1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

| I. | 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. |
| II. | To understand and explore the behaviour of existing and new materials suitable for the design needs. |
| III. | To develop life skills to become design professionals, administrators and Academicians. |
| IV. | To pursue advanced education, research and development and other creative/innovative efforts in their professional career. |

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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<tr>
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<td>An ability to write and present a substantial technical report/document</td>
</tr>
<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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<tr>
<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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**THEORY**

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   Category: PCC  
   Periods: 3 L, 1 T, 0 P  
   Credit: 4

2. **2** ED4152 Advanced Mechanisms in Design  
   Category: PCC  
   Periods: 3 L, 0 T, 0 P  
   Credit: 3

3. **3** ED4153 Computer Applications in Design  
   Category: PCC  
   Periods: 3 L, 0 T, 0 P  
   Credit: 3

4. **4** ED4154 Vibration Analysis and Control  
   Category: PCC  
   Periods: 3 L, 0 T, 0 P  
   Credit: 3

5. **5** RM4151 Research Methodology and IPR  
   Category: PCC  
   Periods: 2 L, 0 T, 0 P  
   Credit: 2

6. **6** Professional Elective- I  
   Category: PEC  
   Periods: 3 L, 0 T, 0 P  
   Credit: 3

7. **7** Audit Course-I*  
   Category: AC  
   Periods: 2 L, 0 T, 0 P  
   Credit: 0

**PRACTICAL**

8. **8** ED4111 CAD and Design for Manufacture and Assembly Laboratory  
   Category: PCC  
   Periods: 0 L, 0 T, 4 P  
   Credit: 2

9. **9** ED4161 Vibration Laboratory  
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**TOTAL**  

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*Audit Course is optional.*
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* Audit Course is optional

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### PROFESSIONAL ELECTIVE COURSES

#### SEMESTER I, ELECTIVES I

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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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**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'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 to unsymmetrical 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.
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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 chainsand 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 -crunode -coupler driven six-bar mechanisms-straight line mechanisms
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
Cognate Lingages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double
dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms- determination
of optimum size of cams. Mechanism defects. Study and use of Mechanism using Simulation Soft-
ware packages. Students should design and fabricate a mechanism model as term project.

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

REFERENCES:
1. Amitabha Ghosh and Asok Kumar Mallik, “Theory of Mechanism and Machines”, EWLP,
   Delhi,1999.

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ED4153 COMPUTER APPLICATIONS IN DESIGN

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 a standards in CAD system.

UNIT – I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS

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
Animation - Conventional, Computer animation, Engineering animation - types and techniques.

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:

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

UNIT-V  EXPERIMENTAL METHODS IN VIBRATION ANALYSIS  9+3

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

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UNIT I  RESEARCH DESIGN  6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II  DATA COLLECTION AND SOURCES  6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III  DATA ANALYSIS AND REPORTING  6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV  INTELLECTUAL PROPERTY RIGHTS  6

UNIT V  PATENTS  6

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
Steels-Advanced high strength steel, Dual phase (DP) steel, Transformation induced plasticity(TRIP) Steel, Maraging steel, Nitrogen steel, Austenitic steel and Q&P steels – Intermetallics, Niand Tialuminides – Alloys – Al, Mg, Cu, Superalloys-Ironbase, Cobaltbase, Nickelbase. Metalmatrixcomposites (MMC)

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

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 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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INTTEGRATED 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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ED4261 SIMULATION AND ANALYSIS LABORATORY  L T P C
0 0 4 2

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

TOTAL: 60 PERIODS

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

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

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

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

TOTAL : 60 PERIODS

COURSE OUTCOMES:
Upon conclusion of this course the student will be able to
- CO1 Appreciate the use of physical prototype models for evaluating product concept
- CO2 Apply theoretical knowledge to design and development of physical products using clay, wood, sheet metal and RP techniques

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ED4311 TECHNICAL SEMINAR

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 should also 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.

