1. PROGRAMME EDUCATIONAL OBJECTIVES (PEO’S):

Graduates of the Programme M.E Infrastructure Engineering & Management will

I. Graduates will apply management and economic theories to formulate strategies to enable organizations to achieve their goals

II. Graduates of the programme will serve as project leaders with critical-thinking and analytical decision-making capabilities

III. Graduates will be capable of integrating their knowledge of multi-disciplines of management to analyze construction industry problems

IV. Graduates of the programme will contribute as team members adding value through innovation, customer focus, prudence, and professional responsibility, consistent with the objectives of the projects in which they are involved and the organizations they support.

V. Graduate of the programme will have competence of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

2. PROGRAMME OUTCOMES (POs):

POs describe what students are expected to know or be able to do by the time of post-graduation from the program. The Program Outcomes of M.E Infrastructure Engineering and Management are as follows:

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<tr>
<th>PO</th>
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<tr>
<td>PO 1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems.</td>
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<td>Research Methodology and IPR, Project Management for Infrastructure, Urban Transportation Systems Planning, Infrastructure Planning and Management, BIM and Project Management Laboratory, Geographical Information Systems for Infrastructure Planning, Advanced Structural Design, Geo Technical Engineering for Infrastructures, GIS Laboratory, Infrastructure Material testing lab, Project Work I, Project Work II</td>
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<td>PO 2</td>
<td>An ability to write and present a substantial technical report/document</td>
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<td>Students should be able to demonstrate a degree of mastery over the area of infrastructure engineering and management.</td>
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4. PEO/PO Mapping:

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Mapping of Course Outcomes and Programme Outcomes

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

SEMMESTER I

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# Audit Courses (AC)

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MA4159  STATISTICAL METHODS FOR ENGINEERS

OBJECTIVES:

- This course is designed to provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis, correlation and regression, design of experiments and multivariate analysis.

UNIT I  ESTIMATION THEORY

12

UNIT II  TESTING OF HYPOTHESIS

12
Sampling distributions - Small and large samples -Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III  CORRELATION AND REGRESSION

12
Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order coefficients.

UNIT IV  DESIGN OF EXPERIMENTS

12
Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design - $2^2$ Factorial design.

UNIT V  MULTIVARIATE ANALYSIS

12
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

OUTCOMES:

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

- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Concept of linear regression, correlation, and its applications.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES:

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IM4101 PROJECT MANAGEMENT FOR INFRASTRUCTURE

OBJECTIVES:


UNIT I PROJECT MANAGEMENT - AN OVERVIEW: 6+3
Introduction, Project Management process, Project Management techniques, Relationship to other management disciplines, Related endeavors, Concentric project management, Project formulation and development

UNIT II PROJECT PLANNING AND TIME MANAGEMENT: 6+3
Purpose, Project scheduling, activity definition, activity sequencing, activity duration estimating, schedule development, schedule control, project management using CPM\PERT- Network basics, Network development, PERT analysis, advantages. Computerized network analysis- features of PM software, capabilities of PM software, multi project analysis,

UNIT III ORGANIZING FOR PROJECT MANAGEMENT: 6+3

UNIT IV RESOURCE PLANNING: 6+3
Introduction, Inputs, Tools, Outputs, Resource scheduling, Resource leveling, Resource restrained scheduling, strategies for shortening the schedule Assigning resources: Work, duration, resources, Effort driven scheduling, create a resource list, Exercise on resource planning using software, Level now command, leveling Gantt chart, assigning rate to resources, techniques of duration cost trade-off.

UNIT V COST ESTIMATION: 6+3

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 Explain project, project management, life cycle and project formulation
- CO2 Analyze and Manage time in projects through Gantt charts, and network techniques.
- CO3 Analyze and manage time in projects through CPM and PERT, update and monitor projects
- CO4 Optimize resources of projects using scheduling, fast tracking and re-estimation techniques
- CO5 Explain different approaches for estimating cost
REFERENCES:
3. Tim Pyron – Microsoft Project 2000 in 24 hours – Sama Teach yourself series- Tech Media Published New Delhi.

COs- PO's & PSO's MAPPING

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IM4102 URBAN TRANSPORTATION SYSTEMS PLANNING L T P C 3 0 0 3

OBJECTIVES:
- To make the leaners to understand and explain the principles of the transportation system planning, covering both passenger and freight transports and the methodology of effective management of transport systems.

UNIT I INTRODUCTION
Introduction and concepts; demand for transport – nature of demand, temporal and special variations; factors influencing demand for transport; effect of land use and socioeconomic activities on the demand; conceptual difference between urban, interurban and regional transport planning processes; Interaction of land-use and transport planning processes; urban transport planning process (morphology).

UNIT II TRIP GENERATION AND DISTRIBUTION
Trip production process; household characteristics; classification based on trip purpose – trips for work, education, shopping, social and recreational purposes; influencing variables of trips made for different purposes; modelling trip production. Trip attraction process; attraction of trips for different purposes, factors influencing trip attraction for different trip purposes; modelling trip attraction. Presentation of trip distribution data – OD matrix, PA matrix to depict trip distribution among zones; factors influencing trip distribution; variable formulation, modelling trip distribution; Gravity model of trip distribution; calibration of Gravity models.

UNIT III MODE CHOICE ANALYSIS
Mode choice for different trip purposes; Influencing factors – socioeconomic characteristics of travelers and characteristics of the different modes of transport; influence of trip purpose on mode choice; modelling mode choice of travelers - trip-end and trip-interchange modelling; Disaggregate mode-choice models; utility concept; Logit model of mode choice; model calibration; model validation.
UNIT IV  ROUTE ASSIGNMENT AND TRANSPORTATION SURVEYS

Route assignment – description of transport network for route assignment; influencing variables and assignment algorithms; all-or-nothing assignment; multipath traffic assignment; capacity restrained traffic assignment. Transportation surveys – inventory of existing travel pattern, transport facilities and land-use and economic characteristics; definition of the study area; cordon lines; zoning; types of movements in the study area; types of planning related surveys.

UNIT V  THE OTHER RELATED TOPICS

Transport related land-use models – Land-use estimation procedure; the Lowry model of land use; the equation system; allocation functions; zonal constraints. Urban Structure – urban activity systems; urban movement hierarchies; types of urban structure - centripetal, grid and linear types. Urban goods movement – factors influencing urban goods movement; classification of urban goods movement; principles of modeling urban goods movement.

TOTAL: 45 PERIODS

OUTCOMES:
C01 Explain transportation planning concepts, the planning morphology and distinction between urban and interurban transportation planning processes.
C02 Explain trip generation and trip distribution processes; formulate causal variables and develop trip generation and trip distribution models.
C03 Identify and analyze the factors influencing mode-choice of urban travelers, calibrate logit model of mode choice to apply for the given urban area.
C04 Develop route assignment variables and calibrate route choice models for assignment of trips distributed to the traffic zones in an urban area.
C05 Explain the conceptual analytical aspects transport related land-use models; describe the principals involved in urban structure and urban goods movement.

