1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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<th>To prepare students to excel in new product design and development through application of knowledge and practical skills</th>
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<td>II.</td>
<td>To provide students with a solid foundation in mathematical modeling of engineering problems required for bringing new products fast into the market</td>
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<tr>
<td>III.</td>
<td>To provide students with required scientific and engineering knowledge so as to comprehend, analyze, design and create innovative products and solutions for real life problems</td>
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2. PROGRAMME OUTCOMES (POs):

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<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<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 the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<td>Students will understand the importance of creativity in design process and will demonstrate an ability to identify, formulate, design a system and solve engineering problems.</td>
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<td>An ability to use the techniques, and modern engineering tools necessary for engineering practice in product development</td>
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<td>Responsibility of understanding ethically and professionally and develop confidence for self-education and ability for life-long learning.</td>
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3. PEO/PO Mapping:

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# ANNA UNIVERSITY, CHENNAI

NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY

M.E. PRODUCT DESIGN AND DEVELOPMENT

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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* Audit Course is optional
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### PROFESSIONAL ELECTIVES

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AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

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COURSE OBJECTIVES:
- To understand fundamental concepts of computer graphics and its tools in a generic framework.
- To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.
- To impart the parametric fundamentals to create and manipulate geometric models using NURBS and solids.
- To provide clear understanding of CAD systems for 3D modeling and viewing.
- To create strong skills of assembly modeling and prepare the student to be an effective user of a standards in CAD system.

UNIT – I  INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS  9
Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations-Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

UNIT – II  CURVES AND SURFACES MODELLING  9
Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations.

UNIT – III  NURBS AND SOLID MODELING  9

UNIT – IV  VISUAL REALISM  9
Animation - Conventional, Computer animation, Engineering animation - types and techniques.

UNIT – V  ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLE MANAGEMENT  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Solve 2D and 3D transformations for the basic entities like line and circle.
2. Formulate the basic mathematics fundamental to CAD system.
3. Use the different geometric modeling techniques like feature based modeling, surface modeling and solid modeling.
4. Create geometric models through animation and transform them into real world systems

REFERENCES:

Mapping of CO with PO

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PD4153 REVERSE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:
1. Applying the fundamental concepts and principles of reverse engineering in product design and development.
2. Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Applying the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyzing the various legal aspect and applications of reverse engineering in product design and development.
UNIT I  INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM  9
Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering -

UNIT II  MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION  9
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength –
Hardness – Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III  MATERIAL IDENTIFICATION AND PROCESS de VERIFICATION  9

UNIT IV  DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY  9
Methodology of Performance Evaluation – System Compatibility.

UNIT V  ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE  9
Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Apply the fundamental concepts and principles of reverse engineering in product design and development.
2. Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyze the various legal aspect and applications of reverse engineering in product design and development

REFERENCES

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PD4151  CREATIVITY AND INNOVATION  L T P C
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COURSE OBJECTIVES:
1. Applying the principles of essential theory of creativity in new product design and development.
2. Applying the principles of various methods and tools for creativity in new product design and development.
3. Applying the design principles of creativity in new product design and development.
4. Applying the various innovation principles and practices in new product design and development.
5. Applying the principles of innovation management in new product design and development.

UNIT I  INTRODUCTION TO ESSENTIAL THEORY OF CREATIVITY  9

UNIT II  METHODS AND TOOLS FOR CREATIVITY  9
Three basic principles behind the tools of directed creativity – Tools that prepare the mind for creative thought – Tools that stimulate the imagination for new idea – Development and action: the bridge between mere creativity and the rewards of innovation - ICEDIP: Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation

UNIT III  DESIGN AND APPLICATION OF CREATIVITY  9
Three levels of emotional design: Visceral, Behavioral and Reflective – Process design, reengineering, and creativity – Creativity and customer needs analysis – Innovative product and service design – Creative problem solving and incremental improvement.

UNIT IV  INNOVATION PRINCIPLES & PRACTICES  9
Methods of Creativity Activation: Morphological Box – Requirements for Inventive Problem Solving – Altshuller’s Engineering Parameters– Altshuller’s Inventive Principles– Altshuller’s Contradiction Matrix Algorithm.

UNIT V  INNOVATION MANAGEMENT  9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Apply the principles of essential theory of creativity in new product design and development.
2. Apply the principles of various methods and tools for creativity in new product design and development.
3. Apply the design principles of creativity in new product design and development.
4. Apply the various innovation principles and practices in new product design and development.
5. Apply the principles of innovation management in new product design and development.
REFERENCES
3. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999

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

PD4152 INTEGRATED PRODUCT DEVELOPMENT L T P C

COURSE OBJECTIVES:
1. To Understand the principles of generic development process; product planning; customer need analysis for new product design and development.
2. To enhance the understanding of setting product specifications and generate, select, screen, and test concepts for new product design and development.
3. To apply the principles of product architecture and the importance of industrial design principles and DFM principles for new product development.
4. To expose the different Prototyping techniques, Design of Experiment principles to develop a robust design and importance to patent a developed new product.
5. Applying the concepts of economics principles; project management practices in development of new product.

UNIT– I INTRODUCTION TO PRODUCT DESIGN 9

UNIT– II PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING 9
Establish Target and Final product specifications – Activities of Concept Generation - Concept Screening and Scoring - Concept Testing Methodologies.
UNIT–III  PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN  9
Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning – Related system level design issues - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design

UNIT– IV  DESIGN FOR MANUFACTURE, PROTOTYPING AND ROBUST DESIGN  9
DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors - Prototype basics - Principles of prototyping – Prototyping technologies - Planning for prototypes - Robust design –Robust Design Process

UNIT– V  PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS  9
Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks- Baseline Project Planning - Accelerating the project - Project execution – Postmortem project evaluation.

TOTAL:45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; product planning; customer need analysis for new product design and development.
2. Set product specifications and generate, select, screen, test concepts for new product design and development.
3. Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.
4. Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.

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UNIT I  RESEARCH DESIGN  6
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  6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III  DATA ANALYSIS AND REPORTING  6
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  6

UNIT V  PATENTS  6

REFERENCES

TOTAL : 30 PERIODS

PD4111  CAD LABORATORY AND MULTIBODY DYNAMICS LABORATORY  L T P C  0 0 4 2

COURSE OBJECTIVE:
- To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modelling software’s.
- To expose the students to understand the forces and torques that come into action in various kinds of mechanical systems.

