ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
M.E. INDUSTRIAL ENGINEERING
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA & SYLLABI

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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<tbody>
<tr>
<td>I.</td>
<td>To prepare the students with scientific, mathematical and</td>
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<td>engineering fundamentals required to excel in the field of</td>
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<tr>
<td></td>
<td>industrial engineering.</td>
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<tr>
<td>II.</td>
<td>To prepare the students to excel in research in India/abroad</td>
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<tr>
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<td>through global, rigorous post graduate education.</td>
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<td>III.</td>
<td>To provide the students with in depth research based knowledge</td>
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<td>in Industrial engineering to recognize, comprehend, analyze</td>
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<td>and to solve complex real life problems.</td>
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2. PROGRAMME OUTCOMES POs

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<th>PO#</th>
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<tbody>
<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work</td>
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<td>to solve practical problems</td>
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<td>2</td>
<td>An ability to write and present a substantial technical report/document</td>
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<td>Students should be able to demonstrate a degree of mastery over the area as per</td>
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<td>the specialization of the program. The mastery should be at a level higher than</td>
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<td>the requirements in the appropriate bachelor program</td>
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<td>4</td>
<td>Graduates will demonstrate the knowledge of professional and ethical responsibility.</td>
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<tr>
<td>5</td>
<td>Graduates will demonstrate an ability to function effectively as an individual</td>
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<td>member or a leader in diverse teams, and in multidisciplinary activities.</td>
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<td>6</td>
<td>Graduates will engage in independent and life-long learning for personal and</td>
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3. PEO/PO MAPPING:

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Every programme objectives must be mapped with 1,2,3,-, scale against the correlation PO’s
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YEAR I

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ANNA UNIVERSITY, CHENNAI
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M.E. INDUSTRIAL ENGINEERING
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABUS

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* Audit Course is optional.
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**TOTAL NO. OF CREDITS: 73**

### FOUNDATION COURSES (FC)

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### PROFESSIONAL ELECTIVE COURSES [PEC]

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### AUDIT COURSES (AC)

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COURSE OBJECTIVES:

- To provide the most appropriate estimator of the parameter in statistical inference.
- To decide whether to accept or reject a specific value of a parameter.
- To establish relationships that makes it possible to predict one or more variables in terms of others.
- To avoid or at least to minimize the problems of estimating the effects of the independent variables by experimental designs.
- To understand many real world problems fall naturally within the framework of multivariate normal theory.

UNIT I  ESTIMATION THEORY


UNIT II  TESTING OF HYPOTHESIS

Sampling distributions - Small and large samples - Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III  CORRELATION AND REGRESSION

Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order coefficients.

UNIT IV  DESIGN OF EXPERIMENTS

Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design - $2^2$ Factorial design.

UNIT V  MULTIVARIATE ANALYSIS

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completing this course, students should demonstrate competency in the following topics:

- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Concept of linear regression, correlation, and its applications.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.
REFERENCES:

IL4101 WORK SYSTEM DESIGN AND ERGONOMICS L T P C 3 0 0 3

COURSE OBJECTIVES:
- Impart knowledge in the area of method study
- Train the students in stop watch time study
- Summarize time standards using predetermined motion time systems.
- Explain the anthropometry measures and its use in the work place design
- Articulate the effect of environmental factors on human performance.

UNIT I METHOD STUDY 9
Work design and Productivity – Productivity measurement - Total work content, Developing methods – operation analysis, motion & micro motion study, graphic tools.

UNIT II WORK MEASUREMENT 9
Stop watch time study, Performance rating, allowances, standard data-machining times for basic operations, learning effect.

UNIT III APPLIED WORK MEASUREMENT 9
Methods time measurement (MTM), Introduction to MOST standards, Work sampling, organization and methods (O & M), Wage incentive plans.

UNIT IV PHYSICAL ERGONOMICS 9

UNIT V ENVIRONMENTAL FACTORS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand the purpose of method study and its method.
CO2: Understand the work measurement methods.
CO3: Know about Work sampling
CO4: Know the better working postures for better working.
CO5: Know about the environmental factors which affect the working condition.
REFERENCES:
3. Introduction to work study, ILO, 3rd edition, Oxford & IBH publishing, 2001

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1 - low, 2-medium, 3-high, ‘-‘- no correlation

IL4102

OPERATION RESEARCH

COURSE OBJECTIVES
- To provide students the knowledge of optimization techniques and approaches. Formulate a real-world problem as a mathematical model and finding solutions
- To enable the students to learn about revised simplex method and sensitivity analysis of LPP.
- To solve networking problems like transportation, Assignment, Maximal flow, Minimum spanning tree and shortest path problems.
- To learn about Decision making under uncertainty and certainty conditions.
- To learn various Queuing models.

UNIT I LINEAR PROGRAMMING

UNIT II ADVANCES IN LINEAR PROGRAMMING

UNIT III NETWORK ANALYSIS
UNIT IV DECISION AND GAME THEORY  
9+3
Decision making under certainty – Decision making under risk – Decision making under uncertainty – Decision tree analysis – Introduction to MCDM; AHP. Game Theory – Two person zero sum games, pure and mixed strategies – Theory of dominance - Graphical Solution – Solving by LP

UNIT V QUEUING THEORY  
9+3
Queuing theory terminology – Single server, multi server- limited and unlimited queue capacity- limited and unlimited population.- Dynamic Programming

TOTAL: 60 PERIODS

COURSE OUTCOMES
CO1: Learned how to translate a real-world problem, given in words, into a mathematical Formulation
CO2: Learn to apply simplex algorithm for LPP.
CO3: Be able to build and solve Transportation Models and Assignment Models, maximal flow problem, minimum spanning tree and shortest path problem.
CO4: The students will be able to handle issues in Decision making under various conditions.
CO5: The students acquire capability in applying and using of queuing models for day today problems.

REFERENCES:

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1 - low, 2-medium, 3-high, “-“- no correlation
UNIT I  RESEARCH DESIGN
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II  DATA COLLECTION AND SOURCES
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III  DATA ANALYSIS AND REPORTING
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV  INTELLECTUAL PROPERTY RIGHTS

UNIT V  PATENTS

TOTAL:30 PERIODS

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

TOTAL: 60 PERIODS

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

COURSE OUTCOMES:
CO1: Apply the method study tools to record the existing methodology.
CO2: Design a better work place using method study tools.
CO3: Set time standards using work measurement techniques.
CO4: Develop time standards using software’s.
CO5: Conduct experiments for physical fitness using appropriate equipment.

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1 - low, 2-medium, 3-high, ‘-‘- no correlation

IL4112 OPTIMIZATION LABORATORY

COURSE OBJECTIVES:
- Provide adequate exposure to applications of a optimization software packages for solving Operations Research problems.
- Learn to solve Linear programming problems using Excel
- Summarize the problem solving techniques writing algorithms and procedures.
- Illustrate the syntax and semantics for C programming language
- Develop the C code for simple logic
LABORATORY EXPERIMENTS

1. LP Models formulation and solving using optimization software
2. Formulation of Transportation Problem and solving using optimization software
3. Formulation of Assignment Problems and solving using optimization software
4. Solving Maximal Flow problem using optimization software
5. Solving Minimal Spanning Tree problems using optimization software
6. Solving shortest route problems using optimization software
7. Solving Project Management problems using optimization software
8. Solving Waiting line problems using optimization software
9. Solving two players zero sum game using optimization software
10. Solving LPP using Microsoft EXCEL

TOTAL: 60 PERIODS

SOFTWARE REQUIREMENTS:
Optimization software

COURSE OUTCOMES:
CO1: Acquire knowledge in using Optimization software Package
CO2: Acquired knowledge using excel to solve LPP
CO3: Ability to write the algorithms for optimization problems.
CO4: Learned various syntax of C programme.
CO5: Ability to develop C ++programming for solving optimization problem.

