UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VIII SEMESTER

MECHANICAL - STREAM - INDUSTRIAL ENGINEERING

SCHEME -2013

VIII SEMESTER

MECHANICAL - STREAM - INDUSTRIAL ENGINEERING (N)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.801	Industrial Scheduling (N)	4	3	1	-	50	4	100	150
13.802	Mechanical Measurements and Metrology (N)	3	2	1	-	50	4	100	150
13.803	Financial Engineering (N)	4	3	1	-	50	3	100	150
13.804	Creativity and Product Development (N)	3	2	1	-	50	3	100	150
13.805	Elective IV	4	3	1	-	50	3	100	150
13.806	Elective V	4	3	1	-	50	3	100	150
13.807	Seminar(MNPSU)	2	-	-	2	100	-	-	100
13.808	Project , Viva-Voce and Industrial Visit (MNPSU)	5	-	-	5	100	-	100	200
	Total	**29**	**16**	**6**	**7**	**500**		**700**	**1200**

13.805 Elective IV

13.805.1	Artificial Intelligence and Neural Networks (N)
13.805.2	Marketing Management (N)
13.805.3	Design and Analysis of Algorithms (N)
13.805.4	Managerial Economics (N)
13.805.5	Multi-criteria Decision Making (N)
13.805.6	Facilities Design and Planning (N)

13.806 Elective V

13.806.1	Flexible Manufacturing Systems (N)
13.806.2	Agile and Lean Manufacturing (N)
13.806.3	Total Quality Management (N)
13.806.4	Business Process Reengineering (N)
13.806.5	Econometrics (N)
13.806.6	Human Factors in Engineering (N)

13.801 INDUSTRIAL SCHEDULING (N)

Teaching Scheme: 3(L)-1(T)-0(P) **Credits**: 4

Course Objectives:

- *Develop knowledge on scheduling and techniques for minimizing flow time.*
- *Understand scheduling methodologies for single machine and parallel machine models.*
- *Acquire knowledge on advanced scheduling methodologies for flow shop and job shop.*

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.

Module – II

General Purpose methodologies for single machine problems:- Dynamic Programming approach, Branch & Bound Approach, Neighbourhood search techniques. Parallel Machine Models:- Parallel Identical processors and Independent jobs, Parallel Identical processors and Dependent jobs.

Module – III

Flow Shop Scheduling:- Permutation schedule, Johnson's problem, Branch & Bound Algorithms for Makespan problems, Heuristic Approaches, Flow shops without Intermediate Queues.

Module – IV

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. Kenneth R. Baker, *Introduction to Sequencing and Scheduling,* John Wiley.
2. Michael L. Pinedo, *Scheduling – Theory, Algorithms and Systems*, Prentice Hall Inc.
3. Kenneth R. Baker and Dan Trietsch, *Principles of Sequencing and Scheduling*, Wiley.

4. French S., *Sequencing and Scheduling*, Elis Horwood Ltd., Chinchester, UK.
5. Conway R. W., W. L. Maxwell and L. W. Miller, *Theory of Scheduling*, Addison-Wesley.
6. Coffman E. G., *Computer and Job shop Scheduling Theory*, Wiley.
7. Bedworth D. D. and J. E. Bailey, *Integrated Production Control System,* Wiley.

Internal Continuous Assessment Pattern: *(Maximum Marks: 50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 3) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

- *Knowledge on the role of scheduling and techniques for minimizing flow time.*
- *Understanding on scheduling methodologies for single machine and parallel machine models.*
- *Knowledge on advanced scheduling methodologies for flow shop and job shop.*

13.802 MECHANICAL MEASUREMENTS AND METROLOGY (N)

Teaching Scheme: 2(L)-1(T)-0(P) **Credits**: 3

Course Objectives:

- *To educate students on different measurement systems and on common types of errors.*
- *To give knowledge about thermocouples, thermometers and flow meters used for measurements.*
- *To introduce measuring equipments used for linear and angular measurements.*
- *To familiarize students with surface roughness measurements on machine components.*

Module – I

Science of Measurement: Mechanical measurement–direct comparison and indirect comparison–the generalized measurement system–types of input quantities–measurement standards–calibration–uncertainty–systematic and random errors–common types of errors–classifications of errors–terms used in rating instrument performance–introduction to uncertainty–zero, first and second order instruments–methods of correcting for spurious inputs –inherent insensitivity–high gain feedback–signal filtering and opposing inputs.

Module – II

Linear and Angular measurements: Slip gauges-stack of slip gauge–method of selecting slip gauges–adjustable slip gauge–measurement of angles–sine bar checking unknown angles – sine center–sources of error–angle gauges-optical instruments for angular measurement–auto collimator–applications–straightness and squareness– angle dekkor–precision spirit levels–clinometers.

Module – III

Miscellaneous measurements: Measurement of surface roughness–surface texture–primary texture–secondary texture and the lay specification for surface textures–methods form measuring surface finish–the Talysurf instrument–the profilograph–Tomlinson surface meter–Tracer type profilograph–measurement of screw thread profiles–errors in pitch–microscopic method–measurement of internal thread–measurement of effective diameter two wire and three wire method– measurement of root diameter–gear tooth measurement- measurement of gear profile–tooth thickness–tooth spacing–pitch circle diameter–Parkinson's gear tester– the coordinate measuring machine constriction and operation.

