1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

| I.  | To become effective and excellent collaborators and innovators, participating in efforts to address and provide fast and efficient solutions |
| II. | To provide creative and innovative solutions to industrial design problems using computer aided tools. |
| III. | To pursue advanced education, research and development and other creative/innovative efforts in their professional career. |

2. PROGRAMME OUTCOMES (POs):

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<tbody>
<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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<tr>
<td>2</td>
<td>An ability to write and present a substantial technical report/document.</td>
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<tr>
<td>3</td>
<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>4</td>
<td>Graduate will develop confidence for self-education and creativity knowledge in their field of Engineering.</td>
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<tr>
<td>5</td>
<td>Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.</td>
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<tr>
<td>6</td>
<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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Every programme objectives must be mapped with 1,2,3,-, scale against the correlation PO’s.
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**YEAR II**
## M.E. Computer Aided Design

### Regulations 2021

#### Choice Based Credit System

I to IV Semesters Curricula & Syllabus

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* Audit Course is optional

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TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 71
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# EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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# AUDIT COURSES (AC)

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# LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

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COURSE OBJECTIVES
1. To learn the concepts of theory of elasticity in three-dimensional stress system.
2. To study the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending.
3. To learn the stresses in flat plates and curved members.
4. To study torsional stress of non-circular sections.
5. To learn the stresses in rotating members, contact stresses in point and line contact applications.

UNIT-I ELASTICITY 9+3

UNIT-II SHEAR CENTRE AND UNSYMMETRICAL BENDING 9+3
Location of shear centre for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section.

UNIT-III STRESSES IN FLAT PLATES AND CURVED MEMBERS 9+3
Circumference and radial stresses - deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates - pure bending of plates - deflection - uniformly distributed load - various end conditions.

UNIT-IV TORSION OF NON-CIRCULAR SECTIONS 9+3
Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl'sstress function - torsional stress in hollow thin walled tubes.

UNIT-V STRESSES IN ROTATING MEMBERS AND CONTACT STRESSES 9+3
Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications.

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Apply the concepts of theory of elasticity in three-dimensional stress system.
CO2 Determine the shear centre of various cross-sections and deflections in beams subjected tounsymmetrical bending.
CO3 Evaluate the stresses in flat plates and curved members.
CO4 Calculate torsional stress of non-circular sections.
CO5 Determine the stresses in rotating members, contact stresses in point and line contactapplications.
REFERENCES:

Mapping of CO with PO

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

ED4153 COMPUTER APPLICATIONS IN DESIGN

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 standards in CAD system.

UNIT – I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS

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
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

UNIT – IV VISUAL REALISM

UNIT – V ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLE MANAGEMENT

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

- To impart knowledge on basic concepts in engineering design.
- To develop a product catering to the need of 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

TOTAL = 45 PERIODS

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:

Mapping of CO with PO

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CD4152  DESIGN FOR SUSTAINABILITY  L  T  P  C 3 0 0 3

COURSE OBJECTIVES
1. Selecting the relevant process; applying the general design principles for manufacturability; GD &T.
2. Applying the design considerations while designing the cast and welded components.
3. Applying the design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.

UNIT-I  INTRODUCTION  9
Introduction - Economics of process selection - General design principles for manufacturability; Geometric Dimensioning & Tolerance (GD&T)– Formtolerancing: straightness, flatness, circularity, cylindricity – Profile tolerancing: profile of a line, and surface – Orientation tolerancing: angularity, perpendicularity, parallelism – Location tolerancing: position, concentricity, symmetry – runout tolerancing: circular and total–Supplementary symbols.

UNIT-II  CAST & WELDED COMPONENTS DESIGN  9

UNIT-III  FORMED &MACHINED COMPONENTS DESIGN  9
Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts. Design considerations for: Turned parts– Drilled parts – Milled, planned, shaped and slotted parts–Ground parts.
UNIT-IV DESIGN FOR ASSEMBLY

UNIT-V DESIGN FOR ENVIRONMENT

TOTAL= 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Select relevant process; apply the general design principles for manufacturability; GD&T.
2. Apply design considerations while designing the cast and welded components.
3. Apply design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.

REFERENCES:
2. Bralla, Design for Manufacture handbook, McGrawhill,1999
8. Harry Peck, Designing for manufacture, Pitman—1973

Mapping of CO with PO

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

TOTAL : 30 PERIODS

REFERENCES
COURSE OBJECTIVES:

- To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's

- CAD Introduction.
- Sketcher
- Solid modeling—Extrude, Revolve, Sweep and variational sweep, Loft
- Surface modeling—Extrude, Sweep, Trim and Mesh of curves, Freeform.
- Feature manipulation—Copy, Edit, Pattern, Suppress, History operations etc.
- Assembly-Constraints, Exploded Views, Interference check

Exercises in modeling and drafting of mechanical components-assembly using parametric and feature-based packages like PRO-E/SOLIDWORKS /CATIA/NX

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course the student will be able to

- Use the modern engineering tools necessary for engineering practice
- Draw 2D part drawings, sectional views, and assembly drawings as per standards.
- Create 3D Model on any CAD software.
- Convert 3D solid models into 2D drawings and prepare different views, sections, and dimensioning of part models.
- Examine interference to ensure that parts will not interfere.