1. CAD Introduction & Sketcher
2. Solid modeling–Extrude, Revolve, Sweep, etc and Variational sweep, Loft, etc
3. Surface modeling–Extrude, Sweep, Trim..etc and Mesh of curves, Free form etc
4. Feature manipulation – Copy, Edit, Pattern, Suppress, History operations etc.
5. Assembly-Constraints, Exploded Views, Interference check
7. CAD data exchange formats-IGES, PDES, PARASOLID, DXF and STL.
8. Free fall of rigid body
9. Projectile motion
10. Simulation of simple & Compound Pendulum
11. Kinematic & Dynamic Analysis four bar and slider crack mechanism and its inversions
12. Design of cam profile for various follower output motion
13. Kinematic & Dynamic Analysis of Gear Tracks
14. Vibration Analysis SDOF and MDOF
15. Project on virtual product design using ADAMS

- Exercises in Modeling and drafting of Mechanical Components - Assembly using Parametric and feature based packages like PRO-E / SOLID WORKS / CATIA / NX etc.
- Exercises in kinematics and dynamics using equations of motion in package like ADAMS.

**COURSE OUTCOMES:**
- With laboratory classes, it helps the students to get familiarized with the computer applications in design and preparing drawings for various mechanical components.
- The students get familiarized with modeling different systems and importing them into the multi body dynamic software.
- The students will be trained to obtain required dynamic properties by conducting multi body dynamic tests.
- The students will learn how to use this data in additional stress analysis software.

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**PD4112** REVERSE ENGINEERING LABORATORY

**COURSE OBJECTIVES:**
1. Applying the fundamental concepts and principles of reverse engineering in product design and development.
2. Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Applying the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyzing the various legal aspect and applications of reverse engineering in product design and development.
Exercises
1. Surface measurement – CMM.
2. 3D Laser scanning of components.
4. Material identification and process verification of welded components.
5. Reverse engineering of dental components - Bio medical applications.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
• Apply the fundamental concepts and principles of reverse engineering in product
  design and development.
• Apply the concept and principles material characteristics, part durability and life
  limitation in reverse engineering of product design and development.
• Apply the concept and principles of material identification and process verification in
  reverse engineering of product design and development.
• Apply the concept and principles of data processing, part performance and system
  compatibility in reverse engineering of product design and development.
• Analyze the various legal aspect and applications of reverse engineering in product
  design and development.

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ED4251 FINITE ELEMENT METHODS IN MECHANICAL DESIGN

L T P C
3 1 0 4

COURSE OBJECTIVES
1. To learn mathematical models for one dimensional problems and their numerical
   solutions
2. To learn two dimensional scalar and vector variable problems to determine field
   variables
3. To learn Iso parametric transformation and numerical integration for evaluation of
   elementmatrices
4. To study various solution techniques to solve Eigen value problems
5. To learn solution techniques to solve non-linear problems
UNIT - I

FINITE ELEMENT ANALYSIS OF ONEDIMENSIONAL PROBLEMS

9+3


UNIT - II

FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS

9+3


UNIT - III

ISO-PARAMETRIC FORMULATION

9+3


UNIT - IV

EIGEN VALUE PROBLEMS

9+3

Dynamic Analysis – Equations of Motion – Consistent and lumped mass matrices – Free Vibration analysis – Natural frequencies of Longitudinal, Transverse and torsional vibration – Solution of Eigenvalue problems - Introduction to transient field problems.

UNIT - V

NON-LINEAR ANALYSIS

9+3

Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and viscoplasticity, stress stiffening, contact interfaces- problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate.

TOTAL = 60 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to

CO1 Develop mathematical models for one dimensional problems and their numericalsolutions.

CO2 Determine field variables for two dimensional scalar and vector variable problems.

CO3 Apply iso-parametric transformation and numerical integration for evaluation of element matrices.

CO4 Apply various solution techniques to solve Eigen value problems.

CO5 Formulate solution techniques to solve non-linear problems.

REFERENCES:
OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Analyzing the different strengthening and failure mechanism of the metals
2. Applying the effects of metallurgical parameters in the materials design
3. Analyzing the relationship between the selection of materials and processing
4. Developing the novel material through understanding the properties of the existing metallic materials
5. Analyzing the different materials used in the engineering applications.

UNIT I: INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM

UNIT II: MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness – Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III: MATERIAL IDENTIFICATION AND PROCESS VERIFICATION

UNIT IV: DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY

UNIT V: ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student will be able to
- Analyze the different strengthening and failure mechanism of the metals
- Apply the effects of metallurgical parameters in the materials design
- Analyze the relationship between the selection of materials and processing
- Develop the novel material through understanding the properties of the existing metallic materials
- Analyze the different materials used in the engineering applications
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1-low, 2-medium, 3-high, '-'- no correlation

REFERENCES:
8. www.astm.org/labs/pages/131350.htm

CM4152 SOLID FREEFORM MANUFACTURING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), proliferation into various fields and its effects on supply chain.
- To gain knowledge on Design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.
- To acquaint with polymerization and sheet lamination processes and their applications.
- To acquaint with material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING
UNIT III  VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES  

UNIT IV  MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES  

UNIT V  JETTING AND DIRECT ENERGY DEPOSITION PROCESSES  
TOTAL: 45 PERIODS

COURSE OUTCOMES:  
At the end of this course, the students shall be able to:  
CO1: Relate the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.  
CO2: Analyze the design for AM and its importance in the quality of fabricated parts.  
CO3: Build knowledge on principles and applications of polymerization and sheet lamination processes with case studies.  
CO4: Explain the principles of material extrusion and powder bed fusion processes and design guidelines.  
CO5: Elaborate jetting and direct energy deposition processes and their applications.

REFERENCES:  
MF4071 DESIGN FOR MANUFACTURE AND ASSEMBLY

OBJECTIVES:
1. To apply various design rules in manufacturing processes
2. To evaluate the process by design guidelines for optimum design
3. To analyze the rules of concepts of GD&T
4. To make the students to learn about tolerance analysis and allocation, geometrical tolerances
5. Guidelines for design for manufacturing and assembly with suitable examples.

