

**MECHANICAL ENGINEERING**  
**M.E. (INDUSTRIAL ENGINEERING)**  
**(Four-Semester Course -Credit System- w.e.f. 2007-2008)**

**FIRST SEMESTER**  
**Scheme of Instruction and Examination**

Course No.	Name of the course	Periods per week		Exam (Hrs)	Max. marks		Credits
		Lec.	Lab		Exam	Sess.	
IE 101	Methods Engineering and Work Design	4	—	3	70	30	4
IE 102	Probability and Statistics	4	—	3	70	30	4
IE 103	Management Principles & Perspectives	4	—	3	70	30	4
IE 104	Engineering & Managerial Economics	4	—	3	70	30	4
IE 105	Advanced Optimization Techniques	4	—	3	70	30	4
IE 106	Elective – I	4	—	3	70	30	4
IE 107	Seminar	—	3	—	—	50	2
IE 108	Work study Lab	—	3	—	—	50	2
Total		24	6	—	420	280	28

- Elective – I :** A. Computer Integrated Manufacturing      B. Maintenance Management  
C. Total Quality Management                                      D. Project Management  
E. Corporate Planning    F. Supply Chain Management

**SECOND SEMESTER**  
**Scheme of Instruction and Examination**

Course No.	Name of the course	Periods per week		Exam (Hrs)	Max. marks		Credits
		Lec.	Lab		Exam	Sess.	
IE 201	Industrial Quality Management	4	—	3	70	30	4
IE 202	Operations Planning & Control Systems	4	—	3	70	30	4
IE 203	Human Resource Development & Industrial Relations	4	—	3	70	30	4
IE 204	Facility Planning and Design	4	—	3	70	30	4
IE 205	System Dynamics	4	—	3	70	30	4
IE 206	Elective – II	4	—	3	70	30	4
IE 207	Seminar	—	3	—	—	50	2
IE 208	Computer Applications Lab	—	3	—	—	50	2
Total		24	6	—	420	280	28

- Elective – II :** A. Manufacturing Resource Planning      B. Technology Management  
C. Management Information Systems                                      D. Product Design Management  
E. Production Management - Strategic Perspectives      F. Human Factor Engineering

THIRD and FOURTH SEMESTER  
Scheme of Instruction and Examination

Course No.	Name of the course	Periods per week	Duration of exam (hours)	Max. marks	Credits
				Exam	
IE 301	Project	12	—	Recommended/Not recommended	14

The prerequisite for submission of the ME thesis is that one should communicate his/her work to any referred journal or Publication in a conference.

## FIRST SEMESTER

### IE 101 METHODS ENGINEERING AND WORK DESIGN

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**Work study:** Concept of work and productivity - Possibility guides - Methods study - Charting techniques - Concept of standard time and bench mark jobs - Timing techniques and work sampling - Elemental motions, THERBLIGS and principles of motion - Economy - Introduction to predetermined motion time standards.

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

**Integration of methods and time** - Learning theory implications on standard time - Work study applications in production, maintenance, quality and other service functions - Synthetic time standards - MTM system and its application to production and maintenance.

**Organization and methods:** Procedure analysis and developing office standards - MTM application to office work - Forms design and control - Records management.

**Value engineering:** VE concepts, Principles, Methodologies and standards - Methods of functional analysis - Creativity - VE case studies/project work.

**Job evaluation and incentive scheme:** Job description and job analysis - Job evaluation-different methods - Individual and group incentive concepts and implications - Different types of incentive schemes - Suggestion schemes.

#### References:

1. Introduction to Work Study, I.L.O., 3rd Revised Edn., 1986.
2. Methods, Standards and Work Design, Benjamin W. Niebel and Andris Freivalds, WCB Mc Graw Hill(1999)
3. Improving Productivity and Effectiveness by Mundel, Marvin, E., Prentice Hall, 1983.
4. Human Factors Engineering & Design by Sounders, M.S. and McCornic, E.J., McGraw Hill, 1983.
5. Fitting the Task to the Man by Grandjean, E., Taylor and Francis, London, 1989.
6. Measuring and Enhancing Productivity of Service and Government Organizations by Mundel Marvin, E., Asian Productivity Organization, Tokyo.
7. Compendium on Value Engineering by Tufty, H.G., The Indo-American Society, Bombay, 1983.
8. Compensation Administration by Belchar, David, W., Prentice Hall, N.J.

**IE 102 PROBABILITY AND STATISTICS**  
(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.  
Examination (Theory): 3hrs.

Ses. : 30 Exam: 70  
Credits: 4

Fundamental distributions (with stress on the normal distribution and its applications in industry), Statement and uses of Chi-square and distributions.

Least square principles, Elements of curve fitting, Correlation and regression analysis, Motion of linear regression, Concepts of bi-variable and multivariate distributions, The partial and multiple correlations.

Populations, Sample, Parameter, Statistics, Sampling distribution, Standard error, Sampling methods including simulated sample by Monte Carlo methods. Random numbers and their uses. Basic notions on consistence unbiasedness and efficiency. Maximum likelihood estimation.

Motion of statistical hypothesis and statistical test large and small sample tests of significance, Motion of non-parametric test.

Stochastic processes, Markov chains and process, Time series components and analysis.

