UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VI SEMESTER

MECHANICAL - STREAM - INDUSTRIAL ENGINEERING

SCHEME -2013

VI 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				
13.601	Industrial Statistics (N)	4	3	1	-	50	3	100	150
13.602	Advanced Operations Research (N)	4	3	1	-	50	3	100	150
13.603	Supply Chain and Logistics Management (N)	4	3	1	-	50	3	100	150
13.604	Mechatronics (N)	3	2	1	-	50	3	100	150
13.605	System Simulation (N)	4	3	1	-	50	3	100	150
13.606	ELECTIVE - II	4	3	1	-	50	3	100	150
13.607	Manufacturing Automation Lab (N)	3	-	-	3	50	3	100	150
13.608	Data Analysis and Optimisation Lab (N)	3	-	-	3	50	3	100	150
	Total	**29**	**17**	**6**	**6**	**400**		**800**	**1200**

13. 606 Elective I

13.606.1	Disaster Mitigation and Management (N)
13.606.2	Industrial Forecasting (N)
13.606.3	Fire Science and Industrial Safety (N)
13.606.4	Financial Management (N)
13.606.5	Design for Manufacturing (N)

13.601 INDUSTRIAL STATISTICS (N)

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

Course Objective:

- *Make sense out of data by constructing appropriate summary measures, tables, and displays.*
- *Apply single and multivariable measures to make decisions.*
- *Work with probability distribution and their summary measures to analyze unknowns.*
- *Apply sampling techniques to make projections about a population.*
- *Develop decision making and analytical skills.*
- *Apply technology tools to business management and administrative support functions.*

Module – I

Introduction and Descriptive Statistics: Samples and Populations, Percentiles and Quartiles, Measures of Central Tendency, Measures of variability, Grouped data and the histogram, Skewness and Kurtosis, Chebyshev's Theorem, The Empirical Rule. Probability Distributions: Random variables-discrete and continuous, Cumulative Distribution Function, Introduction to Bernoulli, Binomial, Geometric, Poisson, Triangular, Weibull, Uniform, Normal, Gamma and Exponential distributions.

Module – II

Measurement design: Primary types of Measurement Scales-Nominal, Ordinal, Interval and Ratio scales. Sampling and Sampling distributions: Introduction, Sampling process, Non-probability and Probability Sampling- different types, Determination of sample size. Introduction to sampling distributions, Central Limit Theorem, Estimators and their properties. Method of data collection–primary and secondary data, observation method, interview method, questionnaire method, Methods of Displaying Data.

Module – III

Hypothesis Testing: Confidence Intervals, One sample and Two sample tests, z-test, t-test, Chi-square test. Analysis of Variance: Theory and computations of ANOVA, ANOVA table, Two-way ANOVA, Blocking designs, Design of Experiments. Simple Regression and Correlation: Introduction, Estimation using the regression line, Correlation Analysis. Multiple Regression: The k-variable multiple regression model, The F-test of a Multiple Regression model.

Module – IV

Non-Parametric methods: Introduction, The sign test for paired data, Rank sum tests – The Mann-Whitney U-test and Kruskal-Wallis test, one sample Runs test, Rank correlation, K-S

test. Time Series Analysis and Index numbers: Trend Analysis, Seasonality and Cyclic behavior, The Ratio-to-Moving average method, Exponential smoothing methods, Index numbers. Introduction to Factor Analysis, Multi-Dimensional Scaling, Cluster Analysis, Discriminant Analysis and Conjoint Analysis. (Overview only).

References:

1. Amir D. Aczel and J. Sounderpandian, *Complete Business Statistics*, Tata McGraw Hill.
2. Richard I. Levin and David S. Rubin, *Statistics for Management,* Pearson Education.
3. Krishnaswamy K. N., A. I. Sivakumar and M. Mthirajan, *Management Research Methodology,* Pearson Education.
4. Gopal K.Kanji, *100 Statistical Tests*, Sage Publications.
5. Paul E. Green, D. S. Tull and Gerald Albaum, *Research for Marketing Decisions,* Prentice Hall.
6. Thomas C. Kinnear and James R. Taylor, *Marketing Research –An Applied Approach,* McGraw Hill Inc.
7. Mitra, *Fundamentals of Quality Control and Improvement,* Pearson Education.
8. Irwin Miller and M. Miller, *Mathematical Statistics*, Prentice Hall India.
9. Montgomery D.C., D. M. Goldsman, C. M. Borror, *Probability and Statistics in Engineering,* John Wiley& Sons.
10. Kothari C. R., *Research Methodology*, New Age Publications (Academic) India.

