1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the Programme M.E Structural Engineering will

PEO1 Gain knowledge and skills in structural engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations

PEO2 Become consultants in Structural Engineering and solve complex real-life issues related to the analysis, design and maintenance of structures under various environmental conditions.

PEO3 Contribute to the enhancement of knowledge in Structural Engineering by performing quality research in institutions of international repute or Research organizations or Academia.

PEO4 Practice their profession with good communication, leadership, ethics and social responsibility and formulate solutions that are technically sound, economically feasible, and socially acceptable.

PEO5 Graduates will function in multi-disciplinary teams and adapt to evolving technologies through life-long learning and innovation

2. PROGRAMME OUTCOMES (POs):

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<tr>
<td>PO1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<td>An ability to write and present a substantial technical report/document</td>
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<td>PO3</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's program</td>
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3. PROGRAM SPECIFIC OUTCOMES (PSOs):

Graduates of the program M.E. Structural Engineering will be able to

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<td>PSO1</td>
<td>Knowledge of Structural Engineering discipline</td>
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<td>Acquire in-depth knowledge of the Structural Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge in structural design.</td>
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<td>PSO2</td>
<td>Critical analysis of Structural Engineering issues and innovation</td>
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<td>Critically analyze complex Structural Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.</td>
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<td>PSO3</td>
<td>Conceptualization and evaluation of Engineering solutions to Structural Design issues</td>
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<td>Conceptualize and solve Structural Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio-cultural factors</td>
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4. PEO/PO Mapping:

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**ANNA UNIVERSITY, CHENNAI**
**NON-AUTONOMOUS AFFILIATED COLLEGES**
**M. E. STRUCTURAL ENGINEERING**
**REGULATIONS 2021**
**CHOICE BASED CREDIT SYSTEM**
**I TO IV SEMESTERS CURRICULA AND SYLLABUS**

### SEMESTER I

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* Audit Course is optional

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**TOTAL NO. OF CREDITS: 70**

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**TOTAL CREDITS** 21

### AUDIT COURSES (AC)

Registration for any of these courses is optional for students

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### SUMMARY

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MA4153 ADVANCED MATHEMATICAL METHODS

OBJECTIVES:

- To provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis. The application of these topics to the solution of problems in physics and engineering is stressed.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS


UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS


UNIT III CALCULUS OF VARIATIONS

Concept of variation and its properties – Euler’s equation – Functional dependent on first and higher order derivatives – Functionals dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz and Kantorovich methods.

UNIT IV CONFORMAL MAPPING AND APPLICATIONS

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications - Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS


OUTCOMES:

After completing this course, students should demonstrate competency in the following skills:

| CO1 | Application of Laplace and Fourier transforms to the initial value, initial–boundary value and boundary value problems in Partial Differential Equations. |
| CO2 | Maximizing and minimizing the functions that occur in various branches of Engineering Disciplines. |
| CO3 | Construct conformal mappings between various domains and use conformal mapping in studying problems in physics and engineering, particularly fluid flow and heat flow problems. |
| CO4 | Understand tensor algebra and its applications in applied sciences and engineering and develops the ability to solve mathematical problems involving tensors. |
| CO5 | Competently use tensor analysis as a tool in the field of applied sciences and related fields. |

TOTAL: 60 PERIODS
REFERENCES:

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ST4101 THEORY OF ELASTICITY AND PLASTICITY

OBJECTIVE:
- To develop the ability to use the principles of theory of elasticity in engineering problems and to introduce theoretical fundamentals of theory of plasticity

UNIT I ELASTICITY
Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke’s law-Constitutive Equations

UNIT II 2D STRESS STRAIN PROBLEMS
Plane stress and plane strain - Simple two-dimensional problems in Cartesian and Polar Coordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION
St. Venant’s approach - Prandtl's approach – Membrane analogy - Torsion of Thin Walled- Open and Closed sections-Design approach to open web section subjected to torsion - Finite Difference Method

UNIT IV BEAMS ON ELASTIC FOUNDATIONS

UNIT V PLASTICITY

TOTAL: 60 PERIODS
OUTCOMES:
On completion of this course, the student is expected to be able to

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<td>Derive and write the fundamental equations of elasticity describing the linear behavior of elements and develop constitutive models based on material behavior</td>
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<td>CO2</td>
<td>Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems</td>
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<td>CO3</td>
<td>Solve torsion problems in circular and non-circular cross-sections</td>
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<td>CO4</td>
<td>Analyse beams resting on elastic foundations</td>
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<td>CO5</td>
<td>Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties</td>
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COs- PO's & PSO's MAPPING

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ST4102 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING

OBJECTIVE:
- To make the students understand the basics of structural dynamics and earthquake engineering and to develop the ability to design an earthquake resistant structure,

UNIT I PRINCIPLES OF VIBRATION ANALYSIS 12
Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Evaluation of damping, Transmissibility, vibration control, Tuned mass damper.

UNIT II DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS 12
Mathematical models of two-degree of freedom systems and multi-degree of freedom systems, free and forced vibrations of two-degree and multi-degree of freedom systems, normal modes of vibration, applications. orthogonality of normal modes, free and forced vibrations of multi-degree of freedom systems, Mode superposition technique, Applications.
UNIT III  DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS  12

UNIT IV  EARTHQUAKE GROUND MOTION AND ITS EFFECTS ON STRUCTURES  12
Engineering Seismology Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation. Effect of Earthquake on Different Types of Structures - Lessons Learnt from Past Earthquakes - Evaluation of Earthquake Forces as per codal provisions - Response Spectra, Design Spectra

UNIT V  EARTHQUAKE RESISTANT DESIGN OF MASONRY AND RC STRUCTURES  12

TOTAL: 60 PERIODS

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

| CO1 | Do vibration analysis of system/structures with a single degree of freedom and can explain the method of damping the systems |
| CO2 | Do the dynamic analysis of system/structures with Multi degrees of freedom under free and forced vibration |
| CO3 | Derive a mathematical model of a continuous system and do a dynamic analysis under free and forced vibration |
| CO4 | Explain the causes and effects of an earthquake |
| CO5 | Design masonry and RC structures for the earthquake forces as per their commendations of IS codes of practice |

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COs- PO’s & PSO’s MAPPING

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RM4151 RESEARCH METHODOLOGY AND IPR L T P C 2 0 0 2

UNIT I RESEARCH DESIGN 6
Overview of the 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 presentations.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