Module – IV

Measurement of Temperature and Flow: Measurement of temperature– liquid in glass thermometer–complete partial and total immersion thermometers–resistance thermometers–constructional details–resistance thermometer circuits–lead wire compensation for resistance thermometers – thermistors–constructional details–measuring circuits for thermistors – thermoelectric thermometers – laws of thermocouples – industrial thermocouples and their ranges–making of thermocouple junctions–ambient temperature compensation–pyrometers–optical total radiation and photo electric– measurement of flow–need for flow metering–rota meter–theory and constructional details–magnetic flow meters–hotwire anemometers.

References:

1. Ernest O Doeblin, *Measurement systems*, McGraw Hill Publishers, 2003.
2. Jain R. K., *Engineering Metrology*, Khanna Publishers, New Delhi, 2009.
3. Gupta I. C., *Engineering Metrology*, Dhanpat Rai Publications, 2004.
4. Beckwith Thomas G., *Mechanical Measurements*, Pearson Education, 2008.

Internal Continuous Assessment: *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

- *Students will be able to work in Quality control and quality assurances divisions in Industries*
- *Students will be able to design measuring equipments for the measurement of temperature and flow.*

13.803 FINANCIAL ENGINEERING (N)

Teaching Scheme: 3(L)-1(T)-0(P) **Credits**: 4

Course Objectives:

- *To provide preliminary knowledge of various topics related to mathematical finance.*
- *To provide the students a basic understanding of interest theory and various derivatives and its pricing aspects.*
- *To create interest among students in the study of mathematical concepts applied to finance.*

Module – I

The Basic theory of interest:- Principal and Interest – Simple interest, Compound interest, Frequent and Continuous compounding. Present and Future value of streams – Future value, Present value, Net Present Value, Internal Rate of Return. Bond Return and Valuation:- Bond basics, Bond risk, Bond return, Yield to maturity, Bond value theorems, Convexity, Yield curve, Duration, Immunization.

Module – II

Stock Return and Valuation:- Return, The anticipated return, Present value of the return, Constant growth model, Two-stage growth model, The Three phase model, Valuation through P/E ratio, Whitbeck Kisor Model, Preferred stock valuation. Efficient market theory:- Basic concepts, The Random-Walk theory, Weak form of EMH, Semi-strong form, Strong form, Market inefficiencies.

Module – III

Mean-Variance portfolio theory:- Portfolio Mean and Variance, The Markowitz model, Mathematical Formulation of the Markowitz model and its solution, The Two-Fund theorem, Inclusion of a Risk free asset, The One-Fund theorem. The Capital Asset Pricing model (CAPM), Arbitrage pricing theory.

Module – IV

Derivative Securities:- Forward contracts, Forward prices, Swaps, Futures contracts, Futures prices, Hedging, Speculation. Options Theory:- Concepts, Nature of option values, Put-Call parity, European and American options, Single period Binomial options theory, The Black-Scholes pricing model.

References:

1. David G. Luenberger, *Investment Science,* Oxford University Press.
2. John C. Hull, *Options, Futures and Other Derivatives,* Prentice Hall.
3. Marek Capinski and T. Zastawnaik, *Mathematics for Finance,* Springer.
4. Damien Lamberton and Bernard Lapeyre, *Introduction to Stochastic Calculus Applied to Finance,* Chapman & Hall.
5. John F. Marshall and K. B. Vipul, *Financial Engineering,* Prentice Hall India.
6. Punithavathy Pandian, *Security Analysis and Portfolio management,* Vikas Publishing House.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, the student shall be able to:

- *Understand various terminologies and processes related to bond and derivatives market.*
- *Build careers in the mathematical applications in financial sector, which is an upcoming area in recent times.*

13.804 CREATIVITY AND PRODUCT DEVELOPMENT (N)

Teaching Scheme: 2(L)-1(T)-0(P) **Credits**: 3

Course Objectives:

- *To provide the students a set of tools and methods for product design and development.*
- *To make the students aware of the role of multiple functions in new product creation.*
- *To introduce students to design thinking techniques and new creativity skills.*

Module – I

Creativity: - Concepts, Systems perspective of creativity, Components of creativity, Managing creativity, Cognition, Creativity and innovation brainstorming, Creativity and Problem solving, Synectics, TRIZ, Morphological analysis. Adaption - Innovation theory, Adaptors and Innovators. Product: - Definition, Types of products, Levels of product. New product development -Complexity of product development, Challenges of product development, Characteristics of successful product development, marketing mix, product-market matrix, Product planning.

Module – II

Product life cycle (PLC): - Strategies during different stages of PLC, Extended PLC, Customer satisfaction, KANO diagram of customer satisfaction, Time to market, Product architecture and modularity. Product Lifecycle Management (PLM), Introduction of PLM softwares. Phases of a generic product development process: - Planning, Concept development, Prototyping, System level design, Detailed design, Testing and refinement.

Module – III

Product design: - Definition, Design by evolution, Design by innovation, Design by imitation, Factors affecting product design. Decision making and iteration - Role of aesthetics in design. Introduction to optimization in design: - Economic factors in design, Design for safety and reliability, Human engineering consideration in design, Product design for environmental sustainability. Value engineering and product design: - Quality assurance in product design, Design for manufacturing and assembly, Reverse engineering.

Module – IV

Identifying customer needs: - Quality Function Deployment (QFD), Concept generation methods, Idea generation methods, Information sources for concept generation. Intellectual property – Concept of Intellectual property, Kinds of Intellectual property, IPR in India. Patents: - Definition, granting, infringement, searching and filing. Copyrights: - Definition,

granting, infringement, searching and filing. Trademarks and their role in commerce. Crowd sourcing and Open innovation.

