1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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<th>To understand the concepts and tools for design and development of engineering principles to conceptualize, create, model, test and evaluate designs within the context of local and global needs.</th>
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<td>II.</td>
<td>To understand and explore the behaviour of existing and new materials suitable for the design needs.</td>
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<td>III.</td>
<td>To develop life skills to become design professionals, administrators and Academicians.</td>
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<td>IV.</td>
<td>To pursue advanced education, research and development and other creative/innovative efforts in their professional career.</td>
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2. PROGRAMME OUTCOMES (POs):

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<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<td>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>Students should be able to understand the importance of creativity process in design and will demonstrate an ability to identify, formulate, design a system and solve engineering problems.</td>
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<tr>
<td>5</td>
<td>Students should be able to use the techniques, and modern engineering tools necessary for engineering problems.</td>
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<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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4. PEO/PO Mapping:

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1, 2, 3,-, scale against the correlation PO's with PEO's
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PROGRESS THROUGH KNOWLEDGE
ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
M.E. ENGINEERING DESIGN
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABUS

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* Audit Course is optional

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## SEMESTER II, ELECTIVES II

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### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students.

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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's stress 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.

TOTAL = 60 PERIODS

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 twosymmetrical 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 contact applications.
REFERENCES:

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
9

UNIT-II KINEMATIC ANALYSIS
9

UNIT-III PATH CURVATURE THEORY, COUPLER CURVE
9
Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp -crunode - coupler driven six-bar mechanisms-straight line mechanisms
UNIT-IV  SYNTHESIS OF FOUR BAR MECHANISMS
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- Freudentein’s Equation-Bloch’s Synthesis.

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

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. Synthesise planar mechanisms
5. Design of six bar coupler driven mechanisms and cam mechanisms

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COURSE OBJECTIVES:
1. To understand fundamental concepts of computer graphics and its tools in a generic framework.
2. To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.
3. To impart the parametric fundamentals to create and manipulate geometric models using NURBS and solids.
4. To provide clear understanding of CAD systems for 3D modeling and viewing.
5. 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 FUNDAMENTAL 9
Output primitives: Line Drawing Algorithm - DDA, Bresenham’s and Parallel Line Algorithm.
Circle generating algorithm – Midpoint Circle Algorithm.
Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations -Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

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

UNIT – III NURBS AND SOLID MODELING 9

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

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

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

CO1 Solve 2D and 3D transformations for the basic entities like line and circle.
CO2 Formulate the basic mathematics fundamental to CAD system.
CO3 Use the different geometric modeling techniques like feature based modeling, surfacemodelling and solid modeling.
CO4 Create geometric models through animation and transform them into real world systems
CO5 Simulate assembly of parts using Computer-Aided Design software.

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

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

UNIT - I FUNDAMENTALS OF VIBRATION 9+3
UNIT-II  TWO DEGREE FREEDOM SYSTEM  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 andcontinuous systems
CO4  Control the vibration and noise levels in a body
CO5  Measure and analyze the vibration levels in a body

REFERENCES:
Publishing Com. Ltd., 2007
House, 2010

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UNIT I RESEARCH DESIGN
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

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

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

UNIT IV INTELLECTUAL PROPERTY RIGHTS

UNIT V PATENTS

TOTAL : 30 PERIODS

REFERENCES
• CAD Introduction.
• Sketcher
• Solid modeling – Extrude, Revolve, Sweep, etc and Variational sweep, Loft ,etc
• Surface modeling – Extrude, Sweep, Trim, etc and Mesh of curves, Free form etc
• Feature manipulation – Copy, Edit, Pattern, Suppress, History operations etc.
• Assembly - Constraints, Exploded Views, Interference check
• Drafting - Layouts, Standard & Sectional Views, Detailing & Plotting.

Exercises in modeling and drafting of mechanical components - assembly using parametric and feature based packages. 2D TO 3D CONVERSION.