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1 - low, 2-medium, 3-high, “-“- no correlation

IL4201 MULTI-VARIATE DATA ANALYSIS

OBJECTIVES:
- Understanding the basic overview on multi variate data analysis
- Predicting the values of one or more variables on the basis of observations on the other variables.
- Formulating the specific statistical hypotheses, in terms of the parameters of multi variate populations
- Data reduction or structural simplification as simply as possible without sacrificing valuable information and will make interpretation easier.
- Sorting and Grouping "similar" objects or variables are created, based upon measured characteristics.
UNIT I REGRESSION
Simple Regression and Correlation – Estimation using the regression line, Correlation analysis, Multiple regression and Correlation analysis – Finding the Multiple Regression equation, Modelling techniques, Making inferences about the population parameters.

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

UNIT III FACTOR ANALYSIS

UNIT IV DISCRIMINANT ANALYSIS

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

OUTCOMES:
CO1: To understand the basic overview on multi variate data analysis
CO2: Predict the values of one or more variables on the basis of observations on the other variables.
CO3: Formulate the specific statistical hypotheses, in terms of the parameters of multi variate populations
CO4: Data reduction or structural simplification as simply as possible without sacrificing valuable information and will make interpretation easier.
CO5: Sorting and Grouping “similar” objects or variables are created, based upon measured characteristics.

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1 - low, 2-medium, 3-high, ‘-‘“- no correlation
OBJECTIVES:
- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing the special control procedures for service and process oriented industries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION

UNIT II QUALITY CONTROL CHARTS
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- $X$, $R$ and $S$ charts, attribute control charts - $p$, $np$, $c$ and $u$- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES
Warning and modified control limits, control chart for individual measurements, multi-vari chart, $X$ chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICAL PROCESS CONTROL
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to:
CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defects in manufacturing companies.
CO3: Control the occurrence of defects in services.
CO4: Analyzing and understanding the process capability study.
CO5: Developing the acceptance sampling procedures for incoming raw material.

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1 - low, 2-medium, 3-high, ‘-‘ - no correlation
OBJECTIVES:
- To learn about generating of random numbers and random variates.
- To learn how to test the random numbers and random variates.
- To learn how to design the simulation experiment.
- To be trained in simulation software packages.
- To apply simulation techniques for various optimization problems.

UNIT I  INTRODUCTION AND RANDOM NUMBERS  12

UNIT II  RANDOM VARIATES GENERATION AND TESTING  12

UNIT III  DESIGN OF SIMULATION EXPERIMENTS  12
Steps on Design of Simulation Experiments – Development of models using of High level language for systems like Queing, Inventory, Replacement, Production etc., - Model validation and verification, Output analysis. Use of DOE tools.

UNIT IV  SIMULATION LANGUAGES  12
Need for simulation Languages – Study of various simulation software packages.

UNIT V  CASE STUDIES USING SIMULATION LANGUAGES  12
Waiting line models, inventory models, and production models.

TOTAL: 60 PERIODS

OUTCOMES:
CO1: Able to generate random numbers and random variates.
CO2: Able to test the statistical stability of random variates.
CO3: Able to develop simulation models for real life systems.
CO4: How to use simulation language to simulate and analyze various problems.
CO5: Able to solve waiting line model, inventory models and production models problems using simulation software.

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1 - low, 2-medium, 3-high, ' - ' - no correlation

IL4204 OPERATIONS MANAGEMENT

OBJECTIVES:
- Summarize the operations, its strategy and design.
- Identify the future demand with accuracy.
- Plan the production and its resources.
- Illustrate the Inventory and its control.
- Interpret the control of production.

UNIT I UNDERSTANDING OPERATIONS AND ITS DESIGN

UNIT II DEMAND FORECASTING
Forecasting as a planning tool, need for forecast, forecasting time horizon, Design of forecasting system, Developing the forecasting Logic, Sources of data, Models for forecasting, Explorative Methods using Time Series - Moving averages, The exponential smoothing method, Extracting the components of time series, Estimating the trend using linear regression and Extracting the seasonal component; Causal Methods of forecasting, Accuracy of Forecasts and using the Forecasting System.

UNIT III PRODUCTION PLANNING
Aggregate Production Planning and Master Production Scheduling; Resources Planning – Dependent demand attributes, the basic building blocks of a planning frame work, MRP logic, Using the MRP system, Capacity Requirements (CRP), Distribution Requirement Planning (DRP), and Resources Planning; Manufacturing Resources Planning (MRP II), Enterprise Resource Planning (ERP) and Resources Planning in Services.

UNIT IV INVENTORY PLANNING AND CONTROL
Inventory planning for independent Demand items, Types of inventory, Inventory Costs, Inventory Control for Deterministic Demand items, Handling Uncertainty in Demand, Inventory Control Systems, Selective Control of Inventory, Inventory Planning for Single - Period Demand and other issues in Inventory Planning and Control.
UNIT V  CAPACITY ANALYSIS AND OPERATIONAL CONTROL
Defining capacity, Measures of capacity, The time horizon in capacity planning, The capacity planning framework, Alternatives for capacity augmentation, Decision tree for capacity planning; Operational control – Input - Output Control, Operational Control issues in mass production systems and Operations planning and control based on the theory of constraints; Elements of JIT Manufacturing and Production planning and Control in JIT.

TOTAL: 45 PERIODS

OUTCOMES
CO1: The students will be able to understand what is operations management, its strategies and design of operations.
CO2: The students will be able to apply various techniques in forecasting the future Demand with accuracy.
CO3: The students will be able to plan the production schedule and apply techniques like Aggregate plan, MRP, MRP II, DRP and ERP.
CO4: The students will be able determine the lot size and understand the inventory systems. Also will be able to classify the inventories for a better control.
CO5: The students will be able to understand capacity planning and exercise control on production. Also understand JIT implementation and control.

REFERENCES:
4. SeetharamaL.Narasimhan, Dennis W.McLeavey, Peter J.Billington,“Production Planning and Inventory Control”, PHI, 2002.

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IL4211  DATA ANALYTICS LABORATORY  L T P C  0 0 4 2

OBJECTIVES:
- Training and Exposure on Correction Analysis, Simple and Multiple Regression.
- Training and Exposure on Factor Analysis, Discriminant and Cluster Analysis.
- Training and Exposure on Control Charts for Variable and Attributes.
- Training and Exposure on Predicting Reliability Parameters.
- Training and Exposure on Analysis of Variance.
LABORATORY EXPERIMENTS
1. Determine the linear regression model for fitting a straight line and calculate the least squares estimates, the residuals and the residual sum of squares.
2. Determine the multivariate regression model for fitting the straight line.
3. Perform the Correlation analysis to determine the relationships among the variables.
4. Perform the factor analysis for the given set of model data using both Exploratory and Confirmatory methods and evaluate the model adequacy.
5. Determine which continuous variable discriminate among the given group and determine which variable is the best predictor.
6. Determine the groups using Cluster Analysis
7. Determine the process is within the control or not by developing the control charts for attributes and variables and estimate the process capability.
8. Estimate the parameters (MTTF, MTBF, failure rate, bathtub curve etc) of components and systems to predict its reliability.
9. Develop the single factor and two factor design of experiment model to predict the significance factor.
10. Develop $2^k$ factorial and $2^{k-p}$ fractional factorial experiment to determine the parameters which affect the system.

TOTAL : 60 PERIODS

OUTCOMES:
CO1: Ability to independently formulate, perform and assess hypothesis
CO2: Ability to select appropriate technique
CO3: Ability to apply selected data analysis techniques
CO4: Ability to interpret the results
CO5: Ability to present the results properly to extract meaningful information from data sets for effective decision making.

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1 - low, 2-medium, 3-high, ‘-‘- no correlation

IL4212 SIMULATION LABORATORY

OBJECTIVES:
- Develop C program to generate random number and random variates.
- Develop C program to fest random number and random variates.
- Apply Monte carlo simulation for random walk problem and paper vendor problem
- Develop simulation model using simulation software for different queuing models.
- Develop simulation model using simulation software for Inventory models.
LIST OF EXPERIMENTS:
1. Generate Random Number by Mid Square, Midpoint and Congruential method using ‘C’ program.
2. Generate Poisson random Variate, uniform random Variate using ‘C’ program.
4. Testing random numbers and random variates for their uniformity.
5. Testing random numbers and random variates for their independence.
7. Solve paper vendor problem using Monte Carlo simulation.
8. Solve single server queuing model using simulation software package.
10. Solve inventory model using simulation software package.