References:

1. Karl T. Ulrich and Steven D. Eppinger, *Product Design and Development,* Tata McGraw Hill.
2. Chitale A. K. and R. C. Gupta, *Product Design and Manufacturing*, Prentice Hall of India.
3. Merie Crawford, *New Product Management*, McGraw-Hill.
4. Kevin Otto and Kristin Wood, *Product Design, Techniques in Reverse Engineering and New Product Development,* Pearson Education.
5. Ajit Parulekar and Sarita D'Souza, *Indian Patents Law: Legal and Business Implications,* Macmillan India Ltd.
6. Narayanan P., *Law of Copyright and Industrial Designs.* Eastern Law House, New Delhi.
7. Jane Henry, *Creative Management and Development,* Sage Publications, New Delhi.
8. Mark A. Runco, *Creativity: Theories and Themes- Research Development and Practice,* Elsevier Academic Press, USA.
9. Vijay Gupta, *An Introduction to Engineering Design Methods,* Tata McGraw-Hill, New Delhi.
10. George E. Dieter and Linda C. Schmidt, *Engineering Design*, McGraw-Hill.
11. Sreenivasulu N. S., *Intellectual Property Rights,* Regal Publications.
12. Anurag K. Agarwal, *Business and Intellectual Property*, RHI.

Internal Continuous Assessment Pattern: *(Maximum Marks: 50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 3) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, the student shall be able to:

- *Use the creativity techniques to come up with new product ideas.*
- *Coordinate multiple, interdisciplinary tasks to achieve a common objective.*

13.805.1 ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS (N) (Elective IV)

Teaching Scheme: 3(L)-1(T)-0(P) **Credits**: 4

Course Objectives:

- *To identify problems that can be expressed in terms of search problems or logic problems and translate into an appropriate form so as to address using an algorithmic approach.*
- *To express problems in terms of neural networks and to select an appropriate learning methodology for the problem area.*

Module – I

Artificial Intelligence (AI): - Concept and Definition, History of AI, Weak and Strong AI, Turing test, Physical symbol system hypothesis. Components of AI – Theoretical components, Hardware/Software components. Parallel and Distributed AI. Problem Solving through AI: - Methodology, Representation of AI problems, Production system, Salient features of production rules, Characteristics of production system, Algorithm of problem solving, Examples of AI problems.

Module – II

Heuristic Search: - Concepts, Generate and test, Best-first search, Problem reduction, Hill-climbing search, Constraint satisfaction, Means ends analysis, Mini-max search. Knowledge: - Types of knowledge, Knowledge representation – Techniques – Frames, Semantic network – Conceptual graphs and dependencies – Script – CYC – Object oriented representation, Knowledge storage, acquisition, organization and management, Knowledge engineering methodologies – Common KADS, SPEDE, MOKA.

Module – III

Logic: - Basics, Propositional calculus, Predicate logic, Resolution, Unification, Logic limitations, Logic programming, Matching, Conflict resolution. Reasoning with uncertainty. Natural Language processing. Introduction to LISP and PROLOG (Overview only). Machine Learning: - Types – Rote learning, Direct Instruction, Induction, Deduction, Analogy. Planning- Components, Block world planning system, Solution identification. Understanding – Complexities, mapping.

Module – IV

Neural Networks: - History, Biological neuron, McCulloch – Pitts Neuron model, Neuron model for ANN, Feed forward ANN, Feedback ANN, Neural processing, Types of activation function, Learning in neural network – Reinforced learning, Unsupervised learning, Hebbian learning. Pattern Recognition: - Process, Syntactic approach, Decision theoretic approach. Computer Vision: - Basics, Human vision processing, The Waltz algorithm. Expert Systems: - Overview, Human experts vs. Expert systems, Characteristics of an expert system, Expert system architecture, Domain exploration.

References:

1. Simon Haykin, *Neural Networks and Learning Machines*, Prentice Hall.
2. Ela Kumar, *Artificial Intelligence,* I.K. International, New Delhi.
3. Bishop C. M., *Neural Networks for Pattern Recognition,* Oxford University Press.
4. Sandhya Samarasinghe, *Neural Networks for Applied Science and Engineering,* Auerbach Publications.
5. Stuart Russell and Peter Norvig*, Artificial Intelligence: A Modern Approach,* Pearson.
6. Rich E. *et al*., *Artificial Intelligence*, Tata McGraw Hill Education Pvt. Ltd.
7. Rajiv Chopra *Artificial Intelligence: A Practical Approach*, S. Chand Publications.
8. Charniak, *Introduction to Artificial Intelligence,* Pearson India.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, the student shall be able:

- *To identify problems that can be expressed in terms of search problems or logic problems and translate into an appropriate form so as to address using an algorithmic approach.*
- *To express problems in terms of neural networks and to select an appropriate learning methodology for the problem area.*

13.805.2 MARKETING MANAGEMENT (N) (Elective IV)

Teaching Scheme: 3(L)-1(T)-0(P) **Credits**: 4

Course Objectives:

- *To understand the various processes involved in Marketing and its Philosophy.*
- *To learn the Psychology of consumers.*
- *To formulate strategies for advertising, pricing and selling.*

Module – I

Core concepts of Marketing – Marketing environment –customer oriented organization– Marketing interface with other functional areas– marketing in a globalised environment. Marketing management process and marketing planning –Marketing mix– product mix– Product Planning and Development– Product Life Cycle– Brand management– Developing New Product.

Module – II

Market segmentation–targeting and positioning- Pricing decisions- Promotion methods: Advertising, personal selling, Public relations-Introduction to industrial marketing. Understanding Buyer Behaviour – Influencing factors – responding buyer behaviour – Building customer satisfaction– marketing of services. Distribution: Channels, Physical Distribution, channel design and Management – Logistics – Communicating with customers.

