UNIVERSITY OF KERALA

REGULATIONS, SCHEME AND SYLLABUS

For

M.Tech. Degree Programme

In

MECHANICAL ENGINEERING

(2013 Scheme)

Stream: INDUSTRIAL ENGINEERING

M.Techprogramme

Mechanical Engineering- Industrial Engineering

Curriculam and Scheme of Examination

SEMESTER I

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam hours	Marks			Remarks
					Internal Continuous Assessment	End Semester Exam	Total	
MIM 1001	Probability and Stochastic Processes	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End sem exam is conducted by the university.
MIC 1001	Industrial Statistics	3	3	3	40	60	100	do
MIC 1002	Financial Management	3	3	3	40	60	100	do
MIC 1003	Operations Planning & Control	3	3	3	40	60	100	do
MIC 1004	Advanced Operations Research	3	3	3	40	60	100	do
MIC 1005	Methods & System Design	3	3	3	40	60	100	do
MIC 1101	Industrial Engineering Lab - 1	1	2	-	100	-	100	No End Sem Examinations
MIC 1102	Seminar	2	2	-	100	-	100	do
	TOTAL	21	22		440	360	800	Seven hours departmental assistance

SEMESTER II

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam hours	Marks			Remarks
					Internal Continuous Assessment	End Semester Exam	Total	
MIC 2001	Six sigma and quality Engineering	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End sem exam is conducted by the university.
MIC 2002	Supply Chain & Logistics Management	3	3	3	40	60	100	do
*	Stream Elective I	3	3	3	40	60	100	do
*	Stream Elective II	3	3	3	40	60	100	do
*	Department Elective	3	3	3	40	60	100	do
MCC 2000	Research Methodology	2	2	3	40	60	100	End semester Examination is Conducted by Individual Institutions
MIC 2101	Industrial Engineering lab - 2	1	2	-	100	-	100	No End Sem Examinations
MIC 2102	Thesis Preliminary Part-1	2	2	-	100		100	do
MIC 2103	Seminar	2	2	-	100	-	100	do
	TOTAL	22	23	---	540	360	900	6 hours departmental assistance

* Students can select a subject from the subjects listed under stream/department electives for the second semester as advised by the course coordinator.

STREAM ELECTIVES FOR SEMESTER II

Stream Elective I	Stream Elective II
MIE 2001 : Systems Simulation and system Dynamics	MIE 2005 : Software Engineering
MIE 2002 : Markov Decision Processes	MIE 2006 : Manufacturing Systems Management
MIE 2003 : Multi Criteria Decision Making	MIE 2007 : Human Aspects of Management
MIE 2004 : Financial Engineering	MIE 2008 : Industrial Automation

SEMESTER III

Code No.	Name of Subject	Credits	Hrs / week	End Sem Exam hours	Marks			Remarks
					Internal \Continuous Assessment	End Semester Exam	Total	
*	Stream Elective III	3	3	3	40	60	100	Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End Sem Exam is conducted by the Individual Institutions.
*	Stream Elective IV	3	3	3	40	60	100	Do
**	Non-Dept. (Interdisciplinary) Elective	3	3	3	40	60	100	Do
MIC 3101	Thesis – Preliminary – Part 2	5	14	-	200		200	No End Sem Examinations
	TOTAL	14	23		320	180	500	6 hours departmental assistance

* Students can select a subject from the subjects listed under stream electives for the third semester as advised by the course coordinator.

**Student can select a subject from the subjects listed under Interdisciplinary electives for the third semester as advised by the course coordinator

STREAM ELECTIVES OFFERED IN INDUSTRIAL ENGINEERING FOR SEMESTER III

Stream Elective III	Stream Elective IV
MIE 3001 : Enterprise Resource Planning MIE 3002 : Inventory Models MIE 3003 : Design thinking and Management MIE 3004 : Design of Algorithms	MIE 3005 : Heuristics for Decision Making MIE 3006 : Econometrics MIE 3007 : Industrial Scheduling MIE 3008 : Management of Projects

SEMESTER IV

Code No.	Name of Subject	Credits	Hrs / week	Marks					
				Continuous Assessment		University Exam		Total	Remark
				Guide	Evaluation Committee	Thesis Evaluation	Viva Voce		
MIC 4101	Thesis Final	12	21	150	150	200	100	600	*5 % of the evaluation mark is earmarked for publication in journal/conference
	TOTAL	12	21	150	150	200	100	600	8 hours departmental assistance

DEPARTMENTAL ELECTIVES FOR SEMESTER II

1. MID 2001 Reliability Engineering
2. MID 2002 Modern Information System
3. MDD 2001 Computational Plasticity
4. MDD 2002 Bio Mechanics
5. MDD 2003 Introduction to Signal Processing
6. MPD 2001 Finite volume method for fluid flow and heat transfer
7. MPD 2002Transport Phenomena
8. MTD 2001 Finite Element Analysis for Heat Transfer.
9. MTD 2002Cryogenics Engineering

M.TECH – INDUSTRIAL ENGINEERING
SYLLABUS

FIRST SEMESTER

MIM 1001: PROBABILITY AND STOCHASTIC PROCESSES 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To introduce basic probability theory and probability distributions which are essential tools for modeling random phenomena.
- To provide some theory of stochastic processes and indicate its diverse range of applications.
- To Give the student some probabilistic intuition and insight in thinking about problems

Learning Outcomes

- After successful completion of the course, the students are expected to.
- View processes from a probabilistic instead of an analytic point of view.
- Appreciate the applicability of probability concepts to real, everyday problems and situations.
- Utilize the same for their future project and research works.

Review:

Probabilitiesdefinedonevents,Conditionalprobabilities,Independentevents,Bayesformula.DiscreteandContinuousrandomvariables,Probability Density Functions,expectations.

Module I

Multiple random variables:Joint and Marginal distributions, Independence of random variables, Covariance, Correlation, Conditional probability distributions, Conditional expectations, Distributions of sum of two random variables. Limit theorems: Central limit theorem and Law of large numbers.

Module II

Stochastic process and their classifications, discrete time Markov chains: transition probability matrix, Chapman- Kolmogorov Equations, classification of states, Ergodicity, Steady State Probabilities. Continuous - time Markov chains:Chapman- Kolmogorov Equations,Kolmogorov forward and backward equations, Steady State Probabilities and flow balance equations, Birth - death process.

Module III

Poisson processes, Interarrival distribution, Renewal processes,Renewal Reward process, Limit theorems. Brownian motion as a limiting case of random walk, Simulation of sample paths, Hitting times, Brownian motion with drift, Geometric Brownian motion, White noise, Gaussian processes.

References:

1. SaeedGhahramani, Fundamentals of Probability with Stochastic process,Pearson.
2. S.M.Ross, Introduction to probability models, Elsevier.
3. S M Ross, Stochastic processes, John Wiley and Sons.
4. G.Grimmett, David Stirzaker, Probability and Random Processes, Oxford University Press.
5. J.R.Norris, Markov Chains, Cambridge University press.
6. Van Kampen, Stochastic Processes in Physics and Chemistry.
7. Gardiner, Introduction to Stochastic Processes.
8. Kishore.S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer science applications, Prentice Hall India.
9. Athanasious Papoulis, S. UnnikrishnaPillai, Probability, Random variables and Stochastic processes, Tata McGraw-hill (5^{th} Edition).
10. D.L. (Paul) Minh, Applied Probability Models, Thomson Asia Pte Ltd., Singapore.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MIC 1001: INDUSTRIAL STATISTICS 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

The course aims to provide students with an introduction to statistical techniques and their applications in the context of business and management problems. At the end of the course students should be able to:

- Make sense out of data by constructing appropriate summary measures, tables, and displays.
- Apply single and multi-variable measures to make decisions.
- Work with probability distributions and their summary measures to analyze unknowns.
- Apply sampling techniques to make projections about a population.
- Perform and interpret elementary statistical inferences (such as confidence intervals and hypothesis tests).
- Understand key concepts for quantifying and managing uncertainty and random variations in business and management problems.
- Develop decision making and analytical skills.
- Apply technology tools to business management and administrative support functions

Learning Outcomes

- Perform data analysis, trend analysis, and regression analysis on data series, create appropriate displays, and explore what-if scenarios and possible solutions.
- Apply techniques for analyzing and interpreting data to real-world datasets relevant to varied fields of business and industry.
- Critically evaluate reports presenting statistical data and translate and communicate the results of statistical analyses.
- Utilize the same for their future project and research works

Module I

Collection of statistical data, Classification and tabulation, Measures of central tendency, Measures of dispersion, Chebyshev's theorem, Skewness, Moments and Kurtosis, Sampling and Sampling distributions.

Module II

Estimation and Confidence Intervals – Point estimation, Interval estimation; Hypothesis Testing.

Non-parametric tests: One sample tests – Chi-square test, K-S test; Two-sample tests – Two samples Median test, Mann-Whitney U-test; K-samples tests – K- samples Median test, Kruskal-Wallis test.

Module III

Correlation Analysis – Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient, Auto-correlation coefficient

Linear regression, Partial and Multiple regression analysis, Analysis of Variance.

Multivariate Analysis - Discriminant analysis, Factor analysis, Cluster analysis, Multidimensional scaling and Conjoint analysis (Overview only)

References:

1. P. E. Green, D. S. Tull, G. Albaum, Research for Marketing decisions, Prentice- hall of India Pvt. Ltd
2. Thomas C. Kinnear, James R. Taylor, Marketing Research: An Applied approach, McGraw-Hill Inc

   A. B. Bowker and G. J. Liberman, Engineering Statistics, Asia, 1972.
3. F. E. Brown, Marketing Research: A structure for decision making, Addison-Wesley publishing Co., California.

   A. J.K. Sharma, Business Statistics, 2nd Edition, Pearson Education.
4. R. Panneerselvam, Research Methodology, Prentice Hall India.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MIC 1002: FINANCIAL MANAGEMENT 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

At the end of the course students should be able to:

- Understand the use of basic financial management concepts.
- Understand and use the tools of analysis such as valuation, risk-return relationships, financial statement analysis, capital budgeting, cost of capital, capital structure and working capital management.

Become familiar with the various types of financing available to a firm

Learning Outcomes

After successful completion of the course, the students are able to:

- Obtain an overview of Indian financial system.
- Analyze financial statements using standard financial ratios.
- Apply techniques to project financial statements for forecasting long-term financial needs.
- Explain the role of short-term financial needs.
- Apply time value, risk, and return concepts.
- Obtain an overview of international financial management.

Module I

Introduction to Financial management: Evolution, Scope, Objectives, Functions, and Environment of corporate finance. Indian financial system: financial markets, capital market, all India financial institutions-IFCI, IDBI, ICICI, investment institutions-LIC, UTI-commercial banks.
International financial management: World monetary system, foreign exchange markets and rates, financing foreign operations.

Module II

Working capital management: importance, objectives, inventory management, receivables management, credit policy, cash management.

Capital budgeting: Purpose, principles in estimating costs and benefits of investments, Appraisal criteria-payback period, ARR, NPV, Benefit –Cost ratio, IRR. Risk analysis in capital budgeting. Cost of capital.

Module III

Sources of finance: Long term-equity capital-debenture capital-term loans, deferred credit-government subsidies -leasing and hire purchase, Short term financing-accruals-trade credit-short term bank finance public deposit-commercial paper.

