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:

<table>
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<tr>
<th>POs</th>
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<tbody>
<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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<tr>
<td>PO 2</td>
<td>An ability to write and present a substantial technical report/document</td>
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<td>PO 3</td>
<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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* Audit Course is optional

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* Audit Course is optional
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### FOUNDATION COURSES (FC)

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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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.

TOTAL: 60 PERIODS

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:
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.
Articulation Matrix

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IM4102 URBAN TRANSPORTATION SYSTEMS PLANNING L T P C

3 0 0 3

OBJECTIVES:
- To make the learners 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 9
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 9
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 9
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 9
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 9
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.

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IM4103 INFRASTRUCTURE PLANNING AND MANAGEMENT L T P C 3 0 0 3

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

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

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

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
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR
development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in
IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR
Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS  6
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification,
Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation,
Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent
agents.

REFERENCES
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament,

TOTAL: 30 PERIODS

IM4111 BIM AND PROJECT MANAGEMENT LABORATORY

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 LEGAL REQUIREMENTS


UNITV LABOUR REGULATION


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,

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IM4202 GEOGRAPHICAL INFORMATION SYSTEMS FOR INFRASTRUCTURE PLANNING

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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.

UNITI INTRODUCTION TO MAPS AND GIS

UNITII DBMS AND GIS DATAMODEL

UNITIII GIS DATA INPUT

UNITIV GIS DATA ANALYSIS
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

UNITV GIS OUTPUT DESIGN AND PRESENTATION
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

TOTAL: 45 PERIODS

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

Articulation Matrix

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IM4203 GEOTECHNICAL ENGINEERING FOR INFRASTRUCTURE

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:

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TOTAL: 45 PERIODS
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.

IM4204 ADVANCED STRUCTURAL DESIGN L T P C 3 0 0 3

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

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 - Codal 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.

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REFERENCES:

IM4211  GIS LABORATORY  L T P C
0 0 4 2

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

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REFERENCE:

IM4212 INFRASTRUCTURE MATERIAL TESTING LABORATORY L T P C
0 0 4 2

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.

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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.

IM4311  SEMINAR  L T P C
0 0 2 1

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)  L T P C
0 0 0 2

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.
IM4313  PROJECT WORK I  

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.

IM4411  PROJECT WORK II

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

SYLLABUS:
The student should continue the phase I work on the selected topic as per the formulated methodology. 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.

ST4073  MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES

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

UNIT I  MAINTENANCE AND REPAIR STRATEGIES
4
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  9
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  9
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  9
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  9
Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Repair to active cracks, Repair to dormant cracks. Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements. Engineered Demolition -Case studies

TOTAL: 45 PERIODS

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

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

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CO-PO-PSO MAPPING
OBJECTIVES:
- To Understand and Explain various types of Material Procurement, Management, Stores management and Quality Control

UNIT I INTRODUCTION: 9
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: 9

UNIT III INVENTORY MANAGEMENT 9
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: 9
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 9

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**

**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:**
CO – PO Mapping - ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION

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CN4074 ORGANIZATIONAL BEHAVIOUR

objetive:
- 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 BEHAVIOR
Definition, need, and importance of organizational behavior –Nature and scope –Frame work – Organizational behavior models.

UNIT II INDIVIDUAL BEHAVIOUR

UNIT III GROUP BEHAVIOUR

UNIT IV LEADERSHIP AND POWER

UNIT V DYNAMICS OF ORGANIZATIONAL BEHAVIOUR

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

| CO1 | Identify the need and importance of organizational behavior and the framework of organizational models |
| CO2 | Explain the various learning theories and develop alternative organizational behavior approaches in the workplace |
| CO3 | Describe the importance of group dynamics and team building. |
| CO4 | Explore the various leadership styles and politics. |
| CO5 | Explain the dynamics of organizational behaviour with the balance of work life. |

REFERENCES:

CO – PO Mapping - ORGANIZATIONAL BEHAVIOUR

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IM4002 MANAGEMENT OF HUMAN RESOURCE AND QUALITY

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

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:

CN4092  SUPPLY CHAIN MANAGEMENT AND LOGISTICS IN CONSTRUCTION  L T P C
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

UNIT II STRATEGIC PERSPECTIVES
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
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
Role of logistics in achieving sustainable construction - Resource efficiency benefits of effective logistics