Module – III

Marketing Research: Types, Process, Tools and Techniques– Application of Marketing research: Product launching, demand estimation, customer satisfaction; customer perception, distribution, Customer Relationship – Competitor analysis and related Aspects– preparation of marketing research reports. On-line marketing – On-line retail – On-line sales promotion – Web enabled advertisements – Web based Marketing research – Emerging new trends and challenges to marketers.

Module – IV

Introduction to International Marketing Management: Overview, International economic institutions, foreign markets, export pricing and finance, India's trade policy. Web enabled Marketing features – specific characteristics and components of marketing mix under web enabled environment.

References:

1. Philip Kotler, *Marketing Management* (Millennium edition), PHI (P) Ltd.
2. Zikmundd'Amico, *Marketing*, South Western, Thomson Learning.

3. Aakar, Day and Kumar, *Essentials of Marketing Research,* John Wiley & Sons.
4. Keith Flether, *Marketing Management and Information Technology*, Prentice Hall.
5. Varshney R. L., S. L. Gupta, *Marketing Management Indian Perspective*, S. Chand.
6. Rafia. Mohammed, *Internet Marketing*, McGraw Hill.
7. David Ferris and Larry Whipple, *Building an Intelligent E-Business*, PHI.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each.All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After completion of this programme, students are expected to know

- *Importance of various elements of marketing mix.*
- *Application of various techniques in design of optimum marketing mix.*
- *Planning marketing programs for better performance of the organisation.*

13.805.3 DESIGN AND ANALYSIS OF ALGORITHMS (N) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *Understand the steps in algorithm analysis.*
- *Understand the limitations of Algorithm power.*
- *Learn different algorithm design techniques.*

Module - I

Role of algorithms in computing, Algorithm Analysis – Time Space Tradeoff – Asymptotic Notations – Conditional asymptotic notation – Removing condition from the conditional asymptotic notation -Properties of big-Oh notation – Recurrence equations – Solving recurrence equations –Analysis of linear sear.

Module - II

Brute Force – Closest-Pair and Convex-Hull Problems-Exhaustive Search – Travelling Salesman Problem – Knapsack Problem – Assignment problem. Divide and conquer methodology – Merge sort – Quick sort – Binary search – Multiplication of Large Integers – Strassen's Matrix Multiplication-Closest-Pair and Convex-Hull Problems.

Module - III

Computing a Binomial Coefficient – Warshall's and Floyd' algorithm – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique– Prim's algorithm-Kruskal's Algorithm- Dijkstra's Algorithm-Huffman Trees. The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs- The Stable marriage Problem.

Module - IV

Limitations of Algorithm Power-Lower-Bound Arguments-Decision Trees-P, NP and NP-Complete Problems–Coping with the Limitations – Backtracking – n-Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem-Branch and Bound – Assignment problem – Knapsack Problem – Travelling Salesman Problem- Approximation Algorithms for NP – Hard Problems – Travelling Salesman problem – Knapsack problem.

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms*, Third Edition, PHI Learning Private Limited, 2012.

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, *Data Structures and Algorithms*, Pearson Education, Reprint 2006.
3. Donald E. Knuth, *The Art of Computer Programming*, Volumes 1& 3 Pearson Education, 2009.
4. Steven S. Skiena, *The Algorithm Design Manual*, Second Edition, Springer, 2008.
5. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, Third Edition, Pearson Education, 2012.

Internal Continuous Assessment Pattern: *(Maximum Marks: 50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 3) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each full question carries 20 marks.

Course Outcomes:

Upon completion of the subject, students will:

- *Be able to design algorithms for various computing problems.*
- *Critically analyze the different algorithm design techniques for a given problem.*
- *Be able to modify existing algorithms to improve efficiency.*

13.805.4 MANAGERIAL ECONOMICS (N) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *The course is aimed at building a perspective necessary for the application of modern economic concepts, precepts, tools and techniques in evaluating business decisions taken by a firm.*
- *The course will also look at recent developments in business in the context of economic theory.*

Module – I

Demand analysis and theory of production: Demand function, Determinants of demand, Elasticity of demand, Applications of demand analysis in managerial decision making, Economic Forecasting: - Sources of data, Time series analysis – Trend projection, Exponential smoothing; Barometric forecasting, Input/output analysis.

Module – II

Demand analysis and theory of production: Demand function, Determinants of demand, Elasticity of demand, Applications of demand analysis in managerial decision making, Economic Forecasting: - Sources of data, Time series analysis – Trend projection, Exponential smoothing; Barometric forecasting, Input/output analysis.

Module – III

Production theory and analysis:- The Production function, Production with one variable input, Production with two variable inputs, Economies of scale and scope, Estimating the production function. Cost Theory and Analysis: Economic concept of cost, Production and cost, Short-Run and Long-run cost functions, Profit contribution analysis, operating leverage, Estimating cost functions. Market Structure:- Introduction to Market structure, Perfect competition, Monopoly, Monopolistic competition, Oligopoly, Barriers to entry, Application of Game theory to oligopoly.

Module – IV

Strategic Behavior of Pricing Decisions – Pricing of Goods and Services, Pricing of multiple products, Price discrimination, Product bundling, Peak-Load pricing, Mark up pricing, Input pricing and employment, Economic rent, Wage and income differentials, Labour unions, Minimum wage laws. Determinants of economic development; Methods of measurement

of national income; Inflation: Meaning, theories and control measures, recent developments in Indian economy.