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:

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

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

13.602 ADVANCED OPERATIONS RESEARCH (N)

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

Course Objective:

- *To introduce advanced topics in Linear Programming and large scale optimization.*
- *To formulate and solve Non-linear Programming and Integer Programming problems.*
- *To familiarize network flow models and solution algorithms.*

Module – I

The Revised Simplex Method and Sensitivity Analysis in Linear Programming. The Product Form of the Inverse. Using Column Generation to Solve Large-Scale LPs. The Dantzig-Wolfe Decomposition Algorithm. Karmarkar''s Method for Solving LPs. Multi-objective Optimization and Goal programming.

Module – II

Non-linear programming: Definition, Formulation of Non-linear Programming Problems. Convex and Concave Functions. Solving NLPs with One Variable. Golden Section Search. Unconstrained Maximization and Minimization with Several Variables. The Method of Steepest Ascent. Lagrange Multipliers. The Kuhn-Tucker Conditions. Quadratic Programming. Separable Programming. The Method of Feasible Directions. Pareto Optimality and Tradeoff Curves.

Module – III

Integer programming – Types of Variables, Standard Applications, Formulation of Integer Programming Problems, Branch and Bound algorithm, Cutting Plane Algorithm, All Integer Algorithms, Branch and Cut algorithm, Branch and Price algorithm, Implicit Enumeration.

Module – IV

Introduction to graph theory-Basic definitions. Network problems: Minimum spanning tree problem-Prim’s algorithm, Kruskal’s algorithm. Shortest path problems-Dijkstra’ algorithm, Floyd’s Algorithm, Successive Shortest path algorithm. Maximum flow problems-Flow augmenting path, Labeling algorithm, Maximum Flow and Minimum Cut, Shortest Augmenting path algorithm. Minimum cost flow problem-Network Simplex method. CPM / PERT networks. Travelling Salesman Problem (TSP) - Branch and Bound and Heuristic algorithms for the TSP. Chinese Postman Problem. Vehicle Routing Problems-Optimal solutions: Little’s algorithm and heuristic solutions: Savings Based algorithm, Holmes and Parker refinement.

References:

1. Wayne L. Winston, *Operations Research: Applications and Algorithms*, PWS-Kent Pub.
2. Ronald L. Rardin, *Optimization in Operations Research*, Pearson Education.
3. Hillier and Lieberman, *Introduction to Operations Research*, Tata McGrew Hill.
4. Srinivasan G., *Operations Research*, Prentice Hall India.
5. Wagner H. M., *Principles of Operations Research with Applications to Managerial Decisions*, Prentice Hall India.
6. Vohra N. D., *Quantitative Methods in Management*, Tata McGrew Hill.
7. Taylor, *Introduction to Management Science*, Pearson Education.
8. Sharma J. K., *Operations Research*, MacMillan.
9. Taha, *Introduction to Operations Research*, Prentice Hall India.

Internal Continuous Assessment Pattern: *(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:

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:

After completion of this programme, students are expected to be able to

- *formulate and solve large scale optimization problems.*
- *Understand and formulate Multi-objective optimization.*
- *formulate and solve Non-linear and Integer Programming problem.*
- *learn network flow models and solution algorithms.*

13.603 SUPPLY CHAIN AND LOGISTICS MANAGEMENT (N)

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

Course Objective:

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

Module - I

Supply Chains – Objectives, Structures, Decision phases, Performance measures, Performance drivers and metrics. Achieving strategic fit and its obstacles. Supply chain agility principles. Designing distribution networks and applications to e-business. Network design factors and framework - Network design in uncertain environment, models for facility location, facilities layout and capacity allocation decisions, designing and evaluating global supply chain networks.