UNIT V PATENTS 6

TOTAL:30 PERIODS

REFERENCES
A) ADVANCED CONSTRUCTION ENGINEERING LABORATORY

OBJECTIVE:
- To provide a thorough knowledge of material selection through the material testing based on specification

LIST OF EXPERIMENTS
1. Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
4. NDT on hardened concrete - UPV, Rebound hammer and core test.
5. Permeability test on hardened concrete (RCPT) – Demonstration

TOTAL: 30 PERIODS

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

<table>
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<tr>
<th>CO1</th>
<th>Do the mix proportion using IS and ACI codal provisions.</th>
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<tr>
<td>CO2</td>
<td>Test the concrete in a non-destructive manner using rebound hammer.</td>
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<td>CO3</td>
<td>Know the permeability characteristics of concrete.</td>
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<tr>
<td>CO4</td>
<td>Observe the effect of mineral and chemical admixture in concrete.</td>
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<td>CO5</td>
<td>Study the flow characteristics of self-compacting concrete</td>
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B) EXPERIMENTAL TECHNIQUES LABORATORY

OBJECTIVE:
- To provide a detailed account of modern experimental techniques in construction Engineering research.
- To introduce the basic working principles, the operational know-how, and the strength and limitations of the techniques.

LIST OF EXPERIMENTS
1. Determination of elastic constants – Hyperbolic fringes
2. Determination of elastic constants – Elliptical fringes
3. Strain gauge meter – Determination of Young’s modulus of a metallic wire
4. Ultrasonic interferometer – ultrasonic velocity in liquids
5. Electrical conductivity of metals and alloys with temperature-four probe method
6. Resistivity measurements
7. NDT – Ultrasonic flaw detector
8. Calibration of Proving Ring and LVDT

TOTAL: 30 PERIODS

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

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<th>CO1</th>
<th>Gain practical knowledge by applying the experimental methods to correlate with the theory</th>
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<td>CO2</td>
<td>Learn the usage of electrical and optical systems for various measurements.</td>
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<tr>
<td>CO3</td>
<td>Apply the analytical techniques and graphical analysis to interpret the experimental data</td>
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<tr>
<td>CO4</td>
<td>Gain practical knowledge of non-destructive testing</td>
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<tr>
<td>CO5</td>
<td>Learn to calibrate and use proving rings and LVDTs</td>
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COs- PO’s & PSO’s MAPPING

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ST4111 TECHNICAL SEMINAR

OBJECTIVE:
- To work on a specific technical topic in Structural Engineering in order to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences.

SYLLABUS: 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 Structural Engineering and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as the audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

TOTAL: 30 PERIODS

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

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<td>CO1</td>
<td>Identify the latest developments in the field of Structural Engineering</td>
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<tr>
<td>CO2</td>
<td>Acquire technical writing abilities for seminars, conferences and journal publications</td>
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<td>CO3</td>
<td>Use modern tools to present the technical details</td>
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<td>CO4</td>
<td>Conduct brainstorming sessions on technical concepts</td>
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<td>CO5</td>
<td>Gain insight on upcoming trends in Structural Engineering</td>
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OBJECTIVE:
- To study the behaviour of members, connections and industrial buildings

UNIT I  GENERAL  12
Design Philosophies and Design Codes (IS, EC, AISC) – Stability Criteria – Beam- Columns and Frames (Sway and Non-Sway) – Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable column and Gable wind girder.

UNIT II  DESIGN OF CONNECTIONS  12

UNIT III  ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS  12
Structural Configurations - Functional and Serviceability Requirements- Analysis and design of different types of trusses – Analysis and design of industrial buildings – Sway and non-sway frames –Gantry Girders –Earthquake resistant design of steel buildings.

UNIT IV  PLASTIC ANALYSIS OF STRUCTURES  12

UNIT V  DESIGN OF LIGHT GAUGE STEEL STRUCTURES  12

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

| CO1 | Design the steel members such as purlins, gable wind girders subjected to combined forces |
| CO2 | Explain and design different types of steel connections such as welded and bolted flexible as well as moment resisting connections |
| CO3 | Analyze and design industrial structures such as trusses and portal frames subjected to wind and seismic forces |
| CO4 | Explain the effect of axial force and shear force on steel structures and analyse continuous beams and frames using plastic theory |
| CO5 | Evaluate the behaviour and design of compression and flexural Cold-formed Steel members |

REFERENCES:
4. Wie Wen Yu, Design of Cold-Formed Steel Structures, McGraw Hill Book Company, 2019
ST4202 ADVANCED CONCRETE STRUCTURES L T P C 3 1 0 4

OBJECTIVE:
- To make the students familiar with the behaviour of RCC beams and columns and to design special structural members with proper detailing

UNIT I BEHAVIOUR AND DESIGN OF R.C. BEAMS 12
Properties and behaviour of concrete and steel – Behaviour and design of R.C. beams in flexure, shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.

UNIT II BEHAVIOUR AND DESIGN OF R.C. COLUMNS 12
Behaviour of short and long columns - behaviour of short column under axial load with uniaxial and bi-axial moments - construction of P_u - M_u interaction curves - Design of slender columns -

UNIT III DESIGN OF SPECIAL R.C. ELEMENTS 12
Design of RC walls - design of corbels - strut and tie method - design of simply supported and continuous deep beams - analysis and design of grid floors.

UNIT IV FLAT SLABS AND YIELD LINE BASED DESIGN 12
Design of flat slabs according to IS method – Check for shear - Design of spandrel beams - Yield line theory and design of slabs - virtual work method - equilibrium method.

UNIT V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES 12

TOTAL: 60 PERIODS

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

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ST4203 FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING

OBJECTIVE:
- To make the students understand the basics of the Finite Element Technique, and to cover the analysis methodologies for 1-D, 2-D and 3-D Structural Engineering problems.