Capital structure and dividend policies. Financial analysis: ratio analysis- types of ratios-time series analysis-common size analysis-DuPont analysis-funds flow analysis. Break even analysis and leverages.

References:

1) Corporate Finance – Berely&Mayers
2) Financial Management Theory and Practice – Prasannachandra – TMH
3) Financial Management – Van Horne – Pearson Education
4) Financial Management – Khan & Jain – TMH
5) Financial Management – S. N. Maheswary – Himalaya
6) Investment Analysis – Preethi Singh – Himalaya

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIC 1003: OPERATIONS PLANNING AND CONTROL 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- Should develop knowledge on product and process related operation systems and models.
- Should be able to use the operations planning tools for real life applications like facility location etc.
- Should acquire advanced knowledge on latest operation planning and control systems and approaches

Learning Outcomes

- Understand various product and process related operation systems and models.
- Understand the use of operations planning tools for real life applications.
- Understand latest operation planning and control systems and approaches.

Module I

Operating System Models, Operating Decision Process in Production Planning. Forecasting- Design Components of Forecasting Systems, Forecasting Models, Forecast Errors. Product Design and Process Selection in Manufacturing and Service, Value Analysis and Value Engineering Process, Approaches for Make or Buy Decision, Capacity Planning Strategies.

Module II

Facilities Location, Multi-facility Location Problems, Plant Layouts - Layout Design Procedure, Algorithms and Models for Group Technology. Aggregate Planning Strategies and models, Models for Assembly Line Balancing, Steps of Line of Balance (LOB). Operation of Inventory Systems (PRP and CRP) and Inventory Models.Shortage Models, Discount Models, Multi-item Lot sizing, Stochastic Models.

Module III

Operations Scheduling - Single Machine Scheduling – Branch and Bound Algorithm, Flow shop and Job Shop Scheduling. Material Requirements Planning – Calculations and Lot sizing in MRP, MRPII,DRP, ERP. Concurrent Engineering, JIT and Kanban Systems, Flexible, Lean and Agile Manufacturing, Business Process Re-Engineering.

References:

1. Naramsimhan et.al, Production Planning and Inventory Control
2. Lee J.Krajewski et.al, Operations Management - Pearson Education
3. R. Paneesrselvam, Production and Opeartions Management. PHI
4. Silver, Pyke, Peterson, Inventory Management and Production Planning and Scheduling, John Willey & Sons
5. R. P. Mohanthy, Advanced Production Planning - Pearson Education.
6. Danny Samson et.al, Operations Management - An Integrated Approach- Cambridge University Press.
7. Norman Gaither et.al, Operations Management – Thomson South Western Publishers

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIC 1004: ADVANCED OPERATIONS RESEARCH 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

The main objectives of this course are:-

- To introduce the students to advanced topics in Operations Research.
- To enhance problem solving skills to more advanced levels.
- To experiment with real life problems and promote decision making skills.

Learning Outcomes

The expected outcomes of the course are:-

- The students will have a knowledge of various applications of Operations research in different types of industries
- The students will have the skill to model and solve real life problems.

Module I

History; Definition;ORmodels;Linear Programming models- model formulation, Graphical solutions, simplex method-two phase method, Big M method, duality and sensitivity analysis; Revised simplex method; Dual Simplex method.
Transportation Problems: General Concepts, Formulations, Solution Methods: North West Corner Method, Least Cost Method, Vogel's Approximation Method, Optimality Tests: Stepping Stone Method and Modified Distribution method, Balanced/Unbalanced transportation problem, Degeneracy Assignment Problems: General Concepts, Assumptions & Limitations, Formulation and solution of assignment problem, Special Issues: Restricted routes/Multiple Optimal Solutions. Generalized Transportation Problem, Generalized Assignment Problem, Multi-objective Transportation Problem.

Module II

Integer linear programming: Branch and Bound technique,Cutting plane algorithm, zero-one implicit enumeration algorithm.Deterministic dynamic programming: Forward and backward recursion, Applications of DP.Classical Optimization techniques: Single variable optimization, Multivariable optimization with no constraints, with equality constraints and with inequality constraints.Non linear programming: One dimensional minimization methods, Unconstrained and Constrained algorithms, Geometric programming.

Module III

Introduction to graph theory-Basic definitions-spanning trees, matching problem,Hamiltonian circuits, Eulerian circuit etc.Network problems: Minimum spanning tree problem-Prim's algorithm, Kruskal's algorithm; Shortest path problems-Dijkstra' algorithm, Successive Shortest path algorithm, Constrained shortest path problems; Maximum flow problems Labellingalgorithm,Maximum Flow and Minimum Cut, Shortest Augmenting path algorithm,Minimum cost flow problem-Network Simplex method. Travelling Salesman Problem(TSP)-Optimal solutions using branch and bound algorithms-Heuristic algorithms for the TSP: Nearest Neighbourhood Algorithm, Pairwise Interchange, Three-opt, Twice around the tree etc.Chinese Postman Problem. Vehicle Routing Problems-Optimal solutions: Little's algorithm and heuristic solutions: savings based algorithm, Holmes and Parker refinement.Queuing theory – Pure Birth and Pure Death processes, relationship between Poisson and Exponential Distributions. Basic Poisson queues. Limited source, limited queue etc. Priority disciplines – Queuing decision models.

References:

1. H.A.Taha, Operations Research: An Introduction, Pearson Education
2. S.S. Rao, Engineering Optimization: Theory and Practice, New Age International Publishers.
3. A.D. Belegundu, T.R. Chandrupatla, Optimization Concepts and Applications in Engineering, Pearson Education.
4. H. M. Wagner, Principles of Operations Research, Prentice- Hall of India Pvt. Ltd.
5. Gross and Harris, Fundamentals of Queuing Theory, John Wiley & Sons
6. M.S.Bazaraa, J.J. Jarvis, H.D. Sherali, Linear Programming and Network Flows, John Wiley& Sons.
7. G Srinivasan, Operations Research-Principles and Applications-PHI.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIC 1005: METHODS AND SYSTEMS DESIGN (N) 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- Explain the basic concepts of 'work study'(WS) : method study and work measurement
- Explain/Use the tools and techniques of 'method study'(charts/diagrams, micro-motion studies and principles of motion economy)
- Explain/Use the tools and techniques of ' work measurement'(WM).(basic concept of WM and various techniques of WM)
- Design, perform and analyze the studies/experiments related to WS(eg process analysis, time study, operation analysis, time study,pre-determined motion systems(PMTS),standard data and work sampling with statistical analysis).
- Applymethods engineering and ergonomics or human factors design principles to the analysis and redesign of an existing work station, work task, piece of equipment, work environment etc.

Learning Outcomes

The students who succeed this course

- Will be able to understand the reasons and logic behind work station design
- Will be able to model work systems using standard techniques, such as flow diagrams, process charts, operation charts, activities charts and block diagrams for purpose of work system documentation, analysis and design.
- Will be able to apply a structured engineering process (analysis/requirements development, design, implementation, operation) to worksystem development.
- Will be able to determine the time required to do a job using standard data, activity sampling, time study and pre-determined time systems.
- Will be able to recognize and constructively address ethical, social and environmental issues that arise in a work systems engineering project.
- Will be able to recognize the human indicators of fatigue and stress.

Module I

Introduction, definition, concept, objectives and need for work study. Work-study and productivity, Productivity Measures – Total and Partial productivity Measures.
Method study: Definition – steps in method study, process analysis, process chart, process chart symbols, outline process chart, flow process charts, multiple activity charts, two handed process charts, flow diagram, string diagram and travel chart. Micro motion and memo motion analysis. Operation Analysis – basic procedure.

Module II

Work Measurement: Definition, Objectives and concept of work measurement, work measurement technique, Stop watch time study, Time study equipments, selecting the job to be timed, selection of workers for time study, for time study, performance Rating, Systems of Rating, Predetermined motion time systems, Methods Time Measurement(MTM), MTM systems, Use of MTM Tables, Work factor systems, Maynard Operation Sequence Technique (MOST) – Use of BasicMOSTDatacard, Work sampling, Use of control chart (P-chart) in work sampling, applications of work measurement techniques. Relationship of Work Study to Incentive Schemes, Wage Incentive Plans.

Module III

Principles of motion economy, Ergonomics-definition and applications, Human-Machine system, Anthropometry and its uses in ergonomics – Types of anthropometric data, Principles of applied anthropometry in ergonomics, Ergonomic approach to work station design – design for standing workers and design for seated workers, Design of manual handling tasks - NIOSH lifting equation-NIOSH approach to the design and evaluation of lifting tasks, Work Capacity-Physical work capacity - Maximum oxygen uptake, Energy expenditure and work load guidelines, Applied physiology in the workplace - Calculation of rest periods in manual work – Murrell's empirical formula, Stress and Fatigue- Fatigue allowance determination, Heat stress – Heat stress Index(HSI) and Wet Bulb Global Temperature(WBGT), heat stress control, Lighting design considerations, Design of the acoustic environment - Industrial noise control, Principles for the design of visual and auditory displays, Design of controls in work place – control-response ratio(C/R – ratio). Case studies in Work study and ergonomics.

References:

1. Barnes, Raiph M., "Motion and Time Study: Design and Measurement of Work", John Wiley & Sons.
2. ILO, Introduction to Work Study.
3. Chandler Allen Phillips, "Human Factors Engineering", John Wiley and Sons.
4. Bridger R S, "Introduction to Ergonomics", Taylor and Francis.
5. Hansen B. L., "Work Sampling: For Modern Management", Prentice Hall.
6. Mundell, M. E. and D. L. Danner, "Motion and Time Study", Prentice Hall
7. Niebel B. W., and Freivalds A., "Methods, Standards and Work Design", Mc-Graw Hill
8. Maynard, "Industrial Engineering Handbook", McGraw Hill.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIC 1101 : INDUSTRIAL ENGINEERING LAB - 1 0-0-2-1

Methods Engineering & Optimization Lab

Structure of the Course

Practical: 2 hrs. / Week Credits: 1
Internal Continuous Assessment : 100 Marks

Course Objectives

- Should develop knowledge on methods engineering and optimization techniques.
- Should be able to prove methods engineering principles through lab experiments.
- Should acquire knowledge on working of data analysis and optimization software packages.

Learning Outcomes

- Understand various methods engineering and optimization techniques.
- Understand methods engineering principles through lab experiments.
- Understand working of data analysis and optimization software packages

a) Methods Engineering Lab
Experiments on
1. Method Analysis
2. Micro motion study
3. Work Measurement
4. Facility layout design
5. Ergonomics

b) Optimization lab
1. Data Analysis using software packages
a. Excel
b. SPSS
c. Systat
d. SAS

2. Solving optimization problems using software packages.
a. Excel Solver
b. I BM ILOGCPLEX
c. GUROBI
d. MPL
e. AIMMS
f. GAMS

MIC 1102 SEMINAR 0-0-2-2

Structure of the Course

Credits: 2

Seminar : 2 hrs/week

Internal Continuous Assessment : 100 Marks

The student has to present a seminar in one of the current topics in the stream of specialization. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report at the end of the semester.