UNIT V LOGISTICS OPERATIONS
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

CO – PO Mapping - SUPPLY CHAIN MANAGEMENT AND LOGISTICS IN CONSTRUCTION

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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:


**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**

**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)

IM4004 SAFETY IN CONSTRUCTION ENGINEERING

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

UNITI CONSTRUCTION ACCIDENTS

UNITII SAFETY PROGRAMMES

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

UNITIV DESIGNING FOR SAFETY

UNITV OWNER’S AND DESIGNERS’ OUTLOOK
Owner’s responsibility for safely – 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.
ST4091  DESIGN OF BRIDGE STRUCTURES  L T P C
                                                  3 0 0 3

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

UNIT I  INTRODUCTION  9
Introduction-Selection of Site and Initial Decision Process - Classification of Bridges- General Features of Design- Standard Loading for Bridge Design as per different codes - Road Bridges – Railway Bridges - Design Codes - Working Stress Method- Limit State Method of Design

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

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

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

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

TOTAL: 45 PERIODS

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

| 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:

CO-PO-PSO MAPPING

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IM4005 MODERN CONSTRUCTION MATERIALS AND TECHNOLOGY L T P C 3 0 0 3

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

UNIT I SPECIAL CONCRETES 9

UNIT II METALS 9

UNIT III COMPOSITES AND OTHER MATERIALS 9
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: 9
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: 9
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  L T P C  3 0 0 3

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

UNIT I INTRODUCTION
9

UNIT II DESIGN FOR FLEXURE, SHEAR AND TORSION
9
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
9
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
9
Pre-stressed concrete compression and tension members – application in the design of prestressed pipes and prestressed concrete cylindrical water tanks – Design of compression members with and without flexure – its application in the design of piles, flag masts and similar structures – Two way pre-stressed concrete floor systems – Connections for pre-stressed concrete elements
UNIT V DESIGN OF PRESTRESSED CONCRETE BRIDGES


TOTAL: 45 PERIODS

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

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<td>CO1</td>
<td>Identify the various methods of prestressing and estimate the loss</td>
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<td>CO2</td>
<td>Design the beams for flexure, shear, bond and torsion</td>
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<td>CO3</td>
<td>Design the continuous beams and composite beams</td>
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<td>CO4</td>
<td>Design the water tank, piles and masts</td>
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<td>CO5</td>
<td>Analyze and design the prestressed concrete bridge</td>
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REFERENCES:

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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 - E I A Approach: Historical development, Legal and Regulatory aspects in India, Types and Objectives, Components, Process of EIA.
UNIT II  PREDICTION & ASSESSMENT: 9

UNIT III  HEALTH ASSESSMENT 9
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, SIA model and the planning process, Land acquisition - Legal aspects, Resettlement & Rehabilitation and Development

UNIT IV  ENVIRONMENTAL MANAGEMENT PLAN 9
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- CBA Social CBA, 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 9
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  L T P C
3 0 0 3

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  9
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- 3Rconcepts.

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
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
Characterization factors and principle of characterization - Selection of impact categories, category indicators and characterization models – Classification -Characterization - Optional elements - normalization , grouping, weighting ,data quality analysis - Characterization models – Impact assessment Case studies - Simplified/streamlined Life Cycle Assessments procedural approaches, numerical approaches - Examples of numerical approaches - contribution analysis, perturbation analysis, uncertainty - analysis, comparative analysis, key issue analysis - Treatment of uncertainties - Elements in uncertainty handling - Sensitivity of LCA results - Sustainability analysis - Extending LCA - economic dimension, social dimension - Life cycle costing - Eco-efficiency - Combining LCA and LCC – Case studies

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:

IM4009 SUSTAINABLE DEVELOPMENT AND URBAN PLANNING  L T P C  3 0 0 3

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

UNIT I INTRODUCTION TO SUSTAINABLE DEVELOPMENT: 9

UNIT II ENVIRONMENTAL SUSTAINABILITY: 9

UNIT III EMPOWERMENT: 9
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: 9
Environment and Resources, Sustainability Assessment, Future Scenarios, Form of Urban Region, Managing the change, Integrated Planning, Sustainable Development

UNIT V THE BUILTIN ENVIRONMENT: 9
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  9

UNIT V   E- GOVERNANCE AND IOT  9

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 stake holders 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.
CO 5 Identify and recognize the role of ICT and data analytics in addressing the urban challenges and key issues

REFERENCES:
3. Jonathan Reichental, 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 9
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 9

TOTAL: 45 PERIODS

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:

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 10

UNIT II AIRPORT COMPONENTS 10
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

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

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:**

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

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.

