, Tata McGraw-Hill.

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7. Sleeper, A, Six Sigma Distribution Modeling, McGraw-Hill.

Program Elective – IV

Subject Code : IEM204A	Category : Program Elective – IV
Subject Name : Management of Inventory Systems	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduce the fundamentals of the topics as mentioned in the coverage, the relevant statistical and mathematical tools, techniques, and methodologies, and the use of these concepts and techniques in manufacturing and service systems for better materials control and inventory management to the students at the undergraduate level.

Course Outline:

- 1. Introduction to Inventory and Materials Management:** Definitions, Need for inventory, Structure of inventory models, Nature of analysis, Relationships with other functions, Inventory costs and their measurement, Types of inventory, Importance and areas of materials management, Selective inventory management techniques, Classification of inventory problems.
- 2. Static Inventory Problems under Risk:** General characteristics, Opportunity cost matrix and cost structure, Mathematical formulations (discrete and continuous cases), Imputation of costs, Problem solving and case studies.
- 3. Static Inventory Problems under Uncertainty:** General characteristics, Decision criteria for uncertainty and inventory problems, Distribution-free analysis (Tchebycheff and other inequalities), Comparison of analyses with full and partial information, Problem solving and case studies.
- 4. Dynamic Inventory Problems under Certainty:** General characteristics, Optimal lot size model (with constant and varying demand), Quantity discounts, Optimal policy curve for more than one item, Solution techniques for multiple items, Inventory problem formulation and solution under several types of constraints, Problem solving and case studies.
- 5. Dynamic Inventory Problems under Risk:** General characteristics, Types of inventory control systems, Switching matrices, Optimal selling policy with fluctuating prices, Queuing model for varying lead time, Problem solving and case studies.
- 6. Dynamic Inventory Problems under Uncertainty:** General characteristics, Moments of convolutions, Design of Q- and P-system of inventory control, Use of central warehouses, Problem solving and case studies.

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- 7. Design of Inventory Study and Decision Procedures:** Elements of inventory study, Approaches available, Size of inventory investment and number of items carried, System analysis with many items carried, many locations, and many departments, System design by simulation, Problem solving and case studies.
- 8. Current Approaches:** Concepts of MRP and JIT-based production systems, Concept of zero inventory, Concept of OPT/Theory of Constraints, Simulation modelling of inventory management systems, Critical Implementation issues related to inventory control.
- 9. Other Areas of Materials Management:** Fundamental concepts of and related techniques (quantitative and non-quantitative) in purchasing, storing, distribution, and value analysis and engineering, Problem solving and case studies.

References:

1. Starr, K K and D W Miller, Inventory Control: Theory and Practice, Prentice Hall.
2. Tersine, R J, Principles of Inventory and Materials Management, PTR Prentice Hall.
3. Silver, E A, Pyke, D F and Peterson, R, Inventory Management and Production Planning and Scheduling, John Wiley.
4. Buchan, J and E Koenisberg, Scientific Inventory Management, Prentice Hall.
5. Orlicky, Material Requirements Planning, McGraw Hill.
6. Perlman, K L, Handbook of Purchasing and Materials Management.
7. Gopalakrishnan, P and M Sunderesan, Materials Management: An Integrated Approach.
8. Hadley, G and Whitin, T M, Analysis of Inventory Systems, Prentice Hall.
9. Vohra, N D, Quantitative Techniques in Management, Tata McGraw Hill

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Subject Code : IEM204B	Category : Program Elective – IV
Subject Name : Logistics and Supply Chain Management	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: to introduce of basic concept and issues in logistics and supply chain for improved and optimized performance of inbound and outbound logistics as well as functional systems, use of these concepts and techniques for select industrial products.

Course Outline:

1. Nature and scope of logistics, Logistics environment;
2. **Logistic decisions:** facility location, transportation, storage and material handling, Logistics information systems, Logistics audit and control. Introduction to SCM- Principles and issues;
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 ;
4. **Distribution strategies:** customer service, physical distribution planning, Material handling, Facility and warehousing decision;
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.

Learning Resources:

1. Levi, D S, Kaminsky, P and Levi, E S, Designing and Managing the Supply Chain, Tata McGraw Hill.
2. Walters, Logistics, An Introduction to Supply Chain Management, Palgrave Macmillan.
3. Ballou, R, Business Logistics/Supply Chain Management, Pearson Education.
4. Coyle, Bardi, and Langley, The Management of Business Logistics A Supply Chain Perspective, Thomson Asia.