Marks:

Report Evaluation : 50

Presentation : 50

SECOND SEMESTER

MIC 2001: SIX SIGMA AND QUALITY ENGINEERING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- Should develop knowledge on foundations, phases and types of six sigma.
- Should be able to understand the measure, analysis, improve and control tools of six sigma.
- Should acquire advanced knowledge on latest quality engineering tools and techniques

Learning Outcomes

- Understand the foundations, phases and types of six sigma.
- Understand the measure, analysis, improve and control tools of six sigma.
- Understand knowledge on latest quality engineering tools and techniques.

Module I

Introduction to Six Sigma - Six Sigma Compared to Total Quality Management – Transactional Vs. Manufacturing Six Sigma – Common Terms, Foundations of Lean Six Sigma – Keys and Laws of Lean Six Sigma. Preparation Phase Six Sigma - Organizational Success Factors – Leadership, Internal Communication Strategy and Tactics, Training Plan, Project Selection, Assessing Organizational Readiness, Pitfalls. Define Phase of Six Sigma: DMAIC phases, Overview, Project Charter – Voice of Customer – High Level Process Map.

Module II

Measure and Analyse Phases of Six Sigma: types of measures – introduction to statistical methods – sampling plan – data collection – choosing statistical software – measure tools – process maps, pareto charts, cause and effect diagrams, histograms, control charts. Improve and Control Phase Six Sigma: process redesign – generating improvement alternatives – design of experiments – pilot experiments – cost/benefit analysis – implementation plan. control phase – overview – control plan – process scorecard – failure mode and effects analysis. Design For Six Sigma (DFSS): Six Sigma Overview – DFSS Tools – Quality Function Deployment (QFD), Theory of Inventive Problem Solving (TRIZ), Failure Modes and Effects Analysis (FMEA), Design of Experiments (DOE).

Module III

Concepts related to Quality Engineering, Tools for Quality Assurance, SQC, SPC, TQC, Acceptance Sampling, Published Sampling Plans, Total Quality Management, Quality Management Philosophies, ISO 9000, Quality Circles, KAIZEN, Quality Cost System. Process Capability, SPAN PLAN method, Use of Nomographs, CMM, Taguchi's Methods.

References:

1. Betsiharris Ehrlich, "Transactional Six Sigma and Lean Servicing", St. Lucia Press, 2002.
2. Ay Arthur, "Lean Six Sigma – Demystified", Tata McGraw Hill Companies Inc, 2007.
3. Michael L George, David T Rowlands, and Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
4. Kai Yang and BasemEl,Haik, "Design for Six Sigma", McGraw Hill, New York, 2004.
5. Thomas Pyzdek, "Six Sigma Handbook: Complete Guide for Greenbelts, Blackbelts and Managers at All Levels", Tata McGraw Hill Companies Inc,2003.
6. AmitavaMithra, Fundamentals of Quality Control and Improvement, Pearson Education
7. E. L. Grant, Statistical Quality Control, McGraw Hill
8. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons
9. Quality Control Handbook – Tata McGraw Hill
10. R C Gupta, Statistical Quality Control, Khanna Publishers.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIC 2002: SUPPLY CHAIN & LOGISTICS MANAGEMENT 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- Should develop knowledge on structures, decision phases, measures and tools of supply chains.
- Should develop understanding on the strategic, tactical and operational decision tools of supply chains.
- Should acquire knowledge on logistics management and related advanced tools and techniques

Learning Outcomes

- Understand the structures, decision phases, measures and tools of supply chains.
- Understand the strategic, tactical and operational decision tools of supply chains.
- Understand knowledge on logistics management and related advanced tools and techniques

Module I

Supply Chains – Structures, Decision Phases, Performance Drivers and Measures, Metrics. Achieving Strategic Fit and its Obstacles.Planning Demand and Supply – Forecasting and Measure of Forecast errors, Aggregate Planning Strategies, Managing Predictable Variability - Quantitative Examples.

Module II

Network Design Decisions, Models for Facility Location and Capacity Allocation, Network design in Uncertain Environment, Inventory Planning Decisions – Managing Economies of Scale - Estimate of Cycle Inventory, Short Term Discounting, Multi-echelon Cycle Inventory, Determination of Safety Inventory, Impact of Supply Uncertainty, Aggregation and Replenishment Policies on Safety Inventory, Multi-echelon Safety Inventory, Quantitative Examples, Determining Optimal Level of Product availability.

Module III

Logistics, 3PL, 4PL, Design Options for Transportation Network. Routing, Scheduling and Sequencing in Transportation, Quantitative Models, Reverse Logistics – Closed Loop Supply Chains, Product Recovery Models, Cross-Functional Drivers - Supplier Scoring and Assessment. Vehicle Routing problems, Bin Packing Problems, Fixed Charge Problems, Knapsack Problem.

References:

1. Sunil Chopra, Peter Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson Education.
2. G. Sreenivasan, Quantitative Models in Operations and Supply Chain Management, PHI
3. Donald J. Bowersox& David J. Closs, Logistical Management, TMH.
4. Martin Christopher, Logistics and supply chain management, Financial times management.
5. Jeremy F. Shapiro, Modeling and Supply Chain,. Thomson Learning, 2001.
6. David Taylor and David Brunt, Manufacturing Operations and Supply Chain Management, Vikas Thomson Learning, 2001.
7. David Simchi – Levi & Philip Kaminsk, Designing and Managing the Supply Chain, McGraw-Hill Companies Inc.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MCC 2000 RESEARCH METHODOLOGY 2-0-0-2

Structure of the Course

Lecture : 2 hrs/ Week Credits : 2
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objective:

To formulate a viable research question
To distinguish probabilistic from deterministic explanations
To analyze the benefits and drawbacks of different methodologies
To understand how to prepare and execute a feasible research project

Outcome

Students are exposed to the research concepts in terms of identifying the research problem, collecting relevant data pertaining to the problem, to carry out the research and writing research papers/thesis/dissertation.

Module 1

Introduction to Research Methodology - Objectives and types of research: Motivation towards research - Research methods *vs.*Methodology. Type of research: Descriptive *vs.*Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, and Conceptual*vs.* Empirical.
Research Formulation - Defining and formulating the research problem -Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem. Literature review: Primary and secondary sources - reviews, treatise, monographs, patents.Web as a source: searching the web. Critical literature review - Identifying gap areas from literature review - Development of working hypothesis.

Module 2

Research design and methods: Research design - Basic Principles- Need forresearch design — Features of a good design. Important concepts relating to research design: Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction. Development of Models and research plans: Exploration, Description, Diagnosis, Experimentation and sample designs.Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection - Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-Testing -Generalization and Interpretation.

Module 3

Reporting and thesis writing - Structure and components of scientific reports -Types of report - Technical reports and thesis - Significance - Different steps in the preparation, Layout, structure and Language of typical reports, Illustrations and tables, Bibliography, referencing and footnotes.Presentation; Oral presentation - Planning - Preparation -Practice - Making presentation - Use of audio-visual aids - Importance of effective communication.

Application of results of research outcome: Environmental impacts –Professional ethics - Ethical issues -ethical committees.Commercialization of the work - Copy right - royalty - Intellectual property rights and patent law - Trade Related aspects of Intellectual Property Rights - Reproduction of published material - Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

References:

1. C.R Kothari, Research Methodology, Sultan Chand & Sons, New Delhi,1990
2. Panneerselvam, "Research Methodology", Prentice Hall of India, New Delhi, 2012.
3. J.W Bames," Statistical Analysis for Engineers and Scientists", McGraw Hill, New York.
4. Donald Cooper, "Business Research Methods", Tata McGraw Hill, New Delhi.
5. Leedy P D, "Practical Research: Planning and Design", MacMillan Publishing Co.
6. Day R A, *"How to Write and Publish a Scientific Paper"*, Cambridge University Press, 1989.
7. Manna, Chakraborti, "Values and Ethics in Business Profession", Prentice Hall of India, New Delhi, 2012.
8. Sople," Managing Intellectual Property: The Strategic Imperative, Prentice Hall of India, New Delhi, 2012.

MIC 2101: INDUSTRIAL ENGINEERING LAB - 2 0-0-2-1

Practical: 2 hrs. / Week Credits: 1
Internal Continuous Assessment : 100 Marks

Quality Control & Simulation Laboratory

Course Objectives

- Should develop knowledge on statistical quality control (SQC), non-destructive evaluation (NDE) and simulation techniques.
- Should be able to familiarize SQC techniques and NDE through lab experiments.
- Should acquire knowledge on simulation model building and simulation through software packages.

Learning Outcomes

- Understand various SQC, non-destructive evaluation (NDE) and simulation techniques.
- Understand and familiarize SQC techniques and NDE through lab experiments.
- Understand simulation model building and simulation through software packages

a) Quality Control Lab

1. Verification of central limit theorem for various populations
2. Study and construction of control charts
3. Study and construction of OC curve of a sampling plan.
4. Study and Demonstration of NDT equipment

b) Simulation Lab

Simulation model building and conducting simulation experiments using

a. C++
b. Simul8
c. Simio
d. WITNESS
e. Vensim
f. ARENA

MIC 2102 THESIS PRELIMINARY PART-I 0-0-2-2

The main objective of thesis is to provide an opportunity to each student to do original and independent study and research on the area of specialization. The student is required to explore indepth and develop a topic of his/her own choice, which adds significantly to the body of knowledge existing in the relevant field.The thesis has three parts (Part I in semester-2 and Part-2 in semester -3 & Part-3 in semester -4). The thesis can be conveniently divided into three parts as advised by the guide and the first part is to be completed in this semester The student has to present a seminar before the evaluation committee at the end of the semester that would highlight the topic, objectives , methodology and expected results and submit a report of the work completed in soft bounded form .

MIC 2103 SEMINAR 0-0-2-2

Structure of the Course

Credits: 2

Seminar : 2 hrs/week

Internal Continuous Assessment : 100 Marks

The student has to present a seminar in one of the current topics in the stream of specialization. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report at the end of the semester.

Marks:

Report Evaluation : 50

Presentation : 50

SECOND SEMESTER STREAM ELECTIVES

MIE 2001: SYSTEM SIMULATION AND SYSTEM DYNAMICS 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

The main objective of the course is to:

- apply system concepts to solve problems in industrial and business organizations,
- review different parametric discrete and continuous probability functions,
- generate random numbers and random variates from parametric and empirical distributions,
- model discrete event simulation models for different systems,
- study the tools for modeling dynamic systems,
- get introduced to softwares for SD modeling and simulation

Learning Outcomes

After successful completion of the course:

- the students have an understanding of real life systems with interacting components, elements and sub-systems, modeling and analysis of these interacting components and elements in a system and the system as a whole,
- the students are able to apply the simulation modeling and analysis concepts in various industrial and business situations,
- the students are able to analyze the output of the simulations and to make conclusions about the model outcomes which benefits the students to build valid system models for simulation,the students are able to conduct experiments on the system models and to predict the system behavior at different environments and input states and parameter settings and to find out the best suited system parameter settings to meet the predefined objectives

Module I

System approach to problem solving, steps in simulation study. Comparison of simulation and numerical methods.Use of Monte Carlo method to find area under curves, value of π.
Discrete and continuous probability functions, uniformly distributed random numbers, properties of random numbers, generation of Pseudo-Random numbers, random number generators, tests for random numbers, frequency, gap, run, and Poker tests, tests for autocorrelation.

