VISION OF THE DEPARTMENT
To develop disciplined, socially committed and technically competent Production Engineers with Creativity, Comprehension and Managerial skills to design and manufacture innovative cost effective quality products for the benefit of mankind.

MISSION OF THE DEPARTMENT
1. Train the students who will be able to design and manufacture Innovative, Environment Friendly, Ergonomic and Cost Effective Quality Products and Services.
2. Improve the technical quality of the students to meet the challenges, competitions and opportunities in production engineering.
3. Prepare the students who will be able to solve socially relevant engineering problems and other complex problems by means of inculcating Managerial Skills.
4. Enhance the department industry / research centre interaction by means of training, internship and student projects to solve industrial problems.
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

I. The graduates acquire ability to create environmental oriented models, design and analyze essential production operational skills, mechanism and automation system.

II. The graduates use their talent, self-confidence, knowledge and engineering practice which facilitate them to presume position of scientific and/or managerial leadership in their career paths towards green manufacturing.

III. The graduates apply their consciousness of moral, professional responsibilities and motivation to practice life-long learning in a team work environment.

PROGRAMME OUTCOMES (PO)

1. Graduate will demonstrate strong basics in mathematics, science and engineering which serve as the foundation for the Programme.
2. Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
3. Graduate will become familiar with modern engineering tools and analyze the problems within the domains of Green Manufacturing as the members of multidisciplinary teams.
4. Graduate will acquire the capability to identify, formulate and solve engineering problems related to production engineering.
5. Graduate will demonstrate an understanding of professional and ethical responsibility with reference to their career in the field of production engineering.
6. Graduate will be able to communicate effectively both in verbal and non-verbal forms.
7. Graduate will be trained towards developing and understanding the impact of environmental oriented components on global, economic, and societal context.
8. Graduate will be capable of understanding the value for life-long learning.
9. Graduate will demonstrate knowledge of contemporary issues pertaining to the health and well-being of desirable living forms inhabiting the environment.
10. Graduate will demonstrate the ability to use the techniques, skills and modern engineering tools necessary for engineering practice in the field of Production Engineering.
11. Graduate will be able to design and develop innovative/ manufacturable / marketable / environmental friendly products useful to the nation and the society.
12. Graduate will be able to manage any organization well and will be able to emerge as a successful entrepreneur.
PROGRAMME SPECIFIC OUTCOMES (PSOs)
By completion of this post graduate programme in Manufacturing Engineering with specialization in green manufacturing, the graduates will have following Program specific outcomes:

1. Foundation of sustainable development: Knowledge on application of appropriate manufacturing systems and their impact on environment towards sustainability.

MAPPING OF PEOS WITH POS

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# M.E. Manufacturing Engineering (With Specialization in Green Manufacturing Engineering) (Part Time)

## I to VI Semesters Curriculum and Syllabus

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**Laboratory Courses**

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# PROGRAM ELECTIVE COURSES (PEC)

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# Research Methodology and IPR Courses (RMC)

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# Open Elective Courses [OEC]

(Out of 6 Courses one Course must be selected)

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# Audit Courses (AC)

Registration for any of these courses is optional to students

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# Employability Enhancement Courses (EEC)

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OBJECTIVES

- To introduce the concept of environmental design and industrial ecology.
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.
- To enlighten the students with knowledge about water pollution and its effects on the environment.
- To introduce the concept of green co-rating and its need.

UNIT I
DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT


UNIT II
AIR POLLUTION SAMPLING AND MEASUREMENT


UNIT III
NOISE POLLUTION AND CONTROL

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthropogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise - Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT IV
WATER DEMAND AND WATER QUALITY

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT V
GREEN CO-RATING


TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:

- CO1 : know the environmental design and selection of eco-friendly materials.
- CO2 : analyze manufacturing processes towards minimization or prevention of air pollution.
- CO3 : analyze manufacturing processes towards minimization or prevention of noise pollution.
- CO4 : analyze manufacturing processes towards minimization or prevention of water pollution.
- CO5 : evaluate green co-rating and its benefits.
REFERENCES

CO/PO Mapping

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GR5102  
ENERGY MANAGEMENT  
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OBJECTIVES
- To familiarize the concepts of energy and environment to the students so that there will be general awareness about renewable energy sources.
- To familiarize the students about conservation of the energy and use it for industries.
- To stress upon the role of various energy technologies so that the students will be able to choose an appropriate technology.
- To stress about energy measurement and its management to energy sector.
- To brief about the finance and economics aspects of energy so that optimal utilisation can be achieved.

UNIT I  
ENERGY AND ENVIRONMENT  

UNIT II  
ENERGY CONSERVATION  

UNIT III  
ENERGY TECHNOLOGIES  

UNIT IV  
ENERGY MEASUREMENT AND MANAGEMENT  
UNIT V ECONOMICS AND FINANCE

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:

CO1 : get familiarity with the concepts of energy and environment, and select suitable renewable energy sources.
CO2 : gain the knowledge acquired to implement and achieve conservation of energy.
CO3 : choose an appropriate energy technology with the knowledge acquired.
CO4 : choose appropriate energy measurement method.
CO5 : achieve optimal utilisation by reducing cost.

REFERENCES

CO/PO Mapping

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GR5111 GREEN CHEMISTRY LABORATORY

OBJECTIVES
- To create awareness about degree of water pollution as per green chemistry norms
- To make the students to understand pH Value of water as per industrial requirements
- To familiarize TDS, hardness and alkalinity of water according to the industrial and domestic needs

LIST OF EXPERIMENTS
1. To determine the Chemical Oxygen Demand of the given water sample
2. To determine biological oxygen demand of the given water sample
3. To estimate dissolved Oxygen (DO) in the waste water sample.
4. To estimate Total Dissolved Solids (DO) in the drinking water sample
5. Determination of PH Value for municipal and industrial waters.
6. Determination of hardness (temporary, permanent and total) of domestic and industrial waters.
7. Estimation of alkalinity of water sample.
8. Properties of acid base

[Signature]
Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
10. To determine Acidity of water titrometric method.
11. Preparation of Eco friendly pesticides
12. Estimation of waterborne bacteria, cysts and viruses inpurified drinking water (RO/UV/UF).