REFERENCES:

COs- PO’s & PSO’s MAPPING

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IM4103  INFRASTRUCTURE PLANNING AND MANAGEMENT  L T P C
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OBJECTIVES:
- To understand and explain concepts of infrastructure, private involvement in infrastructure, challenges to successful infrastructure planning and implementation, strategies for successful infrastructure project implementation, sustainable development of infrastructure
UNIT I AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE:  9
Introduction to Infrastructure, an overview of the Power Sector in India., an Overview of the Water Supply and Sanitation Sector in India., an overview of the Road, Rail, Air and Port Transportation Sectors in India., an overview of the Telecommunications Sector in India, an overview of the Urban Infrastructure in India, an overview of the Rural Infrastructure in India, an Introduction to Special Economic Zones, Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle., an overview of Infrastructure Project Finance.

UNIT II PRIVATE INVOLVEMENT IN INFRASTRUCTURE:  9

UNIT III CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION:  9
Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks: The Case study for Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.

UNIT IV STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION:  9
Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.

UNIT V SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE:  9

TOTAL: 45 PERIODS

OUTCOMES:
CO1 Explain the basic concepts related to Infrastructure Projects
CO2 Discuss the role of private sector in infrastructure growth.
CO3 Describe the strategies for successful Infrastructure Project implementation.
CO4 Develop Infrastructure modeling and Life Cycle Analysis Techniques.
CO5 Explain Sustainable development of Infrastructure

REFERENCES:

COs- PO's & PSO's MAPPING

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

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

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

UNIT IV  INTELLECTUAL PROPERTY RIGHTS  6

UNIT V  PATENTS  6

TOTAL :30 PERIODS

REFERENCES

OBJECTIVES
- To Conduct Laboratory tests on BIM and hands on practice in Project Management Package.

EXPERIMENTS:

BIM Lab
1. Introduction to BIM
2. 2D and 3D Exercises
3. Infrastructure Modelling
4. Introduction to GEOBIM exercises

Project Management Lab
5. Breaking down project components.
6. Defining custom data items.
7. Planning resources and costs.
9. Quantity and Cost Estimation
11. Mini project

TOTAL: 60 PERIODS

SYSTEM SPECIFICATIONS
HP Desktops Computers - 18 Nos
(Intel i7 core, 4 GB RAM, 1 TB HDD and 1 GB Graphics card)

SOFTWARES
1. MS Project – 10 users (latest Version)
2. Primavera – 10 users (latest Version)
3. MS Office – Excel
4. Revit
5. AutoCAD

OUTCOMES:
CO1- Explain the importance of BIM in Infrastructure Projects
CO2- Develop 2D and 3D Exercises using BIM
CO3- Apply the concept of Modelling in Infrastructure Projects
CO4- Implement MS project in planning infrastructure projects
CO5- Practice MS Project and Primavera Software packages

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IM4201 INFRASTRUCTURE CONTRACT MANAGEMENT

OBJECTIVES:
- To study the various types of construction contracts and their legal aspects and provisions.
- To study the of tenders, arbitration, legal requirement, and labour regulations.

UNITI CONSTRUCTION CONTRACTS
UNITII TENDERS

UNITIII ARBITRATION

UNITIV LEGALREQUIREMENTS

UNITV LABOURREGULATION

TOTAL: 45 PERIODS

OUTCOME:
CO1- Explain different types of contracts in construction, arbitration and legal aspect and its provisions.
CO2-Analyse the Tenders based on Technical, Contractual and Commercial points of View
CO3- Describe the powers and duties of Arbitrator
CO4- Examine the legal Requirements of Purchase of Urban and Rural land
CO5- Discuss the laws relating to Wages, Bonus and Industrial Disputes

REFERENCES:
1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India,

COs- PO’s & PSO’s MAPPING

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OBJECTIVES:
- To Understand and Explain maps and GIS, DBMS, GIS data model, Data input, Data Analysis, GIS output design and presentation.

UNIT I  INTRODUCTION TO MAPS AND GIS  6+3

UNIT II  DBMS AND GIS DATAMODEL  6+3

UNIT III  GIS DATA INPUT  6+3

UNIT IV  GIS DATA ANALYSIS  6+3
Introduction to spatial analysis - Raster Data Spatial Analysis: Local, Neighborhood, Zonal Operations - Vector Operations and Analysis: Topological and Non-topological operations - Network Analysis – DEM – Surface Analysis

UNIT V  GIS OUTPUT DESIGN AND PRESENTATION  6+3
Introduction - Spatial and non-spatial data presentation - Map layout – Charts, graphs and multimedia output – Elements of spatial data quality – Meta data - introduction to web GIS – Applications in civil Engineering

OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Understand the fundamentals of maps, their characteristics and GIS, its components
CO2 Appreciate various spatial data models and their advantages
CO3 Produce an error free GIS database for civil engineering applications
CO4 Apply various spatial analysis tools for deriving GIS based outcome
CO5 Present the spatial information along with quality assessment for applications

TEXT BOOKS

COs- PO’s & PSO’s MAPPING

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OBJECTIVES:
- To explain the soil investigation and instrumentation in the field.
- To explain the different types of dewatering and method for safe excavation.
- To design safe foundation on different soil and quality assurance in piling.
- To understand different ground improvement techniques.
- To learn about sustainability in geotechnical projects.

UNIT I  GEOTECHNICAL FIELD INVESTIGATION

UNIT II  DEWATERING, EXCAVATION AND ITS SUPPORTS

UNIT III  FOUNDATION CONSTRUCTION

UNIT IV  GROUND IMPROVEMENT TECHNIQUES

UNIT V  GEOTECHNICS TOWARDS SUSTAINABILITY

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1 Apply the basic elements of site investigation and explain the interpretation of the soil field/lab testing report and collect pertinent information for geotechnical design.
CO2 Critically assess the effectiveness of dewatering and various excavation methods and promote the safety of construction.
CO3 Determine the bearing capacity of shallow and deep foundations on different terrain, including their expected settlement.
CO4 Identify an appropriate method of ground improvement and design remedial measures where necessary.
CO5 Evaluate the key challenges associated with ensuring the sustainability of the project and recommend appropriate state-of-the-art design solutions using geosynthetics for specific problem scenarios.
REFERENCES:
11. IS 2720: All parts: 1990 Methods of Test for Soils
13. IS 4453: 1980 Code of Practice for Subsurface Exploration by Pits, Trenches, Drifts and Shafts
14. IS 4464: 1985 Code of Practice for Presentation of Drilling Information and Core Description in Foundation Investigation.

COs- PO’s & PSO’s MAPPING

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IM4204 ADVANCED STRUCTURAL DESIGN

OBJECTIVES:
- To understand and explain the design of special RC Elements, Steel Structures, Industrial Buildings, Tall Building and special structures.

UNIT I DESIGN OF SPECIAL RC ELEMENTS

UNIT II DESIGN OF COLD FORMED STEEL STRUCTURES

UNIT III TALL BUILDING
The Tall Building in the Urban Context - The Tall Building and its Support Structure - Development of High Rise Building Structures - General Planning Considerations. Dead Loads - Live Loads-

UNIT IV ANALYSIS AND DESIGN OF SPECIAL STRUCTURES

UNIT V PRESTRESSED CONCRETE
Principles of Pre-stressing - Types and Systems of Pre-stressing, need for High Strength materials, Analysis, methods losses, deflection (short- long term), camber, cable layouts - Behavior of flexural members, determination of ultimate flexural strength - Cocal provisions - Design of flexural members, Design for shear, bond and torsion. Design of end blocks.