SOFTWARES REQUIREMENTS:
Simulation software package

OUTCOMES:
TOTAL :30 PERIODS
CO1: Know to generate random number and random variates.
CO2: Learn to test the random number and random variates.
CO3: Able to apply Monte Carlo simulations to random walk and paper vendor problems.
CO4: Able to apply simulation software to various queuing models.
CO5: Know to use simulation software to various inventory models.

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1 - low, 2-medium, 3-high, "-" no correlation

IL4311 TECHNICAL SEMINAR

OBJECTIVES:
- To develop journal paper reading and understanding skill.
- To improve communication and presentation skill of students

GUIDELINES:
- The students are expected to make a presentation on the state of research on a particular topic based on current journal publications in that topic.
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Students are encouraged to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.
OUTCOMES:
The students will be able to 1. Select the method, analysis and optimize the given problem for the given field applications.

IL4312  PROJECT WORK I  L T P C  0 0 12 6

COURSE OBJECTIVES:
To impart knowledge on
• To develop the skill of students for analysing safety problems to control the hazard.
• To expose the students to identify and evaluate the hazards in an industry under study.
• To expose the students to assess the Compliance level of safety norms and procedures.

The Student will identify and select a problem based on comprehensive literature survey. The student should submit a proposal and get it approved by the Head of the department.

Three reviews will be conducted by Project review committee. Students will be evaluated by the committee during the review and suggestions will be offered by members.

The report for PHASE -I should be submitted by the students at the end of course

COURSE OUTCOMES:
At the end of the course, the students will be able to
• This course would make students to train themselves to conduct hazard analysis and suggest solutions to control risks.
• Course would be helpful for the students to know the norms and standards for an Industry.
• Students can recognise hazards and assess or evaluate them by using various techniques.
• Students would be able to suggest suitable measures to prevent hazards by referring the literature and comprehensive hazard analysis.

IL4411  PROJECT WORK II  L T P C  0 0 24 12

COURSE OBJECTIVES:
To impart knowledge on
• To develop the skill of students for analysing safety problems to control the hazard.
• To expose the students to identify and evaluate the hazards in an industry under study.
• To expose the students to assess the Compliance level of safety norms and procedures.

It is the continuation of Phase I project. Three reviews will be conducted by Project review committee. Students will be evaluated by the committee during the review and suggestions will be offered by members.
At least one paper should be published by the student in international / national conference.
The report should be submitted by the students at the end of course.

COURSE OUTCOMES:
At the end of the course, the students will be able to
- This course would make students to train themselves to conduct hazard analysis and suggest solutions to control risks
- Course would be helpful for the students to know the norms and standards for an Industry.
- Students can recognise hazards and assess or evaluate them by using various techniques.
- Students would be able to suggest suitable measures to prevent hazards by referring the literature and comprehensive hazard analysis.

IL4001  APPLIED OBJECT ORIENTED PROGRAMMING  L T P C
3 0 0 3

COURSE OBJECTIVES:
- Explain the fundamentals of C++
- To introduce the object oriented programming
- To learn how to create a class in C++
- Articulate how to derive a class
- Design the object oriented programming for Industrial Problems

UNIT I  C++ BASICS  9
Expression and statements, operators, precedence, type conversion, control statements, loops, Arrays structures, functions, argument passing, reference argument, overloaded function.

UNIT II  FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING  9
Elements of OOP, classes, subjects, messaging, inheritance, polymorphism, OOP paradigm versus procedural paradigm, object-oriented design.

UNIT III  C++ CLASS  9
Definition, class objects, member functions, class argument, operator overloading, user defined conversions.

UNIT IV  CLASS DERIVATION  9
Derivation specification, public and private base classes, standard conversions under derivation, classscope, initialization and assignment under derivation.

UNIT V  APPLICATION  9
OOP’s applications in Industrial Engineering.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Able to and write and execute C++ programs,
CO2: Able to understand the need for object oriented programming
CO3: Able to create class in C++ program
CO4: Able to derive a class from the basic class
CO5: Able to write a program for solving the industrial problem.
REFERENCES:
1. E. Balagurusamy, Object oriented programming with C++, Tata Mc Graw Hill, 2020

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IL4002 ENGINEERING ECONOMICS AND COST ESTIMATION

COURSE OBJECTIVES:
- To study and understand the concept of Engineering Economics and apply in the real world.
- To gain knowledge in the field of cost estimation to enable the students to estimate the cost of various manufacturing processes.

UNIT I INTRODUCTION TO MANAGERIAL ECONOMICS AND DEMAND ANALYSIS

UNIT II PRODUCTION AND COST ANALYSIS

UNIT III PRICING
UNIT IV  
**ESTIMATION OF MATERIAL AND LABOUR COSTS**


UNIT V  
**ESTIMATION OF OPERATIONAL COST**


**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
Students will be able to estimate cost of products, analyze product cost and suggest cost reduction measure.

- **CO1:** know about method to Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- **CO2:** able to Calculate payback period and capitalized cost on one or more economic alternatives.
- **CO3:** know about method to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
- **CO4:** Students able to Prepare the cost estimation report for any project.
- **CO5:** Learn about cost accounting, replacement analysis.

**TEXT BOOKS:**

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COURSE OBJECTIVES:
- Justify the high cost of investment in automation through production economics concepts.
- Summarize the fundamental concepts and elements of computer-integrated manufacturing.
- Articulate various aspects of automated manufacturing such as fixed automation and programmable automation.
- Familiarize the automated material handling and storage systems
- Discover computerized planning, lean and agile systems.

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

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

UNIT III NUMERICAL CONTROL AND ROBOTICS

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

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

COURSE OUTCOMES:
CO1: Select automated equipment based on break-even quantity and compute cost per component.
CO2: Analyze an automated flow line without and with buffer for its performance measures.
CO3: Acquire knowledge in Numerical control programming.
CO4: Identify the elements of manufacturing automation; these include CNC, Robotics, automated assembly and material handling.
CO5: Understand manufacturing planning and control systems.

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IL4004 MANAGEMENT ACCOUNTING AND FINANCIAL MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To enable students to understand accounting mechanism and interpretation of financial statements and to comprehend nuances involved in costing, preparation of budgets and making investment decisions.

UNIT I INTRODUCTION

UNIT II FINANCIAL ACCOUNTING
Salient features of Balance Sheet and Profit and Loss statement, cash flow and Fund flow analysis (Elementary), working capital management, ratio analysis – Depreciation.

UNIT III COST ACCOUNTING
Cost accounting systems: Job Costing, process costing, allocation of overheads, Activity based costing, variance analysis – marginal costing – Break even analysis.

UNIT IV BUDGETING
Requirements for a sound budget, fixed budget – preparation of sales and production budget, flexible budgets, zero based budgets and budgetary control.

UNIT V FINANCIAL MANAGEMENT
Investment decisions – Investment appraisal techniques – payback period method, accounting rate of return, net present value method, internal rate of return and profitability index method method-cost of capital.

COURSE OUTCOMES:

- Ability to prepare and interpret financial statements,
- Understand the basic principles of Accounting,
- Understand the cost Accounting and costing techniques,
- Ability to prepare draft budgets and make sound investment decisions,
- Understand the process of financial management, method of investment.

TOTAL: 45 PERIODS
TEXT BOOKS:

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IL4005 TOTAL QUALITY MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.
UNIT IV  TQM TOOLS AND TECHNIQUES II  
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V  QUALITY MANAGEMENT SYSTEM  

TOTAL: 45 PERIODS

COURSE OUTCOMES: 
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes. 
- Learn about customer support. 
- Know about leadership and team work. 
- Know about ISO standards and requirements. 
- Know about environmental management system

TEXT BOOK: 

REFERENCES: 
4. ISO 9001-2015 standards

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OBJECTIVES:
- Understand the basic steps in development of an algorithm
- Learn and apply various syntax used in C++ programming language.
- Develop knowledge about Structured programming and data structure.
- Comprehend and apply methods of designs to algorithms.
- Acquire knowledge in various algorithms.