DESIGN FOR MANUFACTURE AND ASSEMBLY LABORATORY
The students will be given training on the use and application of the following
1. DFMA software

TOTAL: 60 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
CO1 Use the modern engineering tools necessary for engineering practice
CO2 Draw 2D part drawings, sectional views and assembly drawings as per standards.
CO3 Create 3D Model on any CAD software.
CO4 Convert 3D solid models into 2D drawing and prepare different views, sections and dimensioning of part models.
CO5 familiarize with DFMA package which is necessary for cost estimation and evaluating the product design

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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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COURSE 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 BASIC CONCEPTS OF MATERIAL BEHAVIOR 9
Engineering Design process and the role of materials; materials classification and their properties, Strengthening mechanisms-grain size reduction, solid solution strengthening, strain hardening, grain boundary strengthening, precipitation, particle, fibre and dispersion strengthening, Effect of temperature, strain and strain rate on plastic behavior—Super plasticity—Failure of metals

UNIT-II BEHAVIOUR UNDER CYCLIC LOADS AND DESIGN APPROACHES 9
Stress intensity factor and fracture toughness—Fatigue low and high cycle fatigue test, fracture mechanisms and Paris law—Effect of surface and metallurgical parameters on fatigue—Safe life, Stress-life, strain-life and fail-safe design approaches—Fracture of non-metallic Materials—Failure analysis, sources of failure, procedure of failure analysis

UNIT-III SELECTION OF MATERIALS 9
Selection of materials based on function, Objective, Constraints, free variables and service requirements – Relationship between materials selection and processing – Case studies in advanced materials selection with relevance to aero, auto, marine, machinery and nuclear applications

UNIT-IV MODERN METALLIC MATERIALS 9

UNIT-V NONMETALLIC MATERIALS 9

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Analyze the different strengthening and failure mechanism of the metals
CO2 Apply the effects of metallurgical parameters in the materials design
CO3 Analyze the relationship between the selection of materials and processing
CO4 Develop the novel material through understanding the properties of the existing metallic materials
CO5 Analyze the different materials used in the engineering applications
REFERENCES:
8. www.astm.org/labs/pages/131350.htm

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ED4251 FINITE ELEMENT METHODS IN MECHANICAL DESIGN

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 Isoparametric 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 ONE DIMENSIONAL PROBLEMS

UNIT-II FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS
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 numericalsolutions
CO2  Determine field variables for two dimensional scalar and vector variable problems
CO3  Apply Isoparametric transformation and numerical integration for evaluation of elementmatrices
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 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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ED4261 SIMULATION AND ANALYSIS LABORATORY

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

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.
### PD4261  PRODUCT DESIGN LABORATORY

**OBJECTIVE:**

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

The students in a group have to develop digital and physical prototype models using RP machine / clay models of a new product/ existing product with enhanced feature involving the following areas:

- Automotive components
- Tool and die components
- Press tool components
- Consumer product
- Injection moulded products.

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

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

**COURSE OUTCOMES:**

Upon conclusion of this course the student will be able to

**CO1**  Appreciate the use of physical prototype models for evaluating product concept

**CO2**  Apply theoretical knowledge to design and development of physical products using clay, wood, sheet metal and RP techniques

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COURSE OBJECTIVE:
- To work on a specific technical topic in Engineering design related topics in order 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 audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

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

CO1 Understand inductive and deductive reasoning, and increase their general problem solving skills.

CO2 Develop communicative skills (e.g. speaking, listening, reading, and/or writing).

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ED4312
PROJECT WORK I

COURSE OBJECTIVES:
- To identify a specific problem for the current need of the society and collecting information related to the same through 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 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 utilising 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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ED 4411 PROJECT WORK II L T P C

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

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

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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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 - run out 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 9
Design for assembly - General assembly recommendations - Minimizing the no. of parts - Design considerations for: Rivets - Screw fasteners - Gasket & Seals - Press fits - Snap fits - Automatic assembly- Computer Application for DFMA.

UNIT-V DESIGN FOR ENVIRONMENT 9

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.

TOTAL : 45 PERIODS
REFERENCES:
2. Bralla, Design for Manufacture handbook, McGrawhill, 1999

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ED4072 COMPOSITE MATERIALS AND MECHANICS L T P C

UNIT-I INTRODUCTION TO COMPOSITE MATERIALS 9

UNIT- II MANUFACTURING OF COMPOSITES 9
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, directoxidation-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 Laminites 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 laminites using the Classical Laminate Theory.

