# ANNA UNIVERSITY, CHENNAI
## AFFILIATED INSTITUTIONS
### REGULATIONS 2013
#### M.E. INDUSTRIAL ENGINEERING
##### I TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

## SEMESTER I

<table>
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TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 71

## LIST OF ELECTIVES FOR M.E. INDUSTRIAL ENGINEERING

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OBJECTIVES:
- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 9+3
Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9+3
Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY 9+3

UNIT IV TESTING OF HYPOTHESES 9+3
Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 9+3
Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components Population principal components - Principal components from standardized variables.

TOTAL 45+15:60 PERIODS

OUTCOMES:
- The student will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems

REFERENCES:
UNIT I  METHOD STUDY
Work design and Productivity – Productivity measurement - Total work content, Developing methods – operation analysis, motion & micro motion study, graphic tools.

UNIT II  WORK MEASUREMENT
Stop watch time study, Performance rating, allowances, standard data-machining times for basic operations, learning effect

UNIT III  APPLIED WORK MEASUREMENT
Methods time measurement (MTM), Work sampling, organization and methods (O & M), Wage incentive plans.

UNIT IV  PHYSICAL ERGONOMICS
Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures-sitting, standing - measurement – ergonomic implications. design of displays and controls,

UNIT V  ENVIRONMENTAL FACTORS

REFERENCES
3. Introduction to work study, ILO, 3rd edition, Oxford & IBH publishing,2001

UNIT I  INTRODUCTION-LP
Concepts of OR, development, applications, LP Definitions, assumptions, formulation, graphical method, Simplex algorithm.

UNIT II  LP-EXTENSIONS
Duality- primal dual relationships -Dual Simplex — sensitivity analysis, Data Envelopment Analysis.

UNIT III  NETWORKS
Transportation, Assignment, Maximal flow, Shortest route, Spanning tree problems, Project Net Works.

UNIT IV  DYNAMIC PROGRAMMING
Dynamic Programming-Concepts, formulation, recursive approach; applications

UNIT V  WAITNG LINES
Queuing characteristics and terminology, poisson and non-poisson models.

REFERENCES
UNIT I  INTRODUCTION

UNIT II  FORECASTING:
Need for forecasting, the forecasting process, Forecasting methods- qualitative methods, Quantitative models-Time series forecasting models, moving averages, exponential smoothing with trend and seasonal adjustment, multi-item forecasting, Simple and multiple linear regression models, monitoring and controlling forecasts.

UNIT III  INVENTORY MANAGEMENT:
Types of inventory, Inventory classification methods, Inventory costs Inventory models- deterministic models, probabilistic models - safety stock and reorder points – Inventory control systems.

UNIT IV  PLANNING ACTIVITIES:
Capacity planning- short term and long term capacity, capacity of facilities, break even capacity, use of decision trees, aggregate production planning - strategies, methods, Master Production Schedule, MRP- lot sizing, MRP II, CRP, ERP.

UNIT V  PRODUCTION CONTROL ACTIVITIES:
Production Activity Control, Just-in-time systems, Scheduling in Manufacturing, Theory of constraints and synchronous manufacturing.

REFERENCES

UNIT I  PLANT LOCATION
Plant location analysis – factors, costs, location decisions – single facility location models, multi facility location models- set covering problem – warehouse location problems.

UNIT II  FACILITIES LAYOUT
Facilities requirement, need for layout study – types of layout, Designing product layout-Line balancing.

UNIT III  LAYOUT DESIGN
Design cycle – SLP procedure, computerized layout planning procedure – ALDEP, CORELAP, CRAFT

UNIT IV  GROUP TECHNOLOGY AND LINE BALANCING
Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Line balancing.
UNIT V  MATERIAL HANDLING
Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging.

REFERENCES

TOTAL: 45 PERIODS

IL7111  WORK DESIGN AND ERGONOMICS LAB  L T P C
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AIM:
To understand the theory better and apply in practice, practical training is given in the following areas:

LIST OF EXPERIMENTS
1. Graphic tools for method study
2. Performance rating exercise
3. Stop watch time study
4. Peg board experiment
5. Work sampling
6. MTM practice
7. Study of physical performance using tread mill and Ergo cycle
8. Physical fitness testing of individuals
9. Experiments using sound level and lux meters
10. Experiments using Ergonomics software

TOTAL: 30 PERIODS

LABORATORY EQUIPMENTS REQUIREMENTS
1. Time study Trainer
2. Peg board
3. Stop watches
4. Tread mill
5. Ergo cycle
6. Any one Ergonomics software (Eg.: Ergomaster, Human CAD)

IL7201  MANUFACTURING SYSTEMS AND MODELS  L T P C
3 0 0 3

UNIT I  INTRODUCTION
Manufacturing systems – types and concepts, manufacturing automation - Performance measures – types and uses of manufacturing models.