Module II

Generation of random deviates for Exponential, Uniform, Weibull, Triangular, and discrete distributions, Inverse Transformation method, Direct transformation method for the Normal and Lognormal distributions. Acceptance-rejection technique:- Poisson and Gamma distributions. Input modeling:- data collection, identifying the distribution with the collected data, goodness of fit tests, selecting input models without data.
Discrete event simulation techniques:- Next-Event approach/Event scheduling, Fixed Time Increment method, manual simulation using Event Scheduling and Fixed Time Advance methods. Verification

and Validation of simulation models.Variance reduction techniques, statistical analysis of outputs, and optimization of parameters.

Module III

Structure and Behavior of Dynamic systems:- fundamental modes of dynamic behavior – Exponential growth, goal seeking, oscillation and process point – interactions of fundamental modes.

Tools for systems thinking: - Causal loop diagramming. Behavior of low order systems-analytical approach.Elements of System Dynamics Modeling, physical flows, information flows, level & rate variables, flow diagrams, delays, information smoothing, table functions and table function multipliers. First order positive and negative feedback systems, second order systems.

Steps in system dynamics modeling:- problem identification/conceptualization, fixing model aggregates

and boundary, principles of simulation modeling, developing model equations, algorithm for Euler integration, hand simulation of system dynamics models.

Computer simulation languages, packages, and their application (Overview only).

References:

1. Geoffrey Gordon, System Simulation, PHI
2. NarsinghDeo, System Simulation with Digital Computer, PHI
3. J. Banks, Discrete Event System Simulation, Pearson Education
4. Fishman – John, Concepts and Methods in Discrete Event Digital; Simulation, Willey & Sons
5. Business Dynamics – Sterman – McGraw Hill
6. System Dynamics – Mohapatra – PHI
7. System Dynamics – Ogata – Pearson Education.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MIE 2002 : MARKOV DECISION PROCESSES 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To understand Markov decision process models
- To learn how to make sequential decisions when outcomes are uncertain
- To understand methods to solve optimality equation using value iteration, policy iteration, modified policy iteration and linear programming.

Learning Outcomes

- The studentsare expected to have knowledge of various Markov decision process models and applications of the same in diverse fields in engg..
- The students will have the skill to model and solveresearch problems.

Module I

Overview of decision making in the context of stochastic systems evolving over time examples. Framework and some types of cost criteria: Expected total cost, Discounted cost and Average cost. Finite horizon models; Some classes of policies; Optimality of Markov policies; Dynamic programming principle and algorithm.

Module II

Infinite horizon models: Stationary models, Adequacy of Markov policies. Discounted cost models: Optimality of Markov (pure) policies. Policy iteration, value iteration and modified policy iteration algorithms. Linear and convex programming formulations.

Module III

Average cost models: Unichain and multichain models. Iterative algorithms. Expected total cost models: Positive and Negative models. Math programming formulations of optimal policies.
Learning algorithms: Q-learning algorithms, reinforcement learning algorithms, actor-critic algorithms.

References:

1. M. Puterman, Markov Decision Processes, Wiley, 1994
2. D. Bertsekas, Dynamic Programming and Optimal Control Volumes 1 and 2, Athena Scientific, Belmont, 1995
3. E. Fienberg and A. Shwartz, Handbook of Markov Decision Processes, Kluwer, 2002
4. E. Altman, Constrained Markov Decision Processes, Chapman Hall/CRC, 1999
5. J. Filar and O. Vrize, Competitive Markov Decision Processes, Springer, 1997
6. D. Bertsekas and J. Tsitsiklis, Neuro-dynamic programming, Athena Scientific, Belmont, 1996
7. Open Literature

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE2003: MULTI-CRITERIA DECISION MAKING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
The main objectives of this course are:-

- To introduce the students tovarious tools used in multi criteria decision making.
- To have experience in practical decision making with the help of suitable tools.

Learning Outcomes

- The students will have the knowledge of tools and will have the experience in practical decision making situations where multiple criteria are involved.

Module I

Multi criteria decision making- objectives. SMART- categorization, criterion weights and aggregation Theory of vector optimization: Solution concepts, vector variational inequalities and vector equilibria, multi criteria fractional programming, multicriteria control problems. Goal programming: Classification of GP, Integration and combination of GP with other techniques- applications.

Module II

AHP, pairwise comparisons, criterion weights and aggregation, consistency etc. Evolutionary algorithms and multiple objective optimizations: Definitions, Pareto based and Non-Pareto based techniques- applications. Data Envelopment Analysis in multi criteria decision making: Basic DEA models, GDEA.

Module III

Scenario analysis, Conflict analysis and negotiations. Multi objective combinatorial optimization: Properties, Solution methods Multi criteria scheduling problems: Complexity Single machines problems, Parallel machines problems, shop problems

References:

1. Multiple criteria Optimization-Arakawa,Billaut- Kluwer
2. Multi-Criteria decision analysis via ratio and Difference judgement-Lootsma-springer.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE 2004: FINANCIAL ENGINEERING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

At the end of the course students should be able to:

- Use fundamental economic principles and finance theory coupled with state-of-the-art mathematical methods and computational tools,
- Understand the essential ideas of investment science – such as present value, portfolio immunization, factor models etc,
- Understand the language of investment science, which is largely mathematical,
- Understand the emerging issues associated with new financial instruments, risk assessment, risk measurement and optimization.

Learning Outcomes

After successful completion of the course, the students are able to:

- Formulate and solve realistic and challenging investment problems,
- Understand how statistical models can measure the risk involved with new financial instruments,
- Use financial engineering techniques in investment banks, mutual funds and insurance companies,
- Prepare for master project work and research in the field.

Module I

Portfolio Theory: Portfolio Return and Risk, Efficient frontier, Optimal portfolio, The Markowitz model, The Two fund theorem, Inclusion of a Risk-free asset, The One-fund theorem, Capital asset pricing and Arbitrage pricing theory.

Module II

Forwards, Futures and Swaps: Forward contracts, Forward prices, Value of a Forward contract, Basics of Futures contracts, Futures prices, Swaps.

Models of Asset Dynamics: Binomial lattice model, The Additive model, The Multiplicative model, Lognormal random variables, Random walks and Wiener processes, A Stock price process, Ito's Lemma.

Module III

Options: Option concepts, Option strategies, Put-Call parity, European and American options, Asian and other path dependent options, Factors determining option values, Binomial model for option valuation, Black and Scholes model.

References:

1. David.G. Luenberger, Investment Science, Oxford University Press.
2. M. Capinski and T.Zastawniak, Mathematics for Finance, Springer
3. D. Lamberton and B.Lapeyre, Introduction to Stochastic Calculus applied to Finance, Chapman & Hall.
4. John C. Hull, Options, Futures, and Other Derivatives, Prentice- Hall Inc.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MIE 2005: SOFTWARE ENGINEERING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To understand different phases and its importance in software development.
- To get introduced to software process and software process models.
- To understand different dimensions of system dependability, availability, reliability, safety and security
- To study the factors contributing to software quality and to understand quality policy

Learning Outcomes

On completion of this course, students are expected to have
- Knowledge and logic behind software development
- An understanding of a structured engineering process for software development
- Will be able to recognize and address ethical and professional issues that are important to software engg.

Module1

Introduction to software engineering, Emergence and scope of software engineering-historical aspects, economic aspects, maintenance aspects, specification and design aspects, team programming aspects. Software engineering layered technology-processes, methods and tools. Software processes models-prototyping model, incremental models, spiral model, waterfall model. Phases in Software development – requirement analysis, Planning phase-project planning, objective, project scope, staffing and personal planning. Project size estimation matrices- Line of code, function point, project estimation techniques- empirical estimation, models, COCOMO, single variable models

Module II

Risk management- risks, identification, risk projection, project planning and risk management. Software configuration management- configuration, identification, configuration control, and software configuration management plans. Design phase- design objectives, principles, data flow analysis, topdown, bottomup strategies, design methodology. Coding- programming practice, verification, size measures, complexity analysis, coding standards. Testing-fundamentals, white box testing, control structure testing , black box testing, basis path testing, Levels of testing- unit , integration, system validation and acceptance testing.

Module III

Dependability, critical systems, availability and reliability, safety, security, critical systems specification, critical system development, software maintenance.Software re-engineering. Software quality- factors, software quality assurance standards, CMM, ISO, six sigma quality factors, quality policy

Textbooks:

1. R.S. Pressman, "Software Engineering- A practitioner's approach", 6th ed., McGraw Hill, 2008.

References:

1. Ian Sommerville, Software Engineering, 7/e,Pearson edition Asia Ed.
2. Gahezzi et al., FUNDAMENTALS OF Software Engineering, 2 Edition,PHI,2009
3. Jalote P., An integrated approach to Software Engineering, 3rdEdn, Springer,2009
4. Rajiv Mall- FUNDAMENTALS OF Software Engineering,PHI.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE 2006: MANUFACTURING SYSTEMS MANAGEMENT 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- The ability to apply the concepts of various manufacturing systems in organizations with solutions for issues in design, production flow analysis, operator allocation etc.
- Should be able to use the concepts of FMS with emphasis on automated material handling and storage.
- Ability to apply the techniques such as Synchronous, Agile and Lean manufacturing in organizations.

Learning Outcomes

- Understand various manufacturing systems with solutions for issues in their implementation.
- Understand capabilities of FMS with design of conveyor and AGV systems.
- Understand the concepts of Synchronous, Agile and Lean manufacturing and their implementation in organizations.

Module I

Types of Manufacturing Systems, Cellular Manufacturing Systems: Issues in Design, Production Flow Analysis, Quantitative Algorithms for cellular manufacturing systems, Operator Allocation and planning issues, Product Ownership based design.

Module II

Flexible Manufacturing systems: Overview, Development and implementation of an FMS, Automated material handling and storage: Functions – types – analysis of material handling equipments.Design of conveyor &AGV systems. Design issues and algorithms.

Module III

Synchronous Manufacturing: Concepts, Applications and extensionsAgile Manufacturing: Concepts, Agile Practices for Product Development and manufacturing.Lean manufacturing: Concepts, Implementation of lean manufacturing

References:

1) Mahadevan B, The New Manufacturing Architecture, Tata McGraw Hill Publishing Company, New Delhi, 1999.
2) SA Irani (Editor), Handbook of Cellular Manufacturing, Wiley International, 1998.
3) JT Black, The factory of the future.
4) Goldratt, E, The Goal
5) Rouf and Ahmed (Editors) Flexible Manufacturing Systems
6) Goldmann, S. L., Nagel, R. N., and Priess, J., Agile Competitors and Virtual Organizations, Van Nostrand Reinhold, New York, 1995.
7) Goldratt, E. and Cox, J., The Goal: A Process of Ongoing improvement, Revised Edition, North River Press, New York, 1987.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE 2007: HUMAN ASPECTS OF MANAGEMENT 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- The ability to manage human resources not only to compete but to survive.
- Ability to use innovative techniques to better build up the human relations.
- Should be familiar with Human Resource Management with a complete Personal management concepts and techniques.

Learning Outcomes

- Understand the various dimensions of human behavior to build up the personal relationship and to avoid personal conflict.
- Understand the need of the organizational change and organizational culture for the development of organizations.
- Understand the concepts of Human Resources Management to manage people in organizations to meet organizational objectives

Module I

Dimensions of human behaviour: self development, perception, motivation ,learning, personality and leadership - concepts, theories and applications. Modes of values, beliefs, attitudes and intelligence in determining human behaviour.Group dynamics-nature of groups and group decision making.Interactive conflict and negotiation skills.Transactional Analysis.