Module – II

Planning supply and demand in supply chain – Forecasting, seasonal models, measure of forecast errors; Aggregate planning - Aggregate planning strategies, aggregate planning using linear programming, dynamic programming and quadratic model - quantitative Examples. Disaggregation – Constant demand and capacity, time varying demand and capacity. Internal production chain control decisions - Scheduling and sequencing in single processor cases.

Module - III

Inventory Planning Decisions – Bullwhip effect - Managing economies of scale - Estimation of cycle inventory, discounting models, multi-item inventory models, multi-echelon cycle inventory. Determination of safety inventory, impact of supply uncertainty, Aggregation and replenishment policies on safety inventory, Multi-echelon safety inventory, Quantitative examples of safety stock models.

Module - IV

Logistics Management decisions - 3PL, 4PL, 5PL and 6PL, Design options for transportation network. Routing, scheduling and sequencing in transportation, Multi-stage transportation problems, Product recovery models, Supplier scoring and assessment. Vehicle routing

problems, bin packing problems, fixed charge problems, knapsack problems. Reverse logistics – Closed loop supply chains.

References:

1. Sunil Chopra *et al., Supply Chain Management – Strategy, Planning and Operation*, Pearson.
2. Sreenivasan G*., Quantitative Models in Operations and Supply Chain Management*, PHI.
3. Donald J. Bowersox & David J. Closs, *Logistical Management*, TMH.
4. Martin Christopher, *Logistics and Supply Chain Management, Financial times management*.
5. Jeremy F. Shapiro, *Modeling and Supply Chain*, Thomson Learning, 2001.
6. David Taylor *et al*., *Manufacturing Operations and Supply Chain Management*, VTL.
7. David Simchi, Levi & Philip Kaminsk, *Designing and Managing the Supply Chain*, McGraw Hill.
8. Fawcett *et al*., *Supply Chain Management*, Pearson.
9. Burt *et al*., *World Class Supply Management*, TMH.
10. Ballou, *Business Logistics / Supply Chain Management*, Pearson.
11. Agarwal, *A Text Book of Logistics & Supply Chain Management*, Macmillan.
12. Altekar, *Supply Chain Management*, PHI.
13. John T. Mentzer, *Supply Chain Management*, Sage Publications.
14. Coyle *et al*., *A logistics approach to Supply Chain Management*, Cengage learning.
15. Bozarth, Introduction *to Operations & Supply Chain Management*, Pearson.

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 completion of this course, students should acquire:

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

13.604 MECHATRONICS (N)

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

Course Objectives:

- *To This course will enable the student to get an in-depth knowledge in mechatronic applications from industrial automation perspective*
- *The first module enables the student to understand the control system basic concepts and to analyze mechanical systems using equivalent mathematical models. The advance control system theories also will be familiarized.*
- *The second module gives the student an extensive guidance in to the field of sensors and choosing the right type of sensor for the application based on their characteristics.*
- *The third module has the objective of familiarizing the various industrial applications of Mechatronics. The student gets an in-depth knowledge of the cutting edge technologies used for automation from CNC, PLC to Robotics and will be able to design the ladder programs for the real applications.*
- *The fourth module trains the student to develop suitable signal conditioning circuits for sensors and actuators to meet the requirements arising in industrial automation. It also familiarizes various aspects and methods used in artificial intelligence and heuristics used for control systems.*

Module – I

Introduction: Control systems fundamentals – Open loop control systems and closed loop control systems - modes of closed loop controls -Two Step, Proportional, Derivative, Integral Controls-PI, PD, PID controls, Digital Controllers. Servo control mechanisms – examples – Adaptive control.

Basic System Models: Fundamental building blocks for Mechanical, Electrical, Fluid and Thermal systems. Mathematics Models of various engineering systems – rotational - translational systems, electromechanical systems, Hydraulic-mechanical systems. Dynamic response of systems. First order and second order systems. Performance measures for systems.

Module – II

Definition: Classification of transducers–active and passive transducers, null and deflection type transducers – performance of transducers-Sensors for displacement, position, proximity, velocity, force, pressure, flow, liquid level, temperature, magnetic flux, vibration and noise-selection of sensors.

Module – III

Mechatronics in industry automation– CNC machines – mechanical and electrical actuation systems - stepper and servomotors. Stepper motor control circuits. Electro-Hydraulic and Electro-Pneumatic automation-valves and actuators- PLCs-ladder diagrams-interfacing PLCs with electro - Hydraulics / Pneumatics-simple programs. Robotics-Robot position and proximity sensing–tactile sensing—sensing slip – Man Machine interface – AGVs.

Module – IV

Signal conditioning: Bridge circuits, Amplification, filtration, analog to digital conversion, multiplexing, Data acquisition, PWM, Applications of general purpose ICs like Opamps and logic gates. Practical Circuits for measurement and actuation of systems.
Artificial intelligence - Neural Networks – fundamentals of ANN – Perceptrons – back propagation, RBF networks. Introduction to Fuzzy logic and Genetic Algorithms.

References:

1. Bolton W., Mechatronics, *Electronic control systems in Mechanical and Electrical Engineering*, Pearson Education.
2. Chapman and Hall, Mechatronics – *Electronics in Products and Processes*, Bradley DA
3. *Mechatronics*, HMT, Bangalore.
4. Denny K. Min, *Mechatronics*, Springer.
5. Devadas Shetty, Richard A. Kolk, *Mechatronics System Design*, Thomson Publishers.
6. Gopel Wetal*, Sensors, A Comprehensive Survey–Vol 1-8*, VCH Publishers.
7. Institution of Mechanical Engineers–MEP (UK), *Mechatronics: Designing Intelligent Machines*, 1990.
8. MEP(UK), *Mechatronics: The Integrating of Engineering Design*, 1992.
9. Philip D. Wasserman, *Neural Computing, Theory and Practice*, Reinhold, New York,
10. Sivanandam S. N., S. Sumathi, S. N. Deepa, *Neural networks using MATLAB 6.0*, Tata McGraw Hill.

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 course the student will be able to

- *distinguish various types of control systems and their application in industrial automation.*
- *Describe the various modes of closed loop control. Describe the various modes of adaptive control.*
- *Analyze mechanical systems using their mathematical models. Assesses the performances of industrial mechanism using various performance measures.*
- *Describe the construction and working of different types of sensors.*
- *Design/Choose the right type of sensors for a physical process measurement.*
- *Describe the various applications of Mechatronics in industrial and production automation.*
- *Design ladder logic for real industrial automation problems. Describe various industrial robot configurations and suggest a suitable one for the given application.*
- *Develop signal conditioning application for a given situation. Describe and suggest various heuristics and AI methods for industrial applications.*

13.605 SYSTEM SIMULATION (N)

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

Course Objective:

- *To apply different system theories and techniques to solve problems in industrial and business organizations.*
- *To provide a theoretical base to model various discrete event systems.*
- *To understand various simulation techniques.*

Module – I

Concept of a system, System environment, Continuous and Discrete systems, System models, Types of models, Types of system study, Comparison of Analytical methods and Simulation, System simulation:- Areas of application of simulation, Steps in simulation study, Monte Carlo method, Use of Monte Carlo method to find area under curves, value of π, pure pursuit problem and trajectory simulation. Numerical computation technique for continuous and discrete systems, Distributed Lag models, Cobweb models.

Module – II

Discrete and continuous probability functions, uniformly distributed random numbers, properties of random numbers, generation of Pseudo-Random numbers, random number generators, tests for random numbers: frequency, gap, run, and Poker tests, test for auto correlation.

Module – III

Generation of random deviates for Exponential, Uniform, Weibull, Triangular, and discrete distributions. Inverse Transformation method. Direct transformation method for the Normal and Lognormal distributions. Acceptance-rejection technique: Poisson and Gamma distributions. Time Advance Mechanisms for discrete event simulation: Next-Event time advance and Fixed increment time advance methods.

Module – IV

Input modeling: data collection, identifying the distribution with the collected data, goodness –of-fit tests, selecting input models without data. Verification and Validation of simulation models, Output Data analysis for a single system, Variance Reduction

techniques, Simulation based optimization. Overview of Computer simulation languages and packages.