TOTAL: 60 PERIODS

OUTCOMES
At the end of this course, the students will be able to:
CO1: analyse degree of water pollution as per green chemistry
CO2: evaluate PH Values of water for industrial requirements
CO3: carry out experiments to confirm TDS, hardness and alkalinity of water according to industrial and domestic needs

CO/PO Mapping

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GR5201

ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT

OBJECTIVES
- To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
- To familiarize the students in environmental decision making procedure.
- Make the students to identify, predict and evaluate the economic, environmental and social impact of development activities
- To provide information on the environmental consequences for decision making
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

UNIT I

ENVIRONMENTAL IMPACT ASSESSMENT
Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

UNIT II

ENVIRONMENTAL DECISION MAKING
Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.

UNIT III

ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION
Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT IV

LIFE CYCLE ASSESSMENT
Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting
UNIT V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT

Spatial economics – Knowledge economy and urban regions.

TOTAL : 45 PERIODS

OUTCOMES

At the end of this course, the students will be able to:

CO1: know the concepts of Environment Sustainability and trained to make decision related to Environment.

CO2: make decision that has an effect on our environment

CO3: know the basics of environmental policy, planning and various legislation

CO4: get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.

CO5: create jobs and offer better livelihoods; increase economic growth; improve social inclusion; promote the decoupling of living standards and economic growth from environmental resource use; protect local and regional ecosystems; reduce both urban and rural poverty

REFERENCES

2. Robert B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005

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GR5202 STATISTICAL TECHNIQUES FOR MANUFACTURING

OBJECTIVES

- To train the students so that the students will be able to design experimental designs and use these concepts for research design.
- To introduce the concept of probability so that they can be used for industrial applications.
- To stress upon the importance of the sampling theory and its usefulness in industrial quality control.
- To make students familiarize with the concepts of estimation theory and its applications.
- To help students the usefulness of test of significance and its applications in industry and research.

[Attested]

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
UNIT I PROBABILITY THEORY 9
Sample space - Sample point – Random variable – Discrete and continuous random variable – Probability mass and density functions – Expected value, Variance and standard deviations of random variables – Joint density and mass functions – Covariance and Correlation between random variables – Moment about mean and origin – Moment generating and characteristic functions – Binomial, Poisson and normal distribution and their applications- Green Manufacturing applications.

UNIT II SAMPLING THEORY 9

UNIT III ESTIMATION THEORY 9
Unbiased and efficient estimates – Point and Interval estimation – Confident Interval estimates – Confidence level and Coefficient – confidence limits for mean, proportions, difference of means, proportions- confidence limits using student ‘t’ distribution, chi square and F distribution- applications.

UNIT IV TESTING OF HYPOTHESIS 9
Null and alternate hypothesis - Procedure for testing hypothesis and significance - One and two tailed tests- Level of Significance of large samples for means, proportions, difference of means ,difference of proportions – Tests based on student t distribution, chi square distribution and F distribution – Applications – Research studies in Green Manufacturing.

UNIT V ANALYSIS OF VARIANCE 9
Design of experiments – Total variation, Variation between treatment and within treatment – one factor experiments – Mathematical model for one factor experiments – Two factor experiments, - Mathematical model for two factor experiments – Applications.

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:
  CO1 : design experiments for research and industry.
  CO2 : apply the concept of probability so that they can be used for industrial applications.
  CO3 : use sampling theory and its usefulness in industrial quality control.
  CO4 : apply the concepts of estimation theory to industrial problems.
  CO5 : apply the test of significance and its applications to industry and research.

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GR5211          GREEN PRACTICES LABORATORY          L T P C
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OBJECTIVES

- To study about various green practices to be followed in different industries / environments

1. Spindle and feed drive units power measurement in center lathe / CNC turning or milling machine
   (Consider a typical component and record the power using power sensor under different operation conditions and evaluate the energy consumption and efficiency of the process)
2. Machining under different cooling and lubrication strategy
3. Coolant life management
4. Energy requirement prediction model
5. Estimation of carbon foot print from different machining processes
6. Determination of SO$_2$, NO$_X$, and oxidants concentration in ambient air.
7. Determination of CO and CO$_2$ and unburned hydrocarbons concentration in IC Engine Exhaust.
8. Manufacturing of Green Soap
9. Experiment on Industrial noise measurement
10. Free and forced vibration measurement on simple cantilever beams / Machine members
11. Experimental Measurement of Illumination with various types of bulbs

TOTAL : 60 PERIODS

OUTCOMES

At the end of this course, the students will:

CO1 : have knowledge in implementing green practices in all the fields such as industries, apartments and environments.
COURSE OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I  RESEARCH PROBLEM FORMULATION  6
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II  LITERATURE REVIEW  6
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III  TECHNICAL WRITING/PRESENTATION  6
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV  INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)  6

UNIT V  INTELLECTUAL PROPERTY RIGHTS (IPR)  6

TOTAL: 30 PERIODS

COURSE OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

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GR5301 QUANTITATIVE TECHNIQUES FOR MANUFACTURING  L  T  P  C
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OBJECTIVES
- To introduce the linear programming techniques such as graphical method and simplex method.
- To develop optimal solutions to transportation and assignment problems.
- To familiarize the concepts of game theory and its industrial applications.
- To stress on the importance of queuing theory and its applications in waiting line problems.
- To develop replacement models and to decide on optimal replacement policy.

UNIT I LINEAR PROGRAMMING  12

UNIT II TRANSPORTATION AND ASSIGNMENT METHODS  12

UNIT III THEORY OF GAMES  12

UNIT IV QUEUING THEORY AND SIMULATION  12

UNIT V REPLACEMENT PROBLEMS  12
Replacement of equipment with increase of running cost with time – time value of money – Individual replacement policy – Group replacement policy - staffing problems.

TOTAL : 60 PERIODS

OUTCOMES
At the end of this course, the students will be able to:
- CO1 : use simplex method to solve industrial problems.
- CO2 : develop optimum transportation schedule and assignment for industrial problems.
- CO3 : design a suitable strategy for a given industrial problem using the concepts of game theory.
- CO4 : design a suitable queuing model for a given application.
- CO5 : design optimal replacement policies for replacement of equipments.
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GR5311 CASE STUDIES IN GREEN MANUFACTURING PRACTICE

OBJECTIVES
- To introduce the various live case studies from industries on Green Manufacturing to the students
- Presentation of various case studies from industries / buildings on Green Manufacturing, Green co-rating.