TOTAL: 45 PERIODS

COURSE OUTCOME
CO1 Design various concrete structures and structural elements by limit state design and detailing for ductility as per codal requirements.
CO2 Describe the design procedure for special structures such as Deep beams, Corbels, Deep beams, and Grid floors.
CO3 Design steel structures for different load conditions.
CO4 Explain the design procedure for different types of industrial structures.
CO5 Analyze and Design Bunkers, Silos and Chimneys.

REFERENCES:

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OBJECTIVES:
- To Demonstrate and Acquire skills in using GIS software package.

EXERCISES:
- Data Input – Onscreen Digitization – Creation of Point, Line and Polygon layers
- Projection, Re-projection and Coordinate Transformation of Maps
- Attribute data input and Measurement of Distance, Area
- Linking External Database and Tabular Data Analysis using SQL commands
- Generating Graphs, Charts and Diagrams from Tabular data
- Data Conversion – Vector to Raster and Raster to Vector
- Map Joining, Edge Matching and Layout Design
- Map compilation and Design

TOTAL: 60 PERIODS

SYSTEM SPECIFICATIONS
HP Desktop Computers - 18 Nos
(Intel i7 core, 4 GB RAM, 1 TB HDD and 1 GB Graphics card).

SOFTWARES
i) ESRI – ArcGIS (latest Version) – 18Users
ii) Quantum GIS (Open Source) – 18Users

OUTCOMES:
CO1 Describe the Projection Systems and their applications
CO2 Compile and Design a typical map with suitable map elements
CO3 Generate Spatial Databases through spatial and non-spatial data input
CO4 Analyze attribute data using SQL commands
CO5 Present the outcome in spatial and pictorial form

REFERENCE:

COs- PO’s & PSO’s MAPPING

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OBJECTIVES

- To conduct experiments on construction materials by providing advanced tools & expertise for the pursuit of industrial, field and academic research.
- To understand the application of computational tools in infrastructure engineering design and analysis.
- To prepare, interpret and comprehend the field and laboratory testing for sustainable design and construction of infrastructure.
- To understand the importance of QC/AQ in field construction practices.

EXPERIMENTS

Concrete Engineering Lab
1. Cube Testing – Mix Design
2. Rheology of concrete
3. Fabrication, casting and testing of simply supported Reinforced Concrete Beam for Strength and Deflection behaviour
4. Testing of Simply Supported Steel Beam for Strength and Deflection Behavior.
5. Non-Destructive Testing using Concrete Test Hammers, Ultrasonic pulse velocity testers.
6. Multibay portal frame Analysis using STADDPRO software

Geotechnical Engineering Lab
1. Direct Shear Test
2. Consolidation Test
3. Unconfined Compressive test
4. Triaxial shear test (Drained and Un-drained test)
5. CBR Test.
6. Geotextile Testing
7. Slope stability, bearing capacity and settlement analysis using PLAXIS software.

Environmental Engineering Lab
1. Water testing for construction as stated in IS 456.

EQUIPMENTS

1. Loading frame of 100-ton capacity with required accessories
2. Compression Testing Machine (CTM) with required accessories
3. RCPT test Apparatus/ Sulphate resistance Apparatus
4. V-funnel and L-box Apparatus
5. CBR test Apparatus
6. Sorptivity test Apparatus
7. Tri-axial equipment
8. Consolidometer Accessories include Consolidation Ring Porous Stones, Consolidation Cell, Dial Gauges, Loading Device, Equipment for measuring Initial Height of Test Specimen to an accuracy of 0.1 mm
9. Unconfined compressive strength test equipment consists of trimmers, saws, extruders, and moulding components.
10. Direct shear test consists of shear box, soil container, loading unit, proving ring, dial gauge to measure shear deformation and volume changes
11. NDT equipment consists of Concrete Test Hammers, Ultrasonic pulse velocity testers
12. STAAD PRO & PLAXIS Software
13. Geotextile Permeameter
14. Water testing equipment & Chemicals

Course Outcomes

CO1- Characterize the operational principles of various types of material testing apparatuses and distinguish the merits and pitfalls of different types of tests.
CO2 - Apply rigorous standard testing methods to conduct laboratory tests and interpret test results.

CO3 - Perform QC/QA on the materials used for infrastructure engineering and quantify aspects of the sustainability in the selection of the materials.

CO4 - Demonstrate the computational tools in the analysis of infrastructure projects.

CO5 - Prepare testing report based on field, laboratory and computational techniques.

REFERENCES:
1. IS 2720: All parts: 1990 Methods of Test for Soils
2. IS 3025: Methods of sampling and testing of water
5. IS 1199 (1959): Methods of sampling and analysis of concrete.

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IM4311 SEMINAR

OBJECTIVE:
- To work on a specific technical topic in Infrastructure 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 Infrastructure 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 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

OUTCOME:
- On completion of the course, the student is expected to be able to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences.

IM4312 INDUSTRIAL TRAINING (4 WEEKS)

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

SYLLABUS: The students individually undertake training in reputed engineering companies doing Infrastructure Engineering during the summer vacation for a specified duration of four weeks. At the end of 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.

OUTCOME:
• On completion of the course, the student is expected to be able to develop skills in facing and solving the problems experiencing in the Infrastructure Engineering field.

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

SYLLABUS:
The student individually works on a specific topic approved by faculty member who is familiar in 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 clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

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

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

SYLLABUS:
The student should continue the phase I work on the selected topic as per the formulated methodology. 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 through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOME:
• On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.
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

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

| CO1 | Explain the importance of maintenance assessment and repair strategies |
| CO2 | Acquire knowledge on strength and durability properties and their effects due to climate and temperature. |
| CO3 | Gain knowledge in 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. |
OBJECTIVES:
- To Understand and Explain various types of Material Procurement, Management, Stores management and Quality Control

UNIT I INTRODUCTION:
Importance of material management and its role in construction industry scope, objectives and functions, Integrated approach to materials management, Role of materials manager.

UNIT II CLASSIFICATION AND CODIFICATION OF MATERIALS OF CONSTRUCTION:

UNIT III INVENTORY MANAGEMENT
Store Purchase Manual, Contractors Obligation. Inventory Control techniques. EOQ, Advantages and limitation of use of EOQ, Periodic ordering, order point control, safety stock, stock outs, application of AC analysis in inventory control, concept of (JIT) - Just in time management, Indices used for assessment of effectiveness of inventory management.

UNIT IV STORES MANAGEMENT:
Receipt and inspection, care and safety in handling, loss on storage, wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.

UNIT V QUALITY CONTROL

TOTAL: 45 PERIODS

OUTCOMES:
- CO1 Identify the need and role of material management Understand
- CO2 Classify materials, identify sources of procurement, conduct vendor analysis
- CO3 Exercise control for effective management of inventory
- CO4 Manage stores and exercise quality control on materials
- CO5 Apply MMS in planning, procurement, inventory and cost control, evaluate projects and manage risks
REFERENCES

CN4072 ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION

OBJECTIVE:
- To introduce the various aspects of Construction economics and finance with the systematic evaluation of cost and benefit associated with different projects.