UNIT I INTRODUCTION
Algorithms, basic steps in development.

UNIT II REVIEW OF THE STRUCTURED LANGUAGES
C++ Basics, Expression, operators, control statements, structures, multi-dimensional array, functions, arguments, overload function.

UNIT III BASIC TOOLS
Top down, Structured programming, networks, data structure.

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

UNIT V APPLICATION
Development of sorting, searching, algorithms-combinatorial problems, shortest path, probabilistic algorithms.

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Know about the algorithms and basic steps in development of algorithm.
CO2: Acquire knowledge in basic structured languages.
CO3: To write a structured program using appropriate data structure.
CO4: Choose and apply the appropriate methods of design in algorithms or programs.
CO5: To write programs for applications using various algorithms.

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OBJECTIVES:
• Summarize the basics of Lean and Six Sigma.
• Describe the need and the process of integrating Lean and Six sigma.
• Identify and select the resources required for LSS Projects and selection of projects including Team building.
• Infer the DMAIC process and study the various tools for undertaking LSS projects.
• Relate how to institutionalize the LSS efforts.

UNIT I INTRODUCTION TO LEAN AND SIX SIGMA
Introduction to Lean- Definition, Purpose, Features of Lean ; Top seven wastes, Need for Lean management, The philosophy of lean management, Creating a lean enterprise, Elements of Lean, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept and Critical success factors for six sigma; Case analysis.

UNIT II INTEGRATION OF LEAN AND SIX SIGMA
Evolution of lean six sigma, the synergy of Lean and six sigma, Definition of lean six sigma, the principles of lean six sigma, Scope for lean six sigma. The laws of lean six sigma, Key elements of LSS, the LSS model and the benefits of lean six sigma. Initiation - Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, structure of transforming event and Launch preparation; Case study presentations.

UNIT III PROJECT SELECTION AND TEAM BUILDING
Resource and project selection, Selection of Champions, Identification of potential projects, top down (Balanced score card) and Bottom up approach – Methods of selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Predicting and improving team performance, Nine team roles and Team leadership; Case study presentations. Black belts, Training of Black belts

UNIT IV THE DMAIC PROCESS AND TOOLS
The DMAIC process – Toll gate reviews; The DMAIC tools; Define tools – Project definition form, SIPOC diagram; Measure tools – Process mapping, Lead time/cycle time, Pareto chart, Cause and Effect matrix, FMEA; Idea – generating and organizing tools – Brainstorming, Nominal group technique, Multi-voting and Cause and effect diagram, Data collection and accuracy tools- Check sheet, Gauge R&R; Understanding and eliminating variation- run charts, control charts and process capability analysis; Analyze tools - Scatter plots, ANOVA, Regression analysis, Time trap analysis; Improve tools – Mistake proofing, Kaizen, set up time reduction (SMED), TPM, DOE and the pull system. Control tools – statistical process control.

UNIT V INSTITUTIONALIZING AND DESIGN FOR LSS
Institutionalizing lean six sigma – improving design velocity, creating cycle time base line, valuing projects, gating the projects, reducing product line complexity, Design for lean six sigma, QFD, Theory of Inventive Problem solving (TRIZ), Robust design; Case study presentations.

TOTAL:45 PERIODS
OUTCOMES:
CO1: The students will be able to understand what is Lean and Six sigma and their importance in the globalised competitive world.
CO2: The students will be able to understand the importance of integrating Lean and Six sigma and also the process of their integration.
CO3: The students will be able to plan the Resources required to undertake the LSS projects and also acquire how to select the suitable projects and the teams.
CO4: The students will be able apply DMAIC methodology to execute LSS projects and in this regard they will be acquainted with various LSS tools.
CO5: The students will be able to understand the process of institutionalizing the LSS effort and also understand the Design for LSS.

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IL4071 ADVANCED OPTIMIZATION TECHNIQUES

OBJECTIVES:
- Learn to solve integer programming problems
- To know how to solve the Dynamic programming problems
- Learn to solve non-linear programming problems with unconstrained optimization problems
- Understand to solve non-linear programming problems using KKT conditions, quadratic and separable programming
- To create awareness of Meta heuristic algorithms.

UNIT I INTEGER PROGRAMMING
Branch and Bound technique –cutting plane algorithm method - Travelling Salesman problem - Traveling Salesman Problem - Branch and Bound Algorithms for TSP - Heuristics for TSP - Chinese Postman Problem - Vehicle Routeing Problem
UNIT II  DYNAMIC PROGRAMMING  9
Characteristics of Dynamic Programming Problems - Deterministic Dynamic Programming - Forward
and Backward recursive recursion – selected dynamic programming application – investment model –

UNIT III  NONLINEAR PROGRAMMING - I  9
Types of Nonlinear Programming Problems - One-Variable Unconstrained Optimization - Multivariable
Unconstrained Optimization

UNIT IV  NONLINEAR PROGRAMMING – II  9
The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization - Quadratic Programming -
Separable Programming - Convex Programming - Nonconvex Programming

UNIT V  NON-TRADITIONAL OPTIMIZATION  9
Overview of Genetic algorithms, Simulated Annealing, neural network based optimization. Particle

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Know how to solve integer programming problems
CO2: Able to solve Dynamic programming problems
CO3: Familiar in solving unconstrained non linear optimization problems
CO4: Familiar in solving constrained linear optimization problems
CO5: Know how to solve non linear optimization problems using Meta heuristic algorithms

REFERENCES:
   1995.
   India, 2006.
   1996.

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1 - low, 2-medium, 3-high, ‘-‘- no correlation
OBJECTIVES:
- Impart the basic knowledge on the concepts on logistics and distribution.
- Inculcate knowledge in Logistics Process, Planning and Materials Management.
- Teach the principles and activities in warehousing and storage.
- Provide knowledge on modes of transportation and international transport.
- Inculcate knowledge on performance monitoring, outsourcing and ICT application in logistics and distribution.

UNIT I  CONCEPTS OF LOGISTICS AND DISTRIBUTION  9
Introduction to logistics and distribution- Integrated logistics and the supply chain- Integrated logistics and the supply chain- Customer service and logistics- Channels of distribution - Key issues an challenges for logistics.

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

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Understand the concepts of logistics and distribution
CO2 – Effectively gain knowledge in logistics planning
CO3 – Apply and analyze various principles and concepts in warehousing and storage
CO4 – Effectively design and analyze a system of logistics for freight transport
CO5 – Understand the basic concepts in outsourcing, benchmarking and safety in distribution

REFERENCES:
2. Jean-Paul Rodrigue, Claude Comtois and Brian Slack, “The geography of transport systems” (2009), New York: Routledge,
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IL4093 SUPPLY CHAIN MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
- Explain the role of supply chain management in an organization.
- Identify the various aspects of supply chain management and the factors affecting them.
- Explain the relationship among various factors involved in planning, organising and controlling supply chain operations.
- Summarize the sourcing and inventory decisions involved in supply chain operations.
- Explain the use of information technology in supply chain management.

UNIT I INTRODUCTION SUPPLY CHAIN MANAGEMENT 9
Introduction, Types of supply chains with and examples, Evolution of SCM concepts, Supply chain performance, Strategic Fit, Drivers of Supply Chain Performance – key decision areas – External Drivers of Change. Supply contracts – centralized vs. decentralized system

UNIT II SUPPLY CHAIN NETWORK DESIGN 9
Need for distribution network design- Factors affecting, Design options for distribution network. Network design decisions - Framework, factors influencing, Models of facility location and capacity allocation. Role of Transportation in supply chain, modes of transportation Modal Selection, Classification of carriers, Carrier Selection, Transportation Execution and Control. Food Mile Concept., design options.