Analysis of variance - Design of experiments.

Industrial applications.

**References:**

1. Introduction to Mathematical Statistics by Hogg, R.V. and Craig, A.T.
2. Elements of Probability Theory by Cramer, K.
3. Statistics for Management by Levin and Rubin, PHI, 2001.
4. Mathematical Statistics by John E. Freund, 5th Ed. PHI.
5. Probability & Statistics for Engineers and Scientists by Ronald E. Walpole, Pearson Education Asia Edition.

**IE 103 MANAGEMENT PRINCIPLES AND PERSPECTIVES**  
(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.  
Examination (Theory): 3hrs.

Ses. : 30 Exam: 70  
Credits: 4

**Management principles:** Management functions, Roles & Skills - History of management thought - Various theories and approaches to management - Planning process, tolls and techniques - Management by objectives - Decision making process, approaches and aids - Formal and informal organizations - Organisation structure and design - Organization principles of line and staff authority and span of control - Delegation, decentralization and autonomy - Managerial control-need and principles - Role of information in control - Control methods and techniques - Managerial ethics and social responsibility.

**Systems approach in problem solving:** Systems concepts: System, Environment, Input, Output, Process, Feedback and Control - Classification of systems - System analysis: System design and systems engineering - General systems theory and its application to business problems - Systems design: System purchaser(s), Objectives, Constraints, Design of input, Output process and Feedback control - Examples of application and case studies in different areas of business management.

**References:**

1. Management by Koonetz, H, O'Donnel, C. and Weihrich, H., McGraw Hill International Student Edn., 9th Edn., 1984.
2. Introduction to Management by Plankett, W.R. and Attner, R.F., Kent Publishing Company.
3. Systems Analysis for Business and Industrial Problem Solving by Optner, S.L., McGraw Hill, NY, 1975.

**IE 104 ENGINEERING AND MANAGERIAL ECONOMICS**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

The principle and use of economic analysis in engineering practice - Discounted cash-flow analysis - Corporate tax and investment - Depreciation and economic studies - Replacement analysis - Valuation of assets - Economic analysis for projects - Analysis of risk and uncertainty - Elements of demand analysis and forecasting - Theory of firm as an owner and as a producer - Economic of scale - Market models - Production function - Output and pricing decision - Long run and short run cost curves.

**References:**

1. Engineering Economy, William G. Slivan, James A. Bontadelli and Elin M. Wicks, Pearson Education Asia(2001)
2. Engineering Economy by Theusen, H.G. and Others, 5th Edn. Prentice Hall of India, 1981.
3. Managerial Economics by Dean Joel, Prentice Hall of India, New Delhi, 1978.
4. Managerial Economics - Concepts and Cases by Mote, V.L., Samuel Paul, Gupta, G.S., Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1977.

**IE 105 ADVANCED OPTIMIZATION TECHNIQUES**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**Geometric programming (G.P):** Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P), Complementary Geometric Programming (C.G.P)

**Dynamic programming(D.P):** Multistage decision processes. Concepts of sub optimization and Principal of optimality, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P. and continuous D.P.

**Integer programming(I.P):** Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Branch-and-bound method, Sequential linear discrete Programming, Generalized penalty function method.

**Stochastic Programming (S.P.):** Basic Concepts of Probability Theory, Stochastic Linear programming.

**Non-traditional optimization techniques:** Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated annealing, Neural Networks based Optimization.

**References:**

1. Operations Research- Principles and Practice by Ravindran, Phillips and Solberg, John Wiely
2. Introduction to Operations Research by Hiller and Lieberman, Mc Graw Hill
3. Engineering Optimization - Theory and Practice by Rao, S.S., New Age International (P) Ltd. Publishers.
4. Engineering Optimization By Kalyanmanai Deb, Prentice Hall of India, New Delhi.
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd.

**Elective - I**

**(A) IE 106 COMPUTER INTEGRATED MANUFACTURING**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**Introduction:** Scope of computer integrated manufacturing, Product cycle, Production automation.

**Group technology:** Role of group technology in CAD/CAM integration, Methods for developing part families, Classification and coding, Examples of coding systems, Facility design using group technology, Economics of group technology.

**Computer aided process planning:** Approaches to process planning - Manual, Variant, Generative approach, Process planning systems - CAPP, DCLASS, CMPP, Criteria for selecting a CAPP system, Part feature recognition, Artificial intelligence in process planning.

**Integrative manufacturing planning and control:** Role of integrative manufacturing in CAD/CAM integration, Over view of production control - Forecasting, Master production schedule, Capacity planning, M.R.P., Order release, Shop-floor control, Quality assurance, Planning and control systems, Cellular manufacturing, JIT manufacturing philosophy.

**Computer aided quality control:** Terminology in quality control, Contact inspection methods,

Non-contact inspection methods, Computer aided testing, Integration of CAQC with CAD/CAM.

**Computer integrated manufacturing systems:** Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, FMS.

**References:**

1. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
2. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.