UNIT I TOLERANCE ANALYSIS

UNIT II TOLERANCE ALLOCATION

UNIT III GD&T

UNIT IV TOLERANCE CHARTING

UNIT V MANUFACTURING GUIDELINES

OUTCOMES:
At the end of this course the students are expected
1. To impart the knowledge about the significance of design for manufacturing and assembly
2. To apply the principle of tolerancing in design
3. To evaluate the process of GD & T using design guidelines
4. To apply tolerance allocation and tolerance charting in design
5. To apply guidelines for manufacturing and assembly

TOTAL: 45 PERIODS
REFERENCES:

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CD4151 CONCEPTS OF ENGINEERING DESIGN

COURSE OBJECTIVES

- To impart knowledge on basic concepts in engineering design.
- To develop a product catering to the need for a customer and considering quality and societal aspects in design
- To incorporate various design methods to develop a creative product.
- To gain knowledge on the selection of materials and manufacturing techniques for product design.
- To develop a robust and reliable product.

UNIT-I DESIGN FUNDAMENTALS

UNIT-II CUSTOMER-ORIENTED DESIGN & SOCIETAL CONSIDERATIONS

UNIT-III DESIGN METHODS
UNIT-IV MATERIAL SELECTION PROCESSING AND DESIGN

UNIT-V PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY

OUTCOMES:
On Completion of the course, the student will be able to
- Appreciate the aspects of the need for design, design process used for designing various components.
- Get familiarized with concepts related to legal, human, and marketing factors during the design of products.
- Get acquainted with the knowledge of designing creative components.
- Gain knowledge on the material selection process and various design procedures.
- Get equipped with tools for improving quality, reliability, and performance of a product.

REFERENCES:

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1-low, 2-medium, 3-high, ‘-‘- no correlation
OBJECTIVES:
1. To give exposure to software tools needed to analyze engineering problems.
2. To expose the students to different applications of simulation and analysis tools.

A. SIMULATION
1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of MATLAB to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software

B. ANALYSIS
1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
10. Analysis of machine elements under dynamic loads
11. Analysis of non-linear systems

TOTAL: 60 PERIODS

List of Equipment / Software:
Finite Element Analysis packages

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

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OBJECTIVE:
- To give exposure to develop digital and physical prototype models using RP machine / clay models of a new product/ existing product.

The students in a group have to develop digital and physical prototype models using RP machine / clay models of a new product/ existing product with enhanced feature involving the following areas:
- Automotive components
- Tool and die components
- Press tool components
- Consumer product
- Injection moulded products.

The fabricated models may be in the form of RP models, clay models, sheet metal models or cardboard models etc.

The design and development of the product will be reviewed in two stages for awarding internal marks. The end semester examination mark will be based on the demonstration of the new product developed and oral examination on the same by internal examiners.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
Upon conclusion of this course the student will be able to

CO1 Appreciate the use of physical prototype models for evaluating product concept
CO2 Apply theoretical knowledge to design and development of physical products using clay, wood, sheet metal and RP techniques

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OBJECTIVES:
1. To understand history, concepts and terminology of PLM
2. To understand functions and features of PLM/PDM
3. To understand different modules offered in commercial PLM/PDM tools
4. To demonstrate PLM/PDM approaches for industrial applications
5. To use PLM/PDM with legacy data bases, CAx & ERP systems

UNIT I  HISTORY, CONCEPTS AND TERMINOLOGY OF PLM  9
Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure - Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT II  PLM/PDM FUNCTIONS AND FEATURES  9

UNIT III  DETAILS OF MODULES IN APDM/PLM SOFTWARE  9
Case studies based on top few commercial PLM/PDM tools

UNIT IV  ROLE OF PLM IN INDUSTRIES  9
Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for-business, organization, users, product or service, process performance.

UNIT V  BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE  9
PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

OUTCOMES:
The students will be able to
1. Summarize the history, concepts and terminology of PLM
2. Use the functions and features of PLM/PDM
3. Use different modules offered in commercial PLM/PDM tools.
4. Implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx & ERP systems.

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PD4311 PROJECT WORK I

OBJECTIVES:
1. To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2. To develop the methodology to solve the identified problem.
3. To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:
The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

OUTCOME:
At the end of the course the students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

PD4411 PROJECT WORK II

OBJECTIVES:
- OBJECTIVES:
  - To solve the identified problem based on the formulated methodology.
  - To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:
- The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL : 360 PERIODS
OUTCOMES:
- On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering design and find better solutions to it.

ED4080 TRIBOLOGY IN DESIGN
L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To study and measure the different types of surface features associated with the friction of metals and non-metals.
2. To study the different types of wear mechanism and surface modification techniques.
3. To analyze the various types of lubricants and lubrication system in the tribology.
4. To develop the methodology for deciding lubricants and lubrication regimes for different operating conditions.
5. To study the different types of high-pressure contacts and rolling bearings

UNIT I SURFACE INTERACTION AND FRICTION

UNIT II WEAR AND SURFACE TREATMENT

UNIT III LUBRICANTS AND LUBRICATION REGIMES

UNIT IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION
Reynolds Equation-Assumptions and limitations-One and two dimensional Reynolds Equation Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing Pressure, flow, load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydro static bearings.

UNIT V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION
Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory Soft and hard EHL Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On Completion of the course the student will be able to

- Develop the knowledge on the surface features and its role on the friction behavior of metals and nonmetals
- Understand the various types of wear mechanism and surface modification techniques
- Familiarize the different types of lubricants and lubrication systems in the tribology
- Methodology for deciding lubricants and lubrication regimes for different operating conditions
- Ability to understand the different types of high pressure contacts and rolling bearings

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CC4071 ADVANCED MACHINE TOOL DESIGN L T P C

3 0 0 3

COURSE OBJECTIVES
The main learning objective of this course is to prepare the students for:
1. Selecting the different machine tool mechanisms.
2. Designing the Multi speed Gear Box and feed drives.
3. Designing the machine tool structures.
4. Designing the guideways and power screws.
5. Designing the spindles and bearings.