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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 9
Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits design methodology- design and selection of components - safety and emergency mandrels – Cascade method

UNIT – IV  PNEUMATIC SYSTEMS AND CIRCUITS 9
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 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Design and select appropriate pumps in industries based on need.
CO2 Select correct sizing and rating of control elements in hydraulics.
CO3 Design basic circuits (hydraulic) for industrial applications.
CO4 Design basic pneumatic circuits for industrial applications.
CO5 Identify and provide solution for troubleshooting and design low cost automation for industrial application.
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ED4079 QUALITY CONCEPTS IN DESIGN

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

UNIT – II DESIGN FOR QUALITY
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 SIXSIGMA


UNIT – IV DESIGN OF EXPERIMENTS

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


TOTAL: 45 PERIODS

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

CO1 apply fundamentals of design process and material selection for developing a quality product
CO2 apply the quality concepts to develop a robust product
CO3 perform Failure Mode Effect Analysis on a product and use six sigma principles to enhances its quality
CO4 apply different experimental design methods in product development
CO5 implement various statistical tools to improve its quality and reliability

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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 framework of multivariate normal theory.

UNIT - I  ONE DIMENSIONAL RANDOM VARIABLES  9
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  9
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:
COURSE OBJECTIVES:
1. To study the basics of surface features and different types of friction in metals and non-metals.
2. To analyze the different types of wear mechanism and international standard used in friction and wear measurement.
3. To study the different types of corrosion and its preventive measures.
4. To study the different types of surface treatments and surface modification techniques.
5. To analyze the different types of materials used in the friction and wear applications.

UNIT-I  FRICTION

UNIT-II  WEAR

UNIT-III  CORROSION

UNIT-IV  SURFACE TREATMENTS

UNIT-V  ENGINEERING MATERIALS

COURSE OUTCOMES:
On Completion of the course the student will be able to:
CO1 Understand the basics of surface features, laws of friction and different types of friction.
CO2 Develop the knowledge of various wear mechanism and its measurement.
CO3 Understand the types of corrosion and its preventive measures.
CO4 Familiarize the types of surface properties and various surface modification techniques.
CO5 Ability to understand the different types of materials used in the friction and wear applications.

REFERENCES:
CC4071  ADVANCED MACHINE TOOL DESIGN  L  T  P  C
3  0  0  3

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

UNIT I  INTRODUCTION TO MACHINE TOOL DESIGN

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

UNIT III  DESIGN OF MACHINE TOOL STRUCTURES

UNIT IV  DESIGN OF GUIDEWAYS AND POWER SCREWS

UNIT V  DESIGN OF SPINDLES AND SPINDLE SUPPORT

TOTAL = 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- Select the different machine tool mechanisms.
- Design the Multi speed Gear Box and feed drives.
- Design the machine tool structures.
- Design the guideways and power screws.
- Design the spindles and bearings.
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
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
UNIT III DETAILS OF MODULES IN APDM/PLM SOFTWARE
Case studies based on top few commercial PLM/PDM tools

UNIT IV ROLE OF PLM IN INDUSTRIES
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
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.

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

UNIT I   ARTIFICIAL INTELLIGENCE

UNIT II   INTRODUCTION TO MACHINE LEARNING

UNIT III   SUPERVISED LEARNING

UNIT IV   UNSUPERVISED LEARNING

UNIT V   PROBABILISTIC GRAPHICAL MODELS

TOTAL: 45 PERIODS

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

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REFERENCES:

ED4093 OPTIMIZATION TECHNIQUES IN DESIGN L T P C
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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 applications.
5. To demonstrate selected optimization algorithms commonly used in static and dynamic applications.

UNIT–I UNCONSTRAINED OPTIMIZATION TECHNIQUES 9
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 9
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 9
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 9
Multistage optimization–dynamic programming, stochastic programming Multi objective optimization Genetic algorithms and Simulated Annealing technique.

UNIT–V STATIC AND DYNAMIC APPLICATIONS 9
Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers.Application in Mechanisms–Optimum design of simple linkage mechanisms.

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

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

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CD4091 BIO MATERIALS

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

UNIT I INTRODUCTION
UNIT II  DENTAL MATERIALS

UNIT III  ORTHOPAEDIC MATERIALS

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

UNIT V  CARDIOVASCULAR, OPHTALMOLOGY AND DRUG DELIVERY MATERIALS

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

- Use of Bio materials for cardiovascular Opthalmology and Skin Regeneration
- Use of Bio materials for Dental & Bone application
- Use of shape memory alloys in engineering application
- Explain the characteristics of Bio and smart materials
- Use of smart materials as sensors, actuators.