UNIT II  FOCUSED FACTORIES
GT/CMS, FMS planning, design and control. Process planning – variant and generative approaches of CAPP, general serial systems – analysis of paced and unplaced lines.

UNIT III  LEAN SYSTEMS
Characteristics of Lean systems for services and Manufacturing, Pull method of work flow, Small lot sizes, Kanban system, Value stream mapping, JIT
UNIT IV QUEUING MODELS OF MANUFACTURING
Basic Queuing models, Queuing networks, application of queuing models for AMS.

UNIT V MARKOV AND PETRINET MODELS OF MANUFACTURING

TOTAL: 45 PERIODS

REFERENCES

IL7202 SYSTEMS AND SIMULATION

UNIT I INTRODUCTION
Systems, modeling, general systems theory, concept of simulation, simulation as a decision making tool, types of simulation.

UNIT II RANDOM NUMBERS AND VARIATES
Pseudo random numbers, methods of generating random variates, testing of random numbers and variates.

UNIT III DESIGN OF SIMULATION EXPERIMENTS
Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

UNIT IV SIMULATION LANGUAGES
Comparison and selection of simulation languages, study of any one simulation language.

UNIT V CASE STUDIES / MINI PROJECT
Development of simulation models using the simulation language studied for systems like, queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network.

TOTAL: 45 PERIODS

REFERENCES
UNIT I INTRODUCTION
Statistical concepts for quality Fundamentals of quality history, Quality definitions, Quality dimensions, Quality terminology- Inspection, Quality control, SQC, Quality Assurance, Quality planning policies & objectives, Quality costs Economics of quality, Quality loss function, Quality Vs productivity, Quality Vs reliability.

UNIT II STATISTICAL PROCESS CONTROL
Process variation, Control charts for variables $\bar{X}$, R and S charts preliminary decisions, computation of control limits, Construction and interpretation, Relation between process in control and specification limits, modified and warning control limits, O.C. curve for $\bar{X}$ chart, Control procedure, adjustment for trend in process mean.

UNIT III SPECIAL CONTROL PROCEDURES
Control charts for attributes p, np, c and u charts, demerits control chart, O.C curve for p-chart, Control charts for individual measurements X-chart, moving average and moving range charts, cumulative-sum and exponentially weighted moving average control charts, multi-vari chart.

UNIT IV PROCESS AND MEASUREMENT SYSTEM CAPABILITY
Process stability, process capability analysis using a Histogram or normal probability plot and control chart, process capability indexes, Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING
Acceptance sampling, Economics of sampling, Single sampling plan for attributes O.C. curve, design, double sampling O.C. curve, multiple and sequential sampling plans, sampling plans for variables, MIL-STD-105E and MIL-STD-414 & IS2500 standards.

TOTAL: 45 PERIODS

REFERENCES

UNIT I INTRODUCTION
Definition of Logistics and SCM: Evolution, Scope, Importance Supply chain stages and decision phases process view of a supply chain Supply chain flows Examples of supply chains Competitive and supply chain strategies Achieving strategic fit Expanding strategic scopeDrivers of supply chain performance Framework for structuring drivers Obstacles to achieving fit.

UNIT II LOGISTICS MANAGEMENT
Factors Modes of Transportation Design options for Transportation Networks Routing and Scheduling Inbound and outbound logistics Reverse Logistics 3PL- 4PL Global Logistics -Integrated Logistics Concepts Activities Measuring logistics cost and performance Warehouse Management Case Analysis

UNIT III SUPPLY CHAIN NETWORK DESIGN
Distribution in Supply Chain Factors in Distribution network design Design options Network Design in Supply Chain Framework for network Decisions
UNIT IV SOURCING AND REVENUE MANAGEMENT IN SUPPLY CHAIN
Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

UNIT V COORDINATION AND IT IN SUPPLY CHAIN
Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work- E Business and SCM. Metrics for SC performance – Case Analysis

REFERENCES
2. David J.Bloomberg, Stephen Lemay and Joe B.Hanna, Logistics, PHI 2010
4. Jeremy F.Shapiro ,Modeling the supply chain, Thomson Duxbury, 2002

IL7211 COMPUTER APPLICATIONS LAB

To understand the theory better and apply in practice, practical training is given in the following areas.