## **B) IE 106 MAINTENANCE MANAGEMENT**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

Characteristics, Benefits, Objectives and Policies of maintenance, Organization and structure of maintenance system: Mechanics of maintenance system - Planning and scheduling maintenance activities - Types of maintenance - Preventive maintenance - Development of preventive maintenance schedule: Planned prevention of breakdowns - Predictive maintenance - Condition monitoring - Equipment codification and classification - Maintenance budgeting and cost control - Production maintenance integration - Replacement - Policies and models - Reliability models - State transition diagrams for maintained and non-maintained systems.

Reliability measurement and life testing application of reliability: Maintenance strategies - Maintainability and availability and criteria - Maintenance manpower planning spare parts management - Maintenance downtime analysis - Computerized maintenance system - Application of simulation technique - Design - Implementation and Operation of an integrated maintenance system.

### **References:**

1. Maintainability Principles and Practices by Blanchard, B.S., McGraw Hill, NY, 1969.
2. Maintenance Management by Carder, A.S., McGraw Hill, NY, 1976.
3. Maintenance Engineering and Management by Mishra, R.C. and Pathak, K., PHI, 2002.

## **C) IE 106 TOTAL QUALITY MANAGEMENT**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**Concepts of TQM:** Philosophy of TQM, Customer focus, Organization, Top management commitment, Team work, Quality philosophies of Deming, Crosby and Muller.

**TQM process:** QC tools, Problem solving methodologies, New management tools, Work habits, Quality circles, Bench marking, Strategic quality planning.

**TQM systems:** Quality policy deployment, Quality function deployment, Standardization, Designing for quality, Manufacturing for quality.

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

**Implementation of TQM:** Steps, KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, Case studies.

### **References:**

1. Total Quality Management by Rose, J.E., Kogan Page Ltd., 1993.
2. The Essence of Total Quality Management by John Bank, PHI, 1993.
3. Beyond Total Quality Management by Greg Bounds, Lyle Yorks et al, McGraw Hill, 1994.
4. The Asian Productivity Organization by Takashi Osada, 1991.
5. KAIZEN by Masaki Imami, McGraw Hill, 1986.

## **(D) IE 106 PROJECT MANAGEMENT**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.  
Examination (Theory): 3hrs.

Ses. : 30 Exam: 70  
Credits: 4

Industrial development - Corporate growth and business development. Product innovation research and development - Formulation and implementation of R&D projects. Project identification and formulation - Needs analysis - Resource surveys - Market research - Feasibility analysis. Technical feasibility - Technology forecasting - Choice of technology - Choice of process technology assessment technology - Transfer - Techno economic analysis - Appropriate technology.

Analysis of infrastructures: Inputs transports - Elements of economic geography - Location - Site selection. Investment analysis principles. Industrial policy - Incentives and regulations. Cost estimating - Cost-benefit analysis - Financial analysis - Economic analysis - Social-cost benefit analysis - UNIDO - World Bank and OECD methodologies. Project financing - Source of finance - Cost of capital - Capital structure - Internal finance and foreign exchange regulation - Projects and contracts planning and co-ordination - Project scheduling and monitoring tools and techniques - Project management information systems and documentation - Computer applications in project management.

### **References:**

1. Project Management, David I. Cleland, Mc Graw Hill(1999)
2. Managing Construction Contract by Colier Kinth, Reston Publishing Co.
3. Engineering and Construction Project Management by Kerridge, A.E. and Verveelin, C.H., Gulf Pub. Co., Houston, 1986.
4. Project Formulation and Evaluation Series, No.1, No.2 and No.3, U.N.I.D.O., Oxford and IBH Publishing Co.

## **(E) IE 106 CORPORATE PLANNING**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.  
Examination (Theory): 3hrs.

Ses. : 30 Exam: 70  
Credits: 4

Corporate objectives, Goals and Policies; Process of corporate planning; SWOT analysis, Gap analysis, Strategy formulation.

Environmental scanning and analysis; Technological forecasting, Economic and social environmental, Business forecasting, Market dynamics, Government policies, Elements of futurology, Strategies for growth and survival; Long range planning of R&D, Strategies for technology base industries, Multinational operations.

Investment evaluation, Capital budgeting, Risk analysis. Industrial dynamics, Computer modelling and simulation. Organizing for corporate planning, Implementing corporate strategies, Business plans, Resources planning, Management control and information systems.

### **References:**

1. Introducing Corporate Planning by Hussey, D.E., Pergaman Press, NY, 1985.
2. Strategic Planning System by Lorange, P. and Vancil, R.F., Prentice Hall, NJ, 1980.
3. Corporate Planning & Policy Designs by Lyneis, J.M., MIT Press.



**(F) IE 106 SUPPLY CHAIN MANAGEMENT**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**IE 107 SEMINAR**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 3 Pr.

Ses. : 50

Credits: 2

The student has to give at least three seminars on topics related to Industrial Engineering.

**IE 108 WORK STUDY LAB**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 3Pr.

Ses. : 50

Credits : 2

**MODEL QUESTION PAPER-Mechanical Engineering  
M.E. (INDUSTRIAL ENGINEERING)-I SEMESTER**

**IE 101 METHODS ENGINEERING AND WORK DESIGN  
(Four Semester-Credit System-w.e.f. 2007--2008)**

Time : 3 Hrs.

Max. Marks : 70

Answer any FIVE questions.

All questions carry equal marks.