UNIT I INTRODUCTION

UNIT II ELEMENT PROPERTIES
Natural Coordinates - Triangular Elements-Rectangular Elements - Lagrange and Serendipity Elements - Solid Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration: One, Two and Three Dimensional - Problems

UNIT III ANALYSIS OF FRAME STRUCTURES
Stiffness of Truss Members-Analysis of Truss-Stiffness of Beam Members-Finite Element Analysis of Continuous Beam-Plane Frame Analysis-Analysis of Grid and Space Frame

UNIT IV TWO AND THREE DIMENSIONAL SOLIDS
Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements- Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements- Problems

UNIT V APPLICATIONS OF FEM
Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate - Finite Element Analysis of Thick Plate - Finite Element Analysis of Skew Plate -Introduction to Finite Strip Method - Finite Element Analysis of Shell -Finite Elements for Elastic Stability - Dynamic Analysis

TOTAL: 45 PERIODS
OUTCOMES:
- On completion of the course, the student is expected to be able to

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<td>Formulate a finite element problem using basic mathematical principles</td>
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<td>CO2</td>
<td>Explain the various types of elements and select the appropriate element for modelling</td>
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<td>CO3</td>
<td>Analyse a frame using truss element</td>
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<tr>
<td>CO4</td>
<td>Formulate and analyse the two- and three-dimensional solid finite element problems</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyse shells, thick and thin plates and explain the dynamic analysis using FEM</td>
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REFERENCES:

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ST4211 NUMERICAL AND FINITE ELEMENT ANALYSIS LABORATORY

OBJECTIVE:
- To solve the mathematical equations and finite element analysis with computational methods like MATLAB and Finite element software using software like ANSYS, ABAQUS etc

EXPERIMENTS/ EXERCISES
1. Dynamic analysis of frame using mathematical computational software
2. Finite Element Analysis of 2D truss and 3D space trusses
3. Modelling and Finite Element Analysis of RC beams and slabs
4. Finite Element Analysis of thin and thick plates
5. Stability analysis using FEM

TOTAL: 60 PERIODS

OUTCOMES:
- At the end of the course, the student will be able to carry out

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<tr>
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<td>Thorough knowledge to handle FE software</td>
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<tr>
<td>CO2</td>
<td>Dynamic analysis of frames</td>
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<tr>
<td>CO3</td>
<td>Analysis of thin and thick plates</td>
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<tr>
<td>CO4</td>
<td>Stability Analysis</td>
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<tr>
<td>CO5</td>
<td>Learn to use MATLAB and import MATLAB codes for FE modelling</td>
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ST4212  STRUCTURAL DESIGN STUDIO  L T P C  0 0 4 2

OBJECTIVE:
- To design a structure using modern software tools available like ETABS, STAAD, STRAP, etc. and present it in the form of a complete detailed drawing. Students have to work individually with standard codes, computational tools and software packages for analyzing, designing and detailing a structure. A detailed report on the work done shall be submitted by individual students in the form of a report and presentation.

TOTAL: 60 PERIODS

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

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<td>Understand the requirements of a structure and model it accordingly using computer software</td>
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<td>CO2</td>
<td>Analyze the structure for various loads and load combinations according to the relevant IS codes</td>
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<td>CO3</td>
<td>Design and detail structures using computer software/tools and check the correctness using manual approximate methods</td>
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<tr>
<td>CO4</td>
<td>Prepare the complete structural drawings using computer software</td>
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<tr>
<td>CO5</td>
<td>Observe the flow of forces in a structure and its response to it.</td>
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COs- PO’s & PSO’s MAPPING

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ST4311  PRACTICAL TRAINING (4 Weeks)  L T P C  0 0 0 2

OBJECTIVE:
- To train the students in the field work so as to have firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.

SYLLABUS: The students individually undertake training in reputed engineering companies doing Structural Engineering during the summer vacation for a specified duration of four weeks. At the end of the training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.
OUTCOMES:
- On completion of the course, the student is expected to be able to

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<tbody>
<tr>
<td>CO1</td>
<td>Describe the Structural Engineering organization</td>
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<td>CO2</td>
<td>Realize the various functions of construction activities</td>
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<td>CO3</td>
<td>Gain an understanding of groups and group dynamics</td>
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<td>CO4</td>
<td>Participate in real-life construction projects</td>
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<tr>
<td>CO5</td>
<td>Put to use the theoretical knowledge gained so far</td>
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COs- PO’s & PSO’s MAPPING

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ST4312 PROJECT WORK I

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

SYLLABUS:
The student individually works on a specific topic approved by the faculty member who is familiar with this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and a 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

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

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<tr>
<td>CO1</td>
<td>Apply the knowledge gained from theoretical and practical courses in solving problems</td>
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<tr>
<td>CO2</td>
<td>Recognize the importance of literature review</td>
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<tr>
<td>CO3</td>
<td>Develop a clear outline and methodology for the project</td>
</tr>
<tr>
<td>CO4</td>
<td>Identify the potential research gap and list parameters to work with</td>
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<tr>
<td>CO5</td>
<td>Report and present the findings of the work conducted.</td>
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</table>
COs- PO’s & PSO’s MAPPING

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ST4411  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 / Undergo internship. 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 and the viva-voce examination by a panel of examiners including one external examiner.

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

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<tbody>
<tr>
<td>CO1</td>
<td>Discover potential research areas in the field of Structural Engineering.</td>
</tr>
<tr>
<td>CO2</td>
<td>Apply the knowledge gained from theoretical and practical courses to be creative, well-planned, organized and coordinated</td>
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<tr>
<td>CO3</td>
<td>Represent data acquired in graphical and reader-friendly formats</td>
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<tr>
<td>CO4</td>
<td>Derive detailed conclusions from work carried out</td>
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<tr>
<td>CO5</td>
<td>Report and present the findings of the work conducted</td>
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COs- PO’s & PSO’s MAPPING

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TOTAL: 360 PERIODS
PROFESSIONAL ELECTIVE COURSES

ST4001  NON-LINEAR ANALYSIS OF STRUCTURES  L T P C  3 0 0 3

OBJECTIVE:
- To study the concept of non-linear behaviour and analysis of elements and simple structures.

UNIT I  INTRODUCTION TO NON-LINEAR ANALYSIS  9
Material non-linearity, geometric non-linearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness.

UNIT II  INELASTIC ANALYSIS OF FLEXURAL MEMBERS  9
Inelastic analysis of uniform and variable thickness members subjected to geometric and material non-linearity; inelastic analysis of bars of uniform and variable stiffness members with and without axial Restraints

UNIT III  VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS  9
Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading

UNIT IV  ELASTIC AND INELASTIC ANALYSIS OF PLATES  9
Elastic and inelastic analysis of uniform and variable thickness plates.

UNIT V  NON-LINEAR VIBRATION AND INSTABILITY  9
Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL: 45 PERIODS

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

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<td>CO1</td>
<td>Analyze the bar system considering the material and geometric nonlinearity</td>
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<td>CO2</td>
<td>Perform inelastic analysis of flexural members</td>
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<tr>
<td>CO3</td>
<td>Perform vibration analysis of flexural members</td>
</tr>
<tr>
<td>CO4</td>
<td>Perform elastic and inelastic analysis of Plates</td>
</tr>
<tr>
<td>CO5</td>
<td>Perform nonlinear and instability analysis of elastically supported beams</td>
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REFERENCES:

COs- PO's & PSO's MAPPING

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ST4002  
STRUCTURAL STABILITY  
L T P C  
3 0 0 3  

OBJECTIVE:  
- To study the concept of buckling and analysis of structural elements  

UNIT I  
BUCKLING OF COLUMNS  
9  

UNIT II  
BUCKLING OF BEAM-COLUMNS AND FRAMES  
9  
Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples - Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.  