UNIT III DEMAND AND SUPPLY IN SUPPLY CHAIN 9

UNIT IV SOURCING AND INVENTORY DECISIONS IN SUPPLY CHAIN 9
Purchasing Vs Procurement Vs Strategic Sourcing, Item procurement importance matrix, Strategic Sourcing Methodology, Managing sourcing and procurement process; Supplier selection and evaluation, Bullwhip effect and its management, Economies of scale in supply chain- Cycle inventory, Estimation, Quantity discounts, Multi-echelon cycle inventory. Uncertainty in supply chain- Safety inventory, Determination of appropriate level, Impact on uncertainty.
UNIT V SUPPLY CHAIN AND INFORMATION SYSTEMS


OUTCOMES:
Students will be able to:
CO1: To introduce the concepts and elements of supply chain management.
CO2: to understand supply chain network design aspects for various manufacturing and service sectors.
CO3: To understand the principle of demand and supply in supply chain
CO4: To gain knowledge on the sourcing and inventory decisions in supply chain.
CO5: To understand the concepts of supply chain information systems.

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COURSE OBJECTIVES:
- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning.
- To explore the different supervised learning techniques including ensemble methods.
- To outline different aspects of unsupervised learning and reinforcement learning.
- To outline the role of probabilistic methods for machine learning.
- To understand the basic concepts of neural networks and deep learning.

UNIT I  INTRODUCTION AND MATHEMATICAL FOUNDATIONS  9

UNIT II  SUPERVISED LEARNING  9

UNIT III  UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING  9

UNIT IV  PROBABILISTIC METHODS FOR LEARNING  9

UNIT V  NEURAL NETWORKS AND DEEP LEARNING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand and outline problems for each type of machine learning
CO2: Design a Decision tree and Random forest for an application
CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.
CO4: Use a tool to implement typical Clustering algorithms for different types of applications.
CO5: Design and implement an HMM for a Sequence Model type of application.
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IL4009 MANUFACTURING SYSTEMS AND MODELS

OBJECTIVES
- To introduce the basic manufacturing systems and its performance measures.
- To learn and apply DTMC models
- To learn and apply CTMC models
- To model and analyse the manufacturing systems for queuing problems
- To model the problems as Petrinet-models

UNIT I MANUFACTURING SYSTEMS- PERFORMANCE MEASURES

UNIT II DISCRETE TIME MARKOV CHAINS
Introduction to Markov Chains, DTMC, Properties of DTMC, Sojourn Times in DTMC Models, Applications of DTMC Models in Manufacturing Systems

UNIT III CONTINUOUS TIME MARKOV CHAINS
Introduction to CTMC, Properties of CTMC, Sojourn Times in CTMC Models, Applications of CTMC Models in Manufacturing Systems
UNIT IV QUEUING NETWORK MODELS 9
Birth and death process, performance measures in queuing models, open queuing networks and closed queuing networks- applications in manufacturing systems

UNIT V PETRINET MODELS 9
Introduction to petrinet models-Representational powers of Petrinets- Reachability graphs, Markings, Applications of petrinet models in manufacturing systems.

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Able to identify and measure the performance of manufacturing system
CO2: Able to apply the DTMC model to a Manufacturing systems
CO3: Able to apply the CTMC model to a Manufacturing system
CO4: Able to apply the Queuing network model to a Manufacturing system
CO5: Able to apply the Petrinet model to a Manufacturing system

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IL4092 PROJECT MANAGEMENT L T P C
OBJECTIVES:
Compare various models used in project selection.
Define project planning, and estimate the cost involved.
Apply network techniques for project scheduling and resource allocation.
Summarize the information needed planning, monitoring and controlling cycle of a project.
Recognize the values of project audit.

UNIT I STRATEGIC MANAGEMENT AND PROJECT SELECTION 9
Project selection models, Project portfolio process, Analysis under uncertainty, Project organization, Matrix organization
UNIT II  PROJECT PLANNING AND COST ESTIMATION  9
Work breakdown structure, Systems integration, Interface coordination, Project life cycle, Conflict and

UNIT III  PROJECT IMPLEMENTATION  9
Scheduling: Network Techniques PERT and CPM, Risk analysis using simulation, CPM- crashing a
project, Resource loading, leveling, and allocation.

UNIT IV  MONITORING AND INFORMATION SYSTEMS  9
Information needs and the reporting process, computerized PMIS, Earned value analysis, Planning-
Monitoring-Controlling cycle, Project control: types of control processes, design of control systems,
control of change and scope

UNIT V  PROJECT AUDITING  9
Construction and use of audit report, Project audit life cycle, Essentials of audit and evaluation,
Varieties of project termination, the termination process, The Final Report – A project history

OUTCOMES:
CO1 - Understand various models used in project selection.
CO2 - Acquire knowledge in project planning, and estimate the cost involved.
CO3 - Prepare Project Scheduling and resource allocation.
CO4 - Understand about planning, monitoring and controlling cycle of a project.
CO5 - Understand the values of project audit.

REFERENCES:
1. Harold Kerzner, Project Management – A Systems Approach to Planning, Scheduling and

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1 - low, 2-medium, 3-high, "-"- no correlation
OBJECTIVES:
- Impart knowledge on principles and steps in designing a statistically designed experiment.
- Build foundation in analysing the data in single factor experiments and to perform post hoc tests.
- Provide knowledge on analysing the data in factorial experiments.
- Educate on analysing the data analysis in special experimental designs and Response Surface Methods.
- Impart knowledge in designing and analysing the data in Taguchi’s Design of Experiments to improve Process/Product quality.

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

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

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Understand the fundamental principles of Design of Experiments.
CO2: Analyze data in the single factor experiments.
CO3: Analyze data in the multifactor experiments.
CO4: Understand the special experimental designs & Response Surface Methods.
CO5: Apply Taguchi based approach to evaluate quality.

REFERENCES
OBJECTIVES:
• Gain knowledge of innovation in Product design and development.
• Summarize the development of new products through conceptualization, design and development phases.
• Associate various aspects of product development with industrial design and manufacturing.
• Interpret the fundamental concept of Rapid Prototyping.
• Generate products which are suitable for the needs of the society.

UNIT I  PRODUCT DEVELOPMENT AND CONCEPT SELECTION 9

UNIT II  PRODUCT ARCHITECTURE 9
Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III  INDUSTRIAL AND MANUFACTURING DESIGN 9
Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration -Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors.

UNIT IV  PROTOTYPING AND ECONOMIC ANALYSIS 9

UNIT V  MANAGING PRODUCT DEVELOPMENT PROJECTS 9
Sequential, parallel and coupled tasks - Baseline project planning – Project Budget- Project execution – Project evaluation- patents- patent search-patent laws-International code for patents.

TOTAL: 45 PERIODS

OUTCOMES:
CO1: The students should be able to understand the basic concept of product development.
CO2: Design and develop new products in a systematic using the studied tools and techniques.
CO3: To associate various aspects of product development with industrial design and manufacturing.
CO4: To understand the fundamental concept of Rapid Prototyping.
CO5: To be able to design products which are suitable for the needs of the society.
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IL4011 SERVICES OPERATIONS MANAGEMENT

OBJECTIVES:
- Summarize the importance of services in competitive environment
- Describe the services design and development
- Illustrate the services performance
- Conclude decisions in services facility
- Plan operations involved in services

UNIT I INTRODUCTION
Services – Importance, role in economy, service sector – growth; Nature of services - Service classification, Service Package, distinctive characteristics, open-systems view; Service Strategy – Strategic service vision, competitive environment, generic strategies, winning customers; Role of information technology; stages in service firm competitiveness; Internet strategies – Environmental strategies.

UNIT II SERVICE DESIGN
New Service Development – Design elements – Service Blue-printing - process structure – generic approaches – Value to customer; Retail design strategies – store size – Network configuration; Managing Service Experience – experience economy, key dimensions; Vehicle Routing and Scheduling

UNIT III SERVICE QUALITY
UNIT IV SERVICE FACILITY
Service scapes – behavior - environmental dimensions – framework; Facility design – nature, objectives, process analysis – process flow diagram, process steps, simulation; Service facility layout; Service Facility Location – considerations, facility location techniques – metropolitan metric, Euclidean, centre of gravity, retail outlet location, location set covering problem

UNIT V MANAGING CAPACITY AND DEMAND
Managing Demand – strategies; Managing capacity – basic strategies, supply management tactics, operations planning and control; Yield management; Inventory Management in Services – Retail Discounting Model, Newsvendor Model; Managing Waiting Lines – Queuing systems, psychology of waiting; Managing for growth- expansion strategies, franchising, globalization.