UNIT I BASIC PRINCIPLES
Time Value of Money – Cash Flow diagram – Nominal and effective interest- continuous interest. Single Payment Compound Amount Factor (P/F,F/P) – Uniform series of Payments (F/A,A/F,F/P,A/P)– Problem time zero (PTZ)- equation time zero (ETZ). Constant increment to periodic payments – Arithmetic Gradient(G), Geometric Gradient (C).

UNIT II COMPARING ALTERNATIVES PROPOSALS
Comparing alternatives- Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis, Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR)Analysis, Benefit/Cost Analysis, Break Even Analysis.

UNIT III EVALUATING ALTERNATIVE INVESTMENTS
Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – GST- Input Tax Credit (ITC) – Assessment and Administration of GST – Inflation.

UNIT IV FUNDS MANAGEMENT

UNIT V FUNDAMENTALS OF MANAGEMENT ACCOUNTING

TOTAL : 45 PERIODS
OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Summarize the basic principles of Economic in construction
  CO2 Evaluate alternate proposals
  CO3 Evaluate alternative investments
  CO4 Select best source of finance for a project
  CO5 Elaborate the finance and accounting

REFERENCES:

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CN4074 ORGANIZATIONAL BEHAVIOUR L T P C

OBJECTIVE:
- To learn basic concepts of organizational behavior.
- To gain a solid understanding of human behavior in the workplace from an individual.
- To gain a solid understanding of human behavior in the workplace in the group.
- To learn the concepts of Leadership and power.
- To learn the dynamics of organizational behavior.

UNIT I INTRODUCTION TO ORGANIZATIONAL BEHAVIOUR 9
Definition, need, and importance of organizational behaviour –Nature and scope –Frame work –Organizational behaviour models.

UNIT II INDIVIDUAL BEHAVIOUR 9

UNIT III GROUP BEHAVIOUR 9
UNIT IV  LEADERSHIP AND POWER  9

UNIT V  DYNAMICS OF ORGANIZATIONAL BEHAVIOUR  9

TOTAL: 45 PERIODS

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

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<td>Explain the various learning theories and develop alternative organizational behavior approaches in the workplace</td>
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<td>Describe the importance of group dynamics and team building.</td>
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<td>Explore the various leadership styles and politics.</td>
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<td>Explain the dynamics of organizational behaviour with the balance of work life.</td>
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IM4002 MANAGEMENT OF HUMAN RESOURCE AND QUALITY  L T P C
3 0 0 3

OBJECTIVES :
- To understand and Explain Management of Human Resources, Labour Legislation, Quality Assurance and Control, Quality management in Construction and Total Quality Management.

UNIT I  HUMAN RESOURCES MANAGEMENT  9
UNIT II  
**LABOUR LEGISLATION**  
Labour laws- labour law relating to construction industry- Interstate Migration-Industrial relations- Collective bargaining- Worker’s participation in management. Grievance handling- discipline-role of law enforcing agencies and judiciary – women in construction industry.

UNIT III  
**QUALITY ASSURANCE AND CONTROL**  

UNIT IV  
**QUALITY MANAGEMENT IN CONSTRUCTION**  

UNIT V  
**TOTAL QUALITY MANAGEMENT**  

TOTAL: 45 PERIODS

COURSE OUTCOME:

CO1 Explain the need and importance of human resource management, labour laws relating to Construction industry

CO2 Identify the need and measures to improve safety in construction industry and safety audit

CO3 Explain the need for applying ergonomics to construction industry

CO4 Enumerate the need, importance, elements of quality and significance of quality assurance in industry

CO5 Explain the principles of Total Quality Management.

REFERENCES:

OBJECTIVE:

- To gain knowledge about construction supply chain management.
- To understand the concepts of strategic perspectives.
- To understand the concepts of integrated data management.
- To understand the concepts of construction logistics and sustainability.
- To understand the concepts of logistics operations.

UNIT I  INTRODUCTION  9

UNIT II  STRATEGIC PERSPECTIVES  9
Challenge of construction logistics - Aggregating global products for just-in-time delivery to construction sites - Construction Logistics - Supply of bulk materials - Effective management of a construction project supply chain - Construction supply chain management strategy.

UNIT III  INTEGRATED DATA MANAGEMENT  9
Impact of BIM and new data management capabilities on supply chain management in construction - Data management for integrated supply chains in construction

UNIT IV  CONSTRUCTION LOGISTICS AND SUSTAINABILITY  9
Role of logistics in achieving sustainable construction - Resource efficiency benefits of effective logistics

UNIT V  LOGISTICS OPERATIONS  9
Role of the construction logistics manager - Third-party logistics operators in construction - Managing construction logistics for confined sites in urban areas - Consolidation centers in construction logistics - Delivery management systems.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1 Describe the conceptual and theoretical backgrounds of Supply Chain Management and logistics

CO2 Apply the strategy in logistics functions ranging from planning to execution and control.

CO3 Identify the Impact of BIM and new data management capabilities on supply chain management in construction.

CO4 Analyze the implications of various strategic choices and decide on a better course of action.

CO5 Understand the role of construction logistic Managers and Delivery management systems.

REFERENCES:

4. G Srinivasan, Quantitative Models in Operations and Supply Chain Management, PHI Learning (P) Ltd, New Delhi, 2010
5. David J. Bloomberg, Stephen Lemay and Joe B. Hanna, Logistics, PHI 2010
OBJECTIVE:

- To impart knowledge about the basics of lean construction.
- To impart knowledge about the lean principles.
- To impart knowledge about the core concepts of lean construction.
- To impart knowledge about the lean tools and techniques.
- To impart knowledge about the basics of lean implementation in the construction industry.

UNIT I  INTRODUCTION

UNIT II  LEAN MANAGEMENT
Introduction to lean management – Toyota's management principle-Evolution of lean in the construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design – Lean project delivery system- Forms of waste in the construction industry – Waste Elimination.

UNIT III  CORE CONCEPTS IN LEAN

UNIT IV  LEAN CONSTRUCTION TOOLS AND TECHNIQUES

UNIT V  LEAN CONSTRUCTION IMPLEMENTATION
Lean construction implementation- Enabling lean through information technology – Lean in design - Design Structure Matrix Location Based Management System-BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach

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

CO1 Explains the contemporary management techniques and the issues in the present scenario.
CO2 Apply the basics of lean management principles and their evolution from the manufacturing industry to the construction industry.
CO3 Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.
CO4 Apply lean techniques to achieve sustainability in construction projects.
CO5 Apply lean construction techniques in design and modeling
REFERENCES:

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IM4003 VALUE ENGINEERING

OBJECTIVES:
- To Understand and Explain Value Engineering, Estimation, Job Plan, Reliability estimation and Various Phases.

UNIT I INTRODUCTION
Value Engineering (VE) and Value Analysis (VA) - Life Cycle of a product- Methodology of value engineering – Difference from the conventional methods of cost reduction- Unnecessary costs reasons- Quantitative definition of value- Use value and Prestige value.

UNIT II ESTIMATION

UNIT III JOB PLAN
Functional approach to value improvement-various phases and techniques of Job Plan – Factors governing project selection – Types of Projects-Life Cycle Costing (LCC) for managing the Total Value- Concepts in LCC – Present value concept- Annuity concept- Net Present value- Payback period -Internal rate of return on Investment (IRR)-Examples and Illustrations.