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TOTAL: 60 PERIODS

OBJECTIVES:

- To work on a specific technical topic in Engineering design related topics to acquire the skills of oral presentation.
- To acquire technical writing abilities for seminars and conferences.

The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to Engineering design topics and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as the audience also should interact. Evaluation will be based on the technical presentation and their port and also on the interaction during the seminar.

TOTAL:30 PERIODS
OUTCOMES:
On Completion of the course the student will be able to
- Students comprehend concepts and methods adequate to understand inductive and deductive reasoning, and increase their general problem-solving skills.
- Students develop communicative skills (e.g. speaking, listening, reading, and/or writing).

PD4391  PRODUCT LIFE CYCLE MANAGEMENT  L  T  P  C
3  0  0  3

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

TOTAL: 45 PERIODS

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.
REFERENCES

ED4251    FINITE ELEMENT METHODS IN MECHANICAL DESIGN    L  T  P  C
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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 element matrices
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
Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Iso parametric Elements –Formulation – Shape functions -one dimensional , two dimensional triangular and quadrilateral elements -Serendipity elements- Jacobian transformation - Numerical Integration – Gauss quadrature – one, two and three point integration

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 numerical solutions
CO2  Determine field variables for two dimensional scalar and vector variable problems
CO3  Apply Isoparametric 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

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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
Introduction - Sources of Vibration - Mathematical Models - Displacement, velocity and Acceleration
Review Of Single Degree Freedom Systems - Vibration isolation Vibrometers and accelerometers
- Response To Arbitrary and non-harmonic Excitations – Transient Vibration – Impulse loads
-Critical Speed Of Shaft-Rotor systems

UNIT-II  TWO DEGREE FREEDOM SYSTEM  9+3
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  9+3
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  9+3
Specification of Vibration Limits – Vibration severity standards - Vibration as condition Monitoring
Tool-Vibration Isolation methods - Dynamic Vibration Absorber - Static and Dynamic Balancing
machines – Field balancing - Major sources of noise – Noise survey techniques – Measurement
technique for vehicular noise – Road vehicle noise standards – Industrial noise sources – Control
Strategies – Noise control at the source and along the path – use of acoustic barriers – Noise
control at the receiver.

UNIT-V  EXPERIMENTAL METHODS IN VIBRATION ANALYSIS  9+3
Vibration Analysis Overview - Experimental Methods in Vibration Analysis.- Vibration Measuring
Instruments - Selection of Sensors- Accelerometer Mountings. - Vibration Exciters-Mechanical,
Hydraulic, Electromagnetic And Electrodynamics – Frequency Measuring Instruments-. System
Identification from Frequency Response - Testing for resonance and mode shapes

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. William T. Thomson, "Theory of Vibrations with Applications", Taylor & Francis, 2018

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CM4152 SOLID FREEFORM MANUFACTURING

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  9

UNIT V  JETTING AND DIRECT ENERGY DEPOSITION PROCESSES  9

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.

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COURSE OBJECTIVE:
1. To evaluate the stiffness and natural frequency of spring-mass systems.
2. To determine the natural frequencies of damped and undamped torsional vibrations of single rotor systems and obtain the radius of gyration of a body through torsional oscillations.
3. To acquire the critical speed of shaft supported at its ends.
4. To assess the natural frequency, damping coefficient, mode shapes of specimens under free vibrations.
5. To determine the natural frequency of specimens under forced vibrations.

LIST OF EXPERIMENTS:
1) Determination of stiffness and natural frequency of undamped spring-mass systems arranged in series, parallel and series-parallel fashions
2) Determination of effective radius of gyration of an irregular body through torsional oscillation of tri filar suspension
3) Determination of natural frequency a single rotor undamped shaft system
4) Determination of natural frequency a single rotor damped shaft system
5) Determination of critical speed of shaft
6) Determination of natural frequency and mode shapes of specimens supported at its ends through modal analysis
7) Determination of damping coefficient of specimens supported at its ends
8) Forced vibration of specimens supported under simply supported and cantilever boundary conditions – Determination of natural frequency

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO 1 Evaluate the stiffness and natural frequency of spring-mass systems.
CO 2 Determine the natural frequencies of damped and undamped torsional vibrations of single rotor systems
CO 3 Acquire the critical speed of shaft supported at its ends.
CO 4 Assess the natural frequency, damping coefficient, mode shapes of specimens under free vibrations.
CO 5 Determine the natural frequency of specimens under forced vibrations.

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OBJECTIVES:
• To give exposure to software tools needed to analyze engineering problems.

LIST OF EXPERIMENTS
1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
5. Thermal stress and heat transfer analysis of plates.
7. Vibration analysis of spring-mass systems.
8. Modal 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

LIST OF EQUIPMENTS/SOFTWARE:
Finite Element Analysis packages

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Solve engineering problems numerically using Computer Aided Finite Element Analysis packages
CO2 Analyze the force, stress, deflection in mechanical components.
CO3 Analyze thermal stress and heat transfer in mechanical components.
CO4 Analyze the vibration of mechanical components.
CO5 Analyze the modal, harmonic, transient and spectrum concepts in mechanical components.