References:

1. Craig Petersen H. and W. Cris Lewis, *Managerial Economics*, Pearson.
2. Dwivedi D. N., *Microeconomics: Theory and Applications*, Pearson.
3. Scott Bierman H. and Luis Fernandez, *Game Theory with Economic Applications*, Pearson.
4. Karl. E. Case and R. C. Fair, *Principles of Economics*, Pearson.
5. Christopher R. Thomas and S. Charles Maurice, *Managerial Economics*, McGraw Hill, 2008.
6. Petersen H. C., L. W. Cris and S. K. Jain, *Managerial Economics*, Pearson Education, 2008.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each.All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, students will get necessary foundation on the following:

- *Obtain an overview of modern economic concepts.*
- *Apply the tools and techniques in evaluating business decisions taken by a firm.*
- *To learn the recent developments in business.*

13.805.5 MULTI-CRITERIA DECISION MAKING (N) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To provide knowledge of the latest multi-criteria decision making techniques.*
- *To make the students aware of the application of these techniques in practical applications.*
- *To enable students to select appropriate multi-criteria decision making methods for specific applications.*

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, Multi-criteria control problems.

Module – II

Goal programming: Classification of GP, Integration and combination of GP with other techniques- applications. Evolutionary algorithms and multiple objective optimizations: Definitions, Pareto based and Non-Pareto based techniques- applications.

Module – III

Multi objective combinatorial optimization: Properties, Solution methods. Analytic Hierarchy Process (AHP):- pair wise comparisons, criterion weights and aggregation, consistency etc. Analytic Network Process (ANP).

Module – IV

Data Envelopment Analysis in multi criteria decision making: Basic DEA models, GDEA. Introduction to outranking methods: - ELECTRE and PROMETHEE I and II methods. Applications of MCDM methods: - MCDM in discrete and network location problems, MCDM in Portfolio decision making, MCDM in discrete financial decision making problems.

References:

1. Arakawa and Billaut, *Multiple criteria Optimization*, Kluwer.
2. Lootsma, *Multi-Criteria Decision Analysis via Ratio and Difference Judgement*, Springer.

3. Subhash C. Ray, *Data Envelopment Analysis: Theory and Techniques for Economics and Operations Research*, Cambridge University Press.
4. Vincent T'kindt Jean, Charles Billaut, *Multi-criteria Scheduling: Theory, Models and Algorithms*, Springer.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each.All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, the student

- *shall be able to get an introduction to various multi-criteria decision making techniques, which is one of the fast growing subfields of Operations Research.*
- *is introduced to various tools for making choices in the presence of multiple conflicting criteria.*

13.805.6 FACILITIES DESIGN AND PLANNING (N) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *Should develop knowledge on various facility planning and design methods..*
- *Should be in a position to use various qualitative as well as quantitative methods of facility planning and design in different industries.*
- *Should acquire knowledge on various material handling techniques and line balancing methods.*

Module – I

Basic concepts, Evolution and motivation-Layout Design of factories and facilities -Selection of site and location decisions – Product, Process, combination, fixed and cellular layouts – Systematic layout planning – Graph based processes - Computer applications in layout designs construction and improvement algorithms in layout design.

Module – II

Quantitative Facility Planning Models- Facility Location Models-Rectilinear Facility Location Problem Design of Auxiliary Service Spaces - Receiving and Shipping, Storage, Aisles, Warehousing and Employee services. Office layout techniques and space requirements. Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam, compressed air etc.

Module – III

Material handling system and equipment –Principles, Material handling in Plants, Stores and warehouses, Receiving and dispatching area – Choice of material handling equipment – Cost control in material handling. Automatic Guided Vehicles- Basic concept, Design and operational control of an AGV system transportation control, operational control, Combinations.

Module – IV

Equipment replacement – Repair and replacement based on technical and economical consideration. - Design of Assembly lines, Line balancing methods. Advanced areas in facilities design and planning.

References:

1. White R. L. and J. A. White, *Facilities Location and Layout – An Analytical Approach,* PHI.
2. Tompkins, White, Bozer and Tanchoco, *Facilities Planning,* John Wiley and Sons.
3. John A. Sehbin, *Plant layout and Material Handling*.
4. James A. Apple, *Plant layout and Material Handling*.
5. Peymberton A. W., *Plant layout and Material Handling.*
6. Fred Meyers, *Plant layout and Material Handling.*
7. Sharma S. C., *Material Handling and Layout*.
8. Kuiak, *Intelligent Manufacturing Systems*, Prentice Hall.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

- *Thorough understanding of SLP method and Graph based method.*
- *Should be in a position to design proper material handling device for the designed layout.*
- *Acquire knowledge on Equipment Replacement and its importance in Facilities planning and Design.*

13.806.1 FLEXIBLE MANUFACTURING SYSTEMS (N) (Elective V)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *Should develop knowledge on material handling.*
- *Should be able to use petrinet, DNC and PLC.*
- *Should acquire knowledge on scheduling, GT and JIT.*

Module – I

FMS – An overview: Definition of an FMS – types and configurations concepts – types of flexibility &performance measures. Functions of FMS host computer – Development and implementation of an FMS: Planning phases – Integration – System configuration – layouts – simulation. FMS project development steps. Project management- equipment development – host system development - planning – hardware & software development.

Module – II

Automated material handling and storage: Functions – types – analysis of material handling equipments. Design of conveyor & AGV systems. Automated storages: Storage system performance – AS/RS – carousel storage system – WIP storage system – Interfacing handling storage with manufacturing. Modeling and analysis of FMS: Analytical, heuristics and Petri-net modeling techniques –scope applicability and limitations.