DESCRIPTION
Students will be required to identify case studies from industries related to Green Manufacturing practices and the case study will be presented by students with solutions.

OUTCOME
At the end of this course, the students will be able to:
CO1: analyze the problems and offer solutions related to Green Manufacturing.

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OBJECTIVES

- To familiarize with the various forecasting models.
- To impress upon the importance of sequencing problem in industries.
- To design and develop inventory control models for a given industry.
- To familiarize with project management techniques such as CPM and PERT.
- To train on the plant engineering techniques such as plant location, plant layout, materials handling and work study.

UNIT I FORECASTING


UNIT II SCHEDULING AND SEQUENCING


UNIT III INVENTORY


UNIT IV PROJECT MANAGEMENT


UNIT V PLANT ENGINEERING AND WORK STUDY


TOTAL: 60 PERIODS

OUTCOMES

At the end of this course, the students will be able to:

CO1: Select an appropriate forecasting method for a given industry.
CO2: obtain optimal solutions for sequencing problem in industry.
CO3: design a suitable inventory system for any particular industry.
CO4: use the project management techniques to minimize the project time.
CO5: design plant layout and materials handling systems and can make use of the concepts of work study for work design.

Attested

[Signature]

DIRECTOR

Centre for Academic Courses
Anna University, Chennai-600 025
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CI5072 SUSTAINABLE MANUFACTURING

OBJECTIVES
- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

UNIT I ECONOMIC SUSTAINABILITY

UNIT II SOCIAL AND ENVIRONMENTAL SUSTAINABILITY
Social sustainability – Introduction-Work management -Human rights - Societal commitment -Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources - Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability

UNIT III SUSTAINABILITY PRACTICES
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements –Cost and time model
UNIT IV MANUFACTURING STRATEGY FOR SUSTAINABILITY

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs

UNIT V TRENDS IN SUSTAINABLE OPERATIONS

Principles of sustainable operations - Life cycle assessment manufacturing and service activities - Influence of product design on operations - Process analysis - Capacity management - Quality management - Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

CO1: Discuss the importance of economic sustainability.
CO2: Describe the importance of sustainable practices.
CO3: Identify drivers and barriers for the given conditions.
CO4: Formulate strategy in sustainable manufacturing.
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.

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GR5411 MINI PROJECT WITH SEMINAR

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OBJECTIVE
- To enable the students to select a suitable topic to analyse and solve problems of industries/ research/ academic organizations related to green manufacturing.

DESCRIPTION
- The students will have to identify smaller problems from industries/research/academic organizations pertaining to green manufacturing, analyze and offer solutions to the problems identified based on the knowledge acquired.
- Seminar has to be given periodically for evaluation
- A project report is to be submitted at the end for evaluation.

EVALUATION
- The progress of mini project will be evaluated through reviews and finally presentation with report will be evaluated jointly by external and internal examiners constituted by the Head of the Department.

OUTCOME
At the end of this course, the students will be able to:
- CO1 : apply the knowledge gained from theoretical and practical courses in solving the problems by creative, well planned and organized manner related to green manufacturing.

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GR5412 MODELLING AND FACTORY SIMULATION LABORATORY

0 0 4 2

OBJECTIVES
- To introduce the concepts and applications of CAD modelling and factory related operations
- Students will gain an understanding of the 3D modelling software
- Students will study and practice the sequencing, process planning and line balancing.
- Students will have hands-on experience on virtual reality.

MODELLING LABORATORY
1. 3D Modelling and Assembly of Engine components like Engine Crank Shaft, Connecting Rod, Cotter Joint, Plummer Block and Coupling using 3D modeling software

FACTORY SIMULATION LABORATORY
1. Offline - Programming of movement sequence of Robot Configuration using simulation software.
2. Offline - manufacturing process planning for specific operation sequence graphically using simulation software.
3. Estimation of manufacturing operation time and perform line balancing.
4. Virtual reality viewers using 3D CAD models for industry 4.0.
5. Internet of things application for pilot project.

TOTAL : 60 PERIODS
OUTCOMES
At the end of this course, the students will be able to:

CO1: design and construct a layout for robot simulation
CO2: calculate manufacturing process planning, line balancing using 3D CAD model.

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GR5511 DISSERTATION - I

OBJECTIVE
- To enable the students to select a suitable topic to analyse and solve problems of industries/research/academic organizations related to green manufacturing.

DESCRIPTION
- The students will have to identify problems from industries/research/academic organizations pertaining to green manufacturing, analyze and offer solutions to the problems identified based on the knowledge acquired.
- The students can also identify larger problems for which a part of the work should be completed in dissertation – I and further work should be performed in dissertation – II
- A report for Dissertation - I is to be submitted at the end for evaluation.

EVALUATION
- The progress of dissertation-I will be evaluated through reviews and finally dissertation will be evaluated jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 90 PERIODS

OUTCOME
At the end of this course, the students will be able to:

CO1: apply the knowledge gained from theoretical and practical courses in solving the problems by creative, well planned and organized manner related to green manufacturing.

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GR5611 DISSECTATION II L T P C
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OBJECTIVE
- To enable the students to select a suitable topic to analyse and solve problems of industries/ research/ academic organizations related to green manufacturing.

DESCRIPTION
- The students will have to identify a larger problem from industries/research/academic organizations pertaining to green manufacturing, analyze and offer solutions to the problems identified based on the knowledge acquired.
- The students who have completed a part of the work as dissertation – I should complete the remaining part in dissertation – II.
- A report for Dissertation - II is to be submitted at the end for evaluation.

EVALUATION
- The progress of dissertation-II will be evaluated through reviews and finally dissertation will be evaluated jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 180 PERIODS

OUTCOME
At the end of this course, the students will be able to:
CO1: apply the knowledge gained from theoretical and practical courses in solving the problems by creative, well planned, organized manner related to green manufacturing.