TOTAL: 45 PERIODS

REFERENCES:
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

UNIT – II VIBRATION MEASUREMENTS

UNIT – III ACOUSTICS AND WIND FLOW MEASUREMENTS

UNIT – IV DISTRESS MEASUREMENTS

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

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.

REFERENCES:
ED4002 DESIGN FOR X

UNIT I INTRODUCTION

UNIT II COMPONENT DESIGN - MACHINING CONSIDERATION

UNIT III DESIGN FOR ASSEMBLY

UNIT IV DESIGN FOR RELIABILITY AND MAINTAINABILITY
Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability

UNIT V SUSTAINABLE DESIGN
Industrial ecology, multiple life cycle design, principles of design, green engineering, cradle to cradle design, The Natural Step, biomimicry, design for reuse, dematerialization, modularization, Design to minimize material usage – Design for disassembly – Design for recyclability – design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, – Design for energy efficiency – Design to regulations and standards etc

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 formed and machined components
3. Apply design considerations for assembled systems.
4. Be exposed to maintenance systems and reliability based design
5. Apply design considerations for environmental issues

REFERENCES

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AP4251 INDUSTRIAL INTERNET OF THINGS

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  9

UNIT V  CASE STUDY  9
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.

ED4094  VEHICLE DYNAMICS  L T P C
3 0 0 3

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  9

UNIT-II  TYRES  9

UNIT-III  VERTICAL DYNAMICS  9
UNIT-IV LONGITUDINAL DYNAMICS AND CONTROL

UNIT-V LATERAL DYNAMICS
Steady state handling characteristics. Steady state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Rollcenter, Rollaxis, Vehicle under side forces. Stability of vehicle on banked road and during turn. Effect of suspension on cornering

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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ED4092 ENGINEERING FRACTURE MECHANICS
COURSE OBJECTIVES:
1. Formulation of governing equations for elastic problems
2. Stresses calculations/displacements around the crack tip for different modes of fracture
3. Estimation of K1c/SIF/critical flaws/failure stresses for different crack geometries
4. Life assessment of the cracked components under different types of repeated/variable fatigue loads and design for its life extension.
5. Analysis of failed engineering components under different modes of fracture.
UNIT-I  ELEMENTS OF SOLID MECHANICS

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

UNIT-III  STATIONARY CRACK UNDER STATIC LOADING
Two dimensional elastic fields – Analytical solutions for small scale yielding near a crack front — plastic zone size —Specimen size calculations: K1c Testing for Fracture toughness of the Material.

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

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

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

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

TOTAL (L: 45 )=45 PERIODS
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CM4152 SOLID FREEFORM MANUFACTURING L T P C
3 0 0 3

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

UNIT I INTRODUCTION 9

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9
UNIT III  VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES  9

UNIT IV  MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES  9

UNIT V  JETTING AND DIRECT ENERGY DEPOSITION PROCESSES  9

TOTAL: 45 PERIODS

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

REFERENCES:
ED4080 TRIBOLOGY IN DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES:

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

UNIT I SURFACE INTERACTION AND FRICTION

UNIT II WEAR AND SURFACE TREATMENT

UNIT III LUBRICANTS AND LUBRICATION REGIMES

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

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

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On Completion of the course the student will be able to
- Develop the knowledge on the surface features and its role on the friction behavior of metals and nonmetals
- Understand the various types of wear mechanism and surface modification techniques
- Familiarize the different types of lubricants and lubrication systems in the tribology
- Methodology for deciding lubricants and lubrication regimes for different operating conditions
- Ability to understand the different types of high pressure contacts and rolling bearings

REFERENCES:

BM4074 WEARABLE TECHNOLOGIES

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
UNIT II WEARABLE SENSORS
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

UNIT VI ENERGY HARVESTING SYSTEMS

UNIT V MONITORING PHYSICAL AND PHYSIOLOGICAL PARAMETERS
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.

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

TOTAL: 45 PERIODS

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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 ADAPTATIVE REFINEMENT
Error norms and Convergence rates–h-refinement with adaptivity–Adaptive refinement.