OUTCOMES:
CO1: Able to summarize service strategies
CO2. Able to describe service network
CO3. Able to illustrate service performance using software tools
CO4. Able to locate facilities using simulation
CO5. Able to formulate inventory and queuing models.

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IL4012 SCHEDULING ALGORITHMS

OBJECTIVES:
- Introduce the basic concepts of scheduling theory.
- Understand the application of single machine scheduling algorithms.
- Perceive knowledge in parallel machine scheduling algorithms.
- Grasp the concept of flow shop scheduling and its algorithm.
- Familiarize the students in the use of algorithms for job scheduling problems
UNIT I SCHEDULING THEORY 9

UNIT II SINGLE MACHINE SCHEDULING 9

UNIT III PARALLEL MACHINE SCHEDULING 9

UNIT IV FLOW SHOP SCHEDULING 9

UNIT V JOB SHOP SCHEDULING 9

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Understand the basics of Scheduling theory.
CO2: Understand various single machine scheduling algorithms.
CO3: Understand various parallel machine scheduling algorithms.
CO4: Understand various flow shop scheduling algorithms.
CO5: Understand various job shop scheduling algorithms

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1 - low, 2-medium, 3-high, "-" no correlation
OBJECTIVES:
- Describe basic maintenance concepts
- Extract optimum maintenance decisions
- Illustrate the root cause for maintenance problems
- Plan the spare parts for maintenance activity
- Discover the losses and improve the Overall Equipment Effectiveness

UNIT I MAINTENANCE CONCEPT

UNIT II MAINTENANCE MODELS

UNIT III MAINTENANCE QUALITY

UNIT IV MAINTENANCE MANAGEMENT

UNIT V TOTAL PRODUCTIVE MAINTENANCE

OUTCOMES:
CO1: Able to describe basic maintenance concepts.
CO2: Able to extract maintenance policies for maximizing the profit
CO3: Able to make a diagnosis of maintenance problems
CO4: Able to improve uptime of machines by effective spare parts management
CO5: Able to improve the overall Equipment Effectiveness

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IL4014 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

OBJECTIVES:
- Identify the basic principles of Productivity Models
- Classify various ways in which productivity is measured and evaluated.
- Describe the basic concept of Re-Engineering.
- Use Re-Engineering tools and techniques to improve productivity.
- Compare the various Re-Engineering Models.

UNIT I PRODUCTIVITY

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

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

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

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

TOTAL: 45 PERIODS
OUTCOMES:
Student will be able to:
CO1: Understand the term productivity.
CO2: Measure and evaluate productivity.
CO3: Plan and implement various productivity techniques.
CO4: Reengineer the process for improving the productivity.
CO5: Implement BPR tools for improving the productivity.

REFERENCES:
2. Rastogi, P.N., “Re-engineering and Re-inventing the Enterprise”, Wheeler Pub. New Delhi,
   1995.

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IL4076 PLANT LAYOUT AND MATERIAL HANDLING

COURSE OBJECTIVES:
- To provide provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which includes ventilation, comfort, lighting and its effect based on various nature of work.
- To provide knowledge on effective and safe layout design of an industry.

UNIT I PLANT LOCATION
Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions
Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants
UNIT II  PLANT LAYOUT  
Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers.
Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works

UNIT III  WORKING CONDITIONS  
Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application.
Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S.

UNIT IV  MANUAL MATERIAL HANDLING AND LIFTING TACKLES  
Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations.
Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection

UNIT V  MECHANICAL MATERIAL HANDLING  
Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications.
Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.

TOTAL: 45 PERIODS

OUTCOMES:
CO 1: The students will be able to Identify equipment requirements for a specific process and for various locations and working conditions.
CO 2: The students will be able to Design an efficient material handling system.
CO 3: Understand the difficulties during the design and implementation of the plant layout.
CO 4: Know about material handling requirements and methods
CO 5: Understand the inspection and maintenance techniques.

REFERENCES:
  3. APPLE M. JAMES “Plant layout and material handling”, 3rd edition, John Wiley and sons.
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1 - low, 2-medium, 3-high, ‘-‘- no correlation

IL4015 SOFTWARE QUALITY ENGINEERING

OBJECTIVES:
- Studying the basic principles and concepts in software quality
- Effectively designing, analyzing and developing the software engineering activities
- Gaining knowledge on software quality assurance and risk management
- Analyze the principles and applications of software quality management tools
- Gaining knowledge about software quality standards

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

UNIT II SOFTWARE ENGINEERING ACTIVITIES

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

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

UNIT V QUALITY ASSURANCE MODELS

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – understand the basic principles and concepts in software quality
CO2 – effectively design, analyze and develop software engineering activities
CO3 – gain knowledge on software quality assurance and risk management
CO4 – understand the principles and applications of software quality management tools
CO5 – gain knowledge about software quality standards
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1-low, 2-medium, 3-high, ‘-‘ - no correlation

IS4351 RELIABILITY ENGINEERING

OBJECTIVES:
- Impart knowledge in reliability concepts.
- Facilitate students in filling the life data into theoretical distribution.
- Educate the students in reliability evaluation of various configuration.
- Impart knowledge in reliability monitoring methods.
- Analyze effectively various techniques to improve reliability of the system.

UNIT I RELIABILITY CONCEPTS

UNIT II LIFE DATA ANALYSIS

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

UNIT V  RELIABILITY IMPROVEMENT

TOTAL: 45 PERIODS

OUTCOMES:
CO1 : Understand the basic concepts of reliability engineering
CO2 : Effectively analyze various non parametric methods and failure distributions
CO3 : Conduct reliability assessment and failure analysis on any complex systems
CO4 : Effectively design and analyze reliability monitoring techniques
CO5 : Analyze various techniques to improve reliability of the system

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REFERENCES:

IL4074  HUMAN FACTORS IN ENGINEERING  L T P C
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OBJECTIVES:
• Studying the work procedure and understanding the relationships between the workers and working environments.
• To study the applications of ergonomic principles and physiology of workers.
• To know the concepts of personal protective equipment and its usages.
• To create the knowledge in process and equipment design in safety aspects.

UNIT I  ERGONOMICS AND ANATOMY
Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics
Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions
UNIT II  HUMAN BEHAVIOR  9
Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of
difference on safety, Method of measuring characteristics, Accident Proneness. Motivation,
Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment
theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes-
Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting,
Motivational requirements.

UNIT III  ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND
SEATED WORKS  9
Designing for a population of users, percentile, sources of human variability, anthropometry and its
uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry
in design, design for everyone, anthropometry and personal space, effectiveness and cost
effectiveness
Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design
for standing workers, design for seated workers, work surface design, visual display units, guidelines
for design of static work, effectiveness and cost effectiveness, research directions

UNIT IV  MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND
MANUAL HANDLING TASK  9
Applications of human factors engineering, man as a sensor, man as information processor, man as
controller – Man vs Machine.
Ergonomics interventions in Repetitive works, handle design, key board design- measures for
preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training
Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work
place, design of manual handling tasks, carrying, postural stability

UNIT V  HUMAN SKILL AND PERFORMANCE AND DISPLAY,
CONTROLS AND VIRTUAL ENVIRONMENTS  9
A general information-processing model of the users, cognitive system, problem solving,
effectiveness.
Principles for the design of visual displays- auditory displays- design of controls- combining displays
and controls- virtual (synthetic) environments, research issues.

TOTAL:  45 PERIODS

OUTCOMES:
• Students can have the knowledge in work procedure and applications in hazardous workplaces.
• Students can design their own safety devices and equipment to reduce the accidents
possibilities.
• Students will be able to incorporate human factors in design of Personal protective equipment.
• They know the risk factors, guide lines for safe design of man machine systems considering
human factors.

REFERENCES
4. The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson
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1- low, 2-medium, 3-high, ‘-‘- no correlation

IL4073 HUMAN INDUSTRIAL SAFETY AND HYGIENE L T P C

OBJECTIVES:
- Identify and prevent operational hazard
- Categorize, analyze and interpret the accidents data based on various safety techniques.
- Use proper safety techniques on safety engineering and management.
- Design the system with environmental consciousness by implementing safety regulation
- Use safety management practices in Industries.