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COURSE OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through a detailed review of literature.
- To develop the methodology to solve the identified problem.
- 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 a 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.

TOTAL: 180 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to:

- CO1 Demonstrate a sound technical knowledge of their selected project topic.
- CO2 Undertake problem identification, formulation, and solution.
- CO3 Design engineering solutions to complex problems utilizing a systems approach.

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.

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TOTAL: 360 PERIODS
COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Demonstrate a sound technical knowledge of their selected project topic.
CO2 Undertake problem identification, formulation and solution.
CO3 Design engineering solutions to complex problems utilising a systems approach
CO4 Demonstrate the knowledge, skills and attitudes of a professional engineer to take up any challenging practical problem in the field of engineering design and find better solutions to it.

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PD4152 INTEGRATED PRODUCT DEVELOPMENT

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

UNIT– II PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING
Establish Target and Final product specifications – Activities of Concept Generation - Concept Screening and Scoring - Concept Testing Methodologies.

UNIT–III PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN
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

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

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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COURSE OBJECTIVES:
1. Study of different composite materials and finding its mechanical strength
2. Fabrication of FRP and other composites by different manufacturing methods
3. Stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Calculation of stresses in the lamina of the laminate using different failure theories
5. Calculation of residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory.

UNIT-I   INTRODUCTION TO COMPOSITE MATERIALS

UNIT- II   MANUFACTURING OF COMPOSITES
Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing. Manufacturing of Ceramic Matrix Composites (CMCs)–hot pressing-reaction bonding process-infiltration technique, direct oxidation-interfaces

UNIT-III   LAMINA CONSTITUTIVE EQUATIONS

UNIT-IV   LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES

UNIT- V   THERMO-STRUCTURAL ANALYSIS
Case studies: Implementation of CLT for evaluating residual stresses in the components made with different isotropic layers such as electronic packages etc.

COURSE OUTCOMES:
On Completion of the course the student will be able to
1. Calculate for mechanical strength of the composite material
2. Fabricate the FRP and other composites by different manufacturing methods
3. Analyze fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Evaluate the stresses in the lamina of the laminate using different failure theories
5. Analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

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ED4074 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To introduce the different components of hydraulic systems and its design and selection procedures.
2. To formulate a thorough understanding on the need and use of various control and regulating elements in hydraulic systems.
3. To enable them to independently design hydraulic circuits for industrial applications
4. To expose them to the different components of pneumatic systems and enable them to design simple pneumatic systems.
5. To make them understand the need to integrate electronics and develop low cost systems and provide solution to simple industrial applications

UNIT– I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 9
Hydraulic Power Generators – Selection and specification of pumps, pump characteristics.
Linear and Rotary Actuators – selection, specification and characteristics, Hydrostatic drives, types, selection.

UNIT– II CONTROL AND REGULATION ELEMENTS 9
Pressure-direction and flow control valves-relief valves, non-return and safety valves-actuation systems, Proportional Electro hydraulic servo valves.
UNIT–III HYDRAULIC CIRCUITS

UNIT– IV PNEUMATIC SYSTEMS AND CIRCUITS
Pneumatic fundamentals-control elements, position and pressure sensing, Pneumatic equipments- selection of components - design calculations - logic circuits - switching circuits – fringe conditions modules and these integration-sequential circuits-cascade methods-mapping methods - step counter method - compound circuit design - combination circuit design-Karnaugh-Veitch map

UNIT– V ELECTROMAGNETIC & ELECTRONIC CONTROL OF HYDRAULICS & PNEUMATIC CIRCUIT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Design and select appropriate pumps in industries based on need.
2. Select correct sizing and rating of control elements in hydraulics.
3. Design basic circuits (hydraulic) for industrial applications.
4. Design basic pneumatic circuits for industrial applications.
5. Identify and provide solution for troubleshooting and design low cost automation for industrial application.

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COURSE OBJECTIVES:
1. To impart knowledge on various concepts in engineering design, material selection and manufacturing methods.
2. To learn the principles of implementing quality in a product or services using different tools.
3. To enhance the quality of product by use of failure mode effect analysis and implement methods to uphold the status of six sigma.
4. To develop a robust product or service using various strategies of design of experiments.
5. To maintain the quality of the product by use of statistical tools and enforce methods to improve the reliability of a product.

UNIT – I DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION 9

UNIT – II DESIGN FOR QUALITY 9
Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design – testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT – III FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA 9

UNIT – IV DESIGN OF EXPERIMENTS 9
Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments – Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi’s approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios

UNIT – V STATISTICAL CONSIDERATION AND RELIABILITY 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply fundamentals of design process and material selection for developing a quality product
2. Apply the quality concepts to develop a robust product
3. Perform Failure Mode Effect Analysis on a product and use six sigma principles to enhance its quality
4. Apply different experimental design methods in product development
5. Implement various statistical tools to improve its quality and reliability

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MA4071 APPLIED PROBABILITY AND STATISTICS FOR DESIGN ENGINEERS

COURSE OBJECTIVES:
- To compute moments of standard distributions.
- To gain the knowledge about correlation and regression.
- To provide the most appropriate estimator of the parameter in statistical inference.
- To decide whether to accept or reject specific value of a parameters.
- To understand many real-world problems fall naturally within the frame work of multivariate normal theory.

UNIT - I ONE DIMENSIONAL RANDOM VARIABLES
Random variables - Probability functions – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT - II TWO DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Correlation – Linear Regression.
UNIT- III  ESTIMATION THEORY  9

UNIT - IV  TESTING OF HYPOTHESIS  9
Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT - V  MULTIVARIATE ANALYSIS  9
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables

TOTAL : 45 PERIODS

COURSE OUTCOMES:
After completing this course, students should demonstrate competency in the following topics:
- Moments of discrete and continuous random variables.
- To deal problems involving two dimensional random variables.
- Unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

REFERENCES :

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  9
UNIT II WEAR AND SURFACE TREATMENT

UNIT III LUBRICANTS AND LUBRICATION REGIMES

UNIT IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION

UNIT V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION

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

REFERENCES:
COURSE OBJECTIVES

1. To study concept of Finite Element Analysis to solve problems involving plate and shell elements
2. To learn concept of Finite Element Analysis to solve problems involving geometric and material non linearity
3. To study solution techniques to solve dynamic problems
4. To study the concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
5. To study error norms, convergence rates and refinement.

UNIT-I   BENDING OF PLATES AND SHELLS  
Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements – Degenerated shell elements-Application and Examples.

UNIT-II  NON-LINEAR PROBLEMS  

UNIT-III DYNAMIC PROBLEM  

UNIT-IV FLUID MECHANICS AND HEAT TRANSFER  

UNIT-V ERROR ESTIMATES AND ADAPTIVE REFINEMENT  
Error norms and Convergence rates–h-refinement with adaptivity–Adaptive refinement.

TOTAL=45PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Apply concept of Finite Element Analysis to solve problems involving plate and shell elements
CO2 Apply concept of Finite Element Analysis to solve problems involving geometric and material non linearity
CO3 Formulate solution techniques to solve dynamic problems
CO4 Apply concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
CO5 Investigate error norms, convergence rates and refinement.
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ED4152 ADVANCED MECHANISMS IN DESIGN

COURSE OBJECTIVES
1. To learn the concepts of gross motion capability and develop multi loop kinematic chains and equivalent mechanisms
2. To study complex mechanisms to determine velocity and acceleration of output links.
3. To learn to locate inflection points and to draw the inflection circle
4. To study the synthesis of planar mechanisms
5. To learn to design of six bar coupler driven mechanisms and cam mechanisms

UNIT-I INTRODUCTION

UNIT-II KINEMATIC ANALYSIS

UNIT-III PATH CURVATURE THEORY, COUPLER CURVE
Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp -cunode -coupler driven six-bar mechanisms-straight line mechanisms

36
UNIT-IV SYNTHESIS OF FOUR BAR MECHANISMS 9
Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein’s Equation-Bloch’s Synthesis.

UNIT-V SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS 9

TOTAL = 45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
1. Apply concepts of gross motion capability and develop multi loop kinematic chains and equivalent mechanisms
2. Determine velocity and acceleration of complex mechanisms
3. Evaluate inflection points and draw the inflection circle
4. Synthesize planar mechanisms
5. Design of six bar coupler driven mechanisms and cam mechanisms

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OBJECTIVE:
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

UNIT II INTRODUCTION TO MACHINE LEARNING

UNIT III SUPERVISED LEARNING

UNIT IV UNSUPERVISED LEARNING

UNIT V PROBABILISTIC GRAPHICAL MODELS

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:

CD4001 ADVANCED COMPUTER MANUFACTURING L T P C
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COURSE OBJECTIVES:
1. To understand the impact of computer-integrated manufacturing (CIM) on productivity, product cost, and quality.
2. To obtain an overview of computer technologies for factory management and factory floor operations.
3. To understand the industrial applications of Computer integrated manufacturing.
4. To understand evolution of cloud based design and manufacturing.

UNIT I INTRODUCTION 9

UNIT II ELEMENTS OF A GENERAL CIM SYSTEM 9
Types of CIM systems, CAD-CAM link for CIMS, Benefits of CAM, FMS and CIMS, Automated material handling systems, equipment and their functions. Integration of Robots in CIMS, automated guided vehicle navigation system, Automatic Storage and Retrieval Systems (AS/RS), Carousel storage system, design of automatic material handling system, KWO analysis, work-part transfer mechanisms.

UNIT III APPLICATION OF COMPUTER INTEGRATED MANUFACTURING (CIM) SYSTEMS 9
Concept and terminology, Part family formation, Classification and coding systems for components, Group technology machine cells. Group technology applications for computer-integrated manufacturing, Computer-aided Tooling Design for Manufacturing Processes-Industrial Applications.

UNIT IV INTELLIGENT SYSTEMS IN MANUFACTURING 9
Current Developments and Future Prospects-Artificial intelligence techniques and the components of an intelligent manufacturing system. Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing. Key artificial intelligence technologies (fuzzy logic, artificial neural networks, expert systems and genetic algorithms).

UNIT V CLOUD-BASED DESIGN AND MANUFACTURING 9
Evolution of design and manufacturing systems, Characteristics and requirements for cloud-based design and manufacturing systems, Cloud-based design and manufacturing example scenario, Cloud-Based Desktop Factory.