References:

1. Geoffrey Gordon, *System Simulation,* Prentice Hall India.
2. Narsingh Deo, *System Simulation with Digital Computer,* Prentice Hall India.
3. Banks J., *Discrete Event System Simulation,* Pearson Education.
4. Fishman, *Concepts and Methods in Discrete Event Digital Simulation,* John Willey & Sons.
5. Sheldon M. Ross, *Simulation,* Elsevier.
6. Law A. M. and W. D. Kelton, *Simulation Modeling and Analysis,* McGraw Hill.
7. Trivedi K. S., *Probability and Statistics with Reliability, Queuing and Computer science Applications, John* Wiley& Sons.
8. Manuel Laguna and Johan Marklund, *Business Process, Modeling, simulation and Design,* Pearson Education.

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 completion of this programme, students are expected to have an understanding of real life systems with interacting components, elements and sub-systems. Modeling, simulation and analysis of these interacting components and elements in a system and the system as a whole.

13.606.1 DISASTER MITIGATION AND MANAGEMENT (N) (Elective II)

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

Course Objectives:

- *To provide an understanding of various types of disasters and their impacts.*
- *To provide the basic knowledge necessary for disaster risk management.*
- *To cultivate the capability to develop technologies in line with local conditions and applying problem solving approach in disaster management.*

Module – I

Disaster: Definition, Factors and Significance, Natural and Manmade disasters – Nature, types and magnitude. Consequences of disasters: Loss of Human and Animal life, Economic damage, Destruction of Ecosystem.

Module – II

Disaster Management: D isaster prone areas in India, Monitoring of phenomena triggering a disaster or hazard, Application of Remote sensing, Managing data from meteorological and other agencies, Governmental initiatives, Disaster management cycle. Post disaster diseases and epidemics, Rescue, relief and rehabilitation, Management of essential supplies and shelter, Role of National and International agencies, National disaster policy of India.

Module – III

Disaster risk: Basic concepts, Risk reduction, Quantitative risk assessment, Strategies for Survival. Vulnerability analysis: Concept and parameters, Relationship between risk and vulnerability, Vulnerability identification, Socio-economic factors of vulnerability, Vulnerability analysis.

Module – IV

Disaster mitigation: Concept and Strategies, Structural and Non-structural mitigation, Community basis mitigation, Role of communication, leadership and coordination, Role of Education and training in disaster prevention. Early warning and Prediction systems: Role of IT, RS, GIS, GPS and ICS. Long term disaster counter planning.

References:

1. Bryant Edwards, *Natural Hazards,* Cambridge University Press, UK.
2. Sahni, Pradeep et al, *Disaster Mitigation Experiences and Reflections,* Prentice Hall India.
3. Sharma and Kadambari, *Disaster Management in India,* Jnanada Prakashan (P&D),

New Delhi.
4. *Disaster Management in India: Perspectives, issues and strategies* – New Royal Book Company, Lucknow.
5. *Space Technology for Disaster management: A Remote sensing and GIS perspective* – Indian Institute of Remote Sensing, Dehradun.
6. Sinha P.C, *Disaster Mitigation: Preparedness, Recovery and Response,* SBS Publication and Distributors Pvt. Ltd., New Delhi.
7. Tushar Bhattacharya, *Disaster Science and Management,* McGraw Hill Education India.

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 get a basic knowledge of various disasters, their consequences and mitigation aspects. The subject introduces the students to the latest technology applications in mitigating disasters.

13.606.2 INDUSTRIAL FORECASTING (N) (Elective II)

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

Course Objective:

- *To introduce the students to analytical techniques and forecasting methodologies with application to industrial problems.*
- *To evaluate and compare techniques as they pertain to industrial applications.*

Module – I

Introduction to Forecasting, Review of Basic Statistical Concepts, Performance Measures, Exploratory Data Analysis. Types of forecast, Forecasting accuracy, Tools for Practical Business Forecasting, Types and Sources of Data, Simple Forecasting Methods: Smoothing Methods, Moving Averages, Exponential Smoothing Methods, Adaptive Smoothing, Holt's Method, Winter's Method, Components of Time Series, Decomposition Method.