UNIT I OPERATIONAL SAFETY

UNIT II SAFETY APPRAISAL AND ANALYSIS

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


UNIT V SAFETY MANAGEMENT


OUTCOMES:
CO1: Ability to Identify and prevent operational hazard
CO2: Ability to collect, analyze and interpret the accidents data based on various safety techniques.
CO3: Ability to apply proper safety techniques on safety engineering and management.
CO4: Ability to design the system with environmental consciousness by implementing safety regulation
CO5: Ability to apply safety management practices in Industries.

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1-low, 2-medium, 3-high, ‘-‘- no correlation

IL4016 DECISION SUPPORT SYSTEMS

OBJECTIVES:
• Summarize managerial role in decision making.
• Articulate insights in the models used for decision making
• Interpret knowledge management methods
• Relate knowledge acquisition and representation.
• Discover the issues in implementation of decision making systems.
UNIT I  DECISION MAKING  
Managerial decision making, system modeling and support-preview of the modeling process-phases of decision making process.

UNIT II  MODELING AND ANALYSIS  
DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.

UNIT III  KNOWLEDGE MANAGEMENT  
Group support systems- enterprise DSS- supply chain and DSS-knowledge management methods, technologies and tools.

UNIT IV  INTELLIGENT SYSTEMS  
Artificial intelligence and expert systems-concepts, structure, types-knowledge acquisition and validation, knowledge representation, Graphical user interface

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

TOTAL : 45 PERIODS

OUTCOMES:
CO1 – Make decisions in the semi structured and unstructured problem situations using systems and semantic networks.
CO2 – Understand various components of DSS and modeling& analysis phases of DSS
CO3 – Understand the concepts of knowledge management methods in DSS
CO4 – Gain knowledge on artificial intelligence systems
CO5 – Implement management support systems

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1-low, 2-medium, 3-high, ‘-’- no correlation
OBJECTIVES:

- Describe an idea about ERP
- Creating awareness of core and extended modules of ERP
- Extract knowledge of ERP implementation cycle
- Gaining knowledge about effects of ERP after its implementation.
- Understanding the emerging trends on ERP

UNIT I INTRODUCTION
Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES
Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR, and best business practices - Business process Management, Functional modules.

UNIT III ERP IMPLEMENTATION
Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training – Data Migration, People Organization in implementation-Consultants, Vendors and Employees.

UNIT IV POST IMPLEMENTATION
Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

UNIT V EMERGING TRENDS ON ERP
Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing

OUTCOMES:
CO1: Get an idea about ERP
CO2: Awareness of core and extended modules of ERP
CO3: Knowledge of ERP implementation cycle
CO4: Gain knowledge about effects of ERP after its implementation.
CO5: Understand the emerging trends on ERP

REFERENCES:
3. MahadeoJaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009
**AUDIT COURSES**

**AX4091**  
**ENGLISH FOR RESEARCH PAPER WRITING**  
**L T P C**  
**2 0 0 0**

**OBJECTIVES**

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

**UNIT I**  
**INTRODUCTION TO RESEARCH PAPER WRITING**  
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

**UNIT II**  
**PRESENTATION SKILLS**  

**UNIT III**  
**TITLE WRITING SKILLS**  
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

**UNIT IV**  
**RESULT WRITING SKILLS**  
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

**UNIT V**  
**VERIFICATION SKILLS**  
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

**TOTAL: 30 PERIODS**
OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES

AX4092 DISASTER MANAGEMENT

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Faminers, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL: 30 PERIODS
OUTCOMES:
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

AX4093 CONSTITUTION OF INDIA L T P C
2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION
ELECTION COMMISSION

Outcomes:
Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested Reading:

- The Constitution of India, 1950 (Bare Act), Government Publication.
UNIT IV அருள்நநறித்

1. சிறுபொணொற்றுப்பகட
   - பொரி முல்கலக்குத் தகொடுத்தது, பபகன் மயிலுக்குத் தகொடுத்தது, அதியங்கூறு ஒளகவக்குத் தநல்லிக் தகொடுத்தது, அரந் பட்டுக்காத.

2. நற்றிகண
   - அசதிக்கான பசதன சிறந்த

3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்

4. தர்மங்கலகய
   - வள்ளலொர்

5. புறநொனூறு
   - சிறுவபன

6. அகநொனூறு (4) - பலோ, சிறுவக்குத் (11) - செலெ, குறிக்காரத்துக்குத் (11) - முரசை, புறா
   - காலத்துப் புறா பொரிகள்

UNIT V நவீன தமிழ்

1. உகரநகடத்
   - தமிழின் முதல் புதினம், தமிழின் முதல் சிறுககத, கட்டுகர இலக்கியம், பயண இலக்கியம், நொடகம், பயண இலக்கியம்,
   - தமிழ் இலக்கியமும், தமிழ் இலக்கியமும், தமிழ் இலக்கியமும், தமிழ் இலக்கியமும், தமிழ் இலக்கியமும், தமிழ் இலக்கியமும்.
   - முதொய விடுத்தகலயும்

2. நொட்டு விடுத்தகலமும்
   - பயண இலக்கியமும்

3. அறிவியல்
   - தமிழ் ப்பால்ககலக்கழகம், தஞ் ஊவூர்

4. இகணயத்தில்
   - தமிழ் இலக்கியம்

TOTAL: 30 PERIODS

தமிழ் விக்கிப்பீடியொ / பொருள்கள்

1. தமிழ் விடுத்தகலமும் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ் தர்மபுர ஆதீனன்
4. வொழியல் களஞ்சியம் - தமிழ் பல்ககலக்கழகம், குருக்கள்
5. தமிழ் விக்கிப்பீடியொ களஞ்சியம் (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம் - தமிழ் பல்ககலக்கழகம், குருக்கள்
OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM

Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student is expected to be able to

| CO1 | Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management. |
| CO2 | Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies. |
| CO3 | Apply law and governance in the context of IWRM. |
| CO4 | Discuss the linkages between water-health; develop a HIA framework. |
| CO5 | Analyse how the virtual water concept pave way to alternate policy options. |
REFERENCES:

CO – PO Mapping - INTEGRATED WATER RESOURCES MANAGEMENT

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<td>PSO1 Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
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<td>PSO2 Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability</td>
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<td>PSO3 Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water resources management</td>
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OBJECTIVES:
• Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT
Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation:- Infrastructure- Service Delivery: Health services: Macro and Micro- level; Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives.

UNIT IV GOVERNANCE
Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)-Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V INITIATIVES
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

| CO1 | Capture to fundamental concepts and terms which are to be applied and understood all through the study. |
| CO2 | Comprehend the various factors affecting water sanitation and health through the lens of third world scenario. |
| CO3 | Critically analyse and articulate the underlying common challenges in water, sanitation and health. |
| CO4 | Acquire knowledge on the attributes of governance and its say on water sanitation and health. |
| CO5 | Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects. |

REFERENCES


**CO PO MAPPING : WATER, SANITATION AND HEALTH**

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<td>Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
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<td>Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.</td>
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<td>Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.</td>
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OBJECTIVES:
- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES 9

UNIT II PRINCIPLES AND FRAMEWORK 9

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING 9

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS 10

UNIT V ASSESSING PROGRESS AND WAY FORWARD 8
OUTCOMES:

- On completion of the course, the student is expected to be able to

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REFERENCES:


CO – PO Mapping – Principles of Sustainable Development

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OBJECTIVES:
- To make the students understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION

UNIT II IMPACT IDENTIFICATION AND PREDICTION

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

OUTCOMES:
- On completion of the course, the student is expected to be able to

| CO1 | Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles |
| CO2 | Understand various impact identification methodologies, prediction techniques and model of impacts on various environments |
| CO3 | Understand relationship between social impacts and change in community due to development activities and rehabilitation methods |
| CO4 | Document the EIA findings and prepare environmental management and monitoring plan |
| CO5 | Identify, predict and assess impacts of similar projects based on case studies |
REFERENCES:
1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

CO – PO Mapping- ENVIRONMENTAL IMPACT ASSESSMENT

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OIC431 BLOCKCHAIN TECHNOLOGIES

COURSE OBJECTIVES:
- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II BITCOIN AND CRYPTO CURRENCY

UNIT III INTRODUCTION TO ETHEREUM
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING

UNIT V BLOCKCHAIN APPLICATIONS
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After the completion of this course, student will be able to
CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build decentralized apps on Ethereum
CO5: Develop applications on Blockchain

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CO-PO Mapping

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COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Build and train RNNs, work with NLP and Word Embeddings.
- The internal structure of LSTM and GRU and the differences between them.
- The Auto Encoders for Image Processing.