Module – III

Concepts of distributed numerical control: DNC system – communication between DNC computer &machine control unit – hierarchical processing of data in DNC system – features of DNC systems. Programmable controllers: Control system architecture – elements of programmable controllers: languages, control system flowchart, comparison of programming methods.

Module – IV

Scheduling and loading of FMS: Introduction – scheduling of operations on a single machine – 2 machine job shop scheduling, 3 machine flow shop scheduling – scheduling ‘n’ operations on ‘n’ machines - scheduling rules – loading problems – tool management of FMS. Economic and technological justification for FMS- as GT, JIT – operation and evaluation – personnel and infrastructural aspects – typical case studies – future prospects.

References:

1. Parrish D. J., *Flexible Manufacturing,* Butter Worth Heinemann Ltd, Oxford.
2. Groover M. P., *Automation, Production Systems and CIM,* PHI.
3. Kuiak, *Intelligent Manufacturing Systems,* Prentice Hall.
4. Ranky P. G., *The design and operation of FMS,* IFS Pub., UK.
5. Ronald. G. Askin and Charles R. Standridge, *Modeling and Analysis of Manufacturing Systems,* Wiley, 1993.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, students will get necessary foundation on the following:

- *Understand various advanced material handling systems.*
- *Understand the use of different types of PLC and DNC.*
- *Acquire knowledge on scheduling, GT and JIT.*

13.806.2 AGILE AND LEAN MANUFACTURING (N) (Elective V)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *Provide an understanding of the characteristics of internationally competitive manufacturing systems and knowledge of, and experience in using, the lean/ agile manufacturing philosophy and techniques.*
- *Practice in carrying out the redesign process and in using the appropriate methodologies/ tools for the practical and detailed realization of the newly designed or redesigned lean/ agile manufacturing system.*

Module – I

Agile Production System: Introduction-manufacturing production system-components of agile manufacturing system-production support-production planning and control-quality assurance purchasing- maintenance-overview of production support-business operations-engineering-marketing-human resources-finance and accounting. Agile Manufacturing Vs Mass Manufacturing, Agile Manufacturing Vs Mass Customization - Measurement of agility.

Module – II

Agile Practices for Product Development: Five steps for making product development – sources of new product ideas-understanding the product development process and its time duration-initiation of new product development–use of design for manufacture tools – pursuance of CAD/CAM/CAE tools and techniques-institutionalization of product development tools and techniques-cycles of learning.

Module – III

Manufacturing agile practices: Overview-establishing a manufacturing system design-embedding manufacturing system design in the shop floor- implementing visual methods of control-flow production- agility through group technology-agility through manufacturing cells-agility through setup and change over reduction-material management strategy for agility-make Vs buy strategy for agility- understanding the value of investing in people - agility Vs perfectionism.

Module – IV

Lean manufacturing: Introduction-definition and scope-continuous Vs lean production-benefits and methodology-process oriented continuous improvement teams-lean

manufacturing education-product oriented continuous improvement teams-cell manufacturing training-redesign of plant layout-cross training of team members. Implementation of lean manufacturing: Training of personnel-equipment selection-zero defect quality methods-improving reliability-quick setups-reduction of inventories-shift to shift communication- employee motivation.

References:

1. Gunasekaran A., *Agile Manufacturing, 21st Strategy Competitiveness Strategy*, Elsevier Publications, 2001.
2. Montgomery J. C. and L. O. Levine, *The Transition to Agile Manufacturing – Staying Flexible for Competitive Advantage*, ASQC Quality Press, Wisconsin, 1995.
3. Askin R. G. and J. B.Goldberg, *Design and Analysis of Lean Production Systems*, John Wiley and Sons Inc., 2003.
4. Hobbs D. P., *Lean Manufacturing implementation*, Narosa Publisher, 2004.
5. Goldman S. L., R. N. Nagal and K. Preiss, *Agile Competitors and Virtual Organizations*, Van Nostrand Reinhold, 1995.
6. Brian H., Maskell, *Software and the Agile Manufacturer, Computer Systems and World Class Manufacturing*, Productivity Press, 1993
7. Montigomery J. C., L. O. Levine, *The Transition to Agile Manufacturing Staying Flexible for Competitive Advantage*, ASQC Quality Press.
8. Anderson D. M., Joseph Pine, *Agile Product Development for Mass Customization,-* Irwin Professional Publishing, 1997.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, students will get necessary foundation on the following:

- *Know about modern trend of manufacturing*
- *Customization of product for the manufacturing*
- *Implementation of new technology*
- *Identify the waste and how to eliminate that waste*

13.806.3 TOTAL QUALITY MANAGEMENT (N) (Elective V)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *Should develop knowledge on principles and practices of TQM to achieve quality.*
- *Should be able to use TQM tools for continuous quality improvement.*
- *Should acquire knowledge on implementation of quality standards.*
- *Should acquire advanced knowledge on latest TQM tools and techniques.*

Module – I

History of quality, Major contributions of Deming, Juran and Crossby to quality Management, total quality, quality control tools, principles of Total Quality Management (TQM), Quality trilogy, models for TQM, core concepts, characteristics and subjects of TQM. Total Quality and Quality Management systems, quality principles, Total quality control, total waste elimination, total employee involvement.

Module – II

Quality assurance: total quality assurance, management principles in quality assurance, objectives of quality assurance system, hierarchical planning for Quality Assurance, Vendor rating, Quality improvement: elements, programmes – KAIZEN, PDCA cycle,5S, Quality circles, Benchmarking. Service Quality- Customer Retention, Employee Involvement – Motivation.