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GR5001 DESIGN FOR ENVIRONMENT L T P C
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OBJECTIVES
- To make the students to understand the importance of Design for Environment with respect to existing and future world.
- To make the students to understand the life cycle, concurrent and information obtained from nature.
- To understand the guidelines and rules for various forms of design
- To make the students to realize the decision making with respect to Environmental design
- To understand the applications and implementation of Design & Environment

UNIT I THE GREEN MOVEMENT
UNIT II THE ART AND SCIENCE OF DESIGN FOR ENVIRONMENT
Management environmental Innovation – The rise of green market – Integrated produce
development – organizing for environmental Excellence – Practising concurrent engineering –
Understanding product life cycle – Principles of design for environment – Life cycle
thinking – System perspective – Indicators and Metrics – Design strategies – Analysis
method – Information technology – Learning from Nature – From principle to practices.

UNIT III DESIGN RULES AND GUIDELINES
Design for Dematerialization – Design for Energy and material conservation – Design for
source reduction – Design for servicization – Design for Detoxification – Design for release

UNIT IV ANALYSIS METHODS FOR DESIGN DECISIONS
Tangible Evaluation – Qualitative Assessment – Environmental analysis – Foot print
indicators, life cycle assessment, predictive simulation – Risk Analysis – Financial analysis –
Examples for DFE decisions – The challenges of Decision making – Product life cycle
Management – Case study. Example Caterpillar: New Engines from OLD - 3M responsible
innovation – Towards sustainable supply chain management.

UNIT V THE REAL WORLD PRACTISE OF DESIGN FOR ENVIRONMENT
Electronic Equipment industries – Xerox corporation: reducing the footprint, Hewlett
Packard: A green giant – Sony Electronics: Innovation in design Transportation Industry –

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:
• CO1 : have knowledge of decision making with respect to the green movement
• CO2 : apply the art and science of design environment
• CO3 : apply the design rules and guidelines in preserving the environment
• CO4 : impart the knowledge to analyse methods for design decisions
• CO5 : apply the real world practice for design environment

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OBJECTIVES

- To make the students to design green chemical products and processes to reduce the generation of hazardous substances.
- To introduce the importance of green chemistry's route in the pollution prevention.
- To provide the students about stable and green chemical synthesis.
- To familiarize the student to green chemistry reactions in order to provide safer environment.
- To create awareness to choose safer materials for a safer world.

UNIT I  INTRODUCTION TO GREEN CHEMISTRY

UNIT II  INTERACTION OF ENVIRONMENTAL SPHERES

UNIT III  BASIC BUILDING BLOCKS OF GREEN CHEMICALS
Elements – atoms and atomic theory – hydrogen – helium – lithium – the second period of the periodic table – the special significance of eight outer shell electrons theory for green chemical theory synthesis – the brief periodic table information for stable chemicals, manufacturing for sustainable development.

UNIT IV  GREEN CHEMICAL REACTIONS

UNIT V  SAFER MATERIALS FOR A SAFER WORLD

OUTCOMES

At the end of this course, the students will be able to:
- CO1: design green chemical products and process to reduce hazardous substance.
- CO2: familiarize green chemistry’s route in the pollution prevention.
- CO3: gain knowledge about green chemical synthesis towards suitable development.
- CO4: realize with green chemical reactions for safer environments.
- CO5: select the safer materials for a safer world.
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GR5003 SUSTAINABILITY PRACTICE

OBJECTIVES
- To gain knowledge on the sustainability and present global issues
- To have knowledge on the economy and main stream sustainable development
- To introduce the various concepts of environment, degradation and sustainability
- To have knowledge on balancing the ecology
- To know the various risk faced by the society

UNIT I INTRODUCTION

UNIT II MAIN STREAM SUSTAINABLE DEVELOPMENT

UNIT III ENVIRONMENT, DEGRADATION AND SUSTAINABILITY
Environmental degradation, over population and intensification – overgrazing and new range ecology - Environmental costs of development – Dams, People and resettlement.

UNIT IV ECOLOGY OF SUSTAINABILITY
Poverty, environment and degradation - Forest clearance and forest people - Ecology of conversation - Famine - Deforestation - Tropical deforestation

UNIT V SUSTAINABILITY AND RISK SOCIETY

TOTAL : 45 PERIODS
OUTCOMES
At the end of this course, the students will be able to:
CO1: Know the need for sustainability
CO2: develop the skills to create various sustainable development practices
CO3: know the issues related to the environment degradation
CO4: ecological sustainability and its current issues
CO5: Know the current risk faced by the society.

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GR5004 SAFETY ENGINEERING

OBJECTIVES
- To design or prevention through design is in the core for maintaining engineering systems safe.
- To evaluate occupational safety and health hazards in the workplace.
- To determine appropriate hazard controls following the hierarchy of controls.
- To determine appropriate hazard controls following the hierarchy of controls.
- To prevent incidents using the hierarchy of controls, effective safety and health management systems and task oriented training.

UNIT I SAFETY IN METAL WORKING AND WOOD WORKING MACHINES
General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT II PRINCIPLES OF MACHINE GUARDING
UNIT III  SAFETY IN WELDING AND GAS CUTTING  9
Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common
hazards, personal protective equipment, training, safety precautions in brazing, soldering and
metalizing – explosive welding, selection, care and maintenance of the associated equipment
and instruments – safety in generation, distribution and handling of industrial gases-colour
coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas
cylinders.

UNIT IV  SAFETY IN COLD FORMING AND HOT WORKING OF METALS  9
Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding
and cutting mechanism, hand or foot-operated presses, power press electric controls, power
press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot
working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending
of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles,
ovens, foundry health hazards, work environment, material handling in foundries, foundry
production cleaning and finishing foundry processes.

UNIT V  SAFETY IN FINISHING, INSPECTION AND TESTING  9
Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in
inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers,
pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring
devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.
Health and welfare measures in engineering industry-pollution control in engineering industry –
industrial waste disposal.

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:

CO1 : evaluate workplace to determine the existence of occupational safety and health
hazards

CO2 : identify relevant regulatory and national consensus standards along with best
practices that are applicable.

CO3 : analyze the effects of workplace exposures

CO4 : select appropriate control methodologies based on the hierarchy of control

CO5 : analyze injury and illness data for trends.