Module II

Organizational Development: Concepts of QWL, Organizational change, Goals of organizational change and organizational development, OD techniques. Concept of organizational climate, health and effectiveness. Organizational culture: types nature and characteristic, motivation of person across cultures, managerial leadership across cultures.

Module III

Human Resource Management: Concepts and objectives, Man power planning, Recruitment and selection, Training and development, Performance appraisal, Wage and salary administration, Grievance handling, Compensation policies, Labor relations and collective bargaining. Safety and health maintenance, Labour legislation.Case studies.

References:

1) Jerry l. Gray, Frederick A. Stark, OrganisationalBehaviour concepts and applications
2) Fred Luthans, Organizational Behaviour, McGraw Hill
3) Stephen P.Robbins, Organizational Behaviour, Pearson Education.
4) Uma Sekharan, Organizational Behaviour-Text and Cases, TMH
5) Gary Dessler, Human Resource Management, PHI.
6) Scott, Personnel Management, TMH

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE 2008: INDUSTRIAL AUTOMATION 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- After completion of the course, the student should understand the technologies and concepts which are key to the implementation of the various automation schemes in industries. The student should also be able to select suitable schemes and design them for automating various processes in production industries.
- After the completion of first module, the student shall understand the evolution of the various automation concepts and schemes. The student also gets thorough knowledge on the basic principles of the sensors and transducers used for industrial and process automation.
- After the second module the student gets an in depth knowledge about the basic components of automations schemes like CNC machines, Robots etc and about their working. It also exposes the student to the material handling systems and their coordination using various methodologies.
- The third module gives exposure to the modern automations schemes using PLCs and gives an in depth exposure to the optimization and programming of these devices. It also gives an in depth knowledge about the various schemes and technologies used in automating inspection and quality control

Learning Outcomes

- An indepth knowledge on automation schemes
- Knowledge of CNC and robot systems
- Ability to understand various sensors and select them based on the requirements
- Optimize the automation schemes using mapping techniques
- Programming of PLC systems
- Knowledge of online inspection and measurement systems.

Module I

Automation methodologies: Concept of Mechanisation and Automation – Types of Automation Detroit type Automation, Automated flow lines. Trends in manufacturing –Flexible manufacturing systems – features of FMS, computer integrated manufacturing – need for AI and expert systems in CIM, Automated assembly system – flexible assembly automation.

Sensors and measuring systems: Classification of position and motion sensors, inductive type, electromechanical switches, rotary position sensors – resolver, synchros, encoders, integrated motion systems, fundamental sensor methodologies, LVDT, RVDT, photo electric, thermo electric, capacitive, magnetic detectors, impedance type gauging transducers, linear potentiometer, strain gauges. Practical examples on design, selection and implementation of sensor systems, calibration of sensors.

Module II

Elements of CNC systems: servomotor and servo system design trends, stepper motors and controls, adaptive control, balls crews, preloading, and selection of drives for CNC machines. Industrial Robot Configurations – robot technology fundamentals.Fundamentals of CNC part-programming.Practical examples of cnc programming on trainers and simulators.

Pneumatic automation: Actuators, control valves – direction, pressure and flow, sequential control of single /multiple actuator systems, cascade and KarnaughVeitch map methods, step-counter systems. Electro pneumatic automation: Symbols: Basic electrical elements – relay, solenoid, timers; pneumatic – electrical converters, design of circuits and hands on models on material handling systems.

Module III

Automation Control: Sequence control and programmable controllers – logic control and sequencing elements, ladder diagram, PLC, programming the PLC. Practical Examples on PLC ladder programming.

Inspection automation: Inspection automation, off-line and on-line inspections, computerized co-ordinate measuring machine – CMM construction, online inspection systems., laser interferometer, non-contact inspection methods. Automatic gauging and size control systems, thickness measurement, machine vision systems.

References:

1. "Computer Control of Manufacturing Systems" YoramKoren, Tata McGraw-Hill Edition 2005
2. "Automation, Production Systems and Computer Integrated Manufacturing", GrooverM.P, Prentice – Hall Ltd., 1997.
3. "CNC Machines", Radhakrishnan P., New Central Book Agency, 1992.
4. "Mechatronics: A Multidisciplinary Approach, 4/E", W. Bolton. Pearson Education India.
5. "Mechatronics", HMT, Tata McGraw-Hill, 1998.
6. "Pneumatic Control for Industrial Automation", Peter Rohner& Gordon Smith, John Wiley and Sons, 1987.
7. "Standard Handbook of Industrial Automation", Onsidine D M C &Onsidine G D C, Chapman and Hall, NJ, 1986.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the student

THIRD SEMESTER

MIC 3101 THESIS – PRELIMINARY PART II 0-0-14-5

The student has to continue the thesis work done in the second semester in the same area. The student has to present two seminars.The first seminar shall be conducted in the first half of this semester mainly to highlight the progress of the work for the midterm evaluation and second seminar towards the end of the semester to access the quality and quantum of work done in this semester. The student has to submit a report of the work completed in soft bounded form. The seminars and the report shall be evaluated by the evaluation committee.

Evaluation of marks for the Thesis-Preliminary Part II

Evaluation of the Thesis-Preliminary work by the guide - 100 Marks
Evaluation of the Thesis–Preliminary by the Evaluation Committee-100 Marks

THIRD SEMESTER
STREAM ELECTIVES

MIE 3001: ENTERPRISE RESOURCE PLANNING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- The student should be able to acquire knowledge in ERP architecture and different packages.
- Should have exposure to latest trends in ERP.
- Ability to identify important issues pertaining to implementation of ERP software in an industrial scenario

Learning Outcomes

- Understand the importance of ERP in modern management arena.
- Understand capabilities of ERP for productivity improvement of an organization.
- Understand the correct choice of an ERP package for the selected industry.

Module I

Enterprise Resource Planning: Principle, ERP framework, Business Blue Print, Business Engineering, Business process Re-Engineering, Tools, Languages, Value chain, Supply and Demand chain, Extended supply chain management, Dynamic Models, Process Models.

Module II

Technology and Architecture: Client/Server architecture, Technology choices, Internet direction, CRM , CRM pricing, chain safety, Evaluation framework.ERP Procurement Issues, Market Trends, Outsourcing ERP, Economics, Hidden Cost Issues, ROI

Module III

ERP System Packages: SAP, People soft, BAAN , Oracle and Open source ERP packages. Comparison, Integration of different ERP applications.ERP as sales force automation, Integration of ERP and Internet, ERP Implementation strategies, Organizational and social issues. Oracle: Overview, Architecture, AIM, applications, Oracle SCM.SAP: Overview, Architecture, applications, Before and after Y2K, critical issues – Training on various modules of IBCS. Basic idea of ABAP.

References:

1. Alexis Leon, Demystified ERP, Tata McGraw – Hill Publishing company limited, New Delhi, 2002.
2. Brady, Enterprise Resource Planning, Thomson Learning, 2001.
3. Sadagopan.S ,ERP-A Managerial Perspective, , Tata McGraw Hill, 2001.
4. Jose Antonio Hernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 2001.
5. Vinod Kumar Crag and Bharat Vakharia, Enterprise Resource Planning Strategy, Jaico Publishing house, Mumbai, 1999.
6. Garg&Venkitakrishnan, ERPWARE , ERP Implementation Framework, Prentice Hall, 1999.
7. Vinod Kumar Grag and N.K.Venkitakrishnan, Enterprise Resource Planning, Prentice Hall of India, New Delhi, 2001.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE 3002: INVENTORY MODELS 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

The objectives of this course are:

- To teach the students the essential elements of inventory control and the relevant costs of inventory
- To equip the students to understand the different aspects of a good inventory control system
- To enrich the understanding of the students with the basic as well as the advanced topics in inventory control under different system characteristics such as the lead time, demand, etc.
- To help students to understand the decision making situations in inventory systems under different control policies.

Course Outcomes

The successful completion of the course, the students:

- know the essential elements of inventory control and the relevant costs of inventory
- possess the understanding of the different aspects of a good inventory control system
- Possess sound knowledge in basic as well as the advanced topics in inventory control under different system characteristics such as the lead time, demand, etc.
- Know the decision making situations in inventory systems under different control policies.

Module I

Concept of inventory, elements of inventory systems, classification of inventory systems, importance and functions of inventory control, concept of relevant costs, different costs of inventory, comparison of inventory costs and simple problems in relevant costs, inventory as a strategy, production system components and functions, inventory control in production systems, make-to-order and make-to-stock systems. Type of inventory systems: periodic and continuous systems. One item with constant demand rate. Economic order quantity (EOQ) model of inventory: motivation, the model, assumptions, performance criteria, optimal policy, sensitivity analysis. Inventory systems with back orders, performance criteria, optimal policy, sensitivity analysis. Planned back orders and constrained stock outs, costs of back order systems and stock out costs. Systems with finite production rate: optimal policy. Quantity discounts, imperfect quality, perishable products, present value criterion.

Module II

Time varying demands. Extreme cases, dynamic economic lot size model, model formulation, Wagner-Whitin procedure, modeling and implementation issues, discounted costs, continuously accumulating costs, limited capacity, back orders, quantity discounts, linear decision rule.

Uncertainties in production-inventory systems, managing uncertainties: forecasting, methods of forecasting, forecasting models, with trend and seasonality, concepts of service levels, different service level measures, design problems of inventory systems based on service levels. Safety stock for fast-moving and slow-moving items.

Module III

Stochastic demand system – one item with constant lead time: demand models, policy evaluation for Poisson demand, base stock policies, performance evaluation, news vendor problem, solution and interpretations, back orders and waiting times, world-driven demand, approximations, base stock policies with different approximations, general (r, q) policies, optimization modeling of continuous and discrete approximations. Lumpy demand, expected present value criterion, optimization. Several items with stochastic demands: base stock policies, general (r, q) policies, series systems, echelon based calculations, base stock policy optimization, different demand supply systems.

Stochastic lead times: Model structure, taxonomy, independent stochastic lead times with different demand processes, limited capacity supply systems, flexible capacity, lost sales, exogenous sequential supply systems, lead time demand distributions.

Advances in production-inventory control systems: order-up-to (OUT) policies and variants, generalized OUT in discrete and continuous domains. Concepts of inventory system stability, design problems in OUT models.

Text Book:

1) Paul H. Zipkin, Foundations of Inventory Management, McGraw-Hill, Singapore, 2000

References:

1. Sven Axsäter, Inventory Control, Kluwer Acdemic Publishers, Boston, 2004
2. Silver, Pyke, Peterson, Inventory Management and Production Planning and Scheduling, John Willey & Sons
3. Wallace J. Hopp and Mark L. Spearman, Factory Physics, McGraw-Hill, Singapore, 2000
4. Arnoldo C. Hax and Dan Candea, Production and Inventory Management, Prentice-Hall Inc., New Jersey, 1984

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MIE 3003: DESIGN THINKING AND MANAGEMENT 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

At the end of the course students should be able to:

- Understand design's role in business and the importance of design as a way of creating value in an organization.
- Identify and create the conditions in which design projects can be proposed, commissioned and promoted.
- Demonstrate how strategy can be made visible and tangible through design.
- Understand design management where design projects and outcomes are delivered

Learning Outcomes

After successful completion of the course, the students are able to:

- Investigate the skills required in managing client relations and guiding design decisions.
- Lead design agendas, projects and possibilities.
- Investigate the skills required when managing creative projects.