UNIT I
Development of Simple Programs for Statistical analysis: Frequency distribution, Applications of Graphics. (Charts, Graphs etc).

UNIT II
Programs for OR applications like Initial solution of Transportation Problems, Net Works etc

UNIT III
Solving optimization problems using software packages like LINDO, LINGO, TORA. Excel Solver.

UNIT IV
Development of Random number generator, Testing of random number generator. Non-uniform Random varieties generation and testing,Single server Queuing simulation, Case Studies

UNIT V
Program for Simulation of Single server Queueing System – Use of Simulation software. Case studies.

LABORATORY EQUIPMENT REQUIREMENTS
1. TURBO C++ Software
2. LINDO Software
3. LINGO Software
4. TORA Software
5. GPSS Software
6. MS EXCEL
OBJECTIVE:
To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology

OUTCOME:
Students will develop skills to read, write, comprehend and present research papers. Students shall give presentations on recent areas of research in manufacturing engineering in two cycles. Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

TOTAL: 30 PERIODS

UNIT I EXPERIMENTAL DESIGN FUNDAMENTALS
Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models.

UNIT II SINGLE FACTOR EXPERIMENTS
Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

UNIT III MULTIFACTOR EXPERIMENTS
Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F-tests. $2^k$ factorial Experiments.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS:
Blocking and confounding in $2^k$ designs. Two level Fractional factorial design, nested designs, Split plot design, Response Surface Methods.

UNIT V TAGUCHI METHODS
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization.

T= 15, TOTAL: 60 PERIODS

REFERENCES
UNIT I  INTRODUCTION
Classification of optimization problems, concepts of design vector, Design constraints, constrains surface, objective function surface and multi-level optimization, parametric linear programming

UNIT II  DECISION ANALYSIS
Decision Trees, Utility theory, Game theory, Multi Objective Optimization, MCDM- Goal Programming, Analytic Hierarchy process, ANP

UNIT III  NON-LINEAR OPTIMIZATION
Unconstrained one variable and multi variable optimization, KKT Conditions, Constrained optimization, Quadratic programming, Convex programming, Separable programming, Geometric programming, Non-Convex programming

UNIT IV  NON-TRADITIONAL OPTIMIZATION -1
Classes P and NP, Polynomial time reductions, Introduction to NP- Hard problems, Overview of Genetic algorithms, Simulated Annealing, neural network based optimization.

UNIT V  NON-TRADITIONAL OPTIMIZATION -2
Particle Swarm optimization, Ant Colony Optimization, Optimization of Fuzzy Systems.

REFERENCES

UNIT I  RELIABILITY CONCEPTS

UNIT II  LIFE DATA ANALYSIS

UNIT III  RELIABILITY ASSESSMENT
Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye’s approach – Cut and tie sets – Fault Trees – Standby systems.

UNIT IV  RELIABILITY MONITORING

UNIT V  RELIABILITY IMPROVEMENT

TOTAL: 45 PERIODS
REFERENCES

IL7003 SCHEDULING ALGORITHMS

UNIT I SCHEDULING THEORY

UNIT II SINGLE MACHINE SCHEDULING
Pure sequencing model – Hodgson’s algorithm – Smith’s rule – Wilkerson Irwin algorithm – Neighborhood search – Dynamic programming technique – Branch and Bound algorithm – Non simultaneous arrivals – Minimizing $\bar{T}$ and $\bar{F}$ for dependent jobs – Sequence dependent set up times.

UNIT III PARALLEL MACHINE SCHEDULING
Preemptive jobs: McNaughton’s algorithm – Non preemptive jobs – Heuristic procedures – Minimizing $\bar{F}^w$: $H_1$ & $H_m$ heuristics – Dependent jobs: Hu’s algorithm – Muntz Coffman algorithm.

UNIT IV FLOW SHOP SCHEDULING

UNIT V JOB SHOP SCHEDULING

TOTAL: 45 PERIODS

REFERENCES

IL7004 PRODUCT INNOVATION AND DEVELOPMENT

UNIT I PRODUCT DEVELOPMENT AND CONCEPT SELECTION

UNIT II PRODUCT ARCHITECTURE
Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.
UNIT III   INDUSTRIAL AND MANUFACTURING DESIGN  
Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design - Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors.