UNIT III  
TORSIONAL AND LATERAL BUCKLING  
9  
Torsional buckling – Combined Torsional and flexural buckling - Local buckling - Buckling of Open Sections - Lateral buckling of beams - simply supported and cantilever beams.  

UNIT IV  
BUCKLING OF PLATES  
9  
Governing differential equation - Buckling of thin plates with various edge conditions - Analysis by equilibrium and energy approach – Finite difference method.  

UNIT V  
INELASTIC BUCKLING  
9  
Double modulus theory - Tangent modulus theory - Shanley’s model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates.  

TOTAL: 45 PERIODS  

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

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ST4003 WIND AND CYCLONE EFFECTS ON STRUCTURES

OBJECTIVE:
- To study the concept of wind and cyclone effects for the analysis and design of structures.

UNIT I INTRODUCTION

UNIT II EFFECT OF WIND ON STRUCTURES
Classification of structures – Rigid and Flexible – Effect of wind on structures – Vortex shedding, translational vibration of structures - Static and dynamic effects on Tall buildings – Chimneys

UNIT III DESIGN OF SPECIAL STRUCTURES
Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – Design of Industrial Structures – Tall Buildings – Chimneys – Transmission towers and steel monopoles

UNIT IV CYCLONE EFFECTS

UNIT V WIND TUNNEL STUDIES
Wind Tunnel Studies, Types of wind tunnels, Types of wind tunnel models - Modelling requirements - Aero dynamic and Aero-elastic models, Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design

TOTAL: 45 PERIODS

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

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<tr>
<td>CO1</td>
<td>Explain the characteristics of wind</td>
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<td>CO2</td>
<td>Evaluate the intensity of wind on structures</td>
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<td>CO3</td>
<td>Design some special structures subjected to wind loading</td>
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<tr>
<td>CO4</td>
<td>Design of structures for cyclone</td>
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<tr>
<td>CO5</td>
<td>Model and analyse a structure in a wind tunnel</td>
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REFERENCES:

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TOTAL: 45 PERIODS
OBJECTIVE:
- To study the design principles, analysis and design of Prefabricated structures.

UNIT I DESIGN PRINCIPLES
General Civil Engineering requirements, specific requirements for planning and layout of prefabrication plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and code provisions, safety factors, material properties, Deflection control.

UNIT II REINFORCED CONCRETE
Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, -Connections – Beam to column and column to column.

UNIT III FLOORS, STAIRS AND ROOFS
Types of floor slabs, analysis and design example of cored and panel types and two-way systems, Design analysis for product manufacture, handling and erection, staircase slab, types of roof slabs and insulation requirements. Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

UNIT IV WALLS
Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, Hoisting and placing, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, Lateral load resistance, Location and types of shear walls, approximate design of shear walls.

UNIT V INDUSTRIAL BUILDINGS AND SHELL ROOFS

TOTAL: 45 PERIODS

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

| CO1  | Explain the design principles involved in prefabrication |
| CO2  | Detail the different types of connection                |
| CO3  | Design for stripping forces during manufacture          |
| CO4  | Determine the forces in shear walls                     |
| CO5  | Identify the different roof trusses used in industrial buildings |

REFERENCES:
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CN4071 ADVANCED CONCRETE TECHNOLOGY

OBJECTIVE:
- To study the properties of concrete making materials, tests, mix design, special concretes, and various methods for making concrete.

UNIT I CONCRETE MAKING MATERIALS

UNIT II MIX DESIGN
Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method – Mix design for special concretes- changes in Mix design for special materials.

UNIT III CONCRETING METHODS
Process of manufacturing of concrete, methods of transportation, placing and curing, cracking, plastic shrinkage, Extreme weather concreting, special concreting methods. Vacuum dewatering – Underwater Concrete

UNIT IV SPECIAL CONCRETES

UNIT V TESTS ON CONCRETE

TOTAL: 45 PERIODS

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

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<tbody>
<tr>
<td>CO1</td>
<td>Develop knowledge on various materials needed for concrete manufacture</td>
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<tr>
<td>CO2</td>
<td>Apply the rules to do mix designs for concrete by various methods</td>
</tr>
<tr>
<td>CO3</td>
<td>Develop the methods of manufacturing of concrete.</td>
</tr>
<tr>
<td>CO4</td>
<td>Explain about various special concrete</td>
</tr>
<tr>
<td>CO5</td>
<td>Explain various tests on fresh and hardened concrete</td>
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</tbody>
</table>
REFERENCES:
2. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2019.
5. Job Thomas., Concrete Technology, Cengage learning India Private Ltd, New Delhi, 2015.

CO-PO MAPPING

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ST4071 ADVANCED PRESTRESSED CONCRETE L T P C
3 0 0 3

OBJECTIVE:
- To develop an understanding of the philosophy of design of prestressed concrete
- To be able to design indeterminate prestressed concrete structure
- To design the prestressed concrete bridge and composite sections.

UNIT I INTRODUCTION

UNIT II DESIGN FOR FLEXURE, SHEAR AND TORSION
Behaviour of flexural members, determination of ultimate flexural strength using various Codal provisions - Design for Flexure, Shear, torsion and bond of pre-stressed concrete elements – Transfer of prestress – Box girders - Camber, deflection and crack control.

UNIT III DESIGN OF CONTINUOUS AND COMPOSITE BEAMS
Statically indeterminate structures - Analysis and design of continuous beams and frames– Choice of cable profile - Methods of achieving continuity – concept of linear transformations, concordant cable profile and gap cables – Composite sections of prestressed concrete beam and cast in situ RC slab - Design of composite sections - Partial prestressing - Limit State design of partially prestressed concrete beams

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS
Pre-stressed concrete compression and tension members – application in the design of prestressed pipes and prestressed concrete cylindrical water tanks – Design of compression members with and without flexure – its application in the design of piles, flag masts and similar structures – Two way pre-stressed concrete floor systems – Connections for pre-stressed concrete elements

UNIT V DESIGN OF PRESTRESSED CONCRETE BRIDGES

TOTAL: 45 PERIODS
OUTCOMES:
• On completion of the course, the student is expected to be able to

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ST4005 RELIABILITY ANALYSIS OF STRUCTURES

OBJECTIVE:
• To develop knowledge to solve structural analysis problems using reliability concepts.