REFERENCES
1. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech.
3. Frank R. Spellman and Nancy E. Whiting, Lanham, Md., A Handbook of Safety
Engineering: Principles and applications by Government Institutes,[2010]
5. Ergonomics and human factors in safety management by Pedro M.Arezes and Paula
Applications

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OBJECTIVES

- To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.
- To gain knowledge on function of regulatory agencies for water related issues
- To gain knowledge on function of regulatory agencies for air related issues
- To gain knowledge on environmental protection acts
- To know the provision for forest and court related issues

UNIT I
INTRODUCTION

UNIT II
WATER (P&CP) ACT, 1974
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT III
AIR (P&CP) ACT, 1981
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT IV
ENVIRONMENT (PROTECTION) ACT 1986
Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

UNIT V
OTHER RELATED ACTS
Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC - Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases. international acts

OUTCOMES
At the end of this course, the students will be able to:
- CO1 : get the awareness of laws related to environmental and legal aspects
- CO2 : get legal practices related to water.
- CO3 : expose in the pollution related to air and control prevention techniques
- CO4 : apply the legal practices related to environmental management
- CO5 : expose for various acts related to public and legal procedures.

REFERENCES
1. Central Pollution Control Board, Pollution Control acts, Rules and Notifications issued there under Pollution Control Series – PCL/2/1992, Delhi, 1997.

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GR5006 GREEN BUILDING DESIGN AND MANAGEMENT L T P C 3 0 0 3

OBJECTIVES
- To expose students to various green building concepts.
- To impart knowledge about utilisation and management of water in buildings.
- To enlighten students with knowledge about various energy requirements in buildings and management principles.
- To impart knowledge about thermal design in buildings and its influences.
- To expose students to concept of solid waste management and green composites.

UNIT I GREEN CONCEPTS IN BUILDINGS

UNIT II WATER MANAGEMENT IN BUILDINGS
Water utilisation in buildings – Environmental implications of buildings on water, energy, waste disposal and carbon emissions – Management of sullage and sewage – Methods of waste water treatment and recycling – Low energy approaches to water management.

UNIT III ENERGY MANAGEMENT IN BUILDINGS

UNIT IV THERMAL MANAGEMENT OF BUILDINGS
UNIT V  MANAGEMENT OF SOLID WASTE AND BIOMASS

Low energy approaches in collection, storage, transport, recycling and disposal of solid wastes – Biomass resources for buildings – Green cover and built environment – Concepts of green composites.

TOTAL : 45 PERIODS

OUTCOMES

At the end of this course, the students will be able to:

- CO1 : apply suitable schemes towards design of green building.
- CO2 : apply suitable schemes towards management and treatment of waste water in buildings.
- CO3 : Know the different techniques of energy management.
- CO4 : apply suitable techniques towards management and control of thermal energy (heat) in buildings.
- CO5 : apply suitable schemes towards recycling of solid wastes and green composites.

REFERENCES

2. Low energy Cooling for sustainable buildings, Johy Wiley & Sons, 2009
3. Dennis C Brewer, Green My Home: 10 steps to lowering energy costs and reducing your carbon foot print, Kaplam Publishing Ltd., 2008.

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GR5007  ENERGY SAVING MACHINERY AND COMPONENTS

OBJECTIVES

- To introduce the various energy saving machineries and components to the students for the purpose of conserving energy.
- To understand the basics and principles of transforms, Pumps and motors.
- To impart the knowledge about the methods of energy conservation.
- To introduce the energy efficiency devices and concepts of ENCON.
- To impart the knowledge about CO₂ mitigation.

UNIT I  BASICS OF ELECTRICAL ENERGY USAGE

UNIT II TRANSFORMERS and MOTORS
Transformer – Basics and Types – AVR and OLTC Concepts – Selection of Transformers –
Performance Prediction - Energy Efficient Transformers - Motors : Specification and
Selection – Efficiency / Load Curve – Load Estimation – Assessment of Motor Efficiency
under operating conditions – Factors affecting performance – ill effects of Rewinding and
Transmission Line Losses- Kelvin’s Law Performance Calculation And Analysis

UNIT III FANS, PUMPS AND COMPRESSORS
Basics – Selection – Performance Evaluation – Cause for inefficient operation – scope for
energy conservation – methods adopted for effecting ENCON – Economics of ENCON
adoption in all the 3 utilities

UNIT IV ILLUMINATION AND ENERGY EFFICIENT DEVICES
Specification of luminaries - Types - Efficacy - Selection and Application - ENCON Avenues
and Economic Proposition - New Generation Luminaries (LED - Induction Lighting) - Soft
Starters- Auto Star - Delta - Star Starters- APFC - Variable Speed and Frequency Drives -
Time Sensors - Occupancy Sensors

UNIT V CO₂ MITIGATION AND CASE STUDIES
Evaluation for 3 / 4 Typical Sectors – PAT Scheme (an introduction) – CO₂ Mitigation -
Energy Conservation - Cost Factor: Case Studies on Industrial Energy Audit

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:
CO1 : understand the various energy saving machinery and components.
CO2 : understand the various methods of conservation of energy.
CO3 : evaluate the performance and energy conservation of fans, pumps and
compressors.
CO4 : understand the various energy efficiency devices.
CO5 : understand CO₂ mitigation and cost factor.

REFERENCES
1. Hamies, Energy Auditing and Conservation ; Methods Measurements, management
and Case Study, Hemisphere, Washington, 1980
Delhi, 1997
4. Peters, Krausshaft and Risten, Sustainable Energy, beta – test – draft, Energy and
Problems of a Technical Society, 1993
Auditors (www.energymanagertraining.com )

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DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
OBJECTIVES
- To familiar the various standards and legislation of modern electronic manufacturing.
- To know the conventional electronic processing and lead free electronic manufacturing techniques.
- To recognize the steps involved in assembly process and understand the need of recycle the electronics.
- To implement reliability and product life cycle estimation tools in green electronic manufacturing.
- To demonstrate the green electronic manufacturing procedure in applications.

UNIT I  INTRODUCTION TO GREEN ELECTRONICS  9
Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE) - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).

UNIT II  GREEN ELECTRONICS MATERIALS AND PRODUCTS  9

UNIT III  GREEN ELECTRONICS ASSEMBLY AND RECYCLING  9
Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments - Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

UNIT IV  PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN  9
Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry.