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Subject Code : IEM204C	Category : Program Elective – IV
Subject Name : Enterprise Resource Planning	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Introduction to ERP: Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model, Benefits of ERP, ERP and Related Technologies, Business Process Reengineering (BPR), Data Warehousing, Data Mining, OLAP, SCM.

ERP Implementation: ERP Implementation Lifecycle, Implementation Methodology, Organizing the Implementation, Vendors, Consultants and Users, Contracts with Vendors, Consultants and Employees, Project Management and Monitoring.

ERP Modules: Business Modules- Manufacturing, Materials Management, Finance, Plant Maintenance, Quality Management, Human Resources and Marketing.

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.

ERP Present and Future: Future Directions and Trends in ERP.

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”, Tata McGraw–Hill publishing company Ltd., New Delhi, 1999.
4. Vinod Kumar Garg and Venkitakrishnan N K, “Enterprise Resource Planning – Concepts and Practice”, PHI, New Delhi, 2003.
5. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

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Subject Code : IEM204D	Category : Program Elective – IV
Subject Name : Production Design and Process Planning	Semester : Second
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: To introduce the fundamentals of production systems design with major emphasis on application of the state-of-the-art techniques and processes so as to achieve the best possible planning and control in a manufacturing environment. The knowledge in the topics as mentioned in the course outline is essential to achieve this objective. The course is intended to be designed for creating a knowledge-base of the state-of-the-art manufacturing systems.

Course Outline:

Introduction: Four plane 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.

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.

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.

Process Planning: Manufacturing environment for process planning. Generative process planning, variant process planning, and CAPP system. Computer-aided generation of process plans.

Group Technology, CMS, and MRP: Classification methods – OPITZ, CODE, and MICLASS systems. Master production schedule. Material Requirements Planning (MRP). Manufacturing Resources Planning (MRP-II)–capacity requirement planning, order release planning, and operations sequencing. Group scheduling in MRP-II environment. Introduction to JIT-based techniques.

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 modeling and FMS benefits.

JIT Manufacturing Systems: Overview of TPS, pull versus push system, types of kanban, kanban planning and control models – deterministic and probabilistic models, signal kanban, other types of

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kanbans, alternative JIT systems, JIT purchasing, barriers to and benefits of JIT implementation, examples.

Learning Resources:

1. Groover, M P, Automation, Production Systems, and Computer-Integrated Manufacturing, Third Edition, Pearson Prentice Hall, Upper Saddle River.
2. Singh, N., Systems Approach to Computer-Integrated Design and Manufacturing, John Wiley.
3. Groover, M P and Zimmers, E W Jr, CAD/CAM: Computer-aided Design and Manufacturing, Prentice-Hall of India Private Ltd.
4. Halevi, G, The Role of Computers in Manufacturing Processes, John Wiley.
5. Orlicky, J, Material Requirements Planning, McGraw-Hill.
6. Koren, Y, Computer Control of Manufacturing Systems, McGraw-Hill.
7. Vail, P S, Computer Integrated Manufacturing, PWS-KENT Publishing Co.
8. Rembold, U., Blume, C and Dillmann, R, Computer Integrated Manufacturing Technology and Systems, Marcel Dekker.
9. Hyde, W F, Improving Productivity by Classification, Coding, and Database Standardization, Marcel Dekker.
10. Noori, H, Managing the Dynamics of New Technology: Issues in Manufacturing Management, Prentice-Hall.

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Practical

Subject Code : IEM291	Category : Laboratory– III
Subject Name : Quality Design and Control Laboratory	Semester : Second
L-T-P : 0-0-4	Credit:2
Pre-Requisites:	

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.

Subject Code : IEM292	Category : Laboratory– IV
Subject Name : Product Development Laboratory	Semester : Second
L-T-P : 0-0-4	Credit:2
Pre-Requisites:	

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Sessional

Subject Code : IEM281	Category : Mini Project
Subject Name : Mini Project with Seminar	Semester : Second
L-T-P : 2-0-0	Credit:2
Pre-Requisites:	

Mini Project would be to do some preliminary works that would lead to the detailed project work spanning over Semester III and IV. Related to the same, the Seminar would be based on literature review on some emerging areas related to this course and the preliminary works done on the mini project.

Seminar presentation would be made by an individual student, and a report would have to be submitted by each student separately.

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Program Elective - V

Subject Code : IEM301A	Category : Program Elective – V
Subject Name : Systems Analysis Techniques	Semester : Third
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Outline:

Introduction to Analysis and Design of intelligent systems using soft computing techniques.