UNIT I INTRODUCTION TO MACHINE TOOL DESIGN 9

UNIT II REGULATION OF SPEEDS AND FEEDS 9
Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT III DESIGN OF MACHINE TOOL STRUCTURES 9
UNIT IV  DESIGN OF GUIDEWAYS AND POWER SCREWS  9

UNIT V  DESIGN OF SPINDLES AND SPINDLE SUPPORT  9

OUTCOMES:
On Completion of the course the student will be able to
1. Select the different machine tool mechanisms.
2. Design the Multi speed Gear Box and feed drives.
3. Design the machine tool structures.
4. Design the guideways and power screws.
5. Design the spindles and bearings.

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PD4001  GENERATIVE DESIGN AND TOPOLOGY OPTIMIZATION  L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To impart knowledge on basic concepts in generative design.
2. To develop design methods to meet the needs of a customer.
3. To incorporate various design methods to develop a creative product.
4. To gain knowledge on topology aspects of design.
5. To gain knowledge on optimization in design.
UNIT I  INTRODUCTION  9

UNIT II  GENERATIVE DESIGN  9
Editable geometry - Integrated workflows - Multiple manufacturing methods - Additive – 3 or 5 axis milling – Applications.

UNIT III  LOW-DENSITY AREAS IN TOPOLOGY OPTIMIZATION  9
Localized mode in low-density areas - Localized deformation, Polynomial interpolation model, Breakdown issue in ESO. Dynamics – analysis and topology optimization under harmonic and random force excitations, Thermo-elastic problems - topology optimization in single and multiple materials.

UNIT IV  INTEGRATED LAYOUT AND TOPOLOGY OPTIMIZATION  9
Introduction to integrated optimization, Finite-circle method, Density points and embedded, meshing, MPC-based component-structure connections, integrated optimization based on implicit model.

UNIT V  POTENTIAL APPLICATIONS OF TOPOLOGY OPTIMIZATION  9
Shape-preserving design, Smart structure design, Structural features design, Topology optimization and additive manufacturing.  TOTAL: 45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
• Appreciate the aspects of need for design, design process used for designing various components
• Get familiarized with concepts related to design methods during the design of products
• Get acquainted with the knowledge of designing creative components
• Gain knowledge on topology aspects of design;
• Get equipped with optimization tools for improving quality, reliability and performance of a product.

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COURSE OBJECTIVES:
1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems.

UNIT I INTRODUCTION

UNIT II MULTIPLE REGRESSION
Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).

UNIT III LOGISTIC REGRESSION
Regression with binary dependent variable -Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

UNIT IV PRINCIPAL COMPONENT ANALYSIS
Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

UNIT V LATENT VARIABLE MODELS
Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student will be able to:
• To recognize the importance of data analytics
• To Exhibit competence on data analytics packages
• To apply solution methodologies for industrial problems.

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OBJECTIVES:
- To appreciate the need and scope for robotics and to understand the principles of robot kinematics
- To design the drive systems and its control
- To understand the principles of sensors and vision systems
- To envision the industrial applications of robots and its safety
- To gain knowledge on artificial intelligence and expert systems.

UNIT I      INTRODUCTION AND ROBOT KINEMATICS  9

UNIT II     ROBOT DRIVES AND CONTROL  9
Controlling the Robot motion - Position and velocity sensing devices - Design of drive systems - Hydraulic and Pneumatic drives - Linear and rotary actuators and control valves - Electro hydraulic servo valves, electric drives - Motors - Designing of end effectors - Vacuum, magnetic and air operated grippers.

UNIT III    ROBOT SENSORS  9
Transducers and Sensors - Tactile sensor - Proximity and range sensors - Sensing joint forces - Robotic vision system - Image Representation - Image Grabbing - Image processing and analysis - Edge Enhancement - Contrast Stretching - Band Rationing - Image segmentation - Pattern recognition - Training of vision system.

UNIT IV   ROBOT CELL DESIGN AND APPLICATION  9
Robot work cell design and control - Safety in Robotics - Robot cell layouts - Multiple Robots and machine interference - Robot cycle time analysis. Industrial application of robots.

UNIT V       ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS  9
Methods of Robot Programming - Characteristics of task level languages lead through programming methods - Motion interpolation. Artificial intelligence - Basics - Goals of artificial intelligence - AI techniques - problem representation in AI - Problem reduction and solution techniques - Application of AI and KBES in Robots.

TOTAL : 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- Understand robot kinematics
- Incorporate mechanical components and concepts in robotics
- Understand the basics of various sensors to effectively design a robot
- Design suitable robots for specific applications
- Optimize the robots using Artificial Intelligence

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ED4092 ENGINEERING FRACTURE MECHANICS

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COURSE OBJECTIVES:

1. Formulation of governing equations for elastic problems
2. Stresses calculations/displacements around the crack tip for different modes of fracture
3. Estimation of K1c/SIF/critical flaws/failure stresses for different crack geometries
4. Life assessment of the cracked components under different types of repeated/variable fatigue loads and design for its life extension.
5. Analysis of failed engineering components under different modes of fracture.

UNIT-I ELEMENTS OF SOLID MECHANICS

UNIT-II STRESS AND DISPLACEMENT AROUND THE CRACK TIP FOR DIFFERENT MODES OF FRACTURE

UNIT-III STATIONARY CRACK UNDER STATIC LOADING

Two dimensional elastic fields – Analytical solutions for small scale yielding near a crack front — plastic zone size –Specimen size calculations: K1c Testing for Fracture toughness of the Material.
UNIT-IV  FATIGUE FAILURE AND ENVIRONMENTAL-ASSISTED FRACTURE

Introduction to fatigue failure-S-N Curve-Crack Initiation-Crack propagation- Effect of an Overload-Variable amplitude Fatigue load-Crack closure- Characteristics of fatigue crack-Paris Law- Fatigue Crack Growth Test to evaluate Paris constants- life calculations for a given load amplitude –effects of changing the load spectrum
Environmental-assisted Fracture-Micro mechanisms-factors influencing Environmental-assisted fracture-Environment-assisted Fatigue Failure affecting fatigue performance, fatigue loading, constant and variable amplitude loading.