Module I

Introduction to Design Management, Importance of design management, Power of Design Thinking, Managing the design strategy – Identifying opportunities for design, Understanding the audience and market, Interpreting client and customer needs, Auditing the use of design; Establishing, Promoting and Selling design strategy, Planning for long term growth; Case studies

Module II

Managing the Design Process – Business strategy, Increasing awareness with design, Expressing the Brand through design, Initiating design projects, Design methods, Design processes, Competitive advantage through design; Case studies

Module III

Design Implementation – The Project management process, Social and Environmental responsibilities, Design Activism, Design policies, procedures and guidelines, Translation of Global to Local design, Measurement of design success, Review of design strategy; Case studies.

References:

1. Kathryn Best, Design Management: Managing Design Strategy, AVA Publishing (UK) Ltd.
2. Daniel W. Ramsus, Management by Design: Applying Design Principles to the Work Experience, John Wiley & Sons Inc.
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers, USA.
4. Roger L. Martin, The Design of Business: Why Design Thinking is the Next Competitive Advantage, Harvard Business School Publishing.
5. Thomas Lockwood, Design Thinking: Integrating Innovation, Customer Experience, and Brand Value, Allworth Press, USA.
6. Jeanne Liedtka and Tim Ogilvie, Designing for Growth: A Design Thinking Toolkit for Managers, Columbia University Press.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MIE3004: DESIGN OF ALGORITHMS 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To have basic knowledge of commonly used algorithms.
- To develop algorithms to suit specific needs
- To write programs on the application of algorithms.

Learning Outcomes

- The students will have a basic knowledge on the design and development of algorithms for various applications.

Module I

Algorithms, basic steps in development. Basic tools: Top down, Structured programming, networks, data structure. Review of any one of the structured languages.

Module II

Sub goals, hill climbing and working backward, heuristics, back track programming, Branch and bound recursion process, program testing, documentation, Meta heuristics.

Module III
Development of Algorithms for problems like, Sorting, Searching, Combinatorial problems shortest path, Probabilities algorithms etc.

References:

1. Dromey, "How to Solve in by Computers", Prentice Hall, 1982.
2. Goltfried, B.S., "Programming with Paseal", McGraw-Hill (Schaum series), 1986.
3. "Data Structure and Algorithms in C++", Adam Drozdek, 2000.
4. "Schaum's Outline of Programming on c++", John R.Hubbard, 2000.
5. Goodman S.F. &Headtruemu, S.T., "Introduction to the Design and Analysis of Algorithms", McGraw-Hill, 1977.

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE 3005: HEURISTICS FOR DECISION MAKING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

The main objectives of this course are:-

- To introduce the students toheuristic solution techniques.
- To enhance problem solving skills to more advanced levels.
- To experiment with real life problems and promote decision making skills.
- To demonstrate various meta-heuristic solution techniques which provide faster heuristic solutions as against time consuming exact algorithms.

Learning Outcomes

- The students will have knowledge of various heuristic solution techniques and applications of the same.
- The students will have the skill to model and solvereal life problems.

Module I

Introduction to evolutionary computation: Biological and artificial evolution, Evolutionary computation and AI-different historical branches of EC.
Genetic Algorithm - Genetic Algorithms: Basic concepts, Encoding, Selection, Crossover, Mutation-Binary GA, Continuous GA, Hybrid GA, Parallel GA-Application of GA in solving Constrained and Combinatorial Optimization problems, Reliability problem, Sequencing problem, Scheduling problem, Transportation problem etc.Scatter Search-Components, Algorithm, Applications.

Module II

Greedy Randomized Adaptive Search Procedure ,Ant Colony Algorithms: Overview, Basic algorithm, Variants, Formalization and properties of ant colony optimization, Applications.Lagrangean Relaxation: Basic methodology,Lagrangean heuristic and problem reduction, Lagrangean multipliers, Dual Ascent algorithm, Tree search. Applications of Lagrangean Relaxation in solving facility location problems, Logistics etc.

Module III

Local Search Algorithms, Tabu Search -Neighborhood, Candidate list-Short term and Long term memory, Threshold Accepting,Application of TS in solving facility location problem, Quadratic Assignment problem etc.Simulated Annealing -Main Components of Simulated Annealing,Homogenous vs. Inhomogenous Simulated Annealing , Annealing Schedules Applications in sequencing and scheduling, Travelling salesman problem etc.
Multi objective evolutionary optimization: Pareto optimality, Multiobjective evolutionary algorithms.

References:

1. Baeck T, Fogel D B &Michalewicz Z , Handbook on Evolutionary Computation, IOP Press
2. Michalewicz Z , Genetic Algorithms + Data Structures = Evolution Programms, Springer-Verlag,Berlin
3. Goldberg D E , Genetic Algorithms in Search, Optimization & Machine Learning, Addisson Wesley
4. BanzhafW,NordinP,Keller et al., Genetic Programming :An Introduction, Morgan Kaufmann
5. Yao X , Evolutionary Computation: Theory and Applications, World Scientific Publ.Co,Singapore
6. J.Dreo,A.Petrowski, EricTaillard , Metaheuristics for Hard Optimization:Methods and case studies, Springer.
7. Fred Glover ,Tabu Search.
8. ZbigniewMichalewicz,David B. Fogel , How to Solve It:Modern Heuristics, ACM Press
9. Marco Dorigo Thomas Stützle , AntColonyOptimization, MIT Press
10. GüntherZäpfel • Roland Braune, Michael Bögl, Metaheuristic Search Concepts-A Tutorial with Applications to Production and Logistics, Springer

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE3006: ECONOMETRICS 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To introduce the students to the importance and applications of econometric models.
- To provide students hands on experience on econometric software in addition to theory classes.

Learning Outcomes

- The students will have the knowledge of econometric models.
- The students will show the ability to apply theory into practical situations.
- The students will have the experience on the use of econometric software.

Module I

Introduction to econometrics, classical linear regression models assumptions and diagnostic tests: Multicollinearity-Parameter stability tests.Univariate time series modeling and forecasting: Moving average process, Auto regressive process, ARMA process, forecasting in econometrics.

Module II

Multivariate models: Exogeneity, Vector autoregressive models(VAR). Stationarity and Unit Root testing- Cointegration.Modeling volatility and correlation: ARCH, GARCH,GJR, EGARCH models. Forecasingcovariances and Correlations, multivariate GARCH model

Module III

Switching models:Modeling Seasonality, Markov switching model, Threshold auto regressive models.Panel data: The fixed effects model, the time-fixed effects model, random effects model.Limited dependant variable model: linear probability model, Logit model, Probit model, Ordered Response dependant variable model -Multinomial linear dependant variable, Censored and Truncated variable.Dynamic Econometric models- Granger Causality test

References:

1. Introductory Econometrics for Finance- Chris Brooks-Cambridge.
2. Basic Econometrics- Gujarati-McGraHill
3. Applied Econometric Time Series-Walter Enders-John Wiley
4. An Introduction to Econometrics - G.S.Maddala - Wiley
5. Introduction to Econometrics - Stock - Pearson
6. Econometric Analysis - Greene – Pearson

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE3007: INDUSTRIAL SCHEDULING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

The course aims to provide students, a basis to use quantitative methods to allocate an organization's limited resources to the activities that have to be performed. At the end of the course students should be able to:

- Have an overview of the planning and scheduling objectives and requirements in manufacturing and services.
- Understand the nature of production or service systems and apply mathematical as well as applied methods in finite scheduling problems.
- Get an introduction to the recent developments in the field of scheduling such as the relevance of combinatorial optimization, in addition to specialized techniques of sequencing and scheduling.
- Comprehend a variety of problem-solving approaches for Flow shop and Job shop problems from various methodological disciplines.
- Develop computational, conceptual and algorithmic skills.

Learning Outcomes

Through continuous assessment of the students by tests, quizzes, individual/group assessments and presentations the students are able to:

- Relate the planning and scheduling to the functions in an enterprise
- Understand the practices as well as apply planning and scheduling techniques in different application domains such as assembly systems, process industries, entertainment business, transportation etc.
- Develop planning and scheduling approaches for real-life problems in manufacturing and services.

Module I

Introduction to scheduling, role of scheduling, Terminologies involved in scheduling.
Single Machine Models:- Problems without due dates – Minimizing mean flow time, Minimizing weighted mean flow time. Problems with due dates – Lateness criteria, Minimizing the number of Tardy jobs, Hodgson's Algorithm, minimizing Mean Tardiness, The Wilkerson-Irwin Algorithm.
General Purpose methodologies for single machine problems:- Dynamic Programming approach, Branch & Bound Approach, Neighborhood search techniques.

Module II

Parallel Machine Models:- Parallel Identical processors and Independent jobs, Parallel Identical processors and Dependent jobs.
Flow Shop Scheduling:- Permutation schedule, Johnson's problem, Branch & Bound Algorithms for Makespan problems, Heuristic Approaches, Flow shops without Intermediate Queues.

Module III

Job Shop Scheduling:- Types of schedules, Schedule generation, Branch & Bound Approach, Heuristic procedures, Integer Programming Approach.
Simulation studies of the Dynamic Job shop (Overview only)
Introduction to Stochastic Single Machine and Parallel Machine Models.
Case studies on Scheduling systems.

References:

1. Introduction to Sequencing and Scheduling – Kenneth R.Baker – John Wiley
2. Scheduling – Theory,Algorithms and Systems – Michael Pinedo – Prentice Hall Inc.
3. Theory of Scheduling – R.W.Conway, W.L.Maxwell and L.W.Miller – Addison,Wesley.
4. Computer and Job shop Scheduling Theory – E.G. Coffman – Wiley
5. Sequencing and Scheduling – S.French – Elis Horwood Ltd., Chinchester,U.K
6. Integrated Production Control Systems – D.D.Bedworth and J.E.Bailey - Wiley

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

MIE 3008: MANAGEMENT OF PROJECTS 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- Should develop knowledge on screening and analysis of project ideas.
- Should be able to understand project risk analysis and financing sources and methods.
- Should acquire knowledge on project implementation planning tools & techniques.

Learning Outcomes

- Understand screening and analysis techniques of project ideas.
- Understand the project risk analysis and financing sources or methods.
- Understand knowledge on project implementation planning tools & techniques.

Module I

Concept of Strategy and Resource Allocation, Generation and Screening of Project Ideas, Tools for Identifying Investment Opportunities, Infrastructure Projects, R&D Projects, Project Evaluation, Appraisal and Analysis, Project Cash Flows, Cost Benefit Analysis, IRR, Cost of Capital – CAPM approach, WACC approach, Social Cost Benefit Analysis.

Module II

Project Risk analysis - Sensitivity, Scenario, Break-even, Simulation and Decision Tree Analysis. Multiple Projects and Constraints – Method of Ranking, Mathematical Programming Approach, Valuation of Real Options, Project Financing - Multilateral Project Financing, Sources of Finance, Consortium Financing, Venture Capital, Fund and Non-fund Based Credits.