1. a) How do work study techniques help in improving productivity? Explain.  
b) Explain (i) Flow process chart, (ii) Man-machine chart.
2. Explain the principles of motion economy in detail.
3. a) Define the term ergonomics and discuss the objectives and goals of ergonomic studies.  
b) Explain Bio-mechanical design considerations. What are the functions performed by man and the involved mechanism in order to make a system success?
4. Discuss various techniques of work-measurement.
5. What is O and M analysis? How do you design and apply the same in the control office of a large business organization?
6. What is job evaluation? Explain the different methods of job evaluation techniques.
7. Explain the various wage incentive schemes.
8. Write notes on:
  - i) Therbligs.
  - ii) Value engineering.
  - iii) Learning theory.
  - iv) MTM.

**MODEL QUESTION PAPER-Mechanical Engineering  
M.E. (INDUSTRIAL ENGINEERING)-I SEMESTER**

**IE 102 PROBABILITY AND STATISTICS  
(Four Semester-Credit System-w.e.f. 2007--2008)**

Time : 3 Hrs.

Max. Marks : 70

Answer any FOUR questions.

All questions carry equal marks.

1. Given below is the distribution of 140 candidates obtaining marks x or more in certain examination.

x :	10	20	30	40	50	60	70	80	90	
100										
c.f. :	140	133	118	100	75	45	25	9	2	0

Calculate the mean, median, mode and standard deviation.
2. a) Fit a Posson distribution to the following data with respect to the number of red blood corpuscles (x) per cell:

x :	0	1	2	3	4	5
No. of cells f:	142	156	69	27	5	1

Do you support with reasons, the decision to fit a Posson distribution?

  - b) Define normal distribution and find its variance.
  - c) In a normal population with mean 15 and standard deviation 3.5, it is known that 647 observations exceed 1625. What is the total number of observations in the population?

3. a) The results of measurement of electric resistance  $R$  of a Copper bar at various temperatures  $t$  °C are listed below:

$t$ :	19	25	30	36	40	45	50
$R$ :	79	77	79	80	82	83	85

Find a relation  $R = a + b A$  by the method of least square.

- b) Find the correlation coefficient between  $x$  and  $y$  from the given data:

$x$ :	78	89	97	69	59	79	68	57
$y$ :	125	137	156	112	107	138	123	108

4. a) Find the standard error of a linear function of a number of variables.  
 b) Test the significance of the difference between the means of the sample from the following data:

	Size of sample	Mean	Standard deviation
Sample A :	100	61	4
Sample B :	200	63	6

5. a) Explain random variable, its distribution expectation and variance.

- b) A random variable  $x$  has the following probability function:

Values of $x$ :	-2	-1	0	1	2	3
$P(x)$ :	0.1	$k$	0.2	$2k$	0.3	$k$

Find the value of  $k$  and calculate mean and variance.

6. a) Explain the procedure generally followed in testing of hypothesis. Distinguish between large and small sample tests.

- b) A group of 10 boys fed on a diet A and another group of 8 boys fed on a different diet B recorded the following increase in weights:

Diet A :	5	6	8	1	12	4	3	9	6	10 kgs
Diet B :	2	3	6	8	10	1	2	8 kgs		

Does it show the superiority of diet A over that of B?

7. a) Describe the technique of analysis of variance with an illustration for a one way classification.

- b) The following table gives the retail prices of commodity in same shops selected at random in four cities:

City	Price (Rs. per lb)			
A	22	24	27	23
B	20	19	23	–
C	19	17	21	18
D	24	26	29	26

Carry out analysis of variance to test the significance of the difference between the prices of commodity in four cities.

**MODEL QUESTION PAPER-Mechanical Engineering  
M.E. (INDUSTRIAL ENGINEERING)-I SEMESTER**

**IE 103 MANAGEMENT PRINCIPLES & PERSPECTIVES  
(Four Semester-Credit System-w.e.f. 2007--2008)**

Time : 3 Hrs.

Max. Marks : 70

Answer any FIVE questions.

All questions carry equal marks.

1. “Management is regarded as an art of some, science by others and inexact science by many more. The truth seems to be somewhere in between”. In the light of this statement, explain the exact nature of management.
2. a) What steps are involved in planning process?  
b) What are the major limitations of planning? What action can be taken to make planning effective?
3. a) Distinguish between delegation of authority and decentralization.  
b) What should be done to ensure effective delegation of authority in a business enterprise?
4. a) What are the essential features of good organization structure?  
b) How do clearly defined objectives help in managing the organization?
5. a) Write about decision making process.  
b) What is the need of management control? Explain the principles of managerial control.
6. What is the systems approach of organization theory? Describe the implication of systems approach in organization design.
7. What do you understand by a system? Discuss management as a system bringing out the basic features.
8. Write short notes on any FOUR of the following:
  - a) Managerial ethics.
  - b) Benefits of MBO.
  - c) Concept of feedback.
  - d) Open and closed loop system.
  - e) Role of information in control.

**MODEL QUESTION PAPER-Mechanical Engineering  
M.E. (INDUSTRIAL ENGINEERING)-I SEMESTER**

**IE 104 ENGINEERING AND MANAGERIAL ECONOMICS  
(Four Semester-Credit System-w.e.f. 2007--2008)**

Time : 3 Hrs.