UNIT-V  APPLICATIONS OF FRACTURE MECHANICS

J-integral, Mixed-mode fracture, Crack arrest methodologies - Case studies: Analysis on failed components and design for the extension of its life

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1  Formulate governing equation for elastic problems
CO2  Calculate stresses/displacements around the crack tip for different modes of fracture
CO3  Estimate K1c/SIF/critical flaws/failure stresses for different crack geometries
CO4  Assess the life of the cracked components under different types of repeated/variable fatigue loads and design for its life extension.
CO5  Analyze failed engineering components under different modes of fracture.

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PD4002 ENTERPRISE RESOURCE PLANNING AND MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
1. Students will be able to identify the needs of Enterprise resource planning.
2. Students will be able to understand the various technologies of ERP.
3. Students will be able to distinguish the various ERP packages.
4. Students will be able to understand the various architecture of ERP.
5. Students will be able to identify the issues in ERP procurement.

UNIT I ENTERPRISE RESOURCE PLANNING AND VALUE CHAIN MANAGEMENT 9

UNIT II TECHNOLOGY AND ARCHITECTURE 9

UNIT III ERP SYSTEM PACKAGES 9
SAP, People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organizational and social issues.

UNIT IV ERP ARCHITECTURE 9
Overview – Architecture – AIM – applications – Oracle SCM, SAP: Overview – Architecture – applications – Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET

UNIT V ERP PROCUREMENT ISSUES 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
1. Able to acquire integrated view of the various facets of business, including planning, manufacturing, sales, finance and marketing.
2. Able to understand the development of software to integrate business activities such as inventory management and control, order tracking, customer service, finance and human resources.
3. Awareness on the software applications and tools that are available to business to use to drive out costs and improve efficiency.
4. Understand the architecture of various ERP packages available in the market.
5. Ability to learn the outsourcing concepts of ERP and its economics.

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REFERENCES:

OBJECTIVES:
1. To gain knowledge on artificial intelligence.
2. To understand the concepts of Machine Learning.
3. To appreciate supervised learning and their applications.
4. To appreciate the concepts and algorithms of unsupervised learning.
5. To understand the theoretical and practical aspects of Probabilistic Graphical Models.

UNIT I  ARTIFICIAL INTELLIGENCE  9

UNIT II  INTRODUCTION TO MACHINE LEARNING  9

UNIT III  SUPERVISED LEARNING  9

UNIT IV  UNSUPERVISED LEARNING  9

UNIT V  PROBABILISTIC GRAPHICAL MODELS  9

TOTAL: 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
• Optimize the robots using Artificial Intelligence.
• Design a learning model appropriate to the application.
• Implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
• Use a tool to implement typical Clustering algorithms for different types of applications.
• Identify applications suitable for different types of Machine Learning with suitable justification.
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REFERENCES:

PD4003 DESIGN FOR ADDITIVE MANUFACTURING L T P C
3 0 0 3

OBJECTIVES:
- To acquaint the students with evolution of Additive Manufacturing (AM).
- To gain knowledge on Design aspects of Additive Manufacturing (DFAM).
- To acquaint with Photo polymerization and Sintering processes and their applications.
- To acquaint the students with applications aspects of Additive Manufacturing.
- To gain knowledge in Future trends of Additive Manufacturing

UNIT I BASICS PRINCIPLES OF ADDITIVE MANUFACTURING
Introduction to the Basic Principles of Additive Manufacturing, Additive Manufacturing Processes, Extrusion, Beam Deposition

UNIT II DESIGN CONCEPTS IN ADDITIVE MANUFACTURING
Design/Fabrication Processes: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, Designing for Additive Manufacturing, Multiple Materials, Hybrids, Composite Materials, current and future directions.

UNIT III DESIGN FOR ADDITIVE MANUFACTURING

UNIT IV DESIGNING FOR 3D PRINTING
General design considerations for 3D printing, 3D printed features, Designing for Material Jetting, Binder Jetting, FFF, SLA/DLP, SLS, DMLS/SLM, design rules.

UNIT V DESIGN STANDARDS FOR ADDITIVE MANUFACTURING
Methods of testing and Testing organization - ASTM, ANSI, NBS, NEMA, NFPA, VL, SPI AND SPE.

TOTAL : 45 PERIODS
OUTCOMES:
On Completion of the course the student will be able to
CO1: Recognize the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.
CO2: Evaluate the design for AM and its importance in the quality of fabricated parts.
CO3: Acquire knowledge on principles and applications of polymerization and sheet lamination processes with case studies.
CO4: Acquire knowledge on principles of material extrusion and powder bed fusion processes and design guidelines.
CO5: Perceive jetting and direct energy deposition processes and their applications.

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**REFERENCES:**

PD4004 QUALITY AND FINANCIAL CONCEPTS IN PRODUCT DEVELOPMENT

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OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Applying the concept and principles of quality tools such as seven old and new tools of quality, SPC, multivariate charts, box plots, Pareto charts in product development.
2. Applying the concept and principles of quality tools such as benchmarking, QFD, HoQ, and reliability in product development.
3. Applying the concept and principles of Six Sigma and Lean manufacturing in product development.
4. Applying the concept and principles of robust design and embodiment design in product development.
5. Applying the concept and principles of finance and working capital management in product development.
UNIT I QUALITY TOOLS I
Seven Statistical Tools of Quality – New Seven Management Tools – Multivariable Charts and 3D Plot – Statistical Process Control: Problems in Mean and Range Chart; p, np, u and c chart; Problems in Box Plot and Pareto Chart.

UNIT II QUALITY TOOLS II
Benchmarking: Types; Process; Benefits – Quality Function Deployment (QFD): Concept; Benefits; Process; House of Quality: Structure and Methodology – Reliability: Hazard / Failure Rate; Mean Time Between Failure; Simple problems in Series; Parallel; Combination; Standby Systems.

UNIT III DESIGN FOR SIXSIGMA AND LEAN PRINCIPLES
Six Sigma: Definition; Concept ;Process (DMAIC Methodology) – Project selection for Six Sigma (Types of Quality Problems) – Key Tools in Lean Production / Manufacturing – 4R Total Improvement – PDSA Cycle: Phases; Benefits – Kaizen and Kairyo – 5S House Keeping – TPM: Definition; Objective; Pillars; Steps.

UNIT IV ROBUST DESIGN AND EMBODIMENT DESIGN

UNIT V FINANCE AND WORKING CAPITAL MANAGEMENT
Financial Planning: Definition; Need; Sources; Capital Structure; Capitalization; Term Loans; Short term Finance; Venture Capital; Export Finance – Working Capital Management: Definition; Significance; Assessment; Factors; Sources; Management.

TOTAL: 45 PERIODS

OUTCOMES:
The student will
1. Apply the concept and principles of quality tools such as seven old and new tools of quality, SPC, multivariate charts, box plots, Pareto charts in product development.
2. Apply the concept and principles of quality tools such as benchmarking, QFD, HoQ, and reliability in product development.
3. Apply the concept and principles of Six Sigma and Lean manufacturing in product development.
4. Apply the concept and principles of robust design and embodiment design in product development.
5. Apply the concept and principles of finance and working capital management in product development.

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REFERENCES:

ED4093 OPTIMIZATION TECHNIQUES IN DESIGN

COURSEOBJECTIVES:
1. To understand the basic concepts of unconstrained optimization techniques.
2. To understand the basic concepts of constrained optimization techniques.
3. To provide the mathematical foundation of artificial neural networks and swarm intelligence for design problems.
4. To implement optimization approaches and to select appropriate solutions for design application.
5. To demonstrate selected optimization algorithms commonly used in static and dynamic applications.

UNIT– I UNCONSTRAINED OPTIMIZATION TECHNIQUES
Introduction to optimum design - General principles of optimization - Problem formulation & their classifications- Single variable and multivariable optimization, Techniques of unconstrained minimization - Golden section, Random, pattern and gradient search methods - Interpolation methods.

UNIT– II CONSTRAINED OPTIMIZATION TECHNIQUES
Optimization with equality and inequality constraints-Direct methods-Indirect methods using penalty functions, Lagrange multipliers-Geometric programming.

UNIT–III ARTIFICIAL NEURAL NETWORKS AND SWARM INTELLIGENCE
Introduction-Activation functions, types of activation functions, neural network architectures, Single layer feed forward network, multi layer feed forward network, Neural network applications. Swarm intelligence-Various animal behaviors, Ant Colony optimization, Particle Swarm optimization.

UNIT– IV ADVANCED OPTIMIZATION TECHNIQUES
Multistage optimization-dynamic programming, stochastic programming Multi objective optimization Genetic algorithms and Simulated Annealing technique.

UNIT– V STATIC AND DYNAMIC APPLICATIONS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

CO1 Formulate unconstrained optimization techniques in engineering design application.
CO2 Formulate constrained optimization techniques for various applications.
CO3 Implement neural network technique to real world design problems.
CO4 Apply genetic algorithms to combinatorial optimization problems.
CO5 Evaluate solutions by various optimization approaches for a design problem.

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ED4154 VIBRATION ANALYSIS AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES
1. To appreciate the basic concepts of vibration in damped and undamped systems
2. To calculate the natural frequencies and mode shapes of the two degree freedom systems
3. To determine the natural frequencies and mode shapes of the multi degree freedom and continuous systems
4. To learn the fundamentals of control techniques of vibration and noise levels
5. To use the instruments for the measuring and analyzing the vibration levels in a body

UNIT-I FUNDAMENTALS OF VIBRATION 9+3
UNIT-II TWO DEGREE FREEDOM SYSTEM

Introduction-Free Vibration Of Undamped And Damped - Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates.

UNIT-III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh’s, and Holzer Method-Geared Systems-Eigen Values & Eigenvectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams

UNIT-IV VIBRATION AND NOISE CONTROL


UNIT-V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS


TOTAL = 60 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to

CO1 Apply the basic concepts of vibration in damped and undamped systems
CO2 Determine the natural frequencies and mode shapes of the two degree freedom systems.
CO3 Calculate the natural frequencies and mode shapes of the multi degree freedom and continuous systems
CO4 Control the vibration and noise levels in a body
CO5 Measure and analyze the vibration levels in a body

REFERENCES:
4. WilliamT.Thomson,"TheoryofVibrationwithApplications",Taylor&Francis,2018

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OBJECTIVES:
1. To understand the different architectures for IoT.
2. To learn various protocols at the different layers for IoT.
3. To develop prototype systems using Arduino / RasberryPi.
4. To apply the use of data analytics in IoT.
5. To develop applications of IoT in Industrial contexts.

UNIT I ARCHITECTURES AND MODELS

UNIT II CONNECTIVITY

UNIT III SYSTEM DEVELOPMENT
Design Methodology – Case study – Basic blocks of IoT device – Raspberry Pi – Board, Interfaces, Linux, Setting up, Programming – Arduino – Other IoT Devices.

UNIT IV DATA ANALYTICS AND IoT SECURITY

UNIT V IoT IN INDUSTRY

TOTAL = 45PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- Explain the underlying architectures and models in IoT.
- Analyze different connectivity technologies for IoT.
- Develop simple applications using Arduino/RaspberryPi.
- Apply data analytics techniques to IoT.
- Study the need and suggest appropriate solutions for Industrial applications.

REFERENCES:
IC4291          COMPUTATIONAL FLUID DYNAMICS   L   T   P   C
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COURSE OBJECTIVES:

- This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion. It will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
- To develop finite volume discretised forms of the governing equations for diffusion processes.
- To develop finite volume discretised forms of the convection-diffusion processes.
- To develop pressure-based algorithms for flow processes.
- To introduce various turbulence models, Large Eddy Simulation and Direct Numerical Simulation.

UNIT – I          GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION TECHNIQUES


UNIT – II        DIFFUSION PROCESSES: FINITE VOLUME METHOD


UNIT – III      CONVECTION-DIFFUSION PROCESSES: FINITE VOLUME METHOD

One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme.

UNIT – IV        FLOW PROCESSES: FINITE VOLUME METHOD

Discretisation of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms.

UNIT – V         TURBULENCE MODELS

Turbulence – RANS equation - Algebraic Models, One equation model, Two equation models – k & standard k – ε model, Low Reynold number models of k- ε, Large Eddy Simulation (LES), Direct Numerical Simulation (DNS) - Introduction. Solving simple cases using standard CFD codes.

TOTAL:45 PERIODS
COURSE OUTCOMES:
On successful completion of this course the students will be able to:
- Analyse the governing equations and boundary conditions.
- Analyse various discretization techniques for both steady and unsteady diffusion problems.
- Analyse the various convection-diffusion problems by Finite-Volume method.
- Analyse the flow processes by using different pressure bound algorithms.
- Select and use the different turbulence models according to the type of flows.

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REFERENCES:

OBJECTIVES:
The main learning objective of this course is to prepare students for
1. Applying the fundamental concepts and principles of ergonomics in product design and development.
2. Applying the concept and principles of work place design in product design and development.
3. Applying the concept and principles of equipment design in product design and development.
4. Applying the concept and principles of environmental design in product design and development.
5. Applying the concept and principles of cognitive ergonomics & human factor application in product design and development.

UNIT I FUNDAMENTALS OF ANTHROPOMETRY IN ERGONOMICS
UNIT II ERGONOMICS IN WORKPLACE DESIGN 9

UNIT III ERGONOMICS IN EQUIPMENT DESIGN 9

UNIT IV ERGONOMICS IN ENVIRONMENTAL DESIGN 9
Heat, cold and the design of the physical environment – Vision, light and lighting – Hearing, sound, noise and vibration.

UNIT V COGNITIVE ERGONOMICS & HUMAN FACTOR APPLICATION 9

TOTAL = 45 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the fundamental concepts and principles of ergonomics in product design and development.
2. Apply the concept and principles of workplace design in product design and development.
3. Apply the concept and principles of equipment design in product design and development.
4. Apply the concept and principles of environmental design in product design and development.
5. Apply the concept and principles of cognitive ergonomics & human factor application in product design and development.

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COURSE OBJECTIVES:
1. Fundamental concepts of electric and hybrid vehicle operation and architectures.
2. Understand the properties of batteries and its types.
3. Provide knowledge about design of series hybrid electric vehicles.
4. Provide knowledge about design of parallel hybrid electric vehicles.
5. Understand of electric vehicle drive train.

UNIT– I  INTRODUCTION TO ELECTRIC VEHICLES

UNIT– II  ENERGY SOURCE

UNIT–III  SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN

UNIT– IV  PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN
Control Strategies of ParallelHybridDriveTrain-DriveTrainParameters-EnginePowerCapacity- Electric Motor Drive Power Capacity-Transmission Design- Energy Storage Design

UNIT–V  ELECTRIC VEHICLE DRIVE TRAIN

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

CO1 Explain how a hybrid vehicle works and describe its main components and their function.
CO2 Choose proper energy storage systems for vehicle applications
CO3 Design series hybrid electric vehicles.
CO4 Design parallel hybrid electric vehicles.
CO5 Describe the transmission components and their configurations for electric vehicles

REFERENCES:
OBJECTIVES:
The main learning objective of this course is to prepare students for
1. Apply and develop mathematical model of a system
2. Applying the design and suggest bearings for specific applications
3. Applying a fatigue life calculation for various types of bearings
4. Apply and analyze bearing behavior
5. Study the dynamics of rotors mounted on Hydrodynamic Bearings.

UNIT I
INTRODUCTION TO ROTOR DYNAMICS
Torsional vibrations analysis – critical speeds and response to imbalance- Transfer matrix analysis- Instability of rotors- Gyroscopic effects

UNIT II
HYDRODYNAMIC BEARINGS
Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads, alternating and impulse loads in journal bearings – Journal center Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions.

UNIT III
BALANCING OF ROTORS
Classification of rotors and balancing criteria, balancing of rigid and flexible rotors- balance criteria for flexible rotors

UNIT IV
ROTOR DYNAMICS IN TURBOMACHINEY DESIGN

UNIT V
DYNAMICS OF ROTORS MOUNTED ON HYDRODYNAMIC BEARINGS
Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads, alternating and impulse loads in journal bearings – Journal center Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions.

TOTAL = 45 PERIODS
OUTCOMES:
Upon completion of this course, the students will be able to:
- understand application of various types of bearings and their operating principles
- design and suggest bearings for specific applications
- perform fatigue life calculations for various types of bearings,
- understand and analyze bearing behavior
- study the dynamics of rotors mounted on Hydrodynamic Bearings

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REFERENCES:

CD4091   BIO MATERIALS
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OBJECTIVES:
1. To study different concepts in selecting bio and smart materials
2. To import knowledge on different electro-rheological and piezoelectric materials
3. To import knowledge on different shape memory materials and their applications of materials in biomedical engineering and special materials for actuators, sensors, etc.
4. To import knowledge on Materials for oral and maxillofacial surgery
5. To import knowledge on materials for cardiovascular ophthalmology and skin regeneration.

UNIT I   INTRODUCTION

UNIT II   DENTAL MATERIALS

UNIT III   ORTHOPAEDIC MATERIALS
UNIT IV WOUND DRESSING MATERIALS AND SURGICAL AIDS
Skin structure – defects (burn, ulcer, trauma etc) and disease - skin regeneration – classification of regenerative material – Sutures- Adhesives – classification – Surgical tools- materials – sterilization - Laparoscopic tools

UNIT V CARDIOVASCULAR, OPHTALMOLOGY AND DRUG DELIVERY MATERIALS

OUTCOMES:
On Completion of the course the student will be able to
- Use of Bio materials for cardiovascular Opthalmology and Skin Regeneration
- Use of Bio materials for Dental & Bone application
- Use of shape memory alloys in engineering application
- Explain the characteristics of Bio and smart materials
- Use of smart materials as sensors, actuators.