UNIT IV   PROTOTYPING AND ECONOMIC ANALYSIS  

UNIT V   MANAGING PRODUCT DEVELOPMENT PROJECTS  
Sequential, parallel and coupled tasks - Baseline project planning – Project Budget- Project execution – Project evaluation- patents- patent search-patent laws-International code for patents.

TOTAL: 45 PERIODS

TEXT BOOK :

REFERENCES

IL7005   PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING  
L T P C  
3 0 0 3

UNIT I   PRODUCTIVITY  
Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organisation level - Productivity measurement models

UNIT II   SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT  
Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

UNIT III   ORGANISATIONAL TRANSFORMATION  
Elements of Organisational Transformation and Reengineering-Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model.

UNIT IV   RE-ENGINEERING PROCESS IMPROVEMENT MODELS  
PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model.

UNIT V   RE-ENGINEERING TOOLS AND IMPLEMENTATION  
Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem – Cases.

TOTAL: 45 PERIODS

REFERENCES
IL7006  TOTAL QUALITY MANAGEMENT  L T P C
UNIT I  INTRODUCTION  9

UNIT II  TQM PRINCIPLES  9
Leadership, Customer Satisfaction, Employee Involvement, Continuous Process Improvement, Supplier Partnership, Performance Measures, Cost of Quality.

UNIT III  TOOLS AND TECHNIQUES – 1  9
Benchmarking, Information Technology, Quality Management Systems and environmental management systems.

UNIT IV  TOOLS AND TECHNIQUES  9
QFD, FMEA, Quality Circles, TPM, Traditional Quality Tools and Management tools.

UNIT V  IMPLEMENTATION OF TQM  9
Steps in TQM implementation, national and international quality awards, case studies.

TOTAL: 45 PERIODS

REFERENCES

IS7204  MAINTAINABILITY ENGINEERING  L T P C
UNIT I  MAINTENANCE CONCEPT  6

UNIT II  MAINTENANCE MODELS  12

UNIT III  MAINTENANCE LOGISTICS  11

UNIT IV  MAINTENANCE QUALITY  8

UNIT V  TOTAL PRODUCTIVE MAINTENANCE  8
TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars – Autonomous maintenance – TPM implementation

TOTAL: 45 PERIODS
REFERENCES

IL7007 HUMAN FACTORS AND ERGONOMICS
UNIT I PHYSIOLOGICAL PERFORMANCE
Factors affecting physiological performance, physical work load and energy expenditure, heat stress, manual lifting, shift work

UNIT II WORK SPACE DESIGN
Anthropometry, Workspace designs for standing and seated workers, arrangement of components within a physical space, interpersonal aspect of workplace design.

UNIT III DESIGN OF EQUIPMENT
Ergonomic factors to be considered in the design of displays and control, design for maintainability, design of human computer interaction.

UNIT IV COGNITIVE ERGONOMICS
Information Theory, Information processing, signal detection theory, Human response, human errors, cognitive task analysis.

UNIT V DESIGN OF ENVIRONMENT
Vision and Illumination design – Noise and Vibration

TOTAL: 45 PERIODS

REFERENCES

IL7008 SOFTWARE QUALITY ENGINEERING
UNIT I SOFTWARE QUALITY
Definition of Software Quality, Quality Planning, Quality system – Quality Control Vs Quality Assurance – Product life cycle – Project life cycle models.

UNIT II SOFTWARE ENGINEERING ACTIVITIES

UNIT III SUPPORTING ACTIVITIES
Metrics, Reviews – SCM – Software quality assurance and risk management.

UNIT IV SOFTWARE QUALITY MANAGEMENT TOOLS
Seven basic Quality tools – Checklist – Pareto diagram – Cause and effect diagram – Run chart – Histogram – Control chart – Scatter diagram – Poka Yoke – Statistical process control – Failure Mode and Effect Analysis – Quality Function deployment – Continuous improvement tools – Case study.
UNIT V  QUALITY ASSURANCE MODELS

TOTAL : 45 PERIODS

TEXT BOOKS:

REFERENCES

IL7009  ENGINEERING ECONOMICS AND COSTING

UNIT I  DEMAND ANALYSIS AND FORECASTING

UNIT II  PRODUCTION FUNCTION AND COST ANALYSIS

UNIT III  MARKET COMPETITION AND PRICING

UNIT IV  PROFIT ANALYSIS
The concept of profit: Profit planning, control and measurement of profits. Profit maximisation – Cost volume profit analysis – Investment Analysis.

UNIT V  COSTING
Job costing-Process costing-Operating costing-Standard Costing (variance analysis) and budgeting-.