Module – II

Simple Linear Regression, General Linear Regression Model: General Linear Model, Measuring and Understanding Partial Correlation, Autocorrelation, Heteroscedasticity, Multi-collinearity, Nonlinear Regressions, Forecasting with a Single-equation Regression Model.

Module – III

Univariate Time-series Methods; Univariate Time-series Modeling and Forecasting: Box–Jenkins Approach to Non-structural Models; Combining Forecasts. Short-term Sales Forecasting Models

Module - IV

Long term forecasting: Non-parametric Methods; Statistical Methods of Determining Nonlinear Trends:Nonlinear Growth and Decline, Logistics and Saturation Curves; Predicting Trends Where Cyclical Influences are Important; Projecting Long-run Trends in Real Growth; Forecasting Very Long-range Trends: Population and Natural Resource Trends. Simultaneous- equation Models; Macroeconomic Forecasting: Structural Macroeconomic Models.

References:

1. Michael K. Evans, *Practical Business Forecasting*, Blackwell Publishers.
2. John E. Hanke, Dean W. Wichern, *Business Forecasting*, Eighth Edition, Prentice Hall.

3. Makridakis, Wheelwright and Hyndman, *Forecasting, Methods & Applications*-, Third Edition, John Wiley & Sons.
4. Terence C. Mills, Time Series *Techniques for Economists*, Cambridge University Press.
5. Brockwell and David, Introduction to Time Series and Forecasting, Springer.

Internal Continuous Assessment Pattern: *(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:

Examination duration: 3 hours *(Maximum 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.

***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:

Upon completion of the subject, students will:

- *Have the knowledge of forecasting techniques.*
- *Be able to choose and implement the right forecasting methods for various industrial applications*

13.606.3 FIRE SCIENCE AND INDUSTRIAL SAFETY (N) (Elective II)

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

Course Objective:

- *To acquire the technical knowledge and skills needed to practice safety in a variety of modern professional settings.*
- *To create the basic competencies needed to pursue advanced studies in fire protection engineering and related fields.*
- *To generate the ability to understand and communicate the societal, environmental, economic and safety implications of engineering decisions.*

Module - I

Fire, combustion and explosion, flammability characteristics of chemicals and materials: liquids, vapours, gaseous / vapour mixtures, flame propagation. Flammability diagram, ignition energy, auto ignition and auto oxidation, fire initiation and propagation–severity and duration.

Module - II

Effect of enclosure in fire development, stack and pool fires. Critical aspects of fire dynamics, diffusion flame and fire plumes, flame spread, production and movement of smoke, computer simulation of fire dynamics.

Module - III

Fire detection systems. Fire prevention and control, inserting procedures, static electricity. Control techniques- general design methods, flame arrestors – their design, design of sprinkler systems, flare design, fire extinguishment – different methods.

Module - IV

Importance of safety in design, relief concepts, definitions. Emergency relief system design, determining pressure relief, types of relief devices, design of relief systems, deflagration venting for dust and vapour explosions, venting system design for fires external to process vessels, reliefs for thermal systems, flare design for toxic release from industries.

References:

1. Dougal Drysdale, *An introduction to Fire Dynamics,* John Wiley, 2011.
2. Bjorn Karlsson and James Quintiere, *Enclosure Fire Dynamics*, CRC Press, 1999.
3. James G. Quintiere, *Fundamentals of Fire Phenomena*, John Wiley, 2006.
4. Marc J. Assael and Konstantonos E. Kakosimos, *Fires, Explosions and Toxic gas dispersions(Effects Calculation and Risk analysis),* CRC Press, 2010.

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 Outcomes:

- *Ability to apply knowledge of mathematics, engineering and science in addressing fire science and engineering issues making use of modern techniques, skills and engineering tools available in the professional practice.*
- *Ability to design experimental apparatus, experimental procedures and data analysis generating novel information and knowledge in fire science and engineering.*
- *Ability to design systems, processes and components relevant to the fire protection engineering practice.*

13.606.4 FINANCIAL MANAGEMENT (N) (Elective II)

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

Course Objective:

- *The course is aimed at building an understanding of concepts, vital tools and techniques applicable for financial decision-making by a business firm.*
- *Understand the use of basic financial management concepts.*
- *Become familiar with the various types of financing available to a firm.*

Module - I

Nature and Scope of Financial Management; Financial Objectives; goal of financial management, FM decisions, Time Value of Money, Computation of EMI, Annuity, Annuity Due, Funds Flow Analysis; Cash Flow Statement and its Interpretation, Financial Statement Analysis, Ratio Analysis, Time Series, Common Size Statements, Du Pont Analysis.