UNIT I DATA ANALYSIS
Graphical representation Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form y = ab^x, and parabola, Coefficient of correlation

UNIT II PROBABILITY CONCEPTS
Random events-Sample space and events, Venn diagram and event space, Measures of probability-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye’s theorem

UNIT III RANDOM VARIABLES
Probability mass function, probability density function, Mathematical expectation, Chebyshev’s theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions, Normal, Log normal distributions
UNIT IV  RELIABILITY ANALYSIS

UNIT V  SYSTEM RELIABILITY
Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers, random numbers with standard uniform distribution, continuous random variables, discrete random variables

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

| CO1 | Achieve the Knowledge of design and development of problem-solving skills. |
| CO2 | Understand the principles of reliability. |
| CO3 | Design and develop analytical skills. |
| CO4 | Summarize the Probability distributions |
| CO5 | Understands the concept of System reliability. |

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ST4006  DESIGN OF FORMWORK  L T P C  3 0 0 3

OBJECTIVE:
- To study and understand the detailed planning of formwork, Design of forms for various elements such as foundation, slabs, beams, columns and walls.

UNIT I  INTRODUCTION
General objectives of formwork building - Development of a Basic System - Key Areas of cost reduction - Requirements and Selection of Formwork.
UNIT II FORMWORK MATERIALS AND TYPES
Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, etc.

UNIT III FORMWORK DESIGN

UNIT IV FORMWORK DESIGN FOR SPECIAL STRUCTURES
Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT V FORMWORK FAILURES

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to
  
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<th>CO</th>
<th>Select proper formwork, accessories and material</th>
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<td>CO2</td>
<td>Design the form work for Beams, Slabs, columns, Walls and Foundations</td>
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<td>Design the form work for Special Structures</td>
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<td>CO4</td>
<td>Describe the working of flying formwork.</td>
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<tr>
<td>CO5</td>
<td>Judge the formwork failures through case studies</td>
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</table>

REFERENCES:
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
4. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996

ST4073 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES

OBJECTIVE:
- To study the damages, repair and rehabilitation of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES
Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures- Service life behaviour - importance of Maintenance, causes and effects of deterioration. Non-destructive Testing Techniques
UNIT II  STRENGTH AND DURABILITY OF CONCRETE  
Quality assurance for concrete based on Strength, Durability and Microstructure of concrete - NDT techniques- Cracks- different types, causes – Effects due to Environment, Fire, Earthquake, Corrosion of steel in concrete, Mechanism, quantification of corrosion damage

UNIT III  REPAIR MATERIALS AND SPECIAL CONCRETES  
Repair materials-Various repair materials, Criteria for material selection, Methodology of selection, Special mortars and concretes- Polymer Concrete and Grouting materials- Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets

UNIT IV  PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING  
Concrete protection methods – reinforcement protection methods- cathodic protection - Sacrificial anode - Corrosion protection techniques – Corrosion inhibitors, concrete coatings-Corrosion resistant steels, Coatings to reinforcement, Structural health monitoring.

UNIT V  REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES  
Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Repair to active cracks, Repair to dormant cracks. Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements. Engineered Demolition -Case studies

TOTAL: 45 PERIODS

REFERENCES:
5. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD, Govt of India, New Delhi – 2002
6. BS EN 1504 - Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity

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

| CO | Explain the importance of maintenance assessment and repair strategies |
| CO2 | Acquire knowledge of strength and durability properties and their effects due to climate and temperature. |
| CO3 | Gain knowledge of recent developments in repair |
| CO4 | Explain the techniques for repair and protection methods |
| CO5 | Explain the repair, rehabilitation and retrofitting of structures and demolition methods. |

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OBJECTIVE:
- To study the behaviour of composite materials and to investigate the failure and fracture characteristics.

UNIT I  INTRODUCTION
Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites and Short Fiber Composites.

UNIT II  STRESS STRAIN RELATIONS
Concepts in solid mechanics, Hooke’s law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT III  ANALYSIS OF LAMINATED COMPOSITES
Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates – Static, Dynamic and Stability analysis for Simpler cases of composite plates, Inter laminar stresses.

UNIT IV  FAILURE AND FRACTURE OF COMPOSITES
Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

UNIT V  APPLICATIONS AND DESIGN
Meal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues

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

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OBJECTIVE:
- To develop an understanding of the behaviour and design concrete composite elements and structures.

UNIT I  INTRODUCTION 9
Introduction to steel – concrete composite construction – Codes – Composite action – Serviceability and Construction issues in design.

UNIT II  DESIGN OF COMPOSITE MEMBERS 9

UNIT III  DESIGN OF CONNECTIONS 9

UNIT IV  COMPOSITE BOX GIRDER BRIDGES 9
Introduction – Design concepts of box girder bridges and corrugated web girder bridges

UNIT V  CASE STUDIES 9
Case studies on steel – concrete composite construction in buildings – seismic behaviour of composite structures.

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

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<th>Explain composite action</th>
<th>Design composite elements</th>
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<th>Explain the concept of design of composite box girder bridges</th>
<th>Study and evaluate case studies</th>
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OBJECTIVE:
- To design, detail and retrofit a masonry structure

UNIT I INTRODUCTION

UNIT II DESIGN OF COMPRESSION MEMBER
Principles of masonry design, Masonry standards: IS 1905 and others - Masonry in Compression – Prism strength, Eccentric loading -Kern distance. Structural Wall, Columns and Plasters, Retaining Wall, Pier and Foundation – Prestressed masonry

UNIT III DESIGN OF MASONRY UNDER LATERAL LOADS
Masonry under Lateral loads – In-plane and out-of-plane loads, Ductility of Reinforced Masonry Members Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms. Behaviour of Masonry – Shear and flexure – Combined bending and axial loads – Reinforced and unreinforced masonry – Infill masonry

UNIT IV EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES

UNIT V RETROFITTING OF MASONRY
Seismic evaluation and Retrofit of Masonry – In-situ and non-destructive tests for masonry – properties – Repair and strengthening of techniques.