TOTAL: 45 PERIODS

REFERENCES
4. Jawaharlal, Cost Accounting, Tata McGraw Hill,
UNIT I INTRODUCTION TO LEAN MANUFACTURING AND SIX SIGMA
Introduction to Lean- Definition, Purpose, features of Lean ; top seven wastes, Need for Lean, Elements of Lean Manufacturing, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept, Critical success factors for six sigma.

UNIT II LEAN SIX SIGMA APPROACH
Evolution of lean six sigma, the synergy of Lean and six sigma, Definition of lean six sigma, the principles of lean six sigma, Scope for lean six sigma, Features of lean six sigma, The laws of lean six sigma, Benefits of lean six sigma, Introduction to DMAIC tools.

UNIT III INITIATION FOR LEAN SIX SIGMA

UNIT IV PROJECT SELECTION FOR LEAN SIX SIGMA
Resource and project selection, Selection of Black belts, Selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Balanced score card for project identification, project suitable for lean six sigma.

UNIT V THE DMAIC PROCESS AND INSTITUTIONALIZING THE LSS
Predicting and improving team performance, Nine team roles, Team leadership, DMAIC process, Institutionalizing lean six sigma, Design for lean six sigma, Case study presentations.

TOTAL: 45 PERIODS

REFERENCES
5. Rother M. and hook J., Learning to See: Value Stream Mapping to add value and Eliminate Muda, Lean Enterprise Institute, Brookline, MA.
**UNIT IV**  
**INTELLIGENT SYSTEMS**  
Artificial intelligence and expert systems-concepts, structure, types-knowledge acquisition and validation, knowledge representation  

**UNIT V**  
**IMPLEMENTATION**  
Implementation, integration and impact of management support systems.  

**TOTAL: 45 PERIODS**  

**REFERENCES**  

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**IL7012**  
**DESIGN AND ANALYSIS OF ALGORITHMS**  

<table>
<thead>
<tr>
<th>Unit</th>
<th>Introduction:</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Algorithms, basic steps in development.</td>
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<tr>
<td>II</td>
<td>Review of any one of the structured languages</td>
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<td></td>
<td>ALGOL, PL/I, Ada, Pascal, XPL</td>
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<td>III</td>
<td>Basic tools:</td>
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<tr>
<td></td>
<td>Top down, Structured programming, networks, data structure.</td>
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<td>IV</td>
<td>Methods of design:</td>
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<tr>
<td></td>
<td>Sub goals, hill climbing and working backward, heuristics, back track programming, Branch and bound recursion process, program testing, documentation, Meta heuristics.</td>
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<tr>
<td>V</td>
<td>Application:</td>
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<td>Development of sorting, searching, algorithms- combinatorial problems, shortest path, probabilistic algorithms.</td>
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</tbody>
</table>

**TOTAL: 45 PERIODS**  

**REFERENCES**  

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**IL7013**  
**APPLIED OBJECT ORIENTED PROGRAMMING**  

<table>
<thead>
<tr>
<th>Unit</th>
<th>Fundamentals of Object Oriented Programming</th>
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<th>P</th>
<th>C</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Elements of OOP, classes, subjects, messaging, inheritance, polymorphism, OOP paradigm versus procedural paradigm, object-oriented design.</td>
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<tr>
<td>II</td>
<td>C++ Basics</td>
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<td>15</td>
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<tr>
<td></td>
<td>Expression and statements, operators, precedence, type conversion, control statements, loops, Arrays structures, functions, argument passing, reference argument, overloaded function.</td>
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</tbody>
</table>

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UNIT III C++ CLASS
Definition, class objects, member functions, class argument, operator overloading, user defined conversions.

UNIT IV CLASS DERIVATION
Derivation specification, public and private base classes, standard conversions under derivation, class scope, initialization and assignment under derivation.

UNIT V APPLICATION
OOP’s applications in Industrial Engineering.

TOTAL: 45 PERIODS

REFERENCES

IL7014 MANAGEMENT ACCOUNTING AND FINANCIAL MANAGEMENT

UNIT I FINANCIAL ACCOUNTING

UNIT II COST ACCOUNTING

UNIT III BUDGETING
Requirements for a sound budget. Fixed budget – Preparation of sales and Production budget, Flexible budgets, Zero base budgeting and budgetary control.

UNIT IV FINANCIAL MANAGEMENT
Investment decisions – Capital investment process, Type of investment proposals, Investment appraisal techniques – Payback period method, Accounting rate of return, Net present value method, Internal rate of return and Profitability index method.