Module – III

Quality planning: SWOT analysis-Strategic planning-strategic grid-organizational culture Total Quality Culture, system approach to TQC ,Quality function deployment, QFD concept, overview & QFD process, the voice of customer developing a QFD matrix, reviewing the matrix for priority items, organizing teams & planning QFD projects, Six sigma approach – application of six sigma approach to various industrial situations.

Module – IV

Process RE-engineering, BPR philosophy, possibilities & pitfalls, BPR framework, opportunity assessment, planning & BPR project, risk & impact assessment, planning & implementing the transition; Failure mode & effect analysis; FMEA: concepts & applications in TQM; Quality cost, concepts, quality cost definitions, quality cost program implementation, use of

quality cost, reducing quality cost. Quality standards – Need of standardization - ISO 9000 series – ISO 14000 series –Other contemporary standards.

References:

1. Sharma, *Total Quality Management*, Sultan Chand & Sons.
2. Mohanty R. P. and R. R. Lakhi, *Total Quality Management*, Jaico Pub, New Delhi.
3. Poornima M. Charantimath, *Total Quality Management,* Pearson Education.
4. Lon Roberts, *Process Re-Engineering,* Tata McGraw Hill, New Delhi.
5. Mohamed Zairi, *TQM for Engineering*, Gulf Pub. Co., 2nd Edition, New Delhi.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

- *Understand the principles and practices of TQM.*
- *Understand the use of TQM tools for continuous quality improvement.*
- *Acquire knowledge on implementation of quality standards.*
- *Acquire advanced knowledge on latest TQM tools and techniques.*

13.806.4 BUSINESS PROCESS REENGINEERING (N) (Elective V)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *Should develop knowledge on business process reengineering, its needs benefits and difference between other management techniques.*
- *Should understand relation between business process reengineering and information technology based new industrial engineering.*
- *Should acquire knowledge on advanced role of business process reengineering in enterprises resources planning implementation and future of business process reengineering*

Module – I

Definition of New Industrial Engineering as recursive relation between BPR and IT -Business Processes-Process redesign- Business process reengineering-Business Reengineering - Business Process Management-Business Process Redesign-origin of BPR-need-benefits-golden principles-Difference between BPR and other Management techniques like TQM, JIT Six Sigma etc.

Module – II

Relation between BPR and IT-New Industrial Engineering-Enablers of BPR-Role of technology in reengineering-agile-lean-collaborative manufacturing-collaborative e-commerce-Steps BPR implementation-tools that support BPR- Identification of current business processes – Establishing the scope of the process – Mapping project – Mapping and analyzing the process. Process creation: Creating the ideal process – Testing the new process – Implementing the new process. Evaluation-Evaluating the improvement (criteria) of measurements- hurdles foreseen in - Designing and implementing meaningful measures.

Module – III

Big Small-r reengineering - Role of BPR in ERP implementations-Business Process Visualization-simulation-prototyping-transition and change management for the new process implementation-Role of training in change-BPR is not downsizing-Business Process audit steps- Process innovation-Core process redesign-Organizational change ecology- Risks in BPR.

Module – IV

Future of BPR- Reengineering knowledge work-participative reengineering instead of top down approach-Rapid reengineering using tools that evolve-Reengineering for value and growth- BPR to BPM evolution-Phases in Business Process Management- Case studies.

References:

1. John Neston and Johan Nelis, *Business Process Management: Practical Guidelines to Successful Implementations*, Butterworth –Heinemann, Elsevier, 2006.
2. Jeffrey N. Lowenthal, *Reengineering the Organisation – A Step-by-Step Approach to Corproate Revitalisation*, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1995.
3. Michael Hammer and James Champy, *Reengineering the Corporation – A Manifesto for Business Revolution*, Nicholar Bareky Publishing, London, U.K., 1996.
4. Michel Hammer, *The Reengineering Revolution Handbook*, Harper Collins Publishers, London, UK, 1996.
5. Sethi and King, *Organizational Transformation through Reengineering*, Pearson.
6. Radhakrishnan and Balasubramanian, *Business Process Reengineering*, Prentice Hall India.
7. Jayaraman, Ganesh Natarajan and Rangaramanujan, *Business Process Reengineering*, Tata McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

- *Knowledge on business process reengineering, its needs benefits and difference between other management techniques.*
- *Understanding on relation between business process reengineering and information technology based new industrial engineering.*
- *Knowledge on advanced role of business process reengineering in enterprises resources planning implementation and future of business process reengineering.*

13.806.5 ECONOMETRICS (N) (Elective V)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To introduce the students to the importance and applications of econometric models.*
- *To introduce the students to linear and nonlinear regression analysis and their application to economics and business.*
- *To provide students hands on experience on econometric software in addition to theory classes.*

Module – I

Introduction to Econometrics- History, Methodology and Types. Regression Analysis: Linear Regression Model, Assumptions of the Classical Linear Regression Model, Two-Variable Regression Analysis – Basic Ideas, Problem of Estimation, Classical Normal Linear Regression Model, Interval Estimation and Hypothesis Testing, Extensions; Multiple Regression Analysis; Dummy Variable Regression Models.

Module – II

Multi collinearity: Estimation, Practical Consequences, Detection, Remedial Measures. Heteroscedasticity: OLS Estimation in the Presence of Heteroscedasticity, The Method of Generalized Least Squares (GLS) and Generalized Method of Moments (GMM). Autocorrelation; Econometric Modelling: Model Specification and Diagnostic Testing.