Module III

Project Implementation Planning – Project Organizations, Network Techniques – CPM, PERT, GERT, Resource Leveling, Resource Allocation, Resource Management, Crashing. Network Cost System. Project Review – Control of In-progress Projects, Post Audit, Abandonment Analysis. Work Breakdown-Scheduling, Introduction to Project Management Softwares including MS Project and Primavera.

References:

1. Prasannachandra, Projects - planning, analysis, selection, financing, implementation and review, Tata McGraw Hill
2. Clifford F. Gray & Erik W., Project Management – the Managerial Process, Larson -McGraw Hill
3. Choudhary, Project Management, Tata McGraw Hill
4. Angus et al, Planning, Performing and Controlling Projects, Pearson
5. P. Gopalakrishnan et al, A Text Book of Project Management, Macmillan

Structure of the Question paper

For the End Semester Examination there will be three questions from each module out of which two questions are to be answered by the students

FOURTH SEMESTER

MIC 4101 THESIS – FINAL 0-0-21-12

The student has to continue the thesis work done in the second and third semester. There shall be two seminars (a midterm evaluation on the progress of the work and pre submission seminar to assess the quality and quantum of the work). At least one technical paper is to be prepared for possible publication in journals / conferences. The final evaluation of the thesis shall be an external evaluation. The marks for the Thesis-Final may be proportionally distributed between external and internal evaluation as follows.

Distribution of marks allotted for the Thesis

Internal Evaluation of the Thesis work by the guide - 150 Marks
Internal Evaluation of the Thesis by the Evaluation Committee - 150 Marks
Final Evaluation of the Thesis work by the Internal and External Examiners:
(Evaluation of Thesis: 200 marks + Viva Voce: 100 marks) - 300 Marks

DEPARTMENTAL ELECTIVES IN MECHANICAL ENGINEERING FOR SEMESTER II

MID 2001: RELIABILITY ENGINEERING 3-0-0-3

Objective:

The objective of this course is to understand the theories and their practical uses with real-world examples and problems to solve. The course focuses on system reliability estimation for time independent and failure dependent models. It helps the students in assembling necessary components and configuring them to achieve desired reliability objectives, conducting reliability tests on components, and using field data from similar components. Also to provide more complex aspects regarding both the Maintainability, Availability and some fundamental techniques such as FMECA (Failure Mode, Effects, and Criticality Analysis) and FTA (Fault Tree Analysis) with examples.

Outcome

After the completion of the course one should be able to know:

- Reliability and Hazard Functions
- System Reliability Evaluation
- Time- and Failure-Dependent Reliability
- Estimation Methods of the Parameters of Failure-Time Distributions
- Parametric Reliability Models
- Models for Accelerated Life Testing
- Renewal Processes and Expected Number of Failures
- Preventive Maintenance and Inspection

Pre-requisite: Concepts of Probability and Statistics, Probability Distributions, Point Estimation, Interval Estimation, Goodness-of-fit Tests, Statistics of Extremes.

Module I

Introduction to reliability: definition, Reliability and Quality, failure and failure modes

Failure data analysis: Reliability and rates of failure, Reliability function, expected life, failure rate, hazard function, constant and time dependent hazard models, state dependent hazard models, Markov Analysis.

Module II

System Reliability models – Series, parallel, mixed configurations, k-out-of-m models
Redundancy techniques – component vs unit redundancy, mixed redundancy, Standby redundancy, weakest link technique
Reliability improvement, Reliability allocation

Module III

Fault tree analysis, use of Boolean algebra, Load strength analysis. Understanding of FMECA.
Maintainability- Definition, relationship between reliability and maintainability
Availability- Definition, relationship between reliability and availability, simple Markov models.

Case studies from industries demonstrating Reliability aspects. Computer softwares in reliability.

References

1) Charles E Eblings – An Introduction to Reliability and Maintainability Engineering, McGraw Hill
2) E. Balagrusamy - Reliability Engineering, Tata-McGraw Hill Publishing Company Limited, New Delhi, 1984.
3) L S Srinath – Reliability Engineering, East West Press
4) Lewis, E.E., Introduction to Reliability Engineering, John Wiley & Sons, New York, 1987.
5) O'Connor Patric D.T., Practical Reliability Engineering, 3/e revised, John Wiley & Sons, 1995.
6) StamatisD.H., Failure Mode and Effect Analysis, Productivity Press India (P) Madras, 1997.

Structure of the Question paper

For the End semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MID 2002: MODERN INFORMATION SYSTEMS 3-0-0-3

Course Objectives

- To learn about different information systems.
- To effectively use and manage information technology in today's network enterprises.
- To study inter connected networks of information systems for end user collaboration.
- To learn systems for making timely decisions based on organized informations.

Learning Outcomes

After the completion of the course the student is expected to

- Widen his knowledge about information technology that will enable him to solve management problems.
- Explore full potential of computer as a problem solving tool.

Module I

Introduction to information systems ,Types and examples of information systems, information technology infrastructure. System concepts, system design, development and analysis

Module II

Decision support systems: Overview, Data Mining and Warehousing, Modeling and. Analysis, Knowledge based DSS. Model management, modeling processes, modeling languages.

Module III

Neural computing, applications, advanced artificial intelligent systems and applications. Intelligent software agents, Impact of Management support systems.

References

1. Kenneth C. Laudon and Jane P. Laudon, Management Information Systems – Managing the digital firm, , Pearson education, 2002.
2. Burch John.GJr and Others , Information Systems theory And Practice, John wiley&Sons
3. James A O'Briean, Management Information Systems, Tata McGraw Hill
4. Decision Support Systems and Intelligent Systems, , Prentice Hall International
5. Marakas, Decision Support System, Pearson Education
6. Robert Levine et al ,"Comprehensive Guide to AI and Expert Systems",McGraw Hill Inc..Henry C. Mishkoff, "Understanding AI", BPB Publication, New Delhi, 1986

Structure of the Question paper

For the End semester Examination there will be three questions from each module out of which two questions are to be answered by the students.

MDD 2001: COMPUTATIONAL PLASTICITY **3-0-0-3**

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives:

At the end of this course, the students will
- gain insight into the behavior of metals under loading and heating conditions,
- be able to use elementary theory of plasticity to formulate bulk forming processes,
- be able to master the basic formulations and their applications to sheet forming Processes,
- be able to master and apply the basic theory of metal cutting,
- have the basic knowledge about the cutting tools, cutting fluids and the cutting
- parameters and how they affect the cutting performance,
- be able to optimize metal cutting operations for the selected criteria

Learning Outcomes:

At the completion of the course, students will be able to…
- Predict the changes in the mechanical behavior of materials due to thermo-mechanical processing based finite element modeling.
- Interpret and quantitatively determine elastoplastic behavior of metals.

Module I

Elements of continuum mechanics and thermodynamics – Kinematics of deformation - Infinitesimal deformations - Forces. Stress Measures - Fundamental laws of thermodynamics - Constitutive theory - Weak equilibrium. The principle of virtual work - The quasi-static initial boundary value problemThe finite element method in quasi-static nonlinear solid mechanics - Displacement - based finite elements - Path-dependent materials. The incremental finite element procedure – Large strain formulation - Unstable equilibrium. The arc-length method

Module II

Overview of the program structure of FEM for plasticity
The mathematical theory of plasticity – Phenomenological aspects - One-dimensional constitutive model - General elastoplastic constitutive model - Classical yield criteria – Plastic flow rules - Hardening laws

Module III

Finite elements in small-strain plasticity problems – Preliminary implementation aspects - General numerical integration algorithm for elastoplastic constitutive equations - Application: integration algorithm for the isotropically hardening vonMises model - The consistent tangent modulus – Numerical examples with the vonMises model - Further application: the von Mises model with nonlinear mixed hardening

References:

1. Eduardo de Souza Neto, DjordjePeric, David Owens, Computational methods for plasticity : theory and applications - 2008 John Wiley & Sons Ltd
2. A. Anandarajah, Computational Methods in Elasticity and Plasticity – 2010 Springer
3. Han-Chin Wu, Continuum mechanics and plasticity - CRC Press
4. D R J Owen, E Hinton, Finite Elements in Plasticity Theory and Practice – 1980 Peneridge Press Ltd.
5. Jacob Lubliner, Plasticity theory – 2006
6. J. Chakrabarty, Theory of plasticity third edition – 2006 BH
7. D W A Rees, Basic engineering plasticity an introduction with engineering and manufacturing applications - BH

Structure of the Question paper

For the End Semester Examination There will be three questions from each module out of which two questions are to be answered by the students.

MDD 2002: BIO MECHANICS 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Objective:

- To gain knowledge of bio mechanics
- To gain knowledge of designing of artificial implants
- To gain knowledge of viscoelastic material modeling
- Understand various bio materials

Outcome:

- Students will understand how the theory is used in analyzing human body and motions
- At the end of the course students will know the different bio materials

Industrial relevance:

This course is having direct application to industry.
In medical field, implementation of theory of mechanics will help in implementing various designs

Module I

Human Anatomy & physiology: Anatomy & Physiology of major systems of the body Basic Terminology-Major Joints - Major Muscle Groups -Tissue Biomechanics -Hard and Soft -Bones - Bone Cells and Microstructure- Physical Properties of Bone- Bone Failure (Fracture and Osteoporosis)- Muscle Tissue-Cartilage-Ligaments- Scalp, Skull, and Brain -Skin Tissue

Module II

Kinetics of Human Body -Forces Exerted across Articulating Joints -Contact Forces across Joints - Ligament and Tendon Forces- Joint Articulation
Rheology of body material-Viscoelasticity-Definition of Viscoelasticity 1D Linear Viscoelasticity (Differential Form Based on Mechanical Circuit Models- Maxwell Fluid-Kelvin–Voigt Solid- 1-D Linear Viscoelasticity (Integral Formulation)- 3-D Linear Viscoelasticity -Dynamic Behavior of Viscoelastic Materials

Module III

Biomaterials:- Different types of biomaterials - metals, polymers, ceramics, glasses, glass ceramics, composites. Material properties.Reactions to biomaterials - inflammation, wound healing & foreign body response, immunology and compliment system, -, prostheses and orthotics.Artificial bio-implants – Dental implants, heart valves, kidneys, joints.

References:

1. Principles of Biomechanics by Ronald L Huston-CRC Press
2. Introduction to continuum biomechanics by Kyriacos A. Athanasiou and Roman M. Natoli-Morgan & Claypool
3. Duane Knudson Fundamentals of Biomechanics –Springer
4. Text book of Medical Physiology – C., M. D. Guyton..
5. Biomechanics: Motion,Flow stress and Growth, Y.C. Fung- Springer, New
6. York, 1990
7. Leslie Cromwell, Fred J.Weibell and Erich A.Pferffer. Biomedical instrumentation and Measurements -Prentice Hall of India, New Delhi.

Structure of the Question paper

For the End semester Examination There will be three questions from each module out of which two questions are to be answered by the students.