UNIT V FINANCIAL DECISIONS
Cost of capital – Capital structure – Dividend policy – Leasing.

TOTAL : 45 PERIODS

REFERENCES
UNIT I  
AUTOMATION  
Types of production – Functions – Automation strategies – Production economics – Costs in manufacturing – Break-even analysis.

UNIT II  
AUTOMATED FLOW LINES  
Transfer mechanism - Buffer storage – Analysis of transfer lines - Automated assembly systems.

UNIT III  
NUMERICAL CONTROL AND ROBOTICS  

UNIT IV  
AUTOMATED HANDLING AND STORAGE  
Automated material handling systems – AGV- AS/RS – carousel storage – Automatic data capture – bar code technology- RFID

UNIT V  
MANUFACTURING SUPPORT SYSTEMS  
Product design and CAD, CAD/CAM and CIM, Computer aided process planning- variant and generative approaches, Concurrent engineering and design for manufacture, Lean production, Agile manufacturing.

TOTAL: 45 PERIODS

REFERENCES

UNIT I  
BUSINESS EXCELLENCE MODELS  
Business Excellence Concepts – Need for BE models – Pioneers in the model MBNQA , EFQM and DEMING award

UNIT II  
MBNQA  
Criteria : : LEADERSHIP , Strategic planning , Customer and Market focus , Measurement analysis and Knowledge Management , Human resource focus, process management , business results

UNIT III  
BUSINESS EXCELLENCE AWARDS IN INDIA  
Models in Business excellence: RBNQA CII EXIM Award, Tata BE Model etc

UNIT IV  
IMPLEMENTING BUSINESS EXCELLENCE MODEL  
Basic concepts – Training -Report writing – Internal audit-Report submission – Initial assessment - Site visit – Scoring – Criteria for Award, Award finalization

UNIT V  
CASE STUDY  
TOTAL: 45 PERIODS

TEXT BOOK:

REFERENCES
http://www.baldrige.nist.gov
http://www.baldrige21.com/
www.imc.org
IL7017 KNOWLEDGE MANAGEMENT L T P C 3 0 0 3

UNIT I INTRODUCTION

UNIT II KNOWLEDGE MODELS 9

UNIT III TECHNIQUES OF KNOWLEDGE MANAGEMENT 9
Knowledge Elicitation Techniques – Modeling Communication Aspects – Knowledge Management and Organizational Learning.

UNIT IV KNOWLEDGE SYSTEM IMPLEMENTATION 9

UNIT V ADVANCED KM 9

TOTAL: 45 PERIODS

REFERENCES

IL7018 SYSTEMS SCIENCE AND ENGINEERING L T P C 3 0 0 3

UNIT I SYSTEMS SCIENCE CONCEPTS 9

UNIT II SYSTEMS ENGINEERING PROCESSES 9
UNIT III  ANALYSIS OF ALTERNATIVES  9
Uncertain/ Imperfect information; Cross-impact analysis, Hierarchical inference, logical reasoning inference; Structural modeling; System Dynamics.

UNIT IV  INTERPRETATION OF ALTERNATIVES AND DECISION MAKING  9
Types of decisions – descriptive, prescriptive, normative; Decision assessment efforts types – under certainty, probabilistic uncertainty, probabilistic imprecision, information imperfection, conflict and cooperation; Prescriptive normative decision assessments; Utility theory; Group decision making, Game Theory.

UNIT V  SYSTEMS ENGINEERING MANAGEMENT CONCEPTS  9
Organizational structures, SE management plan; Network based systems planning and management methods; Cognitive factors in SE.

REFERENCES

IL7019  INDUSTRIAL SAFETY AND HYGIENE  L T P C 3 0 0 3
UNIT I  OPERATIONAL SAFETY  9

UNIT II  SAFETY APPRAISAL AND ANALYSIS  9

UNIT III  OCCUPATIONAL HEALTH  9
Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV  SAFETY AND HEALTH REGULATIONS  9
UNIT V  SAFETY MANAGEMENT  9

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES
1. Occupational Safety Manual BHEL.
2. Industrial Safety and the law by P.M.C Nair Publishers, Trivandrum.

IL7020  LOGISTICS AND DISTRIBUTION MANAGEMENT  L T P C
UNIT I  CONCEPTS OF LOGISTICS AND DISTRIBUTION  9
Introduction to logistics and distribution- Integrated logistics and the supply chain- Integrated logistics and the supply chain- Customer service and logistics- Channels of distribution - Key issues and challenges for logistics.