UNIT IV RELIABILITY ESTIMATION
Creative thinking and creative judgment- positive or constructive discontent- Tangible and Intangible costs of Implementation-False material-labour and overhead saving – Relationship between savings and probability of success- Reliability Estimation-System reliability- Reliability elements in series and parallel.

UNIT V VARIOUS PHASES
General Phase-Information Phase – Type of costs- Function Phase – Evaluation of Functional Relationships- Checks for Consistency-Function –cost-weight-matrix-VIP Index – High cost and Poor
value areas- Creativity/Speculation Phase – Rules of Creativity-Brainstorming- Idea activators-

TOTAL :45 PERIODS

COURSE OUTCOME
CO1 Establish the Value engineering methodology
CO2 Recognize the various phases of value engineering
CO3 Perform function cost worth analysis
CO4 Create the ideas for solving the problems
CO5 Analyze the functional importance and functional cost

REFERENCES
2. A.D. Raven, Profit Improvement through Value Analysis, value Engineering and Purchase Price
Analysis, Cassell and Co. London. (1971)
5. Value engineering, Mukhopadhyaya, Anil Kumar, Response Books, New Delhi, ISBN: 0-7619-

IM4004 SAFETY IN CONSTRUCTION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
• To Understand and Explain the of construction accidents, safety programmes, contractual
obligations, and design for safety.

UNITI CONSTRUCTION ACCIDENTS 9
Accidents and their Causes – Human Factors in Construction Safety – Costs of Construction Injuries
– Occupational and Safety Hazard Assessment – Legal Implications.

UNITII SAFETY PROGRAMMES 9
Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site
Safety Assessment – Safety Meetings – Safety Incentives.

UNITIII CONTRACTUAL OBLIGATIONS 9
Safety in Construction Contracts – Substance Abuse – Safety Record Keeping.

UNITIV DESIGNING FOR SAFETY 9
Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers –
Obligation – Project Coordination and Safety Procedures – Workers Compensation.

UNITV OWNER’S AND DESIGNER’S OUTLOOK 9
Owner’s responsibility for safety – Owner preparedness – Role of designer in ensuring safety –
Safety clause in design document.

TOTAL :45 PERIODS

COURSE OUTCOME
CO1 Explain the construction accidents
CO2 Explain the safety programme.
CO3 Describe contractual obligations.
CO4 Explain the safety design.
CO5 Explain the outlook of owner and designer.
REFERENCES:
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt Construction Safety and

ST4091 DESIGN OF BRIDGE STRUCTURES

OBJECTIVE:
- To study the loads, forces on bridges and design principles of several types of bridges.

UNIT I INTRODUCTION
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
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
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
Design of bridge bearings and substructure

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

TOTAL: 45 PERIODS

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

| CO1 | Explain the different types of bridges and design philosophies |
| CO2 | Design an RC solid slab culvert bridge |
| CO3 | Design an RC Tee Beam and Slab bridge |
| CO4 | Design the bridge bearings and substructure |
| CO5 | Explain the design principles of PSC bridges, box girder bridges, truss bridges |

REFERENCES:
OBJECTIVES:

- To Understand and Explain Special Concrete, Metals, Composite and other materials, Sub structure construction and super structure construction.

UNIT I  SPECIAL CONCRETES

UNIT II  METALS

UNIT III  COMPOSITES AND OTHER MATERIALS
Types of Plastics – Properties & Manufacturing process – Advantages of Reinforced polymers– Types of FRP–FRP on different structural elements – Applications of FRP - Types and properties of Water Proofing Compounds – Types of Non-Weathering Materials and its uses – Types of Flooring and Facade Materials and its application Types & Differences between Smart and Intelligent Materials - Special features – Case studies showing the applications of smart & Intelligent Materials.

UNIT IV  SUB STRUCTURE CONSTRUCTION:
Box jacking- pipe jacking- under water construction of diaphragm walls and basement tunneling Techniques - cable anchoring and grouting-driving diaphragm walls, sheet piles, laying operations for built up offshore system- shoring for deep cutting- large reservoir construction- trenchless technology.

UNIT V  SUPERSTRUCTURE CONSTRUCTION FOR BUILDINGS:
Vacuum dewatering of concrete flooring - concrete paving Technology, Techniques of construction for continuous concreting, Operation in tall buildings of various shapes and varying sections – launching techniques- suspended form work - erection techniques of tall structures, Large span structures- launching techniques for heavy decks, in situ pre-stressing in high rise structures, aerial transporting, handling, erecting lightweight components on tall structures

TOTAL: 45 PERIODS

COURSE OUTCOME:
CO1 Explain the properties and applications of special concretes, composites, smart and intelligent materials
CO2 Identify and explain advanced construction techniques used for sub structure construction
CO3 Select appropriate techniques for super structure construction of buildings
CO4 Select suitable techniques for construction of special structures
CO5 Choose relevant technique for demolition and dismantling works

REFERENCES:
1. ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.

ST4071 ADVANCED PRESTRESSED CONCRETE

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
concrete bridges incorporating long-term effects like creep, shrinkage, relaxation, and temperature effects, Dynamic response of bridge decks.

TOTAL: 45 PERIODS

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

| CO   | Identify the various methods of prestressing and estimate the loss |
| CO2  | Design the beams for flexure, shear, bond and torsion             |
| CO3  | Design the continuous beams and composite beams                   |
| CO4  | Design the water tank, piles and masts                            |
| CO5  | Analyze and design the prestressed concrete bridge                |

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IM4006 ENVIRONMENTAL IMPACT ASSESSMENT FOR INFRASTRUCTURE PROJECTS

OBJECTIVES:
- To understand and Explain Overview, Prediction and Assessment, Health Assessment, Environmental management plan and Case studies.

UNIT I OVERVIEW
Sustainable Development challenges and need- Key approaches for Impact Assessment Assessing Environmental Impacts - EIA Approach: Historical development, Legal and Regulatory aspects in India, Types and Objectives, Components, Process of EIA.

UNIT II PREDICTION AND ASSESSMENT:
Tools, impact on air, water, soil & Noise, Role of Biodiversity Impact Assessment, Identification Prediction & Evaluation of Impacts on Biodiversity, Techniques of Biodiversity impact assessment, EIA Report Preparation
UNIT III HEALTH ASSESSMENT
Impact of Environment on Health, Developing framework for Health impact analysis, tools and techniques, Case studies. Socio-Economic Impact Assessment: Overview and Scope of Social Impact Assessment, S I A model and the planning process, Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN
Preparation and implementation, Mitigation and Rehabilitation plans, Post Project Audit. Integrated Analysis Of Environmental, Social And Health Impacts: Challenges for Integrated Approach, Scope for Integrated approach in economic analysis- C B A Social C B A , and Cost effectiveness Analysis, the Analytic Hierarchy process based approach to project appraisal, Emerging Dimensions and future Directions-Strategic Environmental Assessment, Technological Assessment and Risk Assessment.