TOTAL: 45 PERIODS
COURSE OUTCOMES:

- To understand the basics of CAD/CAM integration, PLM management and need of process planning in manufacturing.
- To apply the knowledge of Expert systems, Group technology and part representation for various applications.
- To analyze the use of CIM for the various industrial applications.
- To know the use of AI in manufacturing.
- To know the latest trends in the cloud based design and manufacturing and its contemporary issues.

REFERENCES:

2. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.

ED4093 OPTIMIZATION TECHNIQUES IN DESIGN

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COURSE OBJECTIVES:

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 algorithms and Simulated Annealing technique.

UNIT– V STATIC AND DYNAMIC APPLICATIONS
Structural applications—Design of simple truss members—Design of simple axial, transverse
loaded members for minimum cost, weight—Design of shafts and torsionally loaded members
—Design of springs.
Dynamic Applications—Optimum design of single, two degree of freedom systems, vibration
absorbers. Application in Mechanisms—Optimum design of simple linkage mechanisms.

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

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<th>Formulate unconstrained optimization techniques in engineering design application.</th>
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<td>Formulate constrained optimization techniques for various applications.</td>
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<td>Implement neural network technique to real world design problems.</td>
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<td>Apply genetic algorithms to combinatorial optimization problems.</td>
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<td>Evaluate solutions by various optimization approaches for a design problem.</td>
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TOTAL: 45 PERIODS

REFERENCES:
   Education. 2015,
   Algorithms", PHI, 2011

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

41
OBJECTIVES:
- To study different concepts in selecting bio and smart materials
- To import knowledge on different electro-rheological and piezoelectric materials
- To import knowledge on different shape memory materials and their applications of materials in biomedical engineering and special materials for actuators, sensors, etc.
- To import knowledge on Materials for oral and maxillofacial surgery
- To import knowledge on materials for cardiovascular ophthalmology and skin regeneration.

UNIT I INTRODUCTION

UNIT II DENTAL MATERIALS

UNIT III ORTHOPAEDIC MATERIALS
Bone composition, formation and regeneration - properties - defects - temporary fixation devices - joint replacement - biomaterials used in bone and joint replacement metals and alloys - stress shielding effect - bone tissue engineering.

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, OPHTHALMOLOGY AND DRUG DELIVERY MATERIALS

OUTCOMES:
On Completion of the course the student will be able to
- Use of Bio materials for cardiovascular Ophthalmology 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..

REFERENCES:
COURSE OBJECTIVES:
1. The student will understand the principle of force and strain measurement.
2. The student will understand the vibration measurement and their applications.
3. To impart knowledge on the principle behind acoustics and wind flow measurements.
4. To familiarize with the distress measurements
5. To realize the non destructive testing principle and application

UNIT– I FORCES AND STRAIN MEASUREMENT
Strain gauge, principle, types, performance and uses. Photo elasticity– Principle and applications

UNIT– II VIBRATION MEASUREMENTS
Characteristics of Structural Vibrations–Linear Variable Differential Transformer(LVDT)–
Transducers for velocity and acceleration measurements. Vibration meter– Seismographs–
Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter–
Chart Plotters–Digital data Acquisition systems.

UNIT– III ACOUSTICS AND WIND FLOW MEASUREMENTS
Principles of Pressure and flow measurements–pressure transducers–sound level meter–
venturimeter and flow meters–wind tunnel and its use in structural analysis–structural modeling
–direct and indirect model analysis

UNIT– IV DISTRESS MEASUREMENTS
Diagnosis of distress in structures–crack observation and measurements–corrosion of
reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled
blasting for demolition.

UNIT– V NON DESTRUCTIVE TESTING METHODS
Load testing on structures, buildings ,bridges and towers–Rebound Hamme r–acoustice mission–
ultrasonic testing principles and application–Holography–use of laser for structural testing–Brittl e
coating

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

- **CO1** Measure physical quantities such as forces and strains.
- **CO2** Apply different vibration measurements techniques.
- **CO3** Measure physical quantities such as pressure and flow.
- **CO4** Apply techniques involved in crack measurement.
- **CO5** Select the appropriate nondestructive testing methods for various engineering applications.

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BM4074 | WEARABLE TECHNOLOGIES | L T P C |
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COURSE OBJECTIVES:
- Identify the motivation, guiding principles, and challenges of Wearable Computing.
- Develop skills pertaining to the design of a holistic interactive wearable system comprising of the physical, digital, and the human aspects.
- To provide the basic understanding of measurement and instrumentation systems and the insight of the resistive sensors and its applications in real life.
- To introduce the concept of the reactive sensors and self-generating sensors and its applications in real life.
- To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life.
UNIT I  INTRODUCTION  9

WEARABLE SENSORS  9
Chemical and Biochemical sensors, System design, Challenges in chemical Bio-chemical sensing, Application areas - Inertia sensors, Parameters from inertia sensors - Applications for wearable motion sensors - Measurement of energy expenditure by body worn heat flow sensors.