TOTAL: 45 PERIODS

REFERENCES:
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 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 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
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

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.
REFERENCES

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 Revolution in 1917 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

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

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 I

1. The Constitution of India, 1950 (Bare Act), Government Publication.
   - Articles 1 to 31
   - Articles 82
   - Articles 95, 195
   - Articles

UNIT II

1. Articles 32 to 41
2. Articles 42 to 46
3. Articles 47 to 51
4. Articles 52 to 66

UNIT III

1. Articles 67 to 71
2. Articles 72 to 81
3. Articles

UNIT IV

1. Articles 82 to 97
2. Articles 98 to 103
3. Articles 104 to 109
4. Articles 110 to 115
5. Articles 116 to 121
6. Articles

AX4094

UNIT I

L T P C

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UNIT V நிதி வணிக துறக்கவியல்
1. முற்றுகைசன் தொறை,
   - நேரேற்றத் தகுப்பு புத்தகம்,
   - நேரேற் வளை நம்பிக்கை,
   - காண்டேர் துறக்கவியல்,
   - பாலன் துறக்கவியல்,
   - பந்தை,
2. முற்றை விளையாட்டு வச்சாரனம் தியூக் துறக்கவியல்,
3. விளையாட்டு விளையாட்டு தியூக் துறக்கவியல்,
4. வருண விளையாட்டு விளையாட்டு விளையாட்டு விளையாட்டிற்கான தமிழ்
   துறக்கவியல்,
5. ஆராய்வியல் தொறை,
6. விளையாட்டு தொறை,
7. தகுப்பு தொறை விளையாட்டு தொறை துறக்கவியல்.

TOTAL: 30 PERIODS

தலை வாசிப்பிட்டியாரின் / புத்தகங்கள்
1. தமிழ் விருதுபாண்ட தமிழியங்கை (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விருதுபாண்ட விருதுபாண்ட (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. வண்ணப் புராண வண்ணப் புராண
4. வண்ணப் புராண வண்ணப் புராண
   - நேரேற்ற வண்ணப் புராண வண்ணப் புராண
5. தமிழ் சுருக்கம்/தியூக் (thamilvalarchithurai.com)
6. ஆராய்வியல் துறக்கவியல்
   - தமிழ் புலசொல்லக்கை புலசொல்லக்கை
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OCE431 INTEGRATED WATER RESOURCES MANAGEMENT

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

TOTAL: 45 PERIODS

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

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

CO – PO Mapping - INTEGRATED WATER RESOURCES MANAGEMENT

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<tr>
<td>PO2</td>
<td>Problem analysis</td>
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<tr>
<td>PO3</td>
<td>Design / development of solutions</td>
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<td>Investigation</td>
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<td>PO5</td>
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<td>PO6</td>
<td>Individual and Team work</td>
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<td>Engineer and Society</td>
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<td>Project Management and Finance</td>
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<td>PO12</td>
<td>Life Long Learning</td>
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<tr>
<td>PSO1</td>
<td>Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
<td>3 2 2 2 2 2</td>
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<tr>
<td>PSO2</td>
<td>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>
<td>2 2 2 2 2 2</td>
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<tr>
<td>PSO3</td>
<td>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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**OCE432 WATER, SANITATION AND HEALTH**

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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**


**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.

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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<tr>
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<td>Design / development of solutions</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</td>
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TOTAL: 45 PERIODS
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

UNIT II PRINCIPLES AND FRAME WORK

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS

UNIT V ASSESSING PROGRESS AND WAY FORWARD

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

| CO1 | Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises. |
| CO2 | Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals |
| CO3 | Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption |
| CO4 | Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems. |
| CO5 | Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability. |

REFERENCES:

CO – PO Mapping – Principles of Sustainable Development

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OCE434 ENVIRONMENTAL IMPACT ASSESSMENT L T P C 3 0 0 3
OBJECTIVES:
- To make the students to 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
9

UNIT II IMPACT IDENTIFICATION AND PREDICTION
10

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT
8
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
9
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
9
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

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 L T P C 3 0 0 3

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 CRYPTOCURRENCY

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.
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 de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

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OIC432 DEEP LEARNING

COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- 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
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
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
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

TOTAL: 45 PERIODS

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.
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 L T P C 3 0 0 3

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 9

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9
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 9
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

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 3 0 0 3

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.

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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ETHICAL MANAGEMENT

COURSE OBJECTIVE
- To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I  ETHICS AND SOCIETY 9
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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ET4251        IoT FOR SMART SYSTEMS        LT P C
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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.
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 RASPERRY 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

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
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

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REFERENCES:
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 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, Naive 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

TOTAL : 45 PERIODS

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
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional 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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PX4012 RENEWABLE ENERGY TECHNOLOGY

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 9
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 9

UNIT V OTHER RENEWABLE ENERGY SOURCES 9
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 tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources

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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  9
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  9
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.

TOTAL : 45 PERIODS

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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CP4391 SECURITY PRACTICES

COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through 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


TOTAL: 45 PERIODS

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

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  8

UNIT II  CONTEXTUAL INQUIRY  10
UNIT III DESIGN THINKING, IDEATION, AND SKETCHING 9

UNIT IV UX GOALS, METRICS, AND TARGETS 8

UNIT V ANALYSING USER EXPERIENCE 10

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
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
9

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
9
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
9

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
9
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.

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

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
L T P C
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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
Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II  PROTOCOLS FOR IoT  9
Infrastructure protocol (IPV4/V6/RPL), Identification (URLs), Transport (Wifi, LiFi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT III  CASE STUDIES/INDUSTRIAL APPLICATIONS  9
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  9

UNIT V  IoT AND CLOUD  9

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  L T P C
3 0 0 3

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  9
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

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

REFERENCES

CO-PO Mapping

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VE4202 EMBEDDED AUTOMATION

COURSE OBJECTIVES:
- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system

UNIT - I INTRODUCTION TO EMBEDDED C PROGRAMMING 9
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 9
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 9
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 9

UNIT – V HOME AUTOMATION 9
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System

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
UNIT I REINFORCEMENTS 9
Introduction – composites – classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II MATRICES 9
Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III COMPOSITE MANUFACTURING 9
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 9
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 9
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

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
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS
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

REFERENCES:
1. Introduction to Nanocomposite Materials, Properties, Processing, Characterization- Thomas E. Twardowski. 2007. DEStech Publications. USA.
5. The search for novel, superhard materials- Stan Vepřej (Review Article) JVST A, 1999

TOTAL : 45 PERIODS

BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP L T P C 3 0 0 3

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 Cartagena Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT

TOTAL : 45 PERIODS

REFERENCES