UNIT V CASE STUDIES
Extraction of natural resources and power generation, Primary Processing and Material production, Material Processing, Manufacturing/Fabrication, Service Sectors, Physical Infrastructure including Environmental Services, Building/Construction Projects/Area Development Projects & townships.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1 Understand the necessity to study the impacts that will be caused by projects or industries and the methods to assess these impacts
CO2 Describe the legal requirements of environmental impact assessment for projects
CO3 Prepare terms of reference for environmental impact and socio-economic impact for any Developmental project
CO4 Prepare environmental management plan and mitigation measures by considering environmental aspects, impacts and potential hazards respectively for any project
CO5 Understand the primary processing and extraction of natural resources with case studies

REFERENCES

IM4007 URBAN ENVIRONMENTAL MANAGEMENT
OBJECTIVES:
- To understand and Explain Urban Environmental issues, Urban waste resources management, Urban water supply, Urban waste water management, Municipal solid waste management.

UNIT I URBAN ENVIRONMENTAL ISSUES
Urbanization- Population growth scenario Migration-Pollution of surface water resources rivers, tanks, channels ground water exploitation - wastewater - characteristics - pollution problems - Solid waste - air pollution – CPCB norms. Urban master plans- Planning and organizational aspects.
UNIT II URBAN WASTE RESOURCES MANAGEMENT 9
Water in urban ecosystem – urban water resources planning and organization aspects - storm water management practices - types of storage - magnitude of storage - storage capacity of urban components - percolation ponds - temple tanks - rainwater harvesting.

UNIT III URBAN WATER SUPPLY 9

UNIT IV URBAN WASTE WATER MANAGEMENT 9
Sewage generation - storm drainage estimation - industry contribution - wastewater collection system - separate and combined system - hydraulic design of sewer and storm drain - waste water treatment - disposal methods - concept of decentralization - 3R concepts.

UNIT V MUNICIPAL SOLID WASTE MANAGEMENT 9

COURSE OUTCOMES
CO1 Explain planning of a city and identify various urban environmental issues
CO2 Prepare Project Plans to integrate urban water resource
CO3 Explain water resource management using available water resources
CO4 Develop sustainable wastewater management concepts comparing with successful models followed in developed nation
CO5 Apply the principles of solid waste management

REFERENCES:

IM4008 LIFE CYCLE ANALYSIS AND DESIGN FOR THE ENVIRONMENT L T P C 3 0 0 3

OBJECTIVES:
To impart knowledge and skills on the concept and methodology of Life Cycle Assessment as per international standards and its potential applications to develop sustainable products and promote sustainable consumption.

UNIT I LIFE CYCLE THINKING AND LIFECYCLE MANAGEMENT 9
Introduction to Life Cycle Thinking – Industrial ecology – Life cycle management (LCM) and Stakeholder Expectations - LCM drivers and issues - materials flow analysis - Life cycle of Products and services - International organizations and networks - History and definition of LCA - analytical tools for product and service systems – Value creation along the life cycle – technical characteristics – applications - limitations
UNIT II LCA GOAL, SCOPE AND INVENTORY
ISO 14040 framework for LCA - Life cycle goal and scope definition - function, functional unit and reference flow - System boundaries, data categories, inputs and outputs, data quality, critical review and other procedural aspects - Inventory Analysis: Raw Material Extraction and Processing, Manufacturing and Production, Product Use and Consumption, End-of-life Management, Transportation and Distribution - Dealing with Allocation Issues - Solutions to the multi functionality problem - Flow diagram - Format and data categories - Attributional versus consequential LCI – LCA soft wares and database - Data quality - Data collection and relating data to unit processes - Data validation - Cut-off and data estimation –

UNIT III LIFE CYCLE IMPACT ANALYSIS AND INTERPRETATION

UNIT IV DESIGN FOR ENVIRONMENT AND ECOLABELLING

UNIT V LCA SOFTWARES AND CASE STUDIES

TOTAL: 45 PERIODS

OUTCOMES:
CO1 Explain the various functional elements of Life Cycle Analysis and Design for Environment
CO2 apply the knowledge of science and engineering fundamentals to characterize the environmental interactions of products and services
CO3 design of engineering systems taking into account the material flow and pollutant interactions between engineering decisions and the environment
CO4 select appropriate LCA tools to support product/process design and decision making, taking into account the impact of the solutions in a sustainability context
CO5 conduct research pertinent to Life Cycle Management and communicate effectively to different stakeholders in terms of eco labels as well as engage in independent life-long learning

REFERENCES:
OBJECTIVES:
- To Understand and Explain Sustainable Development, Environmental sustainability, Empowerment, Urban planning and Built in Environment

UNIT I INTRODUCTION TOSUSTAINABLEDEVELOPMENT:

UNIT II ENVIRONMENTALSUSTAINABILITY:

UNIT III EMPOWERMENT:
Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry - Sustainability indicators – Hurdles to Sustainability-Operational Guidelines-Interconnected prerequisites for sustainable development - Science and Technology for sustainable development - Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

UNIT IV URBAN PLANNING AND ENVIRONMENT:
Environment and Resources, Sustainability Assessment, Future Scenarios, Form of Urban Region, Managing the change, Integrated Planning, Sustainable Development

UNIT V THE BUILTIN ENVIRONMENT:
Urban Form, Land Use, Compact Development, Principles of street design- complete streets, Transport Integrated Urban land use Planning, Guidelines for Environmentally Sound Transportation

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1 Describe the concept and socio-economic policies of Sustainable Development
CO2 Identify the strategies for implementing eco development programmes
CO3 Identify different approaches for resource conservation and management
CO4 Suggest action plans for implementation of sustainable development
CO5 Explain Urban Planning environment
CO5 Understand the built in environment principles
REFERENCES

IM4010 INFRASTRUCTURE FOR SMART CITY PLANNING

OBJECTIVES:
• To learn about the state-of-the-art strategies for effectively managing the transition from legacy infrastructure to smart urban systems.
• To understand the management of smart urban transportation systems as well as smart urban energy systems.
• To gain a deep understanding of the nature of disruptive innovations in smart infrastructure systems.

UNIT I SMART CITIES – STATE OF THE ART

UNIT II SMART URBAN MOBILITY

UNIT III SMART ENERGY
Overview – Ways and means to be energy smart – Influence of urbanization and climate change – urban density and energy use – elements of smart energy management system – strategies in making a city energy smart – making of a smart grid – use of electric vehicles(EVs) – Smart energy transformation – Challenges in making cities energy smart.

UNIT IV SMART WATER AND WASTE MANAGEMENT

UNIT V E- GOVERNANCE AND IOT
The power of ICT to integrate urban services – Taxonomy of layers of ICT Architecture, Access layer, Application layer, Data Layer, Communication layer, instrumentation layer, IoT/M2M layer – Major

TOTAL: 45 PERIODS

COURSE OUTCOME

CO1 Explore and understand the fundamental concepts of smart and sustainable cities.

CO2 Explain the component of smart cities and dwell into their technological advancement.

CO3 Appreciate the involvement of stakeholders in the design and implementation of responsive smart cities.

CO4 Explain the importance of different linkages and their roles including government, urban planners, universities, city developers and communities.

CO5 Identify and recognize the role of ICT and data analytics in addressing the urban challenges and key issues

REFERENCES:
3. Jonathan Reichent, Smart Cities for Dummies, 2020
4. Kassim Rehana Dr, Big Data for a Sustainable Smart City, Partridge Publishing Singapore, 2020

IM4011 PAVEMENT MANAGEMENT SYSTEM L T P C 3 0 0 3

OBJECTIVE:
- To introduce the concepts of design, evaluation and performance of existing and new flexible and rigid pavements with due emphasis on systems approach and performance prediction models.

UNIT I PAVEMENT MANAGEMENT PROCESS 9
Historical background – general nature and applicability of systems methodology – basic components of Pavement Management System – Network and Project level of PMS - PMS functions-planning pavement investments.

UNIT II FUNCTIONAL EVALUATION AND PERFORMANCE 9

UNIT III PAVEMENT STRUCTURAL EVALUATION 9
Factors affecting Structural Condition of Flexible and Rigid Pavements- Pavement Deterioration-Evaluation by Non-Destructive Tests such as FWD, Benkelman Beam Rebound Deflection, Plate Load Test, Evaluation by Destructive Test Methods, and Specimen Testing - Structural analysis of Airfield pavements
UNIT IV PERFORMANCE PREDICTION MODELS
Pavement performance prediction - concepts, Techniques for developing prediction models – ranking and optimization methodologies- AASHO, CRRI and HDM models – computer applications – ANN, MATLAB–deterioration modeling- Pavement prioritization techniques.

UNIT V MAINTENANCE AND REHABILITATION

OUTCOME:
CO1 Apply the knowledge on methods of pavement management.
CO2 Conduct research on the functional evaluation and performance of pavements
CO3 Conduct research on the Structural performance of pavements
CO4 Apply the mathematical theories and concepts in predicting the performance of pavements.
CO5 Understand and Select various maintenance and rehabilitation methods with real time case studies.

REFERENCES:

TOTAL: 45 PERIODS

IM4012 AIRPORT SYSTEM PLANNING AND DESIGN L T P C
3 0 0 3

OBJECTIVE:
- Provides a basic understanding on Airport Systems Planning and Operation

UNIT I AIRPORT PLANNING

UNIT II AIRPORT COMPONENTS
Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hangar-Passenger Terminals- Geometric design of runway and Taxiways-Runway Pavement Design-Difference between Highway and airport pavements- Introduction to various design methods- Airport drainage.

UNIT III AIRPORT PLANNING AND AIRLINE ECONOMICS
Demand driven dispatch – Airline Fleet Planning Models – Network Revenue Management – Airport Performance, Slot Issues, Hub Operation, Demand Management, Multi-airport Systems- Pricing – Privatization and Deregulation, Willingness to pay and Competitive Revenue Management

45
UNIT IV  PASSENGER CHOICE, SCHEDULING AND FLEET ASSIGNMENT  
Load Factor Analysis, Airline Schedule Development, Introduction to PODS Passenger Choice Models, Decision Window Model, Fleet Assignment

UNIT V  CASE STUDIES  
Multi airport system – location of airport with respect to urban growth- case studies.

OUTCOME:

**CO1** Conduct Feasibility studies and plan an airport.
**CO2** Design various Airport components.
**CO3** Explain Airport Management and economics.
**CO4** Develop scheduling and various models for Airport management.
**CO5** Explain Airport planning and Design.

REFERENCES:

IM4013  URBAN INFRASTRUCTURE AND ASSET MANAGEMENT

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OBJECTIVE:
- The course will emphasize the use of emerging technologies, information systems, and decision making tools that support the various elements of the asset management framework.

UNIT I  ROAD ASSET MANAGEMENT  
Road Asset management- designing and developing rigid (or flexible) pavement with integrated structure for underground utilities & services- Network of underground road system, need for and planning and development.

UNIT II  INNOVATIVE TRANSPORT MODES  
Straddling bus concept and development (eg China)- e-rickshaws- Alternate (renewable) energy options for powering transport system- solar powered aircraft -bio-bus and its impact on solid waste management - solar-powered traffic signals and street lights- all-electric bus route with wireless charging -buses park over metal plates buried in the road.

UNIT III  TELECOMMUNICATION & ITS IMPACT ON TRANSPORT  
Commerce- e-tailing-mobile application in trade &commerce- internet-banking- internet and mobile phone in governance-services ranging from e-billing & payment for services- EB/telephone/income tax/ municipal tax & service charges/cooking gas booking &payment- booking and payment of air, train &train tickets; booking and payment of cinema tickets- teleshopping of groceries-tele-checking at airports- obtaining birth and death certificates- booking and payment for call taxis & auto rickshaws; carpooling through net and mobile phones-global meets through teleconferencing- case studies
UNIT IV CLOUD-COMPUTING AND ITS IMPACT ON TRANSPORT

The contribution of transport planning & development in conceptualization of smart cities- advances in capturing and processing traffic data in real time and managing traffic congestion- role of SCOOT & SCAT in reducing and minimizing traffic congestion- establishment of a sensor-networked and monitored city communication infrastructure, efficiently phasing traffic lights, and providing real-time guidance to drivers, can aid in reducing congestion. Digitally monitored parking spaces, able to dynamically alter prices according to available spaces, help control time spent cruising for parking.

UNIT V ROLE OF SMART CARD AND COMMUTING

Electronic Road Pricing (ERP) and congestion pricing- Innovative financing- carbon credit - case studies

OUTCOME:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understanding the road assets and their management techniques.</th>
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<tr>
<td>CO2</td>
<td>Classify the various innovative infrastructures and technologies in transport field</td>
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<td>CO3</td>
<td>Understand the impact of telecommunication in transport sectors and their applications.</td>
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<td>CO4</td>
<td>Explain Cloud computing and its impact in Transportation engineering</td>
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<tr>
<td>CO5</td>
<td>Understand the road pricing techniques and financial viability</td>
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</table>

TOTAL: 45 PERIODS

REFERENCES:
AUDIT COURSES

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

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

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

UNIT II PRESENTATION SKILLS 6

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

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

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

TOTAL: 30 PERIODS

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
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II
REPERCUSSIONS OF DISASTERS AND HAZARDS

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

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

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

TOTAL : 30 PERIODS

OUTCOMES

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

REFERENCES
OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I

HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II

PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III

CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES


UNIT IV

ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V

LOCAL ADMINISTRATION


UNIT VI

ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

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

SUGGESTED READING

- The Constitution of India, 1950 (Bare Act), Government Publication.
<table>
<thead>
<tr>
<th>UNIT I</th>
<th>சங்கத்தியம்</th>
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<td>- சைவ மற்றும் சுவாமி வாழிக்கை</td>
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<td>அகந்தர் (82)</td>
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<td>- இயற்கைச் சின்னங்கள் பாதுகாப்பு</td>
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<th>அறநநறித் தமிழ்</th>
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<td>- வாழிக்கை வாழிக்கையின், சமுசுரையின், போன்று, போன்று</td>
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<td>- உரிமையின், பொறியின், உரிமைகளுடைய (சமுசுரையின் மற்றும் வேலை)</td>
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<td>- தெய்வத்தியர் மற்றும் முன்னணி வேலைகள் காப்பியங்கள் பாதுகாப்பு</td>
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<td>- தெய்வத்தியர் அறிவியலியக்களுக்கு காப்பியங்கள்</td>
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<td>திருப்பாண்டம் பாண்டம்</td>
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<td>- பாண்டம் பாண்டம் வருடான வேலைகளுக்கு, வருடான பாண்டம் வாழிக்கைகள், அறிவியல் வேலைகளுக்கு காப்பியங்கள்</td>
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<td>திருச்சிராமி (617, 618)</td>
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<td>2. தொடர் பக்தியின் (11)</td>
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<td>3. பாண்டம், பாண்டம்</td>
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<td>4. திருச்சிராமி 50 (27)</td>
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<td>5. பாண்டம் பாண்டம் வாழிக்கை</td>
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UNIT V

anners தமிழ் இலக்கியம்

1. தமிழ்தமையல், 
- நோக்கின் பதக்கம்,
- தமிழ்தமையல் பதயில் செயல்கள்,
- தமிழ் துற்றமாக வேலைமுறை,
- பாடல் திளக்கியம்,
- முதலகம்.

2. பதவமையல் சிறுககத வேலைமுறை தமிழ் திளக்கியம்,

3. பதவமையல் சிறுககத வேலைமுறை தமிழ் திளக்கியம்,

4. பயண திளக்கியம் விளையாடும் விளையாட்டுச் சிறப்பு வேலை பதவமையல் தமிழ் திளக்கியம்,

5. அறிவியல் தமிழ்,

6. திருச்சங்க விளக்கம் தமிழ்,

7. சுற்றுசூழல் விளக்கம் தமிழ் திளக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய இயக்குனர் / புத்தகங்கள்

1. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
2. தமிழ் விக்கிப்பீடியொ (Tamil Virtual University) - www.tamilvu.org
3. தமிழ் விக்கிப்பீடியொ
4. தமிழ் விக்கிப்பீடியொ - தமிழ் பள்ளிகளாகக் கூறும், தனிப்பதவம்
5. தமிழ் விக்கிப்பீடியொ - தமிழ் விளையாட்டுச் சிறப்பு (thamilvalarchithurai.com)
6. தமிழ் விக்கிப்பீடியொ - தமிழ் பள்ளிகளாகக் கூறும், தனிப்பதவம்
OPEN ELECTIVES

OIC431 BLOCKCHAIN TECHNOLOGIES

LTCP 3003

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 an idea about private and public Blockchain, and smart contract.

UNIT I  INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN  9
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  9

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

UNIT IV  INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  10

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

TOTAL: 45 PERIODS

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

REFERENCES:
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
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
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  9

UNIT II  BASICS OF NOISE  9
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  9

UNIT IV  INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS  9
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  9

TOTAL: 45 PERIODS

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, VENTILLATION & 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

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TOTAL: 45 PERIODS
REFERENCES:
1. Andreas Gebhardt and Jan-Ste

OME434                           ELECTRIC VEHICLE TECHNOLOGY                          L  T  P  C
                                  3  0  0  3

UNIT I                           NEED FOR ELECTRIC VEHICLES                                9
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                                  9
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                                             9
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                                9
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                               9

TOTAL: 45 PERIODS

REFERENCES:

58
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

UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS

UNIT IV CONCEPT GENERATION, SELECTION & TESTING

UNIT V INDUSTRIAL DESIGN & PROTOTYPING

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:
REFERENCES:

OBA431 SUSTAINABLE MANAGEMENT LT P C
3 0 0 3

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

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

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

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

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

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities
REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT

COURSE OBJECTIVES
- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS

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

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

UNIT IV FINANCING SMALL BUSINESS
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin-Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

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

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

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

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

UNIT III STATUTES

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

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

TOTAL: 45 PERIODS

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

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

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

UNIT I ETHICS AND SOCIETY

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

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS

Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT

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

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT

Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

REFERENCES

ET4251  IoT FOR SMART SYSTEMS  LT P C 3 0 0 3

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

UNIT I  INTRODUCTION TO INTERNET OF THINGS  9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II  IOT ARCHITECTURE  9

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

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

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

UNIT V  CASE STUDIES  9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

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:

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
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.
UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

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

REFERENCES:

PX4012 RENEWABLE ENERGY TECHNOLOGY 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
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS

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

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz’s limit-
Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis
wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve
of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and
Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V  OTHER RENEWABLE ENERGY SOURCES

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

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

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

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

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

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 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.

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 9
UNIT II  NETWORK SECURITY  9

UNIT III  SECURITY MANAGEMENT  9

UNIT IV  CYBER SECURITY AND CLOUD SECURITY  9

UNIT V  PRIVACY AND STORAGE SECURITY  9

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

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

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

UNIT II
CLOUD PLATFORM ARCHITECTURE

UNIT III
AWS CLOUD PLATFORM - IAAS

UNIT IV
PAAS CLOUD PLATFORM

UNIT V
PROGRAMMING MODEL

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
COURSE OBJECTIVES:
- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I  UX LIFECYCLE TEMPLATE  8

UNIT II  CONTEXTUAL INQUIRY  10

UNIT III  DESIGN THINKING, IDEATION, AND SKETCHING  9

UNIT IV  UX GOALS, METRICS, AND TARGETS  8

UNIT V  ANALYSING USER EXPERIENCE  10

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

TOTAL : 45 PERIODS
COURSE OUTCOMES:
CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

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

MU4153 PRINCIPLES OF MULTIMEDIA

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

UNIT II SEARCH METHODS AND VISUALIZATION

UNIT III MINING DATA STREAMS

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

UNIT V R LANGUAGE

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 9

UNIT II PROTOCOLS FOR IoT 9

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS 9
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION 9

UNIT V IoT AND CLOUD 9

TOTAL:45 PERIODS

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

MX4073 MEDICAL ROBOTICS

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

UNIT I INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization
Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems
Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

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

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

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

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

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 9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

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

UNIT III HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS 9
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor
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

REFERENCES:
UNIT V  ENVIRO NMENTAL ECONOMICS  9
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and
policy by Tom Tietenberg, Environmental Economics
TOTAL : 45 PERIODS

REFERENCES
Landscape, Island Press.
2. Stephen Daven, Environment and Sustainability Policy: Creation, Implementation,
Evaluation, the Federation Press, 2005
Press, 2019

TX4092  TEXTILE REINFORCED COMPOSITES  L T P C
3 0 0 3

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

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

UNIT III  COMPOSITE MANUFACTURING  9
Classification; methods of composites manufacturing for both thermoplastics and thermostets- Hand
layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding,
pultrusion, vacuum impregnation methods, compression moulding; post processing of
composites and composite design requirements

UNIT IV  TESTING  9
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact,
compression, inter laminar shear stress and fatigue properties of thermostet and thermoplastic
composites.

UNIT V  MECHANICS  9
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical
lamination theory, failure theories and prediction of inter laminar stresses using at ware
TOTAL: 45 PERIODS

REFERENCES
Engineering”,CRCPress,2001
UNIT I  BASICS OF NANOCOMPOSITES

UNIT II  METAL BASED NANOCOMPOSITES
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

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

UNIT IV  NANOCOMPOSITE FROM BIOMATERIALS
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V  NANOCOMPOSITE TECHNOLOGY

REFERENCES:
5. The search for novel, superhard materials- Stan Veprcek (Review Article) JVST A, 1999
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