TOTAL: 45 PERIODS

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

| CO1 | Explain the properties of a masonry unit and the various components |
| CO2 | Design a masonry structure for compression |
| CO3 | Design a masonry structure for lateral loads |
| CO4 | Design an earthquake-resistant masonry wall |
| CO5 | Suggest retrofitting techniques for existing masonry walls |

REFERENCES:
ST4010 DESIGN OF INDUSTRIAL STRUCTURES

OBJECTIVE:
• To disseminate knowledge about planning and design of RCC and Steel Industrial structures.

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS

UNIT II INDUSTRIAL BUILDINGS
Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase.

UNIT III POWER PLANT STRUCTURES
Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe Rack and supporting structures.

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS
Analysis and design of steel monopoles, transmission line towers – Sag and Tension calculations, Methods of tower testing – Design of self-supporting and guyed chimney, Design of Chimney bases.

UNIT V FOUNDATION
Foundation for Towers, Chimneys and Cooling Towers –Design of Block foundations for machines - Design of Turbo Generator Foundation.

TOTAL: 45 PERIODS

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

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ST4011 ADVANCED DESIGN OF FOUNDATION STRUCTURES L T P C
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OBJECTIVE:
- To design various types of foundations to fulfill the required criteria.

UNIT I SHALLOW FOUNDATIONS 9

UNIT II PILE FOUNDATIONS 9

UNIT III WELL FOUNDATION 9

UNIT IV MACHINE FOUNDATIONS 9
- Types – General requirements and design criteria – General analysis of machine foundations-soil system – Stiffness and damping parameters – Tests for design parameters – design of foundation for reciprocating engines, impact type machines and rotary type machines.

UNIT V SPECIAL FOUNDATIONS 9
- General requirements and design criteria – Foundations for towers, Chimneys and Silos – design of anchors

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course student will be able to

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<td>Design shallow and deep foundations for various types of structures</td>
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<td>Design piles and pile caps</td>
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<td>CO3</td>
<td>Design well foundation for bridge piers and related structures</td>
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<td>CO4</td>
<td>Gain knowledge on design and construction of machine foundation</td>
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<td>CO5</td>
<td>Design foundations for bridges, towers and chimneys</td>
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ST4012

OPTIMIZATION OF STRUCTURES

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OBJECTIVE:
- To study the optimization methodologies applied to structural engineering

UNIT I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES


UNIT II LINEAR AND NON-LINEAR PROGRAMMING


UNIT III GEOMETRIC PROGRAMMING

Polynomial – degree of difficulty – reducing G.P.P to a set of simultaneous equations – Unconstrained and constrained problems with zero difficulty – Concept of solving problems with one degree of difficulty.

UNIT IV DYNAMIC PROGRAMMING

Bellman’s principle of optimality – Representation of a multistage decision problem- concept of sub-optimization problems using classical and tabular methods.

UNIT V STRUCTURAL APPLICATIONS

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory -Minimum weight design for truss members - Fully stressed design – Optimization principles to design of R.C. structures such as multistory buildings, water tanks and bridges.

TOTAL: 45 PERIODS
OUTCOMES:
• On completion of the course, the student is expected to be able to

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<td>CO1</td>
<td>Apply the knowledge of engineering fundamentals to formulate and solve engineering problems by classical optimization techniques.</td>
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<td>CO2</td>
<td>Identify, formulate and solve engineering problems by linear and non-linear programming.</td>
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<td>CO3</td>
<td>Analyse the problem and reduce G.P.P to a set of simultaneous equations.</td>
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<tr>
<td>CO4</td>
<td>Apply the Engineering knowledge to understand the concept of dynamic programming.</td>
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<td>CO5</td>
<td>Design various structural elements with minimum weight.</td>
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ST4013           STRUCTURAL HEALTH MONITORING       3 0 0 3

OBJECTIVE:
• To make the students familiar with various structural health monitoring tools and techniques.

UNIT I INTRODUCTION TO STRUCTURAL HEALTH MONITORING

UNIT II SENSORS AND INSTRUMENTATION FOR SHM

UNIT III STATIC AND DYNAMIC MEASUREMENT TECHNIQUES FOR SHM
Static measurement - Load test, Concrete core trepanning, Flat jack techniques, Static response measurement, Dynamic measurement -Vibration based testing- Ambient Excitation methods, Measured forced Vibration-Impact excitation, step relaxation test, shaker excitation method.
UNIT IV DAMAGE DETECTION 9
Damage Diagnostic methods based on vibrational response - Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method, Cross-correlation method, Damage Diagnostic methods based on wave propagation Methods-Bulk waves/Lamb waves, Reflection and transmission, Wave tuningemode selectivity, Migration imaging, Phased array imaging, Focusing array/SAFT imaging

UNIT V DATA PROCESSING AND CASE STUDIES 9

TOTAL: 45 PERIODS

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

<table>
<thead>
<tr>
<th>CO</th>
<th>Understand the need, advantages and challenges of SHM</th>
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<tr>
<td>CO2</td>
<td>Know the different types of sensors and instrumentation techniques</td>
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<tr>
<td>CO3</td>
<td>Gain knowledge of the static and dynamic measurement techniques</td>
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<td>CO4</td>
<td>Compare the various damage detection techniques</td>
</tr>
<tr>
<td>CO5</td>
<td>Know the various data processing methods through case studies</td>
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</table>

REFERENCES
3. Hua-Peng Chen, Structural Health Monitoring of Large Civil Engineering Structures, Wiley Publishers, 2018

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ST4014 DESIGN OF OFFSHORE STRUCTURES L T P C

OBJECTIVE:
- To impart knowledge about the concept of wave theories, forces, offshore foundation, analysis and design of jacket towers, pipes and cables.

UNIT I WAVE THEORIES 9
Wave generation process, small, finite amplitude and nonlinear wave theories.
UNIT II  FORCES OF OFFSHORE STRUCTURES  9
Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.

UNIT III  OFFSHORE SOIL AND STRUCTURE MODELLING  9
Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.

UNIT IV  ANALYSIS OF OFFSHORE STRUCTURES  9
Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT V  DESIGN OF OFFSHORE STRUCTURES  9
Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.

TOTAL: 45 PERIODS

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

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REFERENCES:

COs- PO’s & PSO’s MAPPING

ST4015  PERFORMANCE OF STRUCTURES WITH SOIL STRUCTURE INTERACTION  L T P C
3 0 0 3

OBJECTIVE:
• To study the concept of soil-structure – interaction in the analysis and design of structures.

UNIT I  SOIL-Foundation INTERACTION  9
Introduction to soil-foundation interaction problems – Soil behaviour – Foundation behaviour-
Interface behaviour- Scope of soil foundation interaction analysis- soil response models–Elastic
continuum- Two parameter elastic models- Elastic-plastic behaviour- Time dependent behaviour.