UNIT II  PLANNING FOR LOGISTICS  9
Planning framework for logistics -Logistics processes -Supply chain segmentation- Logistics network planning - Logistics management and organization - Manufacturing and materials management

UNIT III  WAREHOUSING AND STORAGE  9
Principles of warehousing Storage and handling systems (palletized and non-palletized) - Order picking and replenishment- Receiving and dispatch - Warehouse design- Warehouse management and information

UNIT IV  FREIGHT TRANSPORT  9
International logistics: modal choice - Maritime transport - Air transport - Rail and intermodal transport- Road freight transport: vehicle selection, vehicle costing and planning and resourcing- International transportation systems in Global perspective.

UNIT V  OPERATIONAL MANAGEMENT  9
Cost and performance monitoring- Benchmarking- Information and communication technology in supply chain- Outsourcing: services and decision criteria, the selection process - Outsourcing management- Security and safety in distribution - Logistics and the environment.

TOTAL : 45 HOURS

REFERENCES

CM7022 PROJECT MANAGEMENT L T P C 3 0 0 3

OBJECTIVE:
- To develop the skills that professionals need to become effective project managers. With a specific focus on developing practical project management skills for the students to apply proven methodologies to projects within their individual fields.

UNIT I PROJECT SELECTION AND PROJECT ORGANISATION: 9
Project selection and nature of selection, project portfolio process, Analysis under uncertainty, Project organisation, Matrix organisation, Mixed organisational systems.

UNIT II PROJECT PLANNING: 9
Project Co-ordination, sorting out the projects, Work breakdown structure, system integration, Interface co-ordination, Project life cycle, Conflict and negotiation.

UNIT III PROJECT IMPLEMENTATION: 12
Estimating project budgets, Process of cost estimation, Scheduling: Network techniques PERT and CPM, crashing a project, Resource loading and leveling, Multiproduct scheduling and resource allocation.

UNIT IV MONITORING AND INFORMATION SYSTEMS: 9
Planning-Monitoring-Controlling cycle, Information needs and the reporting process, Computerized PMIS, Earned value analysis, Types of project control processes, control as a function of management, control of change and scope.

UNIT V PROJECT TERMINATION: 6
Construction and use of audit report, Project audit life cycle, Essentials of audit and evaluation, Varieties of project termination, termination process, Final report – A project history.

TOTAL: 45 PERIODS

OUTCOME:
Students will gain a solid understanding of current Project Management methodologies and techniques that are being applied worldwide. They will also learn relevant management skills to ensure success in working with teams and entire organization.

REFERENCES

IL7021 SERVICES OPERATIONS MANAGEMENT L T P C 3 0 0 3

UNIT I INTRODUCTION TO SERVICES 6
Manufacturing and Services, Definition of Service, Characteristic of Service, Nature of Services, Importance of Activity, Impact of technology

UNIT II GLOBALIZATION AND STRATEGY 7
Types of Globalized Services, Outsourcing, issues in Globalization, Service strategies

UNIT III OPERATIONS ISSUES 12
UNIT IV SERVICE QUALITY AND PRODUCTIVITY 10
Importance of Quality, Models for Service Quality, GAPS model, issues in productivity measurement, Work measurement

UNIT V TOOLS FOR SERVICES 10
Data Envelopment Analysis, Queuing models, Vehicle Routing models

TOTAL: 45 PERIODS

REFERENCES

IL7022 MULTIVARIATE DATA ANALYSIS
UNIT I REGRESSION 9
Simple Regression and Correlation – Estimation using the regression line, Correlation analysis, Multiple regression and Correlation analysis – Finding the Multiple Regression equation, Modelling techniques, Making inferences about the population parameters.

UNIT II MULTIVARIATE METHODS 9
An overview of Multivariate methods, Multivariate Normal distribution, Eigen values and Eigen vectors.

UNIT III FACTOR ANALYSIS 9

UNIT IV DISCRIMINANT ANALYSIS 9
Discriminant analysis – Discrimination for two multivariate normal Populations – Discriminant functions.

UNIT V CLUSTER ANALYSIS 9
Cluster analysis – Clustering methods, Multivariate analysis of Variance.