Application of soft computing; Soft Computing Methods.

Artificial Neural Network (ANN): Fundamental Model, Learning Rules

Hebb Net Architecture, Algorithm, linear separability; Perceptron Networks- single and m multilayer; Adeline and Madeline Networks;

Feedback Networks – Discrete Hopfield Net – architecture, training and application algorithm, analysis (ATTAA)

Feed Forward Networks (ATTAA): Back Propagation, Radial Basis Function

Self Organizing Feature Map : Kohonen SOM, LVQ

Fuzzy Systems / Logic – Fuzzy Set Theory; Fuzzy Sets Applications

Hybrid : Neuro-Fuzzy Modeling

Genetic Algorithms and Theory

Learning Resources:

1. J.S.R Jang, C.T.Sun, E.Mizutani; Neuro-Fuzzy and Soft Computing, PHI
2. K. Gurney, An Introduction to Neural Networks, UCL Press.
3. Vose M. D., The Simple genetic Algorithm, MIT Press(1999)
4. Andries P Engelbrecht, Computational Intelligence, John Wiley & Sons Ltd., 2003
5. Timothy J Ross, Fuzzy Logic with Engineering Applications, McGraw Hill 1997
6. S. Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI
7. Davis E Goldberg, Genetic Algorithms: Search, Optimisation and Machine Learning, Addison Wesley, N.Y., 1989

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Subject Code : IEM301B	Category : Program Elective – V
Subject Name : Operation Research-II	Semester : Third
L-T-P : 3-0-0	Credit :3
Pre-Requisites:	

Course Objective: To introduce the basic concepts, issues and techniques of operations research as they are applied in manufacturing and service organization for improve performance and design of optimized systems/sub-systems.

Course Outline:

1. **Queuing Systems:** Elements of queuing model, pure birth and death model, generalized Poisson queening models, single-server models, multi-server models, other queuing models, Comprehensive problems;
2. **Markovian Decision Process:** Markovian Decision Problems, finite and infinite stage models, Markov chain, Comprehensive problems;
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.

Learning Resources:

1. Hillier, F S and Lieberman G J, Nag, B and Basu, P, Introduction to Operation Research, McGraw Hill
2. Taha, H A, Operation Research- An Introduction, PHI
3. Ravindran, A, Philips, D T, and Solberg, J J, Operations research, John Wiley and Sons.
4. Hadley, G, Linear Programming, Addison-Wesley.

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Subject Code : IEM301C	Category : Program Elective – V
Subject Name : Design of Experiments	Semester : Third
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Objective: The objective of this course is to introduce the basic concepts and methods of design of experiments and its applications with real-world design problems.

Course Outline:

- 1.Introduction:** Typical applications of experimental design, basic principles, guidelines for designing experiments, experimental design fundamentals.
- 2.Simple Comparative Experiments:** Basic statistical concept, inferences about the differences in means, randomized designs, inferences about the differences in means, paired comparison designs;
- 3.Experiments with a Single Factor**
- 4.Randomized Blocks, Latin Squares, and Related Designs**
- 5.Introduction to Factorial Designs:** Basic definitions and principle, the two factor factorial design.
- 6.The 2^k Factorial Design**
- 7.Blocking and Confounding in the 2^k Factorial Design**
- 8.Two-Level Fractional Factorial Designs**
- 9.Response Surface Methods and Other Approaches to Process Optimization**

Textbooks:

- 1.Montgomery, D C, Design and Analysis of Experiments, Wiley

References:

1. Hinkelmann, K, Design and Analysis of Experiments, Wiley
2. Mitra, A, Fundamentals of Quality Control and Improvement, Prentice-Hall.

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Subject Code : IEM301D	Category : Program Elective – V
Subject Name : Multi-Criteria Decision Making Techniques	Semester : Third
L-T-P : 3-0-0	Credit:3
Pre-Requisites:	

Course Outline:

Multi-Criteria Decision Making – An Overview – Classification of MCDM methods – Simple Additive Weighting method – Weighted Product method – Principle, steps and illustrative examples.

Network based MCDM methods – Analytic Hierarchy Process – Revised Analytic Hierarchy Process – Analytic Network Process – Principle, steps and illustrative examples.

Outranking MCDM methods – PROMETHEE, ELECTRE, TOPSIS - Compromise Ranking method - VIKOR, ORESTE – DEMATEL – Principle, steps and illustrative examples.