UNIT V  CASE STUDIES  9

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:
- CO1: get concise awareness of standards and legislation of modern electronic manufacturing for green environment.
- CO2: explain the conventional electronic processing and lead free electronic manufacturing techniques.
- CO3: realize the assembly process and the need of recycle of electronics.
- CO5: validate the green electronic manufacturing procedures in applications.
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GR5009 GREEN ENERGY SYSTEM

OBJECTIVES
- To familiarize the various energy sources and their uncertainties.
- To stress upon various forecasting techniques for energy demand.
- To introduce the concepts of green cycles.
- To familiarize the students with various green processes associated with chemical, petro chemical refineries and fertilizer industries.
- To train on analysis of energy resources such as wind, water and tidal.

UNIT I ENERGY SOURCES
Energy sources; coal oil, natural gas; nuclear energy; hydro electricity, other fossil fuels; geothermal; supply and demand: depletion of resources; need for conservation; uncertainties; national and international issues.

UNIT II ENERGY FORECASTING
Forecasting techniques - energy demand, magnitude and pattern, input and output analysis, energy modeling and optimal mix of energy sources. Energy - various forms, energy storage, structural properties of environment.

UNIT III GREEN CYCLES
Bio-geo-chemical cycles; society and environment population and technology. Energy and evolution, growth and change, patterns of consumption in developing and advances countries, commercial generation of power requirements and benefit

UNIT IV GREEN PROCESSES
Chemical industries, classification, conservation in unit operation such as separation, cooling tower, drying, conservation applied to refineries, petrochemical, fertilizers, cement, pulp and paper, food industries, chloro alkali industries, conservation using optimization techniques.
UNIT V ANALYSIS OF ENERGY RESOURCES

Sources of continuous power, wind and water, geothermal, tidal and solar power, MHD, fuel cells, hydrogen as fuel. Cost analysis, capacity; production rate, system rate, system cost analysis, corporate models, production analysis and production using fuel inventories, input-output analysis, economics, tariffs.

TOTAL: 45 PERIODS

OUTCOMES

At the end of this course, the students will be able to:

- CO1: select a suitable energy source for a subject industry.
- CO2: select suitable forecasting techniques to estimate the demand of energy.
- CO3: select suitable bio-geo-chemical cycles for environmental design.
- CO4: utilize the green processes in industries such as chemical refineries and petrochemicals.
- CO5: do input-output analysis so that cost savings can be made.

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GR5010 HAZARDOUS MANAGEMENT L T P C

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OBJECTIVES

- To understand the sources of solid and hazardous wastes.
- To evaluate the health risks posed by abandoned waste sites and waste disposal operations.
- To have knowledge on radiation and its effect of nuclear energy.
- To understand methods of solid waste disposal.
- To evaluate the legislation designed to control the production, clean up and disposal of solid and hazardous waste disposal operations.

UNIT I HAZARDOUS WASTES

Hazardous waste definition terminology and classification – Sources of hazardous wastes – Need for hazardous waste management – Handling of hazardous waste, methods of collection, storage and transport – Sampling and analysis of hazardous materials.

UNIT II CHEMICAL AND BIOMEDICAL WASTES, TOXIC MATERIALS

UNIT III NUCLEAR AND RADIATION WASTES

UNIT IV E-WASTES AND BIOLOGICAL TREATMENT OF HAZARDOUS WASTE
Definition, classification and sources of e-waste – collection, segregation, transport, storage, recycling and disposal of e-wastes – Health and environmental issues of e-wastes – problems in developing nations. Biological Treatment of Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation

UNIT V SCIENTIFIC LAND FILL

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:
CO1 : evaluate and examine the technical and economical points related to general hazardous waste management.
CO2 : classify the hazardous wastes according to their properties.
CO3 : design the appropriate treatment systems and disposal systems for hazardous wastes.
CO4 : collect required data for a Hazardous Waste Management Plan and Set up hazardous waste recycling systems.
CO5 : apply the and use of hazardous wastes.

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OBJECTIVES

- To introduce the concept of recycling, recycling techniques and recycling of various kinds of materials
- To expose the students for various recycling techniques.
- To create awareness to recycle the paper, household and metal waste
- To have knowledge on metal waste and its related recycling process.
- To introduce the concept of recycling the plastic, glass and rubber materials

UNIT I  INTRODUCTION

UNIT II  RECYCLING TECHNIQUES / METHODS
Recycling rate, material recovery facilities – Integrating recycling with landfills – Processing equipments.

UNIT III  RECYCLING OF PAPER
Paper board / solid waste - Recycling of papers, pulp, construction and demolition of debris, house hold wastes.

UNIT IV  RECYCLING OF METALS
Recycling of Aluminium cans, scrap metals and steel cans, ferrous metals, non-ferrous metals

UNIT V  RECYCLING OF PLASTICS AND GLASS
Recycling of thermoplastics-mechanical and chemical process, application of recycling materials, recycling of thermosets and polymer composites- application of recycled materials, recycling of used tyres and other rubber products-conversion of tyres to carbon black and oil.

TOTAL : 45 PERIODS

OUTCOMES
At the end of this course, the students will be able to:

CO1 : understand the concept of waste and recycling
CO2 : understand various processing equipment used in recycling methods.
CO3 : to recycle the paper and household waste
CO4 : understand the recycle of ferrous and non ferrous metal waste
CO5 : understand the recycle concept of plastics and rubber.

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OBJECTIVES

- To identify and discuss the public health, regulatory, planning, technical, and economic principles that influence the solid waste management system, our context.
- To describe appropriate methods to minimize the impact to public and occupational health from solid waste related activities.
- To analyze industrial waste generation patterns, as well as management and disposal techniques.
- To analyze and communicate to the students for the importance of one of the components of an integrated solid waste handling system – including source reduction, recycling and reuse, composting, or land filling and combustion.
- To analyze at least one environmental health topic for its impact on health and propose solutions based on what is known about the challenges/barriers.

UNIT I INTRODUCTION


UNIT II WASTE QUANTITIES AND CHARACTERISTICS

Sources of solid waste – Quantities and composition – Physical, Chemical and Biological characteristics.

UNIT III STORAGE AND COLLECTION

Storage - Collection for low-rise dethatched houses - Collection from low and medium rise apartments - Collection from high rise apartments - Vehicles for collection - Transfer and Transport.