Max. Marks : 70

Answer any FIVE questions.

All questions carry equal marks.

Industrial Engineering Tables are permitted

1. Explain the law of demand and supply in detail.
2. Define a production function. Explain and illustrate isoquant and isocost curves.
3. What are the characteristics of monopolistic competition? Explain how output and price is determined under manoplostic competition.
4. a) Explain the concept of break-even analysis and point out its assumptions.

- b) Given the following total cost and total revenue functions, find (i) break-even point, (ii) profit at output 30.

$$\text{Total cost} = 100 + kx,$$

$$\text{Total revenue} = 10x$$

where  $x$  is the quantity sold or purchased.

5. a) Discuss the various methods of depreciation.  
 b) Find out the depreciation annuity by the annuity charging method after 3 years, when the cost of machine is Rs.8000/- and the scrap value is Rs4000/- only. Rate of interest is 5 percent. Also calculate the value of the machine after two years.
6. a) Discuss the various methods of appraising project profitability.  
 b) ABC Co. has got up to Rs.20,000 to invest. The following proposals are under consideration.

Project	Initial outlay Rs.	Annual cash flow Rs.	Life Yrs.
A	10,000	2,500	5
B	8,000	2,600	7
C	4,000	1,000	15
D	10,000	2,400	20
E	5,000	1,125	15
F	6,000	2,400	6
G	2,000	1,000	2

- i) Rank these projects in order of their desirability under the pay-back method.  
 ii) Rank these projects under the net present value index method, assuming the cost of capital to be 10 percent.  
 iii) Explain any glaring inconsistencies between (i) and (ii).
7. A manufacturer is offered two machines A and B. A has cost price of Rs.2,500, its running cost is Rs.400 for each of the first 5 years and increases by Rs.100 every subsequent year. Machine B having the same capacity as A, costs Rs.1,250, has running cost of Rs.600 for 6 years, increasing by Rs.100 per year thereafter. If money is worth 10% per year, which machine should be purchased? Scrap value of both machines is negligibly small.
8. Write short notes on any FOUR of the following:  
 i) Opportunity cost.  
 ii) Economies of scale.  
 iii) Exponential smoothing technique.  
 iv) Long run and short run cost curves.  
 v) Risk and uncertainty.

**MODEL QUESTION PAPER-Mechanical Engineering  
M.E. (INDUSTRIAL ENGINEERING)-I SEMESTER**

**IE 105 ADVANCED OPTIMIZATION TECHNIQUES (Model paper)  
(Four Semester-Credit System-w.e.f. 2007--2008)**

Time : 3 Hrs.

Max. Marks : 70

Answer any FIVE questions.

All questions carry equal marks.

1. a) What is arithmetic – geometric inequality?  
b) Minimize the following function:

$$f(X) = \frac{1}{2}x_1^2 + x_2 + \frac{2}{3}x_1^{-1}x_2^{-1}$$

2. a) Explain the problem of Dimensionality in Dynamic programming.  
b) Maximize  $f(x_1, x_2) = 50x_1 + 100x_2$

Subjected to

$$10x_1 + 5x_2 \leq 2500$$

$$4x_1 + 10x_2 \leq 2000$$

$$x_1 + 1.5x_2 \leq 450$$

$$x_1 \geq 0, \quad x_2 \geq 0$$

3. Solve the following problem using Bala's method.

Minimize  $f = 3x_1 + 2x_2 + x_3 + x_4$

Subjected to

$$x_2x_3 + x_4 \leq 1$$

$$2x_1 + x_2x_3 + x_4 \geq 3$$

$$x_i = 0 \text{ or } 1, \quad i = 1, 2, 3, 4.$$

4. A contractor plans to use four tractors to work on a project in a remote area. The probability of a tractor functioning for a year without a breakdown is known to be 82%. If X denotes the number of tractors operating at the end of a year, determine the probability mass and distribution function of X and also find the expected value and the standard deviation of the number of tractors operating at the end of one year.

5. Find the minimum of

$$f_1 = x_1^2 + x_2^2$$

$$f_2 = (x_1 - 2)^2 + x_2^2$$

Subject to

$$x_1 - x_2 - 1 \leq 0$$

6. a) Construct the objective function to be used in GAs for a minimization problem with mixed equality and inequality constraints.

b) Consider the following two strings denoting the vector  $X_1$  and  $X_2$

$$\mathbf{X}_1: \{1\ 0\ 0\ 0\ 1\ 0\ 1\ 1\ 0\ 1\}$$

$$\mathbf{X}_2: \{0\ 1\ 1\ 1\ 1\ 1\ 1\ 0\ 1\ 1\ 0\}$$

Find the result of crossover at location 2. Also, determine the decimal value of the variable before and after crossover if each string denotes a vector of two variables.

7. a) What is a sigmoid function? How it is affected by weighted sum of inputs, explain.  
b) How is a neuron modeled in neural network-based model, explain with one example.