Module - II

Planning for Sources of Finance (Domestic and International); Capital Structure; Net Income Approach; Net Operating Income Approach; Traditional Approach and MM Approach, Cost of Capital; EBIT – EPS Analysis, Capital Gearing/Debt-Equity Ratio, Generation of Internal Funds.

Module - III

Retained Earning Vs. Dividend Decision; Gordon Model; Walter Model; MM Approach; Lintner Model; Planning of Funds through Management of Assets - Fixed and Current, Short-term financial planning – working capital–planning and management. Management of Cash (Various Theoretical Models), Inventories (Including Risk Analysis) and Receivables; Operating Cycle.

Module - IV

Capital Budgeting - Conventional and DCF Methods; capital budgeting decision criteria, NPV–IRR comparisons, capital rationing, risk analysis. Basic International Capital Budgeting.

References:

1. Khan, M. Y. and Jain P. K., *Financial Management, Text, Problems & Cases*, Tata McGraw Hill Company, New Delhi, 2007.
2. Prasanna Chandra, *Financial Management:Theory and Practice*, Tata McGraw Hill, 2011.
3. Pandey I. M., *Financial Management,* Vikas Publishing House Pvt. Ltd., 2009.

4. Van Horne and C. James, *Principles of Financial Management*, Pearson, 2002.
5. Sheeba Kapil, *Financial Management*, Pearson Education, 2010.
6. Bhalla. V. K., *Financial Management and Policy: Text and Cases*, 9th Edition, Anmol Publications Pvt. Ltd, 2009.
7. Brigham. Eugene F. and Houston. Joel F., *Fundamentals of Financial Management*, 10th Edition, Cengage Learning, 2006.
8. Gitman, L. J., *Principles of Managerial Finance*, New York, 2006.

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 Outcomes:

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

13.606.5 DESIGN FOR MANUFACTURING (N) (Elective II)

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

Course Objective:

- *Understand different manufacturing processes including their capabilities, limitations and how to design for lowest cost.*
- *Gain insight into how designers influence manufacturing schedule and cost.*
- *Learn how to analyze products and be able to improve their manufacturability and lower costs.*
- *Understand the relationship between customer desires, functional requirements, product materials, product design and manufacturing process selection.*

Module – I

Introduction to design for manufacture, DFM principles and rules, Systematic approach to Design engineering systems, Collection of information, Role of Engineering design in production, Flow diagrams for design procedures. Effect of materials and manufacturing processes on design: Major phases of design. The material selection process – cost per unit property, weighted properties, and limits on properties methods. Design considerations for heat treating.

Module – II

Tolerance analysis: Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerances – sure fit law, normal law and truncated normal law.

Selective assembly: Interchangeable part manufacture and selective assembly, deciding the number of groups – Model – I: Group tolerances of mating parts equal; Model-II: total and group tolerances of shaft equal. Control of axial play – Introducing secondary machining operations, laminated shims, examples.

Datum systems: Degrees of freedom, grouped datum systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped datum system with spigot and recess pair and tongue – slot pair – computation of translation and rotational accuracy.

Module – III

True position theory: Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed

fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

Form design of castings and weldments: Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols. Weld design and process selection.

Module – IV

Tolerance charting technique: Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrally analysis, examples, design features to facilitate machining: datum features – functional and manufacturing. Component design – machining considerations, redesign for manufacture, examples. Importance of dimensional tolerance control.