UNIT IV MATERIALS RECOVERY


UNIT V REUSE AND RECYCLING

Composting – Road making – Stabilization – Deactivation – Metal removal and recovery – Aqueous treatment – Biological technologies.

TOTAL : 45 PERIODS

OUTCOMES

At the end of this course, the students will be able to:

CO1: develop the concepts of storage, collection and safe disposal of solid wastes.
CO2: explain the hierarchical structure in solid waste management and a requirement for an integrated solution.
CO3: examine the technical points that are required to set up a solid waste management system.
CO4: apply the legal legislation related to solid waste management.
CO5: make an economical analysis of the solid waste management system.

REFERENCES

GR5013 GREEN SUPPLY CHAIN MANAGEMENT  

OBJECTIVES
- To introduce the concepts of Green supply chain Management (GSCM) to the students.
- To introduce the broad range of Supply chain activities
- To stress on importance of managing GSCM
- To design GSCM
- To develop logistics for GSCM

UNIT I NEED FOR GREEN SUPPLY CHAIN MANAGEMENT
- Green supply Chains – Need for Green Supply Chains – Implications of modern supply chain management – The supply chain strategy – Ingredients of green supply chain strategy

UNIT II MEASURING AND MONITORING GREEN SUPPLY CHAINS
- Evaluating the impact of GSCM activities on sustainability – Economic, Environmental and social impacts of GSCM Stages of GSCM - performance measurement

UNIT III MANAGING GREEN SUPPLY CHAIN MANAGEMENT

UNIT IV SUPPLY NETWORK REDESIGNING
- Problem description – Challenges – Success factors – Transferability – Transportation issues in GSCM – Increasing transportation efficiency – Retail GSCM – Optimisation of goods collection

UNIT V LOGISTICS AND GSCM
- Railway transport – Challenges and issues – Transport market place – Transport exchange – GSCM enablers – Inter model terminals – Cargo securing

OUTCOMES
At the end of this course, the students will be able to:
- CO1: design on logistics for supply chain management
- CO2: monitor Green Supply Chain Management.
- CO3: manage Green Supply Chain Management.
- CO4: design supply network.
- CO5: design suitable logistics.

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GR5014 WASTE STREAM MAPPING

OBJECTIVES
- To introduce various concepts of Material recycling.
- To familiarize the mechanism of biological processing for resources recovery.
- To stress upon the importance of biochemical conversion of waste energy.
- To discuss about thermo chemical conversion of waste energy.
- To discuss case studies on waste recycling.

UNIT I MECHANICAL PROCESSING FOR MATERIAL RECYCLING

UNIT II BIOLOGICAL PROCESSING FOR RESOURCE RECOVERY
Mechanisms of Biological Processing – Aerobic Processing of Organic fraction - Composting methods and processes- factors affecting- Design of Windrow Composting Systems- In Vessel Composting-Compost Quality Control-Vermiculture: definition, scope and importance - common species for culture - Environmental requirements - culture methods- Applications of vermiculture-Potentials and constraints for composting in India- Large scale and decentralized plants.

UNIT III BIO-CHEMICAL CONVERSION OF WASTE TO ENERGY
UNIT IV THERMO-CHEMICAL CONVERSION OF WASTE TO ENERGY


UNIT V CASE STUDIES ON WASTE RECYCLING


OUTCOMES

At the end of this course, the students will be able to:

- CO1: develop methods for resource recovery towards sustainability.
- CO2: identify a suitable mechanism of biological processing for resource recovery.
- CO3: develop suitable designs for biochemical conversion of waste to energy.
- CO4: develop suitable designs for thermo-chemical conversion of waste to energy.
- CO5: find a solution for various waste recycling issues.

REFERENCES

3. Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein, Modern Composting Technologies JG Press, 2005

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OBJECTIVES

- To introduce the lean manufacturing and identify the waste.
- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.
- To provide knowledge on perfect value creation process that has zero waste.
- To apply the lean manufacturing tools and techniques through case studies.

UNIT I  INTRODUCTION TO LEAN MANUFACTURING  9
Introduction to Lean- Definition, Purpose, features of Lean, top seven wastes, Need for Lean, Elements of Lean Manufacturing.

UNIT II  LEAN MANUFACTURING TOOLS AND METHODOLOGIES  9

UNIT III  JUST IN TIME MANUFACTURING, VSM  9
Introduction - Elements of JIT - Uniform production rate - Kanban system - Small lot size - Quick, inexpensive set-up - Continuous improvement. Value stream mapping - Procedure and principles.

UNIT IV  LEAN SIX SIGMA APPROACH  9
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, Sigma implementation Features of lean six sigma, The laws of lean six sigma, Benefits of lean six sigma, Introduction to DMAIC tools.

UNIT V  CASE STUDIES  9
Various case studies of implementation of lean manufacturing at industries

OUTCOMES

At the end of this course, the students will be able to:

- CO1: Identify the waste in various manufacturing process.
- CO2: understanding principles of cellular manufacturing, JIT and TPM
- CO3: Reduce the manufacturing time by applying concepts of TQM, 5S and VSM.
- CO4: get knowledge on six sigma approach
- CO5: get knowledge on applying the lean manufacturing tools and techniques

REFERENCES

OBJECTIVES

- To understand the basics of optimization and its engineering application
- To gain knowledge on linear and non-linear programming and its technique
- To apply basic concepts of mathematics to formulate an optimization problem.
- To provide experience on network techniques.
- To create aware of recent optimization tools like genetic algorithm.

UNIT I

INTRODUCTION


UNIT II

CLASSIC OPTIMIZATION TECHNIQUES


UNIT III

NON-LINEAR PROGRAMMING

Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

UNIT IV

INTEGER AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES


UNIT V

ADVANCES IN SIMULATION

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL: 45 PERIODS

OUTCOMES

At the end of this course, the students will be able to:

CO1: apply the significance of optimization technique.
CO2: Cast engineering minima/maxima problems into optimization framework.
CO3: Apply efficient computational procedures to solve optimization problems related to non-linear programming.
CO4: Use integer and dynamic programming to solve industrial problems.
CO5: Use optimization techniques using algorithms.
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MN5071 FINANCIAL MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
- To introduce the concepts of financial accounting.
- To introduce the various functions of financial management to handle higher level financial decisions.
- To gain the knowledge about concepts of financial and various budgeting and cost accounting.
- To develop the knowledge in the field of capital budgeting and cost accounting.
- To gain the knowledge about financial management techniques to make a profit.