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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ED4071 DESIGN OF HYBRID AND ELECTRIC VEHICLES L T P C
3 0 0 3

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

UNIT– I INTRODUCTION TO ELECTRIC VEHICLES

UNIT– II ENERGYSOURCE

UNIT–III SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN
UNIT– IV  PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN  9
Control Strategies of ParallelHybridDriveTrain-DriveTrainParameters-EnginePowerCapacity-Electric Motor Drive Powerr 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

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ED4003  BEARING DESIGN AND ROTOR DYNAMICS  L T P C
3 0 0 3

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 the design and suggest bearings for specific applications
  3. Applying a fatigue life calculations for various types of bearings
  4. Apply and analyze bearing behaviour
  5. Study the dynamics of rotors mounted on Hydrodynamic Bearings
UNIT-I  CLASSIFICATION AND SELECTION OF BEARINGS  6

UNIT-II  DESIGN OF FLUID FILM BEARINGS  10

UNIT-III  ROLLING CONTACTS SELECTION OF ROLLING BEARINGS  10
Contact Stresses in Rolling bearings-Centrifugalstresses-Elastohydrodynamic lubrication-Fatigue life calculations-Bearing operating temperature-Lubrication- Selection of lubricants-Internal clearance – Shaft and housing fit - Mounting arrangements. Manufacturing methods-Ceramic bearings-Rolling bearing cages-bearing seals selection

UNIT-IV  ROTOR DYNAMICS  9
Motion of the shaft in the bearing-Rotor supported on rigid and flexible supports-Campbell diagram,Rotor Dynamic Analyses- Un damped critical speed - Unbalance response- Damped eigenvalue analysis- Bearing stiffness and damping coefficients- Mechanics of Hydro dynamicInstability-HalffrequencywhirlandResonancewhip-bearing instability and OilWhirl Technologies to Improve the Stability of Rotor-bearing Systems--Design configurations of stable journal bearings

UNIT-V  DYNAMICS OF ROTORS MOUNTED ON HYDRO DYNAMIC BEARINGS  10
Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings-Rotating loads, alternating and impulse loads in journal bearings–Journal Centre Trajectory-Analysis of short bearings under dynamic conditions-Finite difference solution for dynamic conditions

TOTAL= 45 PERIODS

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

CO1  Understand application of various types of bearings and their operating principles
CO2  Design and suggest bearings for specific applications
CO3  Perform fatigue life calculations for various types of bearings,
CO4  understand and analyze bearing behavior
CO5  study the dynamics of rotors mounted on Hydrodynamic Bearings
REFERENCES:
3. Halling, J. (Editor)—“Principles of Tribology”, Macmillan–1984

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ED4073 MATERIAL HANDLING SYSTEMS AND DESIGN
(Use of Approved Data Book is Permitted) 3 0 0 3

COURSE OBJECTIVES:
1. Fundamental concepts related to material handling.
2. Design of various hoisting gears for different material handling applications
3. Development of conveyer 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,jibandluffinggear-cogwheeldrive-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-Balelifter, 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.

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PD4151  CREATIVITY AND INNOVATION  L T P C
            3 0 0 3

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

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

TOTAL : 45 PERIODS

REFERENCES:
3. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999
### 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.

### Course Structure:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>I</strong></td>
<td>Governing Differential Equations and Discretisation Techniques</td>
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<tr>
<td><strong>II</strong></td>
<td>Diffusion Processes: Finite Volume Method</td>
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<tr>
<td><strong>III</strong></td>
<td>Convection-Diffusion Processes: Finite Volume Method</td>
</tr>
<tr>
<td><strong>IV</strong></td>
<td>Flow Processes: Finite Volume Method</td>
</tr>
<tr>
<td><strong>V</strong></td>
<td>Turbulence Models</td>
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</tbody>
</table>

**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.

PO &CO Mapping:

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REFERENCES:

IL4093 SUPPLY CHAIN MANAGEMENT LT PC
3 0 0 3

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

UNIT I INTRODUCTION SUPPLY CHAIN MANAGEMENT 9
Introduction, Types of supply chains with and examples, Evolution of SCM concepts, Supply chain performance, Strategic Fit, Drivers of Supply Chain Performance – key decision areas – External Drivers of Change. Supply contracts – centralized vs. decentralized system
UNIT II  SUPPLY CHAIN NETWORK DESIGN  9
Need for distribution network design- Factors affecting, Design options for distribution network. Network design decisions - Framework, factors influencing, Models of facility location and capacity allocation. Role of Transportation in supply chain, modes of transportation Modal Selection, Classification of carriers, Carrier Selection, Transportation Execution and Control. Food Mile Concept., design options.