UNIT II  BEAM ON ELASTIC FOUNDATION- SOIL MODELS  9
Infinite beam – Two-parameters models – Isotropic elastic half space model – Analysis of beams of
finite length – combined footings.
UNIT III  PLATES ON ELASTIC CONTINUUM
Thin and thick rafts – Analysis of finite plates - Numerical analysis of finite plates.

UNIT IV  ANALYSIS OF AXIALLY AND LATERALLY LOADED PILES AND PILE GROUPS
Elastic analysis of single pile – Theoretical solutions for settlement and load distributions – Analysis of pile group – Interaction analysis – Load distribution in groups with rigid cap – Load deflection prediction for laterally loaded piles – Subgrade reaction and elastic analysis – Interaction analysis – Pile-raft system.

UNIT V  GROUND-FOUNDATION-STRUCTURE INTERACTION
Effect of structure on ground-foundation interaction – Static and dynamic loads- Contact pressure and its estimation – Estimation of the settlement from the constitutive laws – Free-field response – Kinetic interaction – Inertial interaction

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

| CO1 | Explain the concept of soil structure interaction. |
| CO2 | Do a static analysis of infinite and finite beams resting on elastic foundation |
| CO3 | Analyse finite thin and thick plates |
| CO4 | Do a static and dynamic analysis of soil structure interaction problems |
| CO5 | Analyze ground foundation and structure interaction problems |

REFERENCES:

COs- PO's & PSO's MAPPING

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ST4091  DESIGN OF BRIDGE STRUCTURES  L T P C
3 0 0 3

OBJECTIVE:
• To study the loads, forces on bridges and design principles of several types of bridges.
UNIT I  INTRODUCTION 9
Introduction-Selection of Site and Initial Decision Process - Classification of Bridges- General
Features of Design- Standard Loading for Bridge Design as per different codes - Road Bridges –
Railway Bridges -  Design Codes - Working Stress Method- Limit State Method of Design

UNIT II  SUPERSTRUCTURES 9
Selection of main bridge parameters, design methodologies -Choices of superstructure types -
Orthotropic plate theory, load distribution techniques - Grillage analysis - Finite element analysis
Different types of superstructure (RCC and PSC); Longitudinal Analysis of Bridge - Transverse
Analysis of Bridge

UNIT III  BRIDGE DESIGN PRINCIPLES 9
Analysis and Design of RCC solid slab culverts -Design of RCC Tee beam and slab bridges - Design
principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch
bridges – Box culverts – Segmental bridges–Design principles only

UNIT IV  SUBSTRUCTURE, BEARINGS AND DECK JOINTS 9
Design of bridge bearings and substructure

UNIT V  PRESTRESSED CONCRETE BRIDGES & STEEL BRIDGES 9
Design principles of PSC bridges – PSC girders –Design principles of steel bridges - Plate girder
bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.3

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of this course, student will be able to

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<th>CO</th>
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<tr>
<td>CO1</td>
<td>Explain the different types of bridges and design philosophies</td>
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<td>CO2</td>
<td>Design an RC solid slab culvert bridge</td>
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<td>CO3</td>
<td>Design an RC Tee Beam and Slab bridge</td>
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<td>CO4</td>
<td>Design the bridge bearings and substructure</td>
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<tr>
<td>CO5</td>
<td>Explain the design principles of PSC bridges, box girder bridges, truss bridges</td>
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REFERENCES:
   Hall of India Pvt. Ltd. 2009.
   Delhi,2014.
   2021

COs- PO’s & PSO’s MAPPING

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Avg = 2.20

OBJECTIVE:
- To study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

UNIT I  
CLASSIFICATION OF SHELLS  

UNIT II  
FOLDED PLATES  
Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method - pyramidal roof- Prismatic roof.

UNIT III  
INTRODUCTION TO SPACE FRAME  
Space frames - configuration - types of nodes - Design Philosophy - Behaviour.

UNIT IV  
ANALYSIS AND DESIGN  

UNIT V  
SPECIAL METHODS  
Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL: 45 PERIODS

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

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REFERENCES

COs- PO’s & PSO’s MAPPING
AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

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

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


UNIT III TITLE WRITING SKILLS

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

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

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

TOTAL: 30 PERIODS

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

UNIT III
DISASTER PRONE AREAS IN INDIA
6
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.

UNIT IV
DISASTER PREPAREDNESS AND MANAGEMENT
6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V
RISK ASSESSMENT
6

TOTAL: 30 PERIODS

OUTCOMES

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

REFERENCES

OBJECTIVES
Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence nationhood 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.

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
UNIT I

1. தமிழ் துவக்க நூல் தம்பதொல்கைம்
   - தேர்க்கை, தொடர், பார்வெட்
2. அகநொனூறு (82)
   - விழாக்கத் தொடர்விளை அரங்கம்
3. சீமாக்கம் பாடல் கலங்காரணி
4. புருத்தவம் (95, 195)
   - பாடல் திறக்கியும் தாண்டவம்

UNIT II

அறநநறித் தமிழ்

1. அறநநறி வகுத்ததிருவள்ளுவர் - அன்புகடகம், குறித்தல், புகழ்
2. பிற அறநூல்கள் - குறிப்பொருள்
   - தீர்மானம், விளையாட்டுபாடல், கலைக்குழு, அடுத்தகங்கள்
   (கலாபொருள் பெரும் குழு)

UNIT III

இரட்டடக் காப்பியங்கள்

1. கண்காணகியின் புரட்சி
   - கிருபேஸ்வரர் வகுத்த காதல்
   - இந்தியக்கல் அறநநறித் தாண்டவம்
2. பாறைகள்
   - அம்மானக்குரிய புன்னர்
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. புறநொனூறு - சிறுபங்கு மலர்கொட்டி
5. மகாத்மா
   - சிறுபங்கு மலர்கொட்டி
6. அகநொனூறு (4)
   - முதல்
   - கோவிலைக் (11)
   - முதல்
   - குருதியக்கல் (11)
   - பார்வெட், புரர்
   - கலைக்குழு 50 (27)
   - பாடல்
   - குறிப்பொருள் தாண்டவம்
UNIT V நவீன தமிழ் இலக்கியம்
1. உகரநகடத் தமிழ்,
   - கட்டுகர இலக்கியம்,
   - கட்டுகர இலக்கியம்,
   - பயண இலக்கியம்,
   - மொத்தம்.
2. நொட்டுவிடுதகலப் பபொரொட்டமும் தமிழ் இலக்கியமும்,
3. முதொயவிடுதகலயும் தமிழ் இலக்கியமும்,
4. தபணவிடுதகலயும் விளிம்பு நிகலயினரின் பமம்பொட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இகணயத்தில் தமிழ்,
7. சுற்றுசூழல் பமம்பொட்டில் தமிழ் இலக்கியமும்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய பொறித்தல் / பத்தகங்கள்
1. தமிழ் தொலைவு கல்வி கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ் விளிம்பு இலக்கியம்
4. பார்வொலியல் கல்க்கலம் - தமிழ் பல்கலைக்கழகம், திருச்சி
5. தமிழ் விளிம்பு கல்க்கலம் - தமிழ் விளிம்பு கல்க்கலம் தொழில் (thamilvalarchithurai.com)
6. அறிவியல் கல்க்கலம் - தமிழ் பல்கலைக்கழகம், திருச்சி
OPEN ELECTIVES

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.