Module – III

Nonlinear Regression Models: Approaches to Estimating Nonlinear Regression Models. Qualitative Response Regression Models: Linear Probability Model, LOGIT Model, PROBIT Model, Tobit Model, The Poisson Regression Model. Panel Data Regression Models: Panel Data, Pooled OLS Regression Model, Fixed Effect Least-Squares Dummy Variable (LSDV) Model, Fixed-Effect Within-Group (WG) Estimator, Random Effects Model (REM). Dynamic Econometric Models: Autoregressive and Distributed-Lag Models.

Module – IV

Simultaneous-Equation Models; The Identification Problem; Structural Equation Modelling; Simultaneous-Equation Methods: The Method of Indirect Least Squares (ILS), The Method of Two-Stage Least Squares (2SLS). Time Series Econometrics: Concepts, Tests of Stationarity, Unit Root Test, Cointegration. Modeling of Time Series Data: Autoregressive (AR) Models, Moving Average (MA) Models, Autoregressive and Moving Average (ARMA) Models, Autoregressive Integrated Moving Average (ARIMA) Models, Box–Jenkins (BJ) Methodology,

Vector Auto regression (VAR) Models, Measuring Volatility in Financial Time Series: ARCH , GARCH, GARCH–M, EGARCH, TGARCH Models.

References:

1. Damodar N. Gujarati and C. Dawn Porter, *Basic Econometrics*, McGraw-Hill.
2. Davidson, Russell and James G. MacKinnon, *Estimation and Inference in Econometrics*, Oxford: Oxford University Press, 1993.
3. Greene, William H., *Econometric Analysis*, 6th Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.
4. Johnston, Jack and John Enrico DiNardo, *Econometric Methods*, 4th Edition, New York: McGraw-Hill, 1997.
5. Pindyck, Robert S. and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts*, 4th edition, New York: McGraw-Hill, 1998.
6. Wooldridge, Jeffrey M., *Introductory Econometrics: A Modern Approach*, Cincinnati, OH: South-Western College Publishing, 2000.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

- *The students will have the knowledge of econometric models.*
- *The students will show the ability to apply econometric analysis to analyze real world data and solve real world problems.*
- *The students will have the experience on the use of econometric software.*

13.806.6 HUMAN FACTORS IN ENGINEERING (N) (Elective V)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To provide a detailed understanding of human system, and its interaction with other systems and environment.*
- *To provide an adequate background for applying the concept of human factors in Engineering and Design fields.*

Module – I

Introduction to human system: Definition, human technological system, multidisciplinary engineering approach, human machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development, human system modeling.

Module – II

Information input for human system: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, and speech communications. Human system output and control: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices.

Module – III

Human factors in workplace design: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, fatigue.

Module – IV

Work place environment and work place design: Effects of factors such as illumination, climate, noise, motion, sound, vibration in design of workplaces. Applications of human factors in real and virtual environments: Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA's approach, virtual environments.

References:

1. Bridger R. S., *Introduction to Ergonomics*, Taylor and Francis, 2003.

2. Chandler Allen Phillips, *Human Factors Engineering*, John Wiley & Sons, 2000.
3. Martin Helandar, *A Guide to Ergonomics of Manufacturing*, Taylor and Francis, 1996.
4. Mark R. Lehto and James R. Buck, *Introduction to Human Factors and Ergonomics for Engineers*, Lawrence Erlbaum Associates, New York, 2008.
5. Mark S. Sanders and Ernest J. McCormick, *Human Factors in Engineering and Design*, McGraw Hill, 1993.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern: (Maximum Marks: 100)

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** If use of tables and charts are permitted for the university examination for this course, proper direction of the same should be provided on the facing sheet of the question paper.*

Course outcome:

After the completion of this course, students will get necessary foundation on the following:

- *The student will get a strong understanding of human system and its adaptability in the real working environments.*
- *The students will an insight about the functioning and capability of human system in real world.*

13.807 SEMINAR (MNPSU)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective:

The main objective of this course is to provide experience in presentations and to improve their communication skills.

The student shall present a seminar on a topic which is of high relevance to Industrial Engineering. A seminar report must be submitted at the end of the semester. The topic of the seminar shall be different from the topic of his/her project work which is being done during seventh and eighth semesters.

Internal Continuous Assessment *(Maximum Marks-100)*

40% - Assessment by the Guide
40% - Assessment by the Committee.
20% - Regularity in the class

Course Outcome:

After completion of this course the students will be able to

- *Acquire the basic skills to perform literature survey and present papers*
- *Acquire communication skills*

13.808 PROJECT, VIVA-VOCE AND INDUSTRIAL VISIT (MNPSU)

Teaching Scheme: 0(L) - 0(T) - 5(P) **Credits**: 5

Course Objective:

- *To do a detailed study on a selected topic based on current journals or published papers.*
- *To impart the ability to perform as an individual as well as a team member in completing a project work.*

The project work (project phase 1) started in the seventh semester, shall be continued (project phase 2) in the eight semester. The student/s must submit the final project report at the end of the eight semester. At least two evaluations should be conducted by a panel consisting of project coordinator/senior faculty, project guide, and a faculty specialized in the area. The students may be assessed individually and in groups.

Internal Continuous Assessment *(Maximum Marks-100)*

The distribution of marks is as follows:

Work Assessed by Guide:	*50%*
Assessed by a three member committee:	*50%*

University Examination Pattern:

Viva-Voce *Maximum Total Marks: 100*

Marks shall be awarded based on the overall performance, Project report, Seminar report, Subject knowledge and general awareness in the field of Industrial Engineering

Course Outcome:

After completion of this course the students will be able to

- *Acquire the basic skills to perform literature survey and present papers*
- *Acquire communication skills and improve their leadership quality as well as the ability to work in groups.*