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.

TOTAL: 30 PERIODS
<table>
<thead>
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<th>UNIT I</th>
<th>சங்க இலக்கியம்</th>
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<tr>
<td>1. சங்கநிறுவனத் துவக்க நூல் – எழுத்து, நொல், பபொகர்</td>
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<td>2. அகநொனூறு (82)</td>
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<td>3. குரிசிப் பொட்டின் மலர்கொட்சி</td>
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<td>4. புறநொனூறு (95,195)</td>
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<tr>
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<th>அறநநறித் தமிழ்</th>
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<tr>
<td>1. அறநநறித் வகுத்ததிருவள்ளுவர் - அன்புகடகம், ஒப்புரவறிதல், ஈகக், புகழ்</td>
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<tr>
<td>2. பிற அறநூல்கள் – இலக்கியம் மருந்து – ஏலொதி, சிறுபஞ் மூலம், திரிகடுகம் (தூய்கமகய வலியுறுத்தும் நூல்)</td>
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<tbody>
<tr>
<td>1. கணகியின் புரட்சி – சிலப்பதிகொரவழக்குகர் கொகதமூகபகவிலகியங்கள் – சிலப்பதிகொராக்கவிலக்கும் சிலப்பதிகொரவழக்குகர்</td>
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<tr>
<td>1. சிறுபொணொற்றுப்பகட – பொரி முல்கல் பதர் தகொடுத்தது, பபகன் மயிலுக்குப் பபொர் கவதகொடுத்தது, அதியமொன் ஒளகவக்குதனல்லிக் கொடுத்தது</td>
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<td>2. நற்றிகண – அன்கனக்குரிய புன்னனசிறப்பு</td>
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<td>3. திருமந்திரம் (617, 618) – இயம்மநியம் விதிகள்</td>
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<td>4. தர்மகல்யாக்கியநிறுவிய வள்ளலொர்</td>
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<td>5. புறநொனூறு – சிறுவபன் வள்ளலொன்</td>
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<td>6. அகநொனூறு (4) – வோலொன்</td>
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<td>– சிறுபஞ் சிறித்தொலின் (11) – சிறுபஞ்</td>
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<td>– பஞ்சாக்குடல் (11) – மாடைல், பபொகர்</td>
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<td>– சிறித்தொலின் 50 (27) – பபொகர்</td>
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<td>– அதியமொன் ஒளகவக்கு சிலப்பதிகொர</td>
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UNIT V  நவீன தமிழ் இலக்கியம்

1. உகரநகடத் தமிழ்,
   - கதைப்பிட்டிகள், பதிதை பதிவு,
   - கதைப்பிட்டிகள் முதன்மைக் குறிப்பிட்டிகள், முதன்மை தாக்குறுக்கம்,
   - பாரசைக்குறுக்கம்,
   - பாசத் தாக்குறுக்கம்,
   - தாளம்.
2. நொட்டுவிடுதகல் பபொரொட்டமும் தமிழ் இலக்கியமும்,
3. முதொய விடுதகலயும் தமிழ் இலக்கியமும்,
4. பபல் விடுதகலயும் விளிம்பு இணையப்பிரிவு தமிழ்பாடும் தமிழ் இலக்கியமும்,
5. ஐரோப்பிய கதைகள்,
6. இராகத்தக்கள் கதைகள்,
7. குரலாங்கள் இணையப்பாடு தமிழ் இலக்கியமும்.

TOTAL: 30 PERIODS

தமிழ் இலக்கியம் எணிப்பிள்ளை / புத்தகங்கள்

1. தமிழ் விளக்கம் தொல்பாட்டகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ் வினை உலாச்சியகம்
4. தமிழ் விளக்கம் கல்விக்கழகம் - தமிழ் புனித கல்விக்கழகம், திருவள்ளூர்
5. தமிழ் விளக்கம் கல்விக்கழகம் - தமிழ் வல்லுநரக் கல்விக் கழகம் (thamilvalarchithurai.com)
6. ஐரோப்பிய கல்விக்கழகம் - தமிழ் புனித கல்விக்கழகம், திருவள்ளூர்