TOTAL: 30 PERIODS

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

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

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

TOTAL: 360 PERIODS

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
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

UNIT-III FORMED & MACHINED COMPONENTS DESIGN
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
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

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

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ED4072 COMPOSITE MATERIALS AND MECHANICS

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 Polymeric 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.

TOTAL (L:45) = 45 PERIODS

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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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

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 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 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 enhance 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

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:

ED4001 SURFACE ENGINEERING

COURSEOBJECTIVES:
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 FRICITION  7
Topography of Surfaces– Surface features – Properties and measurement– Surface interaction - Adhesive Theory of Sliding Friction–Rolling Friction- Friction properties of metallic and nonmetallic materials–Friction in extreme conditions –Thermal considerations in sliding contact

UNIT-II WEAR  6

UNIT-III CORROSION  10

UNIT-IV SURFACETREATMENTS  12

UNIT-V ENGINEERINGMATERIALS  10

TOTAL = 45PERIODS

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:
3. Halling,J.(Editor)–“Principles of Tribology”,Mac millian–1984
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

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.

TOTAL = 45 PERIODS
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 - 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  
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  9

UNIT II  INTRODUCTION TO MACHINE LEARNING  9

UNIT III  SUPERVISED LEARNING  9

UNIT IV  UNSUPERVISED LEARNING  9

UNIT V  PROBABILISTIC GRAPHICAL MODELS  9

TOTAL: 45 PERIODS

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

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REFERENCES:

ED4093 OPTIMIZATION TECHNIQUES IN DESIGN

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

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

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

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

UNIT – V STATIC AND DYNAMIC APPLICATIONS

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

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

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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  9

UNIT III  ORTHOPAEDIC MATERIALS  9

UNIT IV  WOUND DRESSING MATERIALS AND SURGICAL AIDS  9
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  9

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.

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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–acoustic 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.

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ED4002 DESIGN FOR X

UNIT I INTRODUCTION

UNIT II COMPONENT DESIGN - MACHINING CONSIDERATION
Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area - simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampingability - Design for accessibility.

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

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AP4251 INDUSTRIAL INTERNET OF THINGS L T P C
3 0 0 3

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  IO T 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

TOTAL : 45 PERIODS

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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TOTAL= 45 PERIODS

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

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

UNIT V  JETTING AND DIRECT ENERGY DEPOSITION PROCESSES

TOTAL: 45 PERIODS

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

REFERENCES:
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  9

UNIT II  WEAR AND SURFACE TREATMENT  9

UNIT III  LUBRICANTS AND LUBRICATION REGIMES  9

UNIT IV  THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION  9
Reynolds Equation-Assumptions and limitations-One and two dimensional Reynolds Equation Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing Pressure, flow, load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydro static bearings.

UNIT V  HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION  9
Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory Soft and hard EHL Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.

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

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

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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 ADAPTIVE 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.

TOTAL= 45PERIODS
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ED4071 DESIGN OF HYBRID AND ELECTRIC VEHICLES

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  ENERGYSOURCE 9

UNIT–III SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN 9

53
UNIT– IV PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN


UNIT–V ELECTRIC VEHICLE DRIVE TRAIN

EV Transmission configurations—Transmission components—Ideal gear box—Gear ratio—torque—speed characteristics—EV motor sizing—initial acceleration—rated vehicle velocity—maximum velocity—maximum gradability

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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ED4003 BEARING DESIGN AND ROTOR DYNAMICS

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

UNIT-II DESIGN OF FLUID FILM BEARINGS

UNIT-III ROLLING CONTACTS SELECTION OF ROLLING BEARINGS
Contact Stresses in Rollingbearings-Centrifugal stresses-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
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 dynamic Instability-Half frequency whirl and Resonance whirl - bearing instability and Oil Whirl 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
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
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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
9

UNIT–II DRIVES OF HOISTING GEAR
9
Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorailcranes-slewing,jibandluffinggear-cogwheeldrive-selecting the motor ratings.

UNIT–III CONVEYORS
9
Types-description-design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT–IV ELEVATORS
9
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
9
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

REFERENCES:

APPROVED DATA BOOKS:

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PD4151 CREATION 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

REFERENCES:
3. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999
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 Reynolds 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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IL4093 SUPPLY CHAIN MANAGEMENT L T P C 3 0 0 3

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

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

UNIT III  DEMAND AND SUPPLY IN SUPPLY CHAIN 9
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

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

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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
AUDIT COURSES

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

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

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

UNIT II PRESENTATION SKILLS 6

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

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

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

TOTAL: 30 PERIODS

COURSE OUTCOMES
CO1 – Understand 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
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

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.

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:

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

SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.
UNIT I
1. தமிழ் துவக்க நூல் வதொல்கொப்பியம்
   - சத்து, அசால், பம்பன
2. அகநொனூறு (82)
   - இதுவுக்கு துணைக் கற்போர
3. நீதிக்கு பரப்பல் மூக்கற்றக்கை
4. புறநொனூறு (95,195)
   - பரப்பட்ட திரும்கற்கை ஸ்தாகமார்

UNIT II
1. அரநநறித் தமிழ்
   - அரநநறித் வகுத்த திருவள்ளுவர்
     - ஆலர் மீனவேதிகம், ஆலர்பெரும், கும்பவைத்த வாரிகம், முற்ப, புழு
2. பிற அறநூல்கள் - இலக்கியம்
   - நூறு, சிறுபஞ்சிப், நூல்கள், அரந்தநூறு (அம்பதூரம் தூத்துக்கொள்ளப்பட்ட நூல்)

UNIT III
1. இரட்டக் குறிஞ்சிப் பொட்டியம்
   - கண்கருகியின் புரட்சி
     - இலக்கியம் புரட்சிகர் கொரத
2. மும்மூக்கியம் மணிபாறால்
   - கிறிணகத்து அறக்கொட்டம் மொகியகொத்தம்

UNIT IV
1. அருள்நநறித் தமிழ்
   - சிறுபொணொற்றுப்பகட
     - பார் முல்லத்து தமிழ் கருத்துக்கத்து, பார் முல்லத்து மூக்கற்றக்கை
     - குறிநன்கள் தங்காய்க்குள் இன்றின்கள் கருத்துக்க, பார் பம்பன
2. தொன்றியல்
   - அதியட்டநநறித் புன்னல் திருப்பு
3. கிறிணகியம் (617, 618)
   - இலக்கியம் கிறிணகியம்
4. இரங்காநூறுமல் இலக்கியம் சிறுபநவர்
5. புறநொனூறு
   - கிறிணகியம் முருகாநூறு
6. அகநொனூறு (4)
   - இலக்கியம்
   - கிறிணகியம் (11)
   - இலக்கியம்
   - கிறிணகியம் (11)
   - பார் முல்ல, பார்
   - புறநொனூறு (50, 27)
   - பார்
   - கிறிணகியம் பார் முல்ல வாரிகம்
UNIT V நவீனதமிழிலக்கியம்

1. தர்மூர்த்தி செம்புறே,  
- தமிழ்ப்புத்தகங்கள்,  
- நூல்பூர்வ நாகவியல்,  
- கதைக்குறிப்புத் தலைக்குறிகள்,  
- பார்வை தலைக்குறிகள்,  
- தென்பேர,  
2. மாநில நிறுவன பல்கலைக்கழகத் தமிழ் தலைக்குறிகள்,  
3. உயர்நிலை நிறுவனங்கள் தமிழ் தலைக்குறிகள்,  
4. பொறியியல் நிறுவனங்கள் நிறுவனங்களின் வலாசியகங்கள் தமிழ் தலைக்குறிகள்,  
5. அறிவியல் செம்புறே,  
6. பல்கலைக்கழகத் தமிழ்,  
7. குன்னறை செம்புறே தமிழ் தலைக்குறிகள்.

TOTAL: 30 PERIODS

தமிழ் தலைக்குறிகள் வைக்கியோடு / பல்கலைக்கழகங்கள்

1. தமிழ் விருக்கான கல்விக்கழகம் (Tamil Virtual University)  
   - www.tamilvu.org  
2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia)  
   - https://ta.wikipedia.org  
3. குன்றன் வெளியங்கியர் வெளியங்கி  
4. சமூக களங்சியம் கல்விக்கழகம்  
   - தமிழ் பல்கலைக்கழகம், தென் தொட்டி  
5. தமிழ்நாடுசுல்முக களங்சியம்  
   - தமிழ் வளர்ச்சிச் செல்லம் (thamilvalarchithurai.com)  
6. அறிவியல் களங்சியம்  
   - தமிழ் பல்கலைக்கழகம், தொட்டி தொட்டி
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


OUTCOMES

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

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

REFERENCES:

4. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of

### CO – PO Mapping - INTEGRATED WATER RESOURCES MANAGEMENT

<table>
<thead>
<tr>
<th>POs/PSOs</th>
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<td>PO1 Knowledge of Engineering Sciences</td>
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<tr>
<td>PO12 Life Long Learning</td>
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<tr>
<td>PSO1 Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
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<tr>
<td>PSO2 Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability</td>
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<tr>
<td>PSO3 Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water resources management</td>
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</table>

#### OBJECTIVES:
- Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

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


UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT


UNIT IV GOVERNANCE

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

UNIT V INITIATIVES

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

TOTAL: 45 PERIODS

OUTCOMES:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Capture to fundamental concepts and terms which are to be applied and understood all through the study.</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.</td>
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<td>CO3</td>
<td>Critically analyse and articulate the underlying common challenges in water, sanitation and health.</td>
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<td>CO4</td>
<td>Acquire knowledge on the attributes of governance and its say on water sanitation and health.</td>
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<tr>
<td>CO5</td>
<td>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.</td>
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REFERENCES

## CO PO MAPPING : WATER, SANITATION AND HEALTH

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<tr>
<td>PSO1 Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
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<tr>
<td>PSO2 Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.</td>
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<tr>
<td>PSO3 Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.</td>
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### OCE433 PRINCIPLES OF SUSTAINABLE DEVELOPMENT

**LT PC**

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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 FRAME WORK

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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<td>PSO1 Knowledge of Environmental Management discipline</td>
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OCE434 ENVIRONMENTAL IMPACT ASSESSMENT L T P C 3 0 0 3

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

UNIT I INTRODUCTION

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

CO – PO Mapping - ENVIRONMENTAL IMPACT ASSESSMENT

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OIC431 BLOCKCHAIN TECHNOLOGIES  

COURSE OBJECTIVES:

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

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

UNIT II BITCOIN AND CRYPTOCURRENCY  

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

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  

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

COURSE OUTCOMES:

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

TOTAL: 45 PERIODS

REFERENCES:

OIC432 DEEP LEARNING

COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS 6

UNIT II NEURAL NETWORKS 9

UNIT III CONVOLUTIONAL NEURAL NETWORK 10

UNIT VI NATURAL LANGUAGE PROCESSING USING RNN 10

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

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

OBA431 SUSTAINABLE MANAGEMENT LT P C 3 0 0 3

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

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

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

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

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

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

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


UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN

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

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY

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

UNIT IV FINANCING SMALL BUSINESS
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
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.

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

REFERENCES
3. Journal articles on SME’s.

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OBA433 INTELLECTUAL PROPERTY RIGHTS

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

UNIT I INTRODUCTION
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
3 0 0 3

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

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

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

UNIT III    STAKEHOLDERS IN ETHICAL MANAGEMENT 9
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 9
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 9
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.

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

TOTAL: 45 PERIODS

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ET4251  IoT FOR SMART SYSTEMS  LT P C

COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT
UNIT I INTRODUCTION TO INTERNET OF THINGS 9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business
drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE 9
IoT reference model and architecture - Node Structure - Sensing, Processing, Communication, Powering,
Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth,
Bluetooth Low Energy beacons.

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

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

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

ET4072 MACHININE LEARNING AND DEEP LEARNING L T P C
3 0 0 3

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

UNIT I LEARNING PROBLEMS AND ALGORITHMS 9 Various paradigms of learning problems: Supervised, Semi-supervised and Unsupervised algorithms


UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9 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 9 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 9 State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs.
COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1: Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

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REFERENCES:

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

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

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

UNIT IV WIND ENERGY CONVERSION SYSTEMS

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

TOTAL : 45 PERIODS

OUTCOMES:
After completion of this course, the student will be able to:
CO1: Demonstrate the need for renewable energy sources.
CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources

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PS4093  SMART GRID  L T P C  3 0 0 3

COURSE OBJECTIVES

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

UNIT I  INTRODUCTION TO SMART GRID  9

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

UNIT II  SMART GRID TECHNOLOGIES  9

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

UNIT III  SMART METERS AND ADVANCED METERING INFRASTRUCTURE  9

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

UNIT IV  POWER QUALITY MANAGEMENT IN SMART GRID  9


UNIT V  HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS  9

Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:

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

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CP4391 SECURITY PRACTICES L T P C 3 0 0 3

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 9

UNIT II NETWORK SECURITY 9

UNIT III SECURITY MANAGEMENT 9

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

UNIT V PRIVACY AND STORAGE SECURITY 9

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

CO-PO Mapping

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MP4251
CLOUD COMPUTING TECHNOLOGIES

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

UNIT I
VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE

UNIT II
CLOUD PLATFORM ARCHITECTURE

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

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

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

REFERENCES

IF4072 DESIGN THINKING

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

TOTAL: 45 PERIODS
UNIT II  CONTEXTUAL INQUIRY  

UNIT III  DESIGN THINKING, IDEATION, AND SKETCHING  

UNIT IV  UX GOALS, METRICS, AND TARGETS  

UNIT V  ANALYSING USER EXPERIENCE  

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

TOTAL : 45 PERIODS

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

REFERENCES
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017
MU4153 PRINCIPLES OF MULTIMEDIA

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

UNIT I INTRODUCTION

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

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

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

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

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

UNIT III MULTIMEDIA TOOLS

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

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

UNIT IV MULTIMEDIA SYSTEMS
Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard –

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

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

**UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS**


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

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

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**CO1:** Handle the multimedia elements effectively.

**CO2:** Articulate the concepts and techniques used in multimedia applications.

**CO3:** Develop effective strategies to deliver Quality of Experience in multimedia applications.

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

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

**REFERENCES:**


**DS4015 BIG DATA ANALYTICS**

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION TO BIG DATA**

UNIT II  SEARCH METHODS AND VISUALIZATION  9

UNIT III  MINING DATA STREAMS  9

UNIT IV  FRAMEWORKS  9
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V  R LANGUAGE  9

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL:45 PERIODS

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CO-PO Mapping

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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  9
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

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

UNIT II  MANIPULATORS & BASIC KINEMATICS  9
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

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

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

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

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

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
8. Howie Choset, Kevin Lynch, Seth Hutchinson, “Principles of Robot Motion: Theory,
Algorithms, and Implementations”, Prentice Hall of India, First edition, 2005

### CO-PO Mapping

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COEPO222

**EMBEDDED AUTOMATION**

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

**UNIT I**  **INTRODUCTION TO EMBEDDED C PROGRAMMING**  9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

**UNIT II**  **AVR MICROCONTROLLER**  9
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

**UNIT III**  **HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS**  9
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

**UNIT IV**  **VISION SYSTEM**  9

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

**COURSE OUTCOMES:**

**TOTAL: 45 PERIODS**
On successful completion of this course, students will be able to

CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

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CX4016 ENVIRONMENTAL SUSTAINABILITY

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

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

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

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

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

TOTAL : 45 PERIODS
REFERENCES

TEX4092  TEXTILE REINFORCED COMPOSITES  L T P C
3 0 0 3

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

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

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

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

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

TOTAL: 45 PERIODS

REFERENCES

NT4002  NANOCOMPOSITE MATERIALS  L T P C
3 0 0 3
UNIT I     BASICS OF NANOCOMPOSITES

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


TOTAL: 45 PERIODS

REFERENCES