UNIT I  DEEP LEARNING CONCEPTS

UNIT II  NEURAL NETWORKS

UNIT III  CONVOLUTIONAL NEURAL NETWORK

UNIT VI  NATURAL LANGUAGE PROCESSING USING RNN

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction
REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017

OBA431 SUSTAINABLE MANAGEMENT LT P C
3 0 0 3
COURSE OBJECTIVES:
- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY 9
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY 9
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES 9
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION 9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.

TOTAL: 45 PERIODS
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

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OBA432 MICRO AND SMALL BUSINESS MANAGEMENT

COURSE OBJECTIVES
- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY
Management and Leadership – employee assessments – Tuckman’s stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model.
Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

UNIT IV FINANCING SMALL BUSINESS 9
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin - Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
3. Journal articles on SME’s.

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OBA433 INTELLECTUAL PROPERTY RIGHTS

COURSE OBJECTIVE
➢ To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION 9
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS 9
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES 9

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY 9
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS 9
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.

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OBA434 ETHICAL MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.
UNIT I ETHICS AND SOCIETY
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology- ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations

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COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT.
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT.
5. To familiarize the different platforms and Attributes for IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS 9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE 9

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT 9
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems - Recent trends.

UNIT IV IOT PROCESSORS 9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPBERRY PI and Arduino.

UNIT V CASE STUDIES 9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT.
CO3: Explain different protocols and communication technologies used in IoT.
ET4072  MACHINE LEARNING AND DEEP LEARNING  L T P C  3 0 0 3

COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.
UNIT I LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1-Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1 : Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

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REFERENCES:
OBJECTIVES:
To impart knowledge on
- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India - Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS

UNIT III PHOTOVOLTAIC SYSTEM DESIGN
Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS

UNIT V OTHER RENEWABLE ENERGY SOURCES
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

OUTCOMES:
After completion of this course, the student will be able to:
- CO1: Demonstrate the need for renewable energy sources.
- CO2: Develop a stand-alone photo voltaic system and implement a maximum power point
COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I  INTRODUCTION TO SMART GRID

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II  SMART GRID TECHNOLOGIES

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection,
Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Unit V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9
Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

REFERENCES

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COURSE OBJECTIVES:
- To learn the core fundamentals of system and web security concepts
- To have thorough understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I
SYSTEM SECURITY

UNIT II
NETWORK SECURITY

UNIT III
SECURITY MANAGEMENT

UNIT IV
CYBER SECURITY AND CLOUD SECURITY

UNIT V
PRIVACY AND STORAGE SECURITY

COURSE OUTCOMES:
CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

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MP4251 CLOUD COMPUTING TECHNOLOGIES

COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE

UNIT II CLOUD PLATFORM ARCHITECTURE

UNIT III AWS CLOUD PLATFORM - IAAS
UNIT IV  PAAS CLOUD PLATFORM

UNIT V  PROGRAMMING MODEL
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES

IF4072  DESIGN THINKING  L T P C
3 0 0 3

COURSE OBJECTIVES:
• To provide a sound knowledge in UI & UX
• To understand the need for UI and UX
• Research Methods used in Design
• Tools used in UI & UX
• Creating a wireframe and prototype
UNIT I  UX LIFECYCLE TEMPLATE

UNIT II  CONTEXTUAL INQUIRY

UNIT III  DESIGN THINKING, IDEATION, AND SKETCHING

UNIT IV  UX GOALS, METRICS, AND TARGETS

UNIT V  ANALYSING USER EXPERIENCE

SUGGESTED ACTIVITIES:
1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

MU4153 PRINCIPLES OF MULTIMEDIA L T P C

3 0 0 3

COURSE OBJECTIVES:
- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia.

UNIT I INTRODUCTION

Suggested Activities:
1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:
1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA
Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:
1. Flipped classroom on different file formats of various media elements.

Suggested Evaluation Methods:
1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.
UNIT III  MULTIMEDIA TOOLS  

Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:
1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV  MULTIMEDIA SYSTEMS  

Suggested Activities:
1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:
1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V  MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS  

Suggested Activities:
1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:
1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:

DS4015 BIG DATA ANALYTICS

COURSE OBJECTIVES:
- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA

UNIT II SEARCH METHODS AND VISUALIZATION

UNIT III MINING DATA STREAMS
Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions

UNIT IV FRAMEWORKS
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V R LANGUAGE
**COURSE OUTCOMES:**

CO1: understand the basics of big data analytics

CO2: Ability to use Hadoop, Map Reduce Framework.

CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.

CO4: gain knowledge on R language

CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

**TOTAL: 45 PERIODS**

**REFERENCE:**


**CO-PO Mapping**

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**NC4201 INTERNET OF THINGS AND CLOUD**

**COURSE OBJECTIVES:**

- To understand Smart Objects and IoT Architectures
- To learn about various IoT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

**UNIT I FUNDAMENTALS OF IoT**


**UNIT II PROTOCOLS FOR IoT**


**UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS**
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION

UNIT V IoT AND CLOUD

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Understand the various concept of the IoT and their technologies..
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073 MEDICAL ROBOTICS

COURSE OBJECTIVES:
- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models
UNIT II MANIPULATORS & BASIC KINEMATICS 9
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III SURGICAL ROBOTS 9
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV REHABILITATION AND ASSISTIVE ROBOTS 9
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS 9
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

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**CO-PO Mapping**

**VE4202**
**EMBEDDED AUTOMATION**

**UNIT-I**
**INTRODUCTION TO EMBEDDED C PROGRAMMING**
- C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

**UNIT-II**
**AVR MICROCONTROLLER**
- ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

**UNIT-III**
**HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS**
- Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

**UNIT-IV**
**VISION SYSTEM**

**UNIT-V**
**HOME AUTOMATION**
TOTAL: 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

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CX4016 ENVIRONMENTAL SUSTAINABILITY

UNIT I INTRODUCTION
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

UNIT II CONCEPT OF SUSTAINABILITY
Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

UNIT III SIGNIFICANCE OF BIODIVERSITY
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV POLLUTION IMPACTS
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V  ENVIRONMENTAL ECONOMICS
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES

TX4092  TEXTILE REINFORCED COMPOSITES
L T P C
3 0 0 3

UNIT I  REINFORCEMENTS
Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II  MATRICES
Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III  COMPOSITE MANUFACTURING
Classification; methods of composites manufacturing for both thermoplastics and thermosets-   Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation; methods, compression moulding; post processing of composites and composite design requirements

UNIT IV  TESTING
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V  MECHANICS
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

TOTAL: 45 PERIODS

REFERENCES

NT4002  NANOCOMPOSITE MATERIALS  L T P C
                    3 0 0 3

UNIT I    BASICS OF NANOCOMPOSITES  9

UNIT II    METAL BASED NANOCOMPOSITES  9
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal- Oxide or Metal-Ceramic composites. Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites.

UNIT III POLYMER BASED NANOCOMPOSITES  9
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV    NANOCOMPOSITE FROM BIOMATERIALS  9
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V    NANOCOMPOSITE TECHNOLOGY  9

TOTAL: 45 PERIODS

REFERENCES:
5. The search for novel, superhard materials- Stan Vepřek (Review Article) JVST A, 1999
BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP

UNIT I IPR

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

UNIT III BIOSAFETY

UNIT IV GENETICALLY MODIFIED ORGANISMS
Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT

TOTAL : 45 PERIODS

REFERENCES