8. Explain any four of the following.
- Goal programming method
  - Simulated Annealing Algorithm
  - Continuous Dynamic programming
  - Branch & Bound method
  - Complementary Geometric programming

**MODEL QUESTION PAPER-Mechanical Engineering  
M.E. (INDUSTRIAL ENGINEERING)-I SEMESTER**

**IE-106 TOTAL QUALITY MANAGEMENT  
(Elective-I)**

**(Four Semester-Credit System-w.e.f. 2007--2008)**

Time : 3 Hrs.

Max. Marks : 70

Answer any FIVE questions.

All questions carry equal marks.

- Describe the total quality management philosophy.
- What is the role of top management in setting a road map for quality improvement in an organization?
- What are the advantages of using quality function deployment? What are the key ingredients that are necessary for its success?
- What are the different types of quality audits? Discuss each and identify the context in which they are used.
- Discuss the emerging role of ISO 9000 standards in the global economy.
- Describe the steps of benchmarking relative to a company of your choice.
- State the merits and demerits of JIT production system.
  - Explain quality circles.
- Answer any THREE of the following:
  - Kaizen.
  - Taguchi method.
  - QC tools.
  - Quality policy.
  - Designing for quality.

**SECOND SEMESTER**  
**IE 201 INDUSTRIAL QUALITY MANAGEMENT**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

Basic concepts of quality assurance system - Statistical quality control - Processes capability analysis - Inspection standards - Control charts for process control - Acceptance sampling including sampling tables - Quality costs estimation and reduction - Quality circles including fault-tree analysis - Total quality control including automation - Product and system reliability: Basic concepts, Quantitative measurement, Prediction, Evaluation and Optimization, Maintainability, Case studies in quality and reliability management in manufacturing and service organizations.

**References:**

1. Statistical Quality Control by Grant E.L. and Leavenworth, R.S., 5th Edn., McGraw Hill, NY, 1980.
2. Quality Planning and Analysis from Product Development Through Usage by Juran, J.M. and Gryna, F.M., 2nd Edn., McGraw Hill, NY, 1980.
3. Guide to Quality Control by Kaoru Ishikawa, Asian Productivity Organization, 1982.
4. Applications of Quality Control in Service Industries by Rosander, A.C., Marel Dekker, Inc., (ASOC Quality Press), NY, 1985.
5. Engineering Maintainability, B. S. Dhillon, PHI (2000)
6. Principles of Quality Costs- Principles, Implementation and Use, Jack Comaperella, PHI (2000)
7. Introduction to Statistical Quality Control by Montgomery, John Wiely.
8. An Introduction to Reliability and maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill.

**IE 202 OPERATIONS PLANNING AND CONTROL SYSTEMS**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

Operations strategy - Concept of operation planning and control for various operational systems in manufacturing and non-manufacturing sector - Operations planning and control as an integrated system - Aggregate planning and master planning scheduling - Hierarchical productions planning - Material requirement planning, Lot sizing, MRP-II - Scheduling - Group technology - Engineering trends in planning and scheduling, Concepts of just-in-time, Pull and push system of work flow, Opt, etc. - project planning, Monitoring and control - Logistics, Distribution planning and control - Maintenance planning and control.

Implementation and evaluation of operations planning and control system.

Forecasting techniques including box jenkins - Material requirements, Explosion and levels - Classification and inventory analysis - Codification, Standardization and variety reduction - Make or buy decision - Inventory control techniques - Inventory systems - Material requirement planning, Phasing, Materials functions including budgeting, Purchasing and vendor development - Spare parts management - Stores and material accounting - Import export policies, Legal aspects of purchasing, Evaluation of materials management performance.



**References:**

1. Production Planning and Inventory Control, Narasimhan, Mc Leavy, Billington, PHI(1999)
2. Operation Management- Strategy and Analysis, Lee Krajewski and Larry P. Ritzman, Addison- Wesley (2000).
3. Operations Management : Theory and Problems by Monk, J.G., McGraw Hill, NY, 1985.
4. Computer Aided Production Management, P. B. Mohapatra, PHI (2001)
5. Manufacturing Planning and Control Systems by Vollmann, Thomas, E. and Others, Richard D. Irwin, Illinois, 1984.
6. Service Operations Management by Fitzsimmons, J.A. and Sullivan, R.S., McGraw Hill, NY, 1982.
7. Materials Management by Ammer, Dean, S., Richard D. Irwin, Illinois, 1962.
8. Managing Materials in Industry by Baily, Peter and Farmer, David, Grower Press, London, 1972.

**IE 203 HUMAN RESOURCE DEVELOPMENT & INDUSTRIAL RELATIONS**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**Personnel function:** Its evolution, Objective principles, Philosophies, Duties and responsibilities of the personnel management in India. Manpower planning: Its uses and benefits - Problems and limitations - Manpower inventory: Manpower forecasting - Manpower skills analysis and practices in Indian industry recruitment: Selection process, Psychological testing - Interviewing techniques, Transfer, Promotion and its policies - Induction placement and exit interview wage and salary administration.

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

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

**References:**

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

## IE 204 FACILITY PLANNING AND DESIGN

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

Introduction to layout design process - Systematic layout planning - Computerized layout planning - ALDEP, CORELAP, CRAFT, Single and multi-facility location problems - Desuete and continuous location and layout problems - Quadratic assignment location problems - Minmax layout and location problems - Discrete plant location and covering problems.