Fuzzy based MCDM methods – Hybrid MCDM methods – Group Decision Making- Graph Theory and Matrix approach – Principle, steps and illustrative examples.

Goal Programming – Balanced Scorecard Approach - MCDM application areas – Case studies on application of MCDM techniques.

Learning Resources:

1. Belton, V., Stewart, T.J. “Multiple Criteria Decision Analysis: An Integrated Approach”, Kluwer Academic Publishers, Dordrecht, 2003.
2. Triantaphyllou, E., “Multi-Criteria Decision Making Methods: A Comparative Study”, Springer, 2010.
3. Pedrycz, W., Ekel, P., Parreiras, R., “Fuzzy Multi Criteria Decision-Making: Models, Methods and Applications”, John Wiley & Sons, 2011.
4. Kahraman, C., “Fuzzy Multi-criteria Decision Making: Theory and Applications with Recent Developments”, Springer, 2008.

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Sessional

Subject Code : IEM381	Category : Major Project
Subject Name : Dissertation-I (Progress)	Semester : Third
L-T-P : 0-0-20	Credit:10
Pre-Requisites:	

A Project Dissertation would be of two-semester duration and one project would be allotted to one student. 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. The Progress of project dissertation up to the end of the Third Semester would be presented by the student concerned and viva voce will be conducted by a panel of examiners.

Quality of the project is 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.
- Benchmarks used / Assumptions made
- Interpretation of results and justification thereof and validity of the results presented.
- Overall presentation of the report

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Sessional

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

Total output of the project work would have to be submitted in form of a bound thesis containing literature review, objective, details of work done, conclusion, reference, etc. The evaluation of the thesis will be done by a panel of examiners.

Final presentation and viva voce of the project will be based on the project thesis submitted to be conducted by a panel of examiners.

Quality of the project is 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.
- Benchmarks used / Assumptions made
- Interpretation of results and justification thereof and validity of the results presented.
- Overall presentation of the report

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Mandatory Learning Course

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Subject Code : MLC101	Category : Mandatory Learning Course
Subject Name : Research Methodology and IPR	Semester : First
L-T-P : 2-0-0	Credit:2
Pre-Requisites:	

Course Outcomes:

- At the end of this course, students will be able to
- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Outline:

Unit 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

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 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

Unit 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.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: 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.

Learning Resources:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
- Mayall, "Industrial Design", McGraw Hill, 1992.
- Niebel, "Product Design", McGraw Hill, 1974.
- Asimov, "Introduction to Design", Prentice Hall, 1962.

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- *Introduction To Research*, NPTEL online certification course.

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Audit courses 1& 2

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Subject Name : English for Research Paper Writing	Category: Audit course
Subject Code : AC101A / AC201A	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
Ensure the good quality of paper at very first-time submission

Course Outline:

Units	Contents	Hours
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.	4
4	Key skills are needed when writing a Title; key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	4
5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Learning Resources:

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

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Heidelberg London, 2011

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Subject Name : Pedagogy Studies	Category: Audit Courses
Subject Code : AC101B/ AC201B	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Course Outline:

Units	Contents	Hours
1	<ul style="list-style-type: none"> ❖ Introduction and Methodology: <ul style="list-style-type: none"> • Aims and rationale, Policy background, Conceptual framework and terminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions. • Overview of methodology and Searching 	4
2	<ul style="list-style-type: none"> • Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education 	2
3	<ul style="list-style-type: none"> • 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. 	4
4	<ul style="list-style-type: none"> • Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment 	4

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	<ul style="list-style-type: none"> • Barriers to learning: limited resources and large class sizes 	
5	<ul style="list-style-type: none"> ❖ Research gaps and future directions <ul style="list-style-type: none"> • Research design • Contexts • Pedagogy • Teacher education • Curriculum and assessment • Dissemination and research impact 	2

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Learning Resources:

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

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Subject Name : Constitution of India	Category: Audit Courses
Subject Code : AC101C/ AC201C	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

Course Outline:

Units	Contents	Hours
1	❖ History of Making of the Indian Constitution: <ul style="list-style-type: none"> • History • Drafting Committee, (Composition & Working) 	4
2	❖ Philosophy of the Indian Constitution: <ul style="list-style-type: none"> • Preamble • Salient Features 	4
3	❖ Contours of Constitutional Rights & Duties: <ul style="list-style-type: none"> • 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. 	4
	❖ Organs of Governance: <ul style="list-style-type: none"> • Parliament • Composition • Qualifications and Disqualifications • Powers and Functions • Executive 	4

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	<ul style="list-style-type: none"> • President • Governor • Council of Ministers • Judiciary, Appointment and Transfer of Judges, Qualifications • Powers and Functions 	
	<p>❖ Local Administration:</p> <ul style="list-style-type: none"> • 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 	4
	<p>❖ Election Commission:</p> <ul style="list-style-type: none"> • 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

Course Outcome:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. 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.
4. Discuss the passage of the Hindu Code Bill of 1956.