UNIT III  FLEXIBLE ELECTRONICS  9

UNIT VI  ENERGY HARVESTING SYSTEMS  9

UNIT V  MONITORING PHYSICAL AND PHYSIOLOGICAL PARAMETERS  9
Wearable sensors for physiological signal measurement - Physical measurement: Cardiovascular diseases, Neurological diseases, Gastrointestinal diseases - Wearable and non-invasive assistive technologies: Assistive devices for individuals with severe paralysis, Wearable tongue drive system, Sensor signal-processing algorithm, Dual-mode tongue drive system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand the fundamentals of wearables, wearable design issues and user interfaces
CO2: Identify the different types of sensors used in wearable devices
CO3 : Recognize the materials used in the field of flexible electronics technology and its power constraints
CO4: Summarize the techniques and issues associated with energy harvesting from human body
CO5: Elucidate the applications of wearable technology in health care

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OBJECTIVES:
- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using IoT
- To apply the concept of IOT in the real world scenario

UNIT I  INTRODUCTION AND ARCHITECTURE OF IoT

UNIT II  INDUSTRIAL IoT

UNIT III  IIoT ANALYTICS
Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop

UNIT IV  IOT SECURITY

UNIT V  CASE STUDY
Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries

COURSE OUTCOMES:
Upon completion of this course, student will be able to
CO1: Understand the basic concepts and Architectures of Internet of Things.
CO2: Understand various IoT Layers and their relative importance.
CO3: Realize the importance of Data Analytics in IoT.
CO4: Study various IoT platforms and Security.
CO5: Understand the concepts of Design Thinking.

REFERENCES:
1. Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017
3. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Apply and develop mathematical model of a system
2. Applying vehicular vibrations and response of vehicle
3. Applying attire model based on required performance.
4. Applying the various vehicle performance, control methodologies to ensure stability and ride comfort
5. Applying the principles vertical, longitudinal and lateral dynamics vehicle design

UNIT-I BASIS OF VIBRATION

UNIT-II TYRES

UNIT-III VERTICAL DYNAMICS

UNIT-IV LONGITUDINAL DYNAMICS AND CONTROL

UNIT-V LATERAL DYNAMICS

TOTAL = 45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Understand the basics of finding vibration in vehicle components and measuring equipments
CO2 Develop the knowledge of various tyres model and their parameters.
CO3 Design analysis and computer simulation of vertical dynamics in vehicles.
CO4 Understanding the aerodynamic concepts in longitudinal dynamics and control in vehicle dynamics.
CO5 Understand the concepts in lateral dynamics of vehicles.
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PD4151 CREATIVITY AND INNOVATION

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

UNIT II  METHODS AND TOOLS FOR CREATIVITY
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
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
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

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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CD4092  INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS  L T P C
3 0 0 3

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

UNIT III ROBOT SENSORS

UNIT IV ROBOT CELL DESIGN AND APPLICATION

UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

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

REFERENCES

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

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:

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

TOTAL (L: 45 )=45 PERIODS

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/variablefatigue loads and design for its life extension
CO5  Analyze failed engineering components under different modes of fracture.

REFERENCES:
ED4071  DESIGN OF HYBRID AND ELECTRIC VEHICLES  L  T  P  C
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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  9

UNIT–II  ENERGY SOURCE  9

UNIT–III  SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN  9

UNIT–IV  PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN  9
Control Strategies of ParallelHybridDriveTrain-DriveTrainParameters-EnginePowerCapacity-Electric Motor Drive Power Capacity-Transmission Design- Energy Storage Design

UNIT–V  ELECTRIC VEHICLE DRIVE TRAIN  9

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:
http://nptel.ac.in/courses/108103009/

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IL4093
SUPPLY CHAIN MANAGEMENT

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

UNIT I INTRODUCTION SUPPLY CHAIN MANAGEMENT
Introduction, Types of supply chains with and examples, Evolution of SCM concepts, Supply chain performance, Strategic Fit, Drivers of Supply Chain Performance – key decision areas – External Drivers of Change. Supply contracts – centralized vs. decentralized system
UNIT II  SUPPLY CHAIN NETWORK DESIGN
Need for distribution network design- Factors affecting, Design options for distribution network. Network design decisions - Framework, factors influencing, Models of facility location and capacity allocation. Role of Transportation in supply chain, modes of transportation Modal Selection, Classification of carriers, Carrier Selection, Transportation Execution and Control. Food Mile Concept., design options.

UNIT III  DEMAND AND SUPPLY IN SUPPLY CHAIN
Forecasting in supply chain- Methods, Approach, Errors. Aggregate planning in supply chain- Problem, Strategies and Implementation. Predictable variability in supply chain, Managing supply and demand. Distribution strategies-direct shipment, traditional warehousing, cross docking, inventory pooling, transhipment, Choosing appropriate strategy, Milk Run Model.