UNIT I FINANCIAL ACCOUNTING

UNIT II FINANCIAL MANAGEMENT

UNIT III CAPITAL BUDGETING
UNIT IV  COST ACCOUNTING


UNIT V  DEPRECIATION AND PROFIT PLANNING


TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to

CO1 : Train in various functions of finance such as working capital management, current assets managements to make investment decisions.

CO2 : Handle the highest level financial decisions.

CO3 : Work in a capital financing policy and handle the cash management.

CO4 : Perform the various method in capital budgeting, understand and analyse different costs involved in financial managements.

CO5 : Make investment decisions when they take up senior managerial position.

REFERENCES:
OBJECTIVES

- To expose the students to the various quality control techniques and also to understand the importance and concept of reliability and maintainability in industries.
- To study the approaches and techniques to assess and improve process and/or product quality and reliability.
- To Introduce the principles and techniques of Statistical Quality Control and their practical uses in product and/or process design and monitoring.
- To Introduce the recent principles and techniques of Statistical Quality Control and their applications.
- To illustrate the students the basic concepts and techniques of modern reliability engineering tools.

UNIT I  INTRODUCTION
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of Quality management (QM) - Definition of QM – QM Framework - Contributions of Deming, Juran and Crosby – Barriers to QM.

UNIT II  QM PRINCIPLES
Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III  QM TOOLS AND TECHNIQUES I

UNIT IV  QM TOOLS AND TECHNIQUES II

UNIT V  QUALITY SYSTEMS

OUTCOMES
At the end of this course, the students will be able to:
- CO1: understand the various quality principles, tools and control techniques and to construct the various quality control charts
- CO2: develop design concepts for reliable system by implementing quality systems in industries.
- CO3: attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability and Use control charts to analyze for improving the process quality.
- CO4: describe different sampling plans and student will be able to solve problems by various design methods.
- CO5: acquire basic knowledge of reliability and the concepts of reliability and maintainability.
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OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS

COURSE OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCEn

Attested
DIrector
Centre for Academic Courses
Anna University, Chennai-600 025
Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK

Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS
Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce.
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.
REFERENCES:

OE5092 INDUSTRIAL SAFETY

COURSE OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION

UNIT IV FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Attested

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Centre for Academic Courses
Anna University, Chennai-600 025
UNIT V PERIODIC AND PREVENTIVE MAINTENANCE

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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COURSE OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I
Transportation problems - Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem - Hungarian algorithm

OE5093 OPERATIONS RESEARCH L T P C
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Attended

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UNIT IV NETWORK ANALYSIS – II
Shortest path problem: Dijkstra’s algorithms, Floyd’s algorithm, systematic method - CPM/PERT

UNIT V NETWORK ANALYSIS – III
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
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COURSE OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.
UNIT III PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

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2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

OE5095 COMPOSITE MATERIALS

COURSE OBJECTIVES:
- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.
UNIT I  INTRODUCTION  
Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II  REINFORCEMENTS  
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whisks, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III  MANUFACTURING OF METAL MATRIX COMPOSITES  

UNIT IV  MANUFACTURING OF POLYMER MATRIX COMPOSITES  

UNIT V  STRENGTH  
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
• CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
• CO2 – Know the various reinforcements used in composite materials.
• CO3 – Understand the manufacturing processes of metal matrix composites.
• CO4 – Understand the manufacturing processes of polymer matrix composites.
• CO5 – Analyze the strength of composite materials.

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REFERENCES:
OE5096 WASTE TO ENERGY

COURSE OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

UNIT IV BIOMASS COMBUSTION 9
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY 9
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

OUTCOMES:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

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TOTAL: 45 PERIODS

[Signature]
Attested

[Director]
Centre for Academic Courses
Anna University, Chennai-600 025
REFERENCES:

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING  L T P C  2 0 0 0

COURSE 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  6
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  6

UNIT III TITLE WRITING SKILLS  6
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  6
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  6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE 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

AX5092 DISASTER MANAGEMENT

COURSE 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

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  6
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

COURSE 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

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AX5093                SANSKRIT FOR TECHNICAL KNOWLEDGE             L T P C
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COURSE OBJECTIVES:
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I    ALPHABETS  6
Alphabets in Sanskrit

UNIT II   TENSES AND SENTENCES  6
Past/Present/Future Tense - Simple Sentences

UNIT III  ORDER AND ROOTS  6
Order - Introduction of roots
UNIT IV  SANSKRIT LITERATURE  6
Technical information about Sanskrit Literature

UNIT V  TECHNICAL CONCEPTS OF ENGINEERING  6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

COURSE OUTCOMES:
• CO1 - Understanding basic Sanskrit language.
• CO2 - Write sentences.
• CO3 - Know the order and roots of Sanskrit.
• CO4 - Know about technical information about Sanskrit literature.
• CO5 - Understand the technical concepts of Engineering.

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REFERENCES
1. "Abhyasputakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094  VALUE EDUCATION  L T P C
2 0 0 0

COURSE OBJECTIVES:
Students will be able to
• Understand value of education and self-development
• Imbibe good values in students
• Let the should know about the importance of character

UNIT I

UNIT II

UNIT III
UNIT IV

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

AX5095

CONSTITUTION OF INDIA

L T P C

2 0 0 0

COURSE 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 Revolutionin1917and 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:
UNIT VI ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE 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
1. The Constitution of India,1950(Bare Act),Government Publication.

AX5096 PEDAGOGY STUDIES

COURSE OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DIID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.
UNIT IV  PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V  RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

AX5097  STRESS MANAGEMENT BY YOGA

COURSE OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga (Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don't’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects - Types of pranayam

TOTAL: 30 PERIODS
COURSE OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. ‘Yogic Asanas for Group Tarining-Part-I”:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama
   (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

COURSE OBJECTIVES:
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-
29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) -
Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41,
47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-
Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad
geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

COURSE OUTCOMES:
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality
  and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and
  prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-
vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication
   Department, Kolkata, 2016.

Attested
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