Learning Resources:

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

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Subject Name : Disaster Management	Category: Audit Courses
Subject Code : AC101D/ AC201D	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. 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:

Units	Contents	Hours
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.	4
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.	4
5	Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-	4

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	Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	
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

Learning Resources:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, PardeepEt.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.

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Subject Name : Value Education	Category: Audit Courses
Subject Code : AC101E/ AC201E	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objectives:

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outline:

Units	Contents	Hours
1	<ul style="list-style-type: none"> ❖ 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	<ul style="list-style-type: none"> ❖ 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 	6
3	<ul style="list-style-type: none"> ❖ Personality and Behavior 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 	6
	<ul style="list-style-type: none"> ❖ 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 	6

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Course Outcomes:

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

Learning Resources:

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

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Subject Name : Stress Management by Yoga	Category: Audit Courses
Subject Code : AC101F /AC201F	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

1. To achieve overall health of body and mind
2. To overcome stress

Course Outline:

Units	Contents	Hours
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	8
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.	8

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Learning Resources:

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

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Subject Name : Personality Development through life Enlightenment skills	Category: Audit Courses
Subject Code : AC101G/ AC201G	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course Outline:

Units	Contents	Hours
1	<ul style="list-style-type: none"> ❖ Neetisatakam-Holistic development of personality: <ul style="list-style-type: none"> • 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) 	8
2	<ul style="list-style-type: none"> • 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. 	8
3	<ul style="list-style-type: none"> • 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 	8

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students

Learning Resources:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata

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2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Subject Name : Sanskrit for Technical Knowledge	Category : Audit Courses
Subject Code : AC101H/ AC201H	Semester : First/ Second
L-T-P : 2-0-0	Credit : 0
Pre-Requisites:	

Course Objective:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

Course Outline:

Units	Contents	Hours
1	❖ Alphabets in Sanskrit, ❖ Past/Present/Future Tense, ❖ Simple Sentences	8
2	❖ Order ❖ Introduction of roots ❖ Technical information about Sanskrit Literature	8
3	❖ Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Course Outcome:

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

Learning Resources:

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

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Open Electives

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Subject Name : Business Analytics	Category: Open Elective
Subject Code : OE301A	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Objective:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Manage business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outline:

Units	Contents	Hours
1	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 modeling, sampling and estimation methods overview.	9
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.	8
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.	9

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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.	10
5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
6	Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

Course Outcomes:

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Learning Resources:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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Subject Name : Operations Research	Category :Open Elective
Subject Code : OE301B	Semester : Third
L-T-P : 3-0-0	Credit :3
Pre-Requisites:	

Course Outcomes:

At the end of the course, the student should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Course Outline:

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method duality theory dual simplex method - sensitivity analysis - parametric programming

Unit-III

Nonlinear programming problem -Kuhn-Tucker conditions min cost flow problem max flow problem CPM/PERT

Unit-IV

Scheduling and sequencing single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming

Unit-V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Learning Resources:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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Subject Name : Cost Management of Engineering Projects:	Category: Open Elective
Subject Code: OE301C	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

Introduction and Overview of the Strategic Cost Management Process

Unit-I

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.

Unit-I

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

Unit-I

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.

Unit-I

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.

Unit-I

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Learning Resources:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

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5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

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Subject Name : Industrial Safety	Category: Open Elective
Subject Code : OE301D	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety colour codes. Fire prevention and fire fighting, equipment and methods.

Unit-II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:
i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

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Learning Resources:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

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Subject Name : Composite Materials	Category: Open Elective
Subject Code : OE301E	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

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.

Unit-II

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 Isostress conditions.

UNIT – III

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.

UNIT–IV

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.

UNIT – V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Learning Resources:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.

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6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi

Subject Name : Waste to Energy	Category: Open Elective
Subject Code : OE301F	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications

Unit-III

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.

Unit-IV

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.

Unit-V

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.

Learning Resources:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.