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

UNIT V  SUPPLYCHAIN AND INFORMATION SYSTEMS

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

REFERENCES

CO-PO MAPPING:

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TOTAL: 45 PERIODS
OBJECTIVES:
The students will be able to

- Understand Industry 4.0
- Apply IoT and IIoT for Industry 4.0
- Understand CPS for Industry 4.0

UNIT I
9
Introduction to Industry 4.0 - The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT II
9
Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

UNIT III
9

UNIT IV
9
Role of data, information, knowledge and collaboration in future organizations - Resource-based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics - Cloud Computing and Industry 4.0

UNIT V
9
Industry 4.0 IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0

TOTAL : 45 PERIODS

OUTCOMES:
The students will be able to

- Use Industry 4.0 for Industrial Applications
- Use IoT and IIoT for Industry 4.0
- Apply smart devices Industrial Applications

TEXT BOOKS
1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things
COURSE OBJECTIVES:
1. Fundamental concepts related to material handling.
2. Design of various hoisting gears for different material handling applications.
3. Development of conveyor systems for material flow in different industrial production systems.
4. Design of elevators for various manufacturing and service applications.
5. Integrated mechanical system design for machine tools, power transmission and engine parts.

UNIT I  INTRODUCTIONS AND DESIGN OF HOISTS

UNIT II  DRIVES OF HOISTING GEAR
Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes-slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT III  CONVEYORS
Types-description-design and applications of Belt conveyors, apron conveyors and escalators - Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT IV  ELEVATORS
Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

UNIT V  INTEGRATED DESIGN
Integrated Design of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Bale lifter, Cam Testing Machine, Power Screws, Gear Box Design more than six speed.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Design hoists and brakes used in any handling applications.
CO2 Design drive mechanisms and hoisting gear for different handling applications.
CO3 Design different conveyor systems for material handling applications.
CO4 Design bucket, cage and fork lift elevators for to and fro transportation of materials in vertical direction.
CO5 Design of integrated mechanical system for machine tools, power transmission and engine parts

REFERENCES:
APPROVED DATA BOOKS:

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AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVES

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

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

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

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

REFERENCES
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  6
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  6
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III  DISASTER PRONE AREAS IN INDIA  6
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  6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V  RISK ASSESSMENT  6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

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


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

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik 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

63
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 III

1. கணங்கள் காப்பியங்கள் 6
   - விளக்கத்தைச் சுமார் காத்து
     தகுதிகள் இணைப்பில் பொருளிகரும
   - சிங்கக்கள் அறிக்கைப்புப் பொருளிகர

UNIT IV

1. சிலப்பதிகொரவழக்குகரொமூககிலகியம் 6
   - பாரி முன்னைகள் செல்ல வாழ்க்கை, உயர் முழுமைகளை
     பார்த்து விளக்கத்தைச் சுமார் அறிமுகத்தின் சுருக்கக்கள், சுருக்க
   2. முறைகள்
     - அல்காலாலாப் பல்கர்
   3. இயற்கையியல் (617, 618)
     - விளக்கத் தொழிலக
   4. குழந்தைப் பொருளிய விளக்கத் தொழிலாக
   5. புறநொனூறு
     - நிறைவூட் பொருளாதாரங்கள்
   6. அம்மகியம் (4)
     - குழந்தைப் பொருளிய விளக்கத் தொழிலாக
     - குழந்தைப் பொருளிய விளக்கத் தொழிலாக

UNIT V

1. விளக்கத் தொழிலாக விளக்கத் தொழிலாக
   - குழந்தைப் பொருளிய விளக்கத் தொழிலாக
   - விளக்கத் தொழிலாக
   - குழந்தைப் பொருளிய விளக்கத் தொழிலாக
   2. நொட்டுவிடுதகலயும் விளக்கத் தொழிலாக
   3. முதொயவிடுத்தகலயும் விளக்கத் தொழிலாக
   4. தபணுவிடுத்தகலயும் விளக்கத் தொழிலாக
   5. அறிவியல் விளக்கத் தொழிலாக
   6. இகணயத்தில் விளக்கத் தொழிலாக
   7. சுற்றுசூழல் விளக்கத் தொழிலாக

TOTAL: 30 PERIODS

கல்வி திட்டம் வெளிப்புரோக்கம் / புத்தகங்கள் 6

1. தமிழ் விளக்கத் தொழிலாக விளக்கத் தொழிலாக (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விளக்கத் தொழிலாக விளக்கத் தொழிலாக (Tamil Wikipedia) - https://ta.wikipedia.org
3. வெளியிட்டு வெளியிட்டு
4. வெளியிட்டு வெளியிட்டு - தமிழ் விளக்கத் தொழிலாக
5. தமிழ் விளக்கத் தொழிலாக - தமிழ் விளக்கத் தொழிலாக (thamilvalarchithurai.com)
6. அறிவியல் விளக்கத் தொழிலாக - தமிழ் விளக்கத் தொழிலாக
OBJECTIVE

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

UNIT I CONTEXT FOR IWRM

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

UNIT II WATER ECONOMICS

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

UNIT III LEGAL AND REGULATORY SETTINGS

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

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT

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

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM

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

TOTAL: 45 PERIODS

OUTCOMES

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

<table>
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<th>Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.</th>
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<td>Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.</td>
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<td>Apply law and governance in the context of IWRM.</td>
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<td>Discuss the linkages between water-health; develop a HIA framework.</td>
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<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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<td>Knowledge of field research method, gender, legal and environmental aspects in the context of integrated water resources management</td>
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<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>
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<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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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  9
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  9

UNIT III  CHALLENGES IN MANAGEMENT AND DEVELOPMENT  9

UNIT IV GOVERNANCE  9
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  9
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

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


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

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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 FRAMEWORK

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS

UNIT V ASSESSING PROGRESS AND WAY FORWARD

TOTAL: 45 PERIODS
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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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

UNIT II IMPACT IDENTIFICATION AND PREDICTION

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

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

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

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
5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional
OIC431 BLOCKCHAIN TECHNOLOGIES

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

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

UNIT II BITCOIN AND CRYPTOCURRENCY
UNIT III  INTRODUCTION TO ETHEREUM  9
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV  INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  10

UNIT V  BLOCKCHAIN APPLICATIONS  8
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

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

REFERENCES:

CO-PO Mapping

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OIC432  DEEP LEARNING  L T P C

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

TOTAL : 45 PERIODS

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

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

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

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

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

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

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

REFERENCES
3. Journal articles on SME’s.