Weberian location theory: Contribution of Hoover, Greenhut and Losch, Isard and others to locational dynamics of manufacturing facilities - Plant and warehouse location and multiproduct distribution system design problems.

Approaches for solving location decision problems with private or public sector goals - Economics of scale - Capacity and configuration constraints and multiperiods

### References:

1. Manufacturing Facilities- Location, Planning and Design, D.R. Sule, PWS- Kent Publishing Co.
2. Facilities Planning, James A. Tompkins and John A. White, John Wiely
3. Facility Layout and Location- An Analytical Approach, Richard L. Francis, Leon F Mc Ginnes and John A. White, PHI(1999)
4. Location on Network Theory and Algorithms by Handler, G.Y., Mirchandani, P.B., MIT Press, 1979.

## IE 205 SYSTEM DYNAMICS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**Introduction to system dynamics:** Basic problem - Fundamental system concepts - Occurrence of dynamic phenomena in managerial and economic systems - Objectives of a system dynamic analysis.

**System structure and behaviour:** Principles for formulating dynamic system models - Structure of dynamic system model - System of equations - Symbols for flow diagrams - Representation of delays - Policies and decisions - Aggregation of variation - Exogenous variable judging model validity.

**Examples of dynamic system model:** Model of production distribution system (Forrester models).

**Further examples:** System dynamics in manufacturing - Marketing and distribution - Research and development - Managerial control and financial applications.

**Application of system dynamics to societal:** Problems - Regional economic simulation model - Urban transportation planning model - Natural resources management and sociological systems - Case studies.

### References:

1. A Study Notes on System Dynamics, Goodman, MIT Press
2. Industrial Dynamics, Forester, MIT Press
3. System Dynamics Modelling and Policy Design, Mohapatra, Bora and Mandal, University Press

4. Management System Dynamics by Coyle, John Wiley, 1977.
5. System Dynamics by Ogata, K., Prentice Hall, NJ, 1978.
6. Managerial Application of System Dynamics by Roberts, E.B., MIT Press.

**Elective - II**

**(A) IE 206 MANUFACTURING RESOURCE PLANNING**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

An overview of MRP-II, Master production scheduling and final assembly scheduling, Strategic and business planning, Sales and operations planning, Demand management, Master production scheduling, Bill of materials, Capacity management, Shop floor control, Introduction to ERP, SCM and CRM.

**Reference:**

1. Manufacturing Resource Planning (MRP-II) by Khalid Sheikh, Tata McGraw Hill, 2002.

**Elective - II**

**(B) IE 206 TECHNOLOGY MANAGEMENT**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

Technology development and society: Technology and Corporate growth, Technology forecasting, Technology transfer, Adoption and diffusion, Technology innovation and applied research, Technology assessment, Evaluation of R & D projects, Budgeting and cost control, Managing technology development, Product development, Market development.

**References:**

1. Managing Technology - The Strategic Vies by Lowell W. Steele, McGraw Hill.
2. Technology Strategy and the Firm by Mark Dodgson, Longman.

**Elective - II**

**( C ) IE 206 MANAGEMENT INFORMATION SYSTEMS**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

**Concepts of MIS:** Meaning and role of MIS in an organization. Analysis and design of information systems; Conceptual modelling of data and process in organizations. Tools for modelling and analysis of data: Data flow diagram, Data dictionary.

**Tools for modelling and analysis of processes:** Flow charts, Structured english and pseudocode, Decision tables, Decision trees. Structured design of data processes: Structured design of data (File design), Structure chart, Transform analysis, Transaction analysis.

**Semi structured problems and DSS. Management perspectives:** Evolution of MIS in an organization (Nolan's state model), System development life cycle model and Project planning for MIS.

**Contingency approaches to information, Requirements analysis.** Contingency approaches to applications. Development. Pitfalls in MIS development. Information system audit. Long term MIS planning. Applications: MIS in various functional areas. Case studies and project assignments.

**References:**

1. Management Information Systems, Laudon and Laudon, PHI(1999)
2. An Introduction to Data Base Management System by Data, C.J., Narosa Publication House, New Delhi, 1985.
3. Design of Computer Data Files by Owen Hansan, Pitman.
4. Management Information Systems by Davis Gordon.
5. Information Systems for Modern Management by Murdic, Ross and Clagget, PHI, 1985.
6. Management Information Systems-Conceptual Foundations by Davis Gordon, McGraw Hill.

**Elective – II**

**(D) IE 206 PRODUCT DESIGN MANAGEMENT**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.

Ses. : 30 Exam: 70

Examination (Theory): 3hrs.

Credits: 4

Introduction to design, Product design, Design management, Product management. Traditional & modern design, Design process, Organizational objectives.

Need related intelligence, Identification of latent needs, Technology related intelligence, Development of technological competence.

Organizational strength & weakness, Criteria for a new product, New product management, Forward planning, Coordination and communication.

Innovation, creativity and diffusion, Techniques for creative idea generation. Evaluation of new products ideas, Functions- technological, Ecological, Legal.

Investigating user behaviour - User habits, Expectations, Perception, Techniques for investigating user behaviour.

Stating objectives, Product formulation, Development of business analysis, Analysis for development, Boundary search and functional innovation.