MDD 2003: INTRODUCTION TO SIGNAL PROCESSING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- Understand Fundamentals of DSP and its use in Noise and Vibration Enhancement
- Understand how to correctly implement and use the results of an FFT
- Interpretation of common Frequency Domain Measurements
- Understand the fundamentals and applications of Digital Filters
- Application and interpretation of Order Tracking analysis

Learning Outcomes:

As an outcome of completing this course, students will be able to:

- Understand how the combination of A/D conversion, digital filtering, and D/A conversion may be used to filter analog signals such as speech and music (1-D), and images (2-D).
- Understand the time- and frequency-domain concepts related to A/D conversion.
- Understand the time- and frequency-domain concepts related to D/A conversion.
- Understand the role of oversampling in A/D and D/A conversion.
- Understand the roles of downsampling and upsampling in digital processing of analog signals.
- Understand the respective roles of the magnitude and phase response of a digital filter.
- Understand the concepts of phase delay and group delay of a digital filter.
- Understand the relations between the DTFT, the DFT, and the FFT.
- Understand the computational issues in the implementation of digital filters.
- Understand the notion of random signals as an aid to filter design.
- Design FIR filters using the Windowing Method.
- Write reports on filter design and DSP applications projects
- Assess the societal impact of DSP, and the engineer's responsibilities in this regard.

Module I

Introduction to Signal Processing: Descriptions of Physical Data (Signals), Classification of Data. **Deterministic Signals:** Periodic, Almost Periodic and Transient Signals.Periodic Signals and Fourier series, Delta Function, Complex Form of the Fourier Series, Spectra. Fourier Integral, Energy Spectra, Properties of Fourier Transforms, Importance of Phase, Echoes, Continuous-Time Linear Time-Invariant Systems and Convolution, Group Delay (Dispersion), Minimum and Non-Minimum Phase Systems, Hilbert Transform, Effect of Data Truncation (Windowing).

Module II

Fourier Transform of an Ideal Sampled Signal, Aliasing and Anti-Aliasing Filters, Analog-to-Digital Conversion and Dynamic Range, Shannon's Sampling Theorem.Sequences and Linear Filters, Frequency Domain Representation of Discrete Systems and Signals, Discrete Fourier Transform, Properties of DFT, Convolution of Periodic Sequences, Fast Fourier Transform. Basic Probability Theory, Random Variables and Probability Distributions, Expectations of Functions of a Random Variable.

Module III

Stochastic Processes: Probability Distribution Associated with a Stochastic Process, Moments of a Stochastic Process, Stationarity, and the Second Moments of a Stochastic Process, Ergodicity and Time Averages.Single-Input Single-Output Systems,Estimator Errors and Accuracy, Mean Value and Mean Square Value , Correlation and Covariance Functions, Power Spectral Density Function, Cross-spectral Density Function, Coherence Function, Frequency Response Function .Description of Multiple-Input Multiple-Output (MIMO) Systems, Residual Random Variables, Partial and Multiple Coherence Functions, Principal Component Analysis.

Reference:

1. Fundamentals of Signal Processing for Sound and Vibration Engineers, K. Shing and J.K. Hammond, Wiley, 2007
2. Digital Signal Processing for Measurement Systems:Theory and Applications, G. D'Antona and Alessandro Ferrero, Springer
3. Digital Signal Processing, Alan V. Oppenheim, Ronald W. Schafer, Prentice hall

Structure of the Question paper

For the End Semester Examination There will be three questions from each module out of which two questions are to be answered by the students.

MPD 2001: FINITE VOLUME METHOD FOR FLUID FLOW AND HEAT TRANSFER

Structure of the Course

Lecture : 3 hrs/ Week Credits :3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives:

- A number of physical problems related to Propulsion Engineering and Thermal Engineering can be modeled as partial differential equation and often non-linear. These equations cab not be solved by analytical methods and suitable numerical techniques are to be applied. The objective this stream elective is to give the students the necessary fundamentals ideas and their applications for real problems. An exposure to open source computational tools is also aimed. Reading and understanding at least two Journal Publications dealing with later developments in solution algorithms for flow and heat transfer.

Learning Outcomes:

- Mathematical formulation of physical problems and their solution.
- Capability to write computer programs based on the techniques learned.
- Development of a directory containing the basic and applied computer programs, tutorials and their document.

Module I

Governing equations of fluid flow and heat transfer-Programming in object oriented C++, Classes, Structures and Union (Portions up to this is for study by students themselves. Questions may be asked for the examinations). Governing equations in primitive variables – general scalar form for incompressible flow-conservative vector form for compressible flow-Linearisation -Jacobian-Mathematical nature of governing equations- Governing equations in terms of stream function and vorticity (2D and 3D).
Finite difference approximations for differential coefficients, order of accuracy, numerical examples-Stability, convergence and consistency of numerical schemes - Von-Neumann analysis for stability-Courant-Friedrich-Lewi criterion.

Module II

Rayleigh-Ritz, Weighted Residual, Galerkin and sub-domain methods, Interpolation and shape functions in FEM, FE discretisation of Laplace, Poissons and convection diffusion equations. Element equations for triangular, quadrilateral, tetrahedral and hexahedral elements.Numerical integration-Newton Cotes and Gauss quadrature.Application of boundary conditions, Solution of system of equations using TDMA and Conjugate gradient methods.

Module III

Finite volume discretisation of Laplace, Poissons and convection diffusion equations. Evaluation of gradients on regular and arbitrary cells, Upwind, Central and Power Law schemes. Structured and unstructured grids.Staggered and collocated grids, Pressure Poisson's equation, SIMPLE, PISO and PROJECTION algorithms for incompressible flow. Flux vector splitting method for compressible flow. Hybrid FE and FV, Semi Lagrangianand Spectral methods, Development of computer programs - Introduction to OpenFOAM. Computer assignments.

References:

1. Applied finite element analysis, Larry J. Segerlind
2. Numerical heat transfer and fluid flow, Suhas V. Patankar
3. Computational fluid dynamics: the basics with applications, John D. Anderson
4. Modern Compressible Flow: with Historical Perspective. John D. Anderson, JR
5. Introduction to Computational Fluid Dynamics, Anil W. Date

Structure of the Question paper

For the End Semester Examination There will be three questions from each module out of which two questions are to be answered by the students.

MPD 2002:TRANSPORT PHENOMENA 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

1.To develop and detailed understanding of the physics behind transport phenomena in engineering systems.
2. To learn solution techniques in advanced transport phenomana.

Learning Outcomes

1. Student will be capable of applying theoretical knowledge in various industrial and academic situations
2. They will be in a position to develop models for a particular problem involving heat and mass transfer.

Module I

Viscosity and the mechanism of momentum transport-pressure and temperature dependence of viscosity-Theory of viscosity of gases at low density- Theory of viscosity of liquids.

Thermal conductivity and the mechanism of energy transport-temperature and pressure dependence of thermal conductivity in gases and liquids-theory of thermal conductivity of gases at low density – theory of thermal conductivity of liquids- thermal conductivity of solids.

Diffusivity and the mechanism of mass transport- definitions of concentrations, velocities and mass fluxes-Fick's law of diffusion- temperature and pressure dependence of mass diffusivity- theory of ordinary diffusion in gases at low density- theories of ordinary diffusion in liquids.

Module II

Shell balance for momentum, energy and mass, boundary conditions, Adjacent flow of two immiscible fluids- heat conduction with a nuclear heat source-diffusion through a stagnant gas film-diffusion with heterogeneous chemical reaction- diffusion with homogeneous chemical reaction-diffusion into a falling liquid film: Forced convection mass transfer-diffusion and chemical reaction inside a porous catalyst; the "Effectiveness factor'.
The equations of change for isothermal, non isothermal and multi component systems- the equations of continuity of species A in curvilinear co-ordinates-dimensional analysis of the equations of change for a binary isothermal mixture.

Module III

Concentration distributions in turbulent flow- concentration fluctuations and the time smoothed concentration-time smoothing of the equations of continuity of A.

Inter phase transport in multi component systems-definition of binary mass transfer coefficients in one phase – correlations of binary mass transfer coefficients in one phase at low mass transfer rates- definition of binary mass transfer coefficients in two phases at low mass transfer rates- definition of the transfer coefficients for high mass transfer rates.

Macroscopic balances for multi component systems- the macroscopic mass, momentum, energy and mechanical energy balance-use of the macroscopic balances to solve steady state problem.

References:

Text book: Transport Phenomena Bird R B, Stewart W E and Lightfoot F N

Note: Use of approved charts & tables are permitted in the examinations.

Structure of the Question paper

There will be three questions from each module out of which two questions are to be answered by the students.

MTD2001: FINITE ELEMENT ANALYSIS FOR HEAT TRANSFER 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

To impart an awareness regarding various types of equations and their methods of solving
To analyse a given situation to find out the temperature profiles and rate of heat transfer

Learning Outcomes

The students will be capable of analyzing theoretically any heat transfer problems by using FEM

Module I

Review of the fundamentals of the three modes of heat transfer. Governing differential equations.Initial and boundary conditions.

Review of the numerical techniques for the solution of matrix equations.
Basic concepts of Finite Element method. Mesh generation-
Types of elements, Node numbering scheme.Interpolation polynomials.Finite element equations and element characteristic matrices.Variational approach, Galerkin approach.Assembly of element matrices.Solution of finite element system of equations.

Module II

Steps involved in a thermal analysis. Analysis of linear and nonlinear conduction problems in steady and transient hea t transfer.1D, 2D and 3D analysis with simple examples.Axisymmetric heat transfer.Finite element solution in the time domain.

Effects of convection in heat transfer- advection-diffusion. Analysis of heat transfer problems with radiation.

Module III

Concepts of adaptive heat transfer analysis. Implementation of the adaptive procedure.

Computer programming and implementation of FEM. Introduction to general purpose FEM packages.

References:

1. R W Lewis, K Morgan, H R Thomas and K Seetharamu: The Finite Element Method in Heat Transfer Analysis
2. H C Huang and A Usmani: Finite Element Analysis for Heat Transfer
3. L J Segerland: Applied Finite Element Analysis
4. C Zeinkewicz: The Finite Element Method

Structure of the Question paper

For the End semester Examination There will be three questions from each module out of which two questions are to be answered by the students.

MTD 2002: CRYOGENIC ENGINEERING 3-0-0-3

Structure of the Course

Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To impart a basic concepts of low temperature production and utilization
- To study various systems for low temperature production

Learning Outcomes

- The students will be capable of designing a liquefaction system
- They will be able to produce liquefaction systems with minimum energy consumption

Module I

Introduction: Historical development-present areas involving cryogenic engineering. Low temperature properties of engineering materials-Mechanical properties-Thermal properties-Electric and magnetic properties-Properties of cryogenic fluids.

Module II

Gas liquefaction systems: Introduction-Production of low temperatures-General liquefaction systems-Liquefaction systems for Neon, Hydrogen and Helium-Critical components of liquefaction systems.
Cryogenic Refrigeration systems: Ideal Refrigeration systems-Refrigerators using liquids and gases as refrigerants-refrigerators using solids as working media.

Module III

Cryogenic fluid storage and transfer systems: Cryogenic fluid storage vessels-Insulation-Cryogenic fluid transfer systems.
Applications of Cryogenics: Super conducting devices-Cryogenics in Space Technology- Cryogenics in biology and medicine.

References:

1. Cryogenic Systems – Randall Barron
2. Cryogenic Engineering- R.B.Scott
3. Cryogenic Engineering – J.H.Bell Jr.

Structure of the Question paper

For the End semester Examination There will be three questions from each module out of which two questions are to be answered by the students.