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OBA433 INTELLECTUAL PROPERTY RIGHTS L T P C 3 0 0 3

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

UNIT I INTRODUCTION
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
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

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

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

TOTAL: 45 PERIODS
COURSE OUTCOMES
CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

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

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OBA434 ETHICAL MANAGEMENT L T P C
COURSE OBJECTIVE ➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

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

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

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

Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

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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.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I  INTRODUCTION TO INTERNET OF THINGS

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II  IOT ARCHITECTURE


UNIT III  PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT

PROTOCOLS:

NFC, SCADA and RFID, Zigbee, MIPI, M-PHY, UniPro, SPI, SPI, M-PCIe, GSM, CDMA, LTE, GPRS, small cell.
Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV IOT PROCESSORS 9

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.

Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPBERRY PI and Arduino.

UNIT V CASE STUDIES 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

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REFERENCES:
COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I   LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II   NEURAL NETWORKS

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

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

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

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.
REFERENCE:

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


UNIT V OTHER RENEWABLE ENERGY SOURCES

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

TOTAL : 45 PERIODS

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

CO1: Demonstrate the need for renewable energy sources.
CO2: Develop a stand-alone photo voltaic system and implement a maximum power point 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

REFERENCES:

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

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

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE
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

Unit V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS
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  L  T  P  C
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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.

REFERENCES

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MP4251 CLOUD COMPUTING TECHNOLOGIES L T P C
3 0 0 3

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
Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation –
Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management
Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage
Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization
structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource
Management – Virtualization for data center automation

UNIT II CLOUD PLATFORM ARCHITECTURE
Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid,
community – Categories of cloud computing: Everything as a service: Infrastructure, platform,
software- A Generic Cloud Architecture Design – Layered cloud Architectural Development –
Architectural Design Challenges

UNIT III AWS CLOUD PLATFORM - IAAS
Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up
AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for
Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy,
AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling,
AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV PAAS CLOUD PLATFORM
Windows Azure- Service Model and Managing Services: Definition and Configuration, Service
runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure
Storage Characteristics-Storage Services- REST API- Blops

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
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to
4. Rajkumar Buyya, Christian Vacchola, S.Thamarai Selvi, Mastering Cloud Computing ,
Media, 2009.
Elsevier/Morgan Kaufmann, 2005.
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

MU4153 PRINCIPLES OF MULTIMEDIA L T P C
3 0 0 3

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

UNIT I INTRODUCTION 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
9

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

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.

CO4: Design and implement algorithms and techniques applied to multimedia objects.

CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:
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.

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NC4201 INTERNET OF THINGS AND CLOUD L T P C 3 0 0 3

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

UNIT I FUNDAMENTALS OF IoT

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

UNIT IV CLOUD COMPUTING INTRODUCTION

UNIT V IoT AND CLOUD

TOTAL:45 PERIODS

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

REFERENCES

MX4073 MEDICAL ROBOTICS

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

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

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS
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
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
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
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL: 45 PERIODS

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

REFERENCES

CO-PO Mapping

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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
- C Overview and Program Structure
- C Types, Operators and Expressions
- C Control Flow
- C Functions and Program Structures
- C Pointers And Arrays
- FIFO and LIFO
- C Structures
- Development Tools

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

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

UNIT – IV  VISION SYSTEM
- Fundamentals of Image Processing
- Filtering
- Morphological Operations
- Feature Detection and Matching
- Blurring and Sharpening
- Segmentation
- Thresholding
- Contours
- Advanced Contour Properties
- Gradient
- Canny Edge Detector
- Object Detection
- Background Subtraction

UNIT – V  HOME AUTOMATION
- 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

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

REFERENCES:
CO-PO Mapping

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CX4016    ENVIRONMENTAL SUSTAINABILITY    L  T  P  C
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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
Introduction – composites – classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

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

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

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

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

TOTAL: 45 PERIODS

REFERENCES

NT4002  NANOCOMPOSITE MATERIALS

UNIT I  BASICS OF NANOCOMPOSITES

UNIT II  METAL BASED NANOCOMPOSITES
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:
5. The search for novel, superhard materials- Stan Veprek (Review Article) JVST A, 1999

TOTAL : 45 PERIODS

BY4016  IPR, BIOSAFETY AND ENTREPRENEURSHIP

UNIT I  IPR

UNIT II  AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES
UNIT III BIOSAFETY

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

UNIT V ENTREPRENEURSHIP DEVELOPMENT

REFERENCES