Product design and design methods, Selection of methods appropriate to design stage. Design evaluation - Analysis for fault, Value and Reliability. Ergonomic analysis, Analysis for maintenance and useful life.

Market preparation vendor search, Sales promotion, Test marketing product and introduction strategy.

Organizational structure for effective product innovation and role of product manager.

**References:**

1. Corporate Strategy and product Innovation by Rothberg, Robert, R., The Free Press, 1976.
2. Design Methods, Seeds of Human Future by Jones, J.C., John Wiley, 1970.
3. New Product Development by Grunwald, G., Business Books, Illinois, 1985.
4. Product Design and Manufacturing, A. K. Chitale and R. C. Gupta, PHI (2002)

**Elective – II**  
**(E) IE 206 PRODUCTION MANAGEMENT - STRATEGIC PERSPECTIVES**  
(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.  
Examination (Theory): 3hrs.

Ses. : 30 Exam: 70  
Credits: 4

**Strategic role of production management** - Meshing of short and medium term operations planning and control with long term strategic goals of the organisation.

**Concepts of strategy.** Hierarchy of strategic decisions.

**Strategic choices in manufacturing:** Capacity - Amount, Timing, Type. Facilities - Size, Location, Specialization (focus). Process - Span, Scale, Flexibility. Vertical - Direction, Extent, Balances. Integration - Alternatives. Vendors - Number, Structure, Relationship. Quality - Strategic role, Various dimensions, Balance. Systems - Organisation, Planning, Scheduling and Control. Human resources - People based strategy, Various practices.

**Emerging production management concepts and practices,** Such as just-in-time with examples and cases.

**Manufacturing strategy interconnectedness** with financial, Costing and reward systems and need for change in reporting and evaluation systems.

**Service operations strategy** - Comparison with manufacturing strategy.

**References:**

1. Restoring Our Competitive Edge, Competing Through Manufacturing by Hayes, R.H. and Wheelwright, S.C., John Wiley, NY, 1984.
2. Manufacturing Strategy by Hill Terry, McMillan Educational Foundation, London, 1985.
3. Manufacturing the Formidable Competitive Weapon by Skinner, W., John Wiley, NY, 1985.
4. Strategic Manufacturing: Dynamic (New) Directions for the 1990s by Moody, Patricia (Ed.), Don Jone Irwin, 1990.

**Elective - II**  
**(F) IE 206 HUMAN FACTORS ENGINEERING**  
(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th.  
Examination (Theory): 3hrs.

Ses. : 30 Exam: 70  
Credits: 4

**Introduction** to Human factors and systems.

**Information Input:** Information input and processing, Text, Graphics, Symbols, and Codes, Visual displays of dynamic information, Auditory, Tactual, and Olfactory displays, communications

**Human Output and Control:** Physical Work and Manual Materials Handling, Motor Skills, Human Control of Systems, Controls and Data Entry Devices, Hand Tools and Devices

**Workplace Design:** Applied Anthropometry, Work-Space Design and Seating, Arrangement of Components within Physical Space, Interpersonal Aspects of Workplace Design

**Environmental Conditions:** Illumination, Climate, Noise, Motion

**Human Factors Applications:** Human Error. Accidents, and Safety, Human Factors In Systems Design

**References:**

1. Human Factors in Engineering and Design, by Mark S. Sanders and Ernest J. McCormic, Tata McGraw-Hill & McGraw-Hill International Editions.
2. Human Factors Methods: A Practical Guide for Engineering and Design by Paul M. Salmon, Neville A. Ashgate Publishing, Ltd.
3. Ergonomics at Work by David J. Osborne, John Wiley & Sons Ltd.
4. Fitting the Task to the Man – A Text Book of Occupational Ergonomics by Taylor & Francis.
5. A Guide to the Ergonomics of Manufacturing by Martin Helender, Taylor & Francis.
6. Human Factors in Product Design by William H. Cushman and Daniel J. Rosenberg, Elsevier.

**IE 207 SEMINAR**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 3 Pr.

Ses. : 50

Credits: 2

The student has to give at least three seminars on topics related to Industrial Engineering.

**IE 208 COMPUTER APPLICATIONS LAB**

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 3 Pr.

Ses. : 50

Credits: 2

**Data analysis:**

Statistical analysis of data with graphs - Linear regression - Multiple linear regression.

**Operations research:**

Linear programming - Networks - Queuing.

**Production management:**

Inventory - Layout/Line balancing - Forecasting - Scheduling.

Simulation models.

**THIRD SEMESTER**  
(Four-Semester Course -Credit System- w.e.f. 2007-2008)  
**IE 301 PROJECT**

Project (to be continued in Fourth semester)

Periods per week: 12 Credits: 14

Semester end appraisal of Project Through seminar by a committee consisting of Head of the Department, Chairman, Board of Studies & Guide

**FOURTH SEMESTER**  
(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Project (continued from Third semester)

Periods per week: 12

Presentation followed by Viva-Voce Examination with the following members.

1. Chairman, Board of Studies.
2. Head of the Department.
3. External Examiner.
4. Internal Guide and External Guide (if any).

No marks are allotted for the Project work.  
Viva-voce - Examination: Recommended/Not recommended.  
For final result the dissertation credits are not added for CGPA..