TOTAL: 45 PERIODS

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

REFERENCES:
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 IV NATURAL LANGUAGE PROCESSING USING RNN 10

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

REFERENCES
1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
OBJECTIVES
- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT I  BASICS OF VIBRATION

UNIT II  BASICS OF NOISE
Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra - Types of sound fields - Octave band analysis - Loudness.

UNIT III  INSTRUMENTATION FOR VIBRATION MEASUREMENT

UNIT IV  INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS
Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT V  METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL

OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.
REFERENCES:

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

COURSE OBJECTIVES:
- To learn the present energy scenario and the need for energy conservation.
- To understand the different measures for energy conservation in utilities.
- Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
- To identify the energy demand and bridge the gap with suitable technology for sustainable habitat.
- To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement.

UNIT I ENERGY SCENARIO

UNIT II HEATING, VENTILATION & AIR CONDITIONING

UNIT III LIGHTING, COMPUTER, TV

UNIT IV ENERGY EFFICIENT BUILDINGS

UNIT V ENERGY STORAGE TECHNOLOGIES
Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.
REFERENCES:

OME433 ADDITIVE MANUFACTURING

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

UNIT III VAT POLYMERIZATION

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION

POWDER BASED PROCESS

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES

TOTAL: 45 PERIODS
REFERENCES:

OME434 ELECTRIC VEHICLE TECHNOLOGY

UNIT I NEED FOR ELECTRIC VEHICLES
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II ELECTRIC VEHICLE ARCHITECTURE
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV ELECTRIC DRIVES AND CONTROL
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor -drives and control, AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers

UNIT V DESIGN OF ELECTRIC VEHICLES

TOTAL: 45 PERIODS

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of Industrial design and prototype for new product design and development.

UNIT I  INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT  9

UNIT II  OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING  9

UNIT III  IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS  9

UNIT IV  CONCEPT GENERATION, SELECTION & TESTING  9

UNIT V  INDUSTRIAL DESIGN & PROTOTYPING  9

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and test the concepts for new product design and development.
5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:
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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

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 CREATING 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 - Turnaroud strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS
COURSE OUTCOMES
CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
3. Journal articles on SME’s.

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

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

UNIT I INTRODUCTION
9
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS
9
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES
9

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY
9
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS
9
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

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.

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 9
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS 9
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.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations
ET4251  IoT FOR SMART SYSTEMS

COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I  INTRODUCTION TO INTERNET OF THINGS
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II  IOT ARCHITECTURE

UNIT III  PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIP, 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
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPERY PI and Arduino.

UNIT V  CASE STUDIES
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

REFERENCES
REFERENCES:

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

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

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

UNIT II NEURAL NETWORKS

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

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1 : Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:

PX4012  RENEWABLE ENERGY TECHNOLOGY  \text{L T P C}  3 0 0 3

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

UNIT I  INTRODUCTION  9
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  9
UNIT III PHOTOVOLTAIC SYSTEM DESIGN 9
Block diagram of solar photo voltaic system: Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification - standalone PV systems - Grid tied and grid interactive inverters - grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS 9

UNIT V OTHER RENEWABLE ENERGY SOURCES 9
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

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

REFERENCES:

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

REFERENCES

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
Model of network security – Security attacks, services and mechanisms – OSI security architecture

UNIT II NETWORK SECURITY

UNIT III SECURITY MANAGEMENT

UNIT IV CYBER SECURITY AND CLOUD SECURITY

UNIT V PRIVACY AND STORAGE SECURITY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES
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  6

UNIT II  CLOUD PLATFORM ARCHITECTURE  12

UNIT III  AWS CLOUD PLATFORM - IAAS  9

UNIT IV  PAAS CLOUD PLATFORM  9

UNIT V  PROGRAMMING MODEL  9
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

TOTAL: 45 PERIODS

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

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
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

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 L T P C
3 0 0 3

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 9

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

TOTAL: 45 PERIODS

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.

REFERENCE:

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  L T P C
3 0 0 3

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

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

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

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

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

UNIT III  SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study
UNIT IV  REHABILITATION AND ASSISTIVE ROBOTS
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication, Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

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

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

VE4202  EMBEDDED AUTOMATION  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system
UNIT I  INTRODUCTION TO EMBEDDED C PROGRAMMING
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

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

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

UNIT IV  VISION SYSTEM

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

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

TOTAL: 45 PERIODS

REFERENCES:
### CX4016 ENVIRONMENTAL SUSTAINABILITY

<table>
<thead>
<tr>
<th>Unit</th>
<th>Introduction</th>
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<td></td>
<td>Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems</td>
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<tr>
<th>Unit</th>
<th>Concept of Sustainability</th>
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<td>Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture</td>
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<th>Significance of Biodiversity</th>
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<td>Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation</td>
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<th>Pollution Impacts</th>
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<td>Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.</td>
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<th>Unit</th>
<th>Environmental Economics</th>
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<td></td>
<td>Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics</td>
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**REFERENCES**


### TX4092 TEXTILE REINFORCED COMPOSITES

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<th>Unit</th>
<th>Reinforcements</th>
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<tr>
<td></td>
<td>Introduction – composites – classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites</td>
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<td>Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices</td>
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<th>Unit</th>
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<td>Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements</td>
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<td>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.</td>
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</table>
REFERENCES

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:

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

**UNIT I  IPR**  

**UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES**  

**UNIT III BIOSAFETY**  

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

**UNIT V ENTREPRENEURSHIP DEVELOPMENT**  

**TOTAL : 45 PERIODS**
REFERENCES