References:

1. Harry Peck, *Designing for Manufacture*, Pitman Publications, 1973.
2. Matousek R., *Engineering Design – A systematic Approach*, Blackie & Son Ltd., 1972.
3. Spotts M.F., *Dimensioning and Tolerance for Quantity Production*, Prentice Hall, 1983.
4. Wade O. R., *Tolerance Control in Design and Manufacturing,* Industrial Press, 1967.
5. James G. Bralla, *Hand Book of Product Design for Manufacturing*, McGraw Hill, 1986.
6. Trucks H. E., *Design for Economic Production*, Society of Manufacturing Engineers, Michigan, 2nd Edition, 1987.
7. Farag M. M., *Selection of Materials and Manufacturing Process for Engineering Design*, Prentice Hall, 1997.
8. Dieter G. E., *Engineering Design,* McGraw Hill, 1991.
9. Asimov M., *Introduction to Design*, Prentice Hall, 1962.
10. Jones J. C., *Design Methods,* John Wiley & Sons, 1992.
11. Stoll H. W., *Product Design for Efficient Manufacture,* Workshop Notes, 1986.

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:

- *Acquires knowledge on the principles and theories of design for manufacturing.*
- *Imparts the knowledge regarding facts of tolerancing, interchangeability and selective assembly.*
- *Imparts theoretical and practical knowledge in the designing of castings and weldments.*
- *Provides inputs to the fundamentals of tolerance charting technique.*

13.607 MANUFACTURING AUTOMATION LAB (N)

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

Course Objective :

- *The students should be able to get a feel of the various aspects of modern industrial automation techniques and components.*
- *At the end of the course one should be able to configure and program an industrial automation system.*
- *Also he/she should be able to modify/optimise existing systems with adding reconfiguring suitable components.*

List of Experiments:

1. Experiments and programming of ABB/Allen Bradley/Rexroth-PLCs.
2. Experiments and programming of Motion Controller package.
3. CNC Trainer lathe programming.
4. CNC Trainer milling machine programming.
5. Experiments and programming on industrial robot.
6. Experiments on Machine Vision Inspection System.
7. Experiments on sensors and transducers.
8. Calibration of Pressure sensors.
9. Calibration of LVDT module.
10. Calibration of Thermocouple/RTD.
11. Programming on CNC production machines (CNC Turning centre, CNC Machining centre, CNC EDM.)
12. Experiment on Servo-motor control.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test (minimum 1)

40% - Lab performance (evaluation of models, rough record, fair record etc.)

20% - Regularity in the class

University Examination Pattern:

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

Questions based on the list of exercises prescribed.

Split of marks for evaluation

Familiarity of tool *-15%*

Modeling/ formulation -50%
Final result and inference - 15%
Viva-voce - 20%

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

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

- *Setup and program various types of PLCs.*
- *Program ladder logic any type of PLC or motion controller package.*
- *Do part programming for various types of CNC machines and CNC controllers.*
- *Program industrial robots and other material handling devices in synchronization with other automation components/machines.*
- *Perform online measurements and quality checks using machine vision systems.*
- *Understand the characteristics of different sensors and use suitable sensors for the automation requirements.*
- *Understand the characteristics and use of servomotors and servo systems.*

13.608 DATA ANALYSIS AND OPTIMIZATION LAB (N)

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

Course Objective :

The course is designed to provide in-depth knowledge of handling data and Business Analytics' tools that can be used for fact-based decision-making. Students are trained to:

- *Analyse data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.*
- *Use decision-making tools / Operations Research techniques.*
- *Use advanced analytical tools to analyse complex problems under uncertainty.*
- *Manage business processes using analytical and management tools.*
- *Use analytics in customer requirement analysis, general management, marketing, finance, operations and supply chain management.*

Exercises:

1. Use of OR packages for solving LPP, Transportation, Assignment, Traveling Salesman, inventory Control, queuing problems etc.
2. Use of Statistical packages like SPSS, Excel for descriptive statistics ,curve fitting, Correlation testing ,regression analysis, one way and two ways ANOVA, design of experiments etc

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test (minimum 1)

40% - Lab performance (continuous evaluation of rough record, fair record etc.)

20% - Regularity in the class

University Examination Pattern:

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

Questions based on the list of exercises prescribed.

Split of marks for evaluation

Familiarity of tool	*-15%*
Modeling/ formulation	*-15%*
Final result and inference	*- 50%*
Viva-voce	*- 20%*

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

- *Analyse and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.*
- *Undertake consulting projects with significant data analysis component.*