TOTAL : 45 PERIODS

REFERENCES

IL7023 TECHNOLOGY MANAGEMENT
UNIT I INTRODUCTION 9
Technology management - Scope, components, and overview, Technology and environment, Technology and society, Technology Impact analysis, environmental, social, legal, political aspects, techniques for analysis - steps involved. Technology policy strategy: Science and technology Policy of India, implications to industry, The dynamics of technology change

UNIT II TECHNOLOGY FORECASTING 9
UNIT III  TECHNOLOGY CHOICE AND EVALUATION  9
Issues in the development new high tech products, Methods of analyzing alternate technologies, Techno-economic feasibility studies, Need for multi-criteria considerations such as, social, environmental, and political, Analytic hierarchy method, Fuzzy multi-criteria decision making, and other methods.

UNIT IV  TECHNOLOGY TRANSFER AND ACQUISITION  9
Import regulations, Implications of agreements like Uruguay Round and WTO, Bargaining process, Transfer option, MOU- Technology Adoption and Productivity - Adopting technology-human interactions, Organisational redesign and re-engineering, Technology productivity.

UNIT V  TECHNOLOGY ABSORPTION AND INNOVATION  9
Present status in India, Need for new outlook, Absorption strategies for acquired technology, creating new/improved technologies, Innovations, Technology Measurement- Technology Audit, Risk and exposure, R&D portfolio management

TOTAL: 45 PERIODS

REFERENCES
5 . Irvin M. Rubin, Organisational behavior an experimental approach, Prentice Hall, 1995

IL7024  DATA ANALYTICS  L T P C
UNIT I  STATISTICAL DATA ANALYSIS  9

UNIT II  DATA ANALYSIS I  9
Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques – Types of multivariate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation – Approaches to multivariate model building.

UNIT III  DATA ANALYSIS II  9
Simple and Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function – Validation of the model.
Canonical Correlation Analysis - Objectives – Canonical variates and canonical correlation – Interpretation of variates and correlations.

UNIT IV  DATA ANALYSIS III  9
Multiple Discriminant Analysis - Basic concepts – Separation and classification of two populations - Evaluating classification functions – Validation of the model.
UNIT V  DATA ANALYSIS IV  9
Conjoint Analysis – Definitions – Basic concepts – Attributes – Preferences – Ranking of
Preferences – Output of Conjoint measurements – Utility - Interpretation.
Multi Dimensional Scaling – Definitions – Objectives – Basic concepts – Scaling techniques –
Attribute and Non-Attributes based MDS Techniques – Interpretation and Validation of models.
Advanced Techniques – Structural Equation modeling

TOTAL: 45 PERIODS

REFERENCES
1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data
   Hall, New Delhi, 2005.
3. David R Anderson, Dennis J Sweeney and Thomas A Williams, Statistics for Business and

IL7025  SYSTEMS ANALYSIS AND DESIGN  L T P C  3 0 0 3
UNIT I  SYSTEMS ANALYSIS FUNDAMENTALS  9
Information systems analysis overview, Classification of information systems, Systems
development life cycle, Role of systems analyst, and Role of case tools

UNIT II  INFORMATION REQUIREMENT ANALYSIS  9
Sampling and investigating hard data, Interviewing, Using Questionnaires, Developing prototype,
System requirements specification, Feasibility analysis

UNIT III  ANALYSIS PROCESS  9
Data flow diagrams, Data dictionary, Process specifications, Presenting the systems proposal

UNIT IV  ESSENTIALS OF DESIGN  9
Designing effective output, designing the database, designing the user interface, Designing data
entry procedures

UNIT V  SOFTWARE ENGINEERING AND IMPLEMENTATION  9
Quality assurance through software engineering, Implementation approaches, Implementing
distributed systems, Object oriented systems analysis and design

TOTAL: 45 PERIODS

REFERENCES

IL7026  CELLULAR MANUFACTURING SYSTEMS  L T P C  3 0 0 3
UNIT I  INTRODUCTION  5
Introduction to Group Technology, limitations of traditional manufacturing systems, characteristics
and design of groups, benefits of GT and issues in GT.

UNIT II  CMS PLANNING AND DESIGN  12
Problems in GT/CMS - Design of CMS – Production Flow Analysis, Optimization Models,
traditional approaches and non-traditional approaches- Simulated Annealing, Genetic Algorithms,
UNIT III IMPLEMENTATION OF GT/CMS
Inter and intra cell layout and capacity planning. Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS. Linkages to JIT systems

UNIT IV PERFORMANCE MEASUREMENT AND CONTROL
Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework.

UNIT V ECONOMIC OF GT/CMS
Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS - cases.

TOTAL: 45 PERIODS

REFERENCES