UNIT III  DEMAND AND SUPPLY IN SUPPLY CHAIN  9
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  9
Purchasing Vs Procurement Vs Strategic Sourcing, Item procurement importance matrix, Strategic Sourcing Methodology, Managing sourcing and procurement process, Supplier selection and evaluation, Bullwhip effect and its management, Economies of scale in supply chain- Cycle inventory, Estimation, Quantity discounts, Multiechelon cycle inventory. Uncertainty in supply chain- Safety inventory, Determination of appropriate level, Impact on uncertainty.

UNIT V  SUPPLY CHAIN AND INFORMATION SYSTEMS  9

TOTAL: 45 PERIODS

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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</table>

Avg.  (1+2)/2=1.5  2/1=2

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

UNIT IV
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
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

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
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
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

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

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

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

SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.
UNIT I
1. தமிழின் துவக்க நூல் இதொல்கொப்பியம் – முதல், வகுல், பட்னொன்
2. ஆகர்சியம் (82)
   - துவக்க திறகித்த அரங்கம்
3. நூல்கள் பரப்பல் மற்றும் காலம்
4. புறநூறு (95, 195)
   - பபகன் பார்க்கியம் ஒன்றமையா

UNIT II
1. ஆந்தநூறு மற்றும் இறுதிப்பொருள்
   - அழுதி முற்கல் அருப்படலம், அடையவல்ல, துப்பதிகொர அடைகள், எது, பகு
2. பி ஆந்தநூறு - இறுதிப்பொருள்
   - ரங்கம், எம்பாரணம், இறுதிப்பொருள், அந்தகரங்கறவை (நமூனைக் கொண்டு காணுக)

UNIT III
1. இரட்டக் காப்பியங்கள் – புரட்சி
2. முகக் கவிதையிலக்கியம் – சிகறக்கொட்ட அறக்கொட்டமையனைப் பதிவுகொண்டிருந்து

UNIT IV
1. சிறுபொணொற்றுப்பகட – பொரிமுல்தல் பதர் தகொடுத்தது, பபகன் மயிலுக்குப் பபொர்கவதகொடுத்தது, அதியமொன் ஒளக்குத்தநல்லிக்கனி தகொடுத்தது, அரசு பண் புகள்
2. இறிதிகண – அன்னக்குரிய புன்றக் கன
3. குறிநூறு (617, 618)
4. தமிழகக் காலம் திரிகடுகம் அறக்கொட்டமையனைப்
5. புறநூறு - சிறுவபன் வள்ளலொன்
6. ஆகனூறு (4) – எந்தற்கொரடிகள் (11) – காலூர்
   - கால்காட்கள் (11) – பபொர்கவ், பபக
   - குறிப்பிட்டு 50 (27) – பபக
   - அரசு பார்க்கியம் ஒன்றமைத்த
UNIT V நவீன தமிழ் இலக்கியம் 6
1. சுழற்சியால் சுருக்கம்,
- குழுமச் சுருக்க புதுக்காம்,
- குழுமச் சுருக்க சிறுககத,
- கூற்றை தலைகிணையம்,
- பார்க்க தலைகிணையம்,
- தவறுக,
2. தான் நிறுவன பராமரிப்பு பின்னு தலைகிணையம்,
3. குற்றால் நிறுவன பின்னு தலைகிணையம்,
4. பண்டய நிறுவன நிறைவு திருத்தபெரும் செயல்பாடு பின்னு தலைகிணையம்,
5. அறிவியல் சுருக்கம்.
6. ஆட்சியாளர் சுருக்கம்,
7. கதாகக் கூடு செயல்பாடு பின்னு தலைகிணையம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய செயல்பாடுகள் / பட்டகங்கள்
1. தமிழ் விரைவுவிளையாட்டு கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீட்டையும் (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. கதாகக் கூட்டு பட்டகங்கள்
4. பார்க்க தலைகிணையம்
   - சுருக்கம்
5. தான் நிறுவன பராமரிப்பு
   - சுருக்கம்
6. பார்க்க தலைகிணையம்
   - சுருக்கம்