1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the programme M.E Construction Engineering & Management will

PEO1 Excel in research or will succeed in Construction Engineering and Management profession in the government, public and private sector organizations.

PEO2 Have a sound knowledge in statistics, project management and construction engineering fundamentals required for solving real time construction Engineering and Management problems using modern equipment and software tools.

PEO3 Become entrepreneurs and develop processes and construction technologies through innovation, by integrating their knowledge in multidisciplinary management to meet the needs of society and formulate solutions that are technically sound, economically feasible, and socially acceptable.

PEO4 Have professional and ethical attitude, effective communication skills, teamwork skills, leadership quality, multidisciplinary approach and an ability to relate Construction Engineering and Management issues in broader social context.

PEO5 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 Construction Engineering and Management are as follows:

The students will able to

PO1: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

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<th>Pos</th>
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PO 3 Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program. Design of Energy Efficient Buildings, Project Safety Management, Environmental Impact Assessment For Construction Engineers, Shoring, Scaffolding and Formwork, Lean Construction Concepts, Tools & Practices, Construction Planning, Scheduling and Control, Quality control and assurance in construction, Supply chain management and Logistics in construction, Digital Design and Construction, Maintenance, Repair and Rehabilitation Of Structures.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):
Graduates of the program M.E. Construction Engineering and Management will be able to

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<tr>
<th>PSO1</th>
<th>Knowledge of Construction Engineering and Management discipline</th>
<th>In-depth knowledge in the construction management, engineering and technologies necessary to formulate, plan, schedule and execute construction projects.</th>
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<td>PSO2</td>
<td>Critical analysis of Construction management problems and innovation</td>
<td>Critically analyze and solve construction engineering and management problems by applying the modern tools and concepts of Construction Engineering &amp; Management and make innovative advances in theoretical and practical.</td>
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<tr>
<td>PSO3</td>
<td>Conceptualization and evaluation of engineering solutions to Construction Issues</td>
<td>Conceptualize the problems in construction industry and develop appropriate solutions which are technically feasible and economically viable with due consideration of sustainability.</td>
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PEO / PO Mapping:

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* Audit Course is optional

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## AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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### SUMMARY

Name of the Programme: M.E CONSTRUCTION ENGINEERING AND MANAGEMENT

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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^a 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:

COs- PO's & PSO's MAPPING

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CN4101 MODERN CONSTRUCTION MATERIALS  L T P C  
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OBJECTIVE:
- To study and understand the properties of modern construction materials used in construction such as special concretes, metals, composites, water proofing compounds, non-weathering materials, and smart materials.

UNIT I STRUCTURAL MATERIALS  9

UNIT II NON-STRUCTURAL MATERIALS, ASSOCIATIORS AND FINISHES  9

UNIT III COMPOSITES  9
Types of Plastics – Polymer - Properties & Manufacturing process – Advantages of Reinforced polymers – Types of FRP – FRP on different structural elements – Applications of FRP - Bituminous Materials - Glass - Closure - Environmental Concerns.

UNIT IV SPECIAL CONCRETES  9
Concretes - Behavior of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self-compacting concrete, Geo Polymer Concrete, Alternate Materials to concrete on high performance & high Strength concrete.

UNIT V SMART AND INTELLIGENT MATERIALS  9
Types & Differences between Smart and Intelligent Materials – Special features – Nano Concrete - Nano Technology in Construction - Case studies showing the applications of smart & Intelligent Materials.

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to
  CO1 Explain the various types of special concretes
  CO2 Select the different processing of steel and applications of coating
CO3  Explain the manufacturing process and applications of polymer composites
CO4  Identify the different flooring materials and application of façade materials
CO5  Apply the knowledge of smart and intelligent materials in construction field

REFERENCES:

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CN4102  PROJECT FORMULATION AND APPRAISAL  L T P C

OBJECTIVE:
- To study and understand the formulation, and costing of construction projects, appraisal, finance, and private sector participation.

UNIT I  PROJECT FORMULATION  12

UNIT II  PROJECT COSTING  12

UNIT III  PROJECT APPRAISAL  12

UNIT IV  PROJECT FINANCING  12

UNIT V  PRIVATE SECTOR PARTICIPATION  12
Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT-Technology Transfer and Foreign Collaboration - Scope of Technology Transfer.

TOTAL: 60 PERIODS
OUTCOME:

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

CO1 Perform Formulations Of Projects
CO2 Analyze Project Costing
CO3 Evaluate Project Appraisal
CO4 Apply Project Financing
CO5 Perform Private Sector Participation & Implementation

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CN4103  CONSTRUCTION EQUIPMENT AND MANAGEMENT  L T P C  3 0 0 3

OBJECTIVE:

- To study and understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

UNIT I   CONSTRUCTION EQUIPMENT SELECTION  9

UNIT II  EQUIPMENT FOR EARTHWORK  9

UNIT III  OTHER CONSTRUCTION EQUIPMENT  9
UNIT IV  ASPHALT AND CONCRETING EQUIPMENT


UNIT V  MATERIALS HANDLING EQUIPMENT

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.

TOTAL: 45 PERIODS

OUTCOME:

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

  CO1  Develop knowledge on the planning of equipment and selection of equipment
  CO2  Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment
  CO3  Develop the knowledge on special construction equipments
  CO4  Apply the knowledge on asphalt and concrete plants
  CO5  Apply the knowledge and select the proper materials handling equipment

REFERENCES:

5. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2019

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RM4151  RESEARCH METHODOLOGY AND IPR

UNIT I  RESEARCH DESIGN

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

UNIT II  DATA COLLECTION AND SOURCES

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.
UNIT III DATA ANALYSIS AND REPORTING 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

ST4161 ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTAL TECHNIQUES LABORATORY L T P C 0 0 4 2

A ) ADVANCED CONSTRUCTION ENGINEERING LABORATORY

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

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

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

CO1 Do the mix proportion using IS and ACI codal provisions.
CO2 Analyse the flow characteristics of SCC
CO3 Analyse the effect of mineral and Chemical Admixtures
CO4 Test the concrete in a non-destructive manner using a rebound hammer.
CO5 Know the permeability characteristics of concrete.
B) EXPERIMENTAL TECHNIQUES LABORATORY

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

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

TOTAL : 30 PERIODS

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

CO1 Apply the experimental methods to correlate with the theory.
CO2 Learn the usage of electrical systems for various measurements.
CO3 Learn the usage of optical systems for various measurements.
CO4 Analyse of Data and interpretation
CO5 Apply the analytical techniques and graphical analysis to interpret the experimental data

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CN4111 TECHNICAL SEMINAR

OBJECTIVE:
- To work on a specific technical topic in Construction Engineering and Management 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 construction engineering and management 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:
CO1 Identify latest developments in the field of Construction Engineering
CO2 Identify latest developments in the field of Construction Management
CO3 Presentation Skills and ability to answer the queries during Interaction
CO4 Acquire technical writing abilities for seminars, conferences and journal publications
CO5 Use modern tools to present the technical details

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CN4201 ADVANCED CONSTRUCTION TECHNIQUES

OBJECTIVE:
- To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures.
- To gain the knowledge about the rehabilitation and strengthening techniques.
- To learn about the various demolition techniques.

UNIT I SUB STRUCTURE CONSTRUCTION
Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.

UNIT II SUPER STRUCTURE 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 – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- Aerial transporting – Handling and erecting lightweight components on tall structures.

UNIT III CONSTRUCTION OF SPECIAL STRUCTURES
Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, and sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.

UNIT IV REHABILITATION AND STRENGTHENING TECHNIQUES
Seismic retrofitting - Strengthening of beams, columns, slab and masonry wall - Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.
UNIT V  DEMOLITION
Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Classify the modern construction techniques used in the sub structure construction.
  CO2 Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings
  CO3 Summarize the concepts used in the construction of special structures
  CO4 Distinguish Various strengthening and repair methods for different cases.
  CO5 Identify the suitable demolition technique for demolishing a building.

REFERENCES:
2. Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El-Reedy, 2020

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CN4202  CONSTRUCTION PLANNING, SCHEDULING, AND CONTROL  L T P C
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OBJECTIVE:
- To study and understand the concept of planning.
- To impart concepts in Network representation and analysis.
- To impart concepts in Precedence Network analysis.
- To impart concepts in resource scheduling.
- To learn Concepts in project monitoring and controlling

UNIT I  CONSTRUCTION PLANNING
UNIT II  NETWORK REPRESENTATION AND ANALYSIS

UNIT III  PRECEDENCE NETWORK ANALYSIS

UNIT IV  SCHEDULING PROJECT WORK AND RESOURCE SCHEDULING

UNIT V  PROJECT MONITORING AND CONTROLLING

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  - CO1 Identify and estimate the activity in the construction.
  - CO2 Schedule the networking of activities using the critical path method.
  - CO3 Evaluate the project budget required for the particular construction project.
  - CO4 Recognize the various quality control tool required in the construction industry.
  - CO5 Explain the different databases that can be maintained in the construction industry using computers.

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OBJECTIVE:

- To study the various types of construction contract and their legal aspects and provisions.
- To learn concepts in Tenders.
- To learn concepts in Arbitration and legal requirements
- To study the concepts in labour regulations.

UNIT I  CONSTRUCTION CONTRACTS  9

UNIT II  TENDERS  9

UNIT III  ARBITRATION  9

UNIT IV  LEGAL REQUIREMENTS  9

UNIT V  LABOUR REGULATIONS  9

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to
  
  CO1  Design the construction contracts
  CO2  Develop a skill for the tendering process.
  CO3  Explain the duties of the arbitrator.
  CO4  Develop an idea on the various legal requirements to be met in relation to land and construction.
  CO5  Identify and apply the provisions provided in the labour welfare schemes.

REFERENCES:

OBJECTIVE:
- To train the students in utilizing the sophisticated spreadsheets programs,
- To train the students to handle estimation software.
- To train the students to handle the Project management software.

LIST OF EXPERIMENTS
1. Scheduling of a small construction project using Primavera scheduling systems including reports and tracking.
2. Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking.
3. Simulation models for project risk analysis.
4. Virtual progress tracking of small construction project using Navisworks
5. Model a simple building project using Building Information Modelling (BIM)

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Prepare the proposal for a construction project
  CO2 Store and retrieve information about the equipments.
  CO3 Track the activities and schedule a construction project using PRIMAVERA
  CO4 Track and schedule a construction project using MS Project.
  CO5 Develop a simulation model for analysing the project risk

TOTAL: 60 PERIODS
OBJECTIVE:
- To provide hands on training in basic spread sheet software.
- To provide hands on training in advanced spread sheet software.
- To provide hands on training in data analytical tools.

LIST OF EXPERIMENTS:
1. Descriptive Statistics: frequency distribution, Applications (Charts, Graphs etc.)
2. Use of statistical packages Correlation, ANOVA, Cross Tabulation, t-Test and Simple and Multiple Regression
3. Solving Linear Programming Problems, Transportation and Assignment Models
4. Solving Network Flow Models
5. Solving Decision making Problems in Project Management

TOTAL: 60 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Formulate descriptive statistics with charts and graphs using spreadsheet softwares and interpretation of results
  CO2 Analyse construction management field data using Statistical tools.
  CO3 Solve Linear Programming Problems, transportation and assignment problems by appropriate techniques and evaluate the behaviour under different range of parameters
  CO4 Perform network analysis and decision making in project management
  CO5 Solve Construction management problems using decision making tool.

COs- PO's & PSO's MAPPING

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CN4311 PRACTICAL TRAINING (4 Weeks)

OBJECTIVE:
- To train the students in the fieldwork so as to have firsthand knowledge of practical problems related to Construction Management in carrying out engineering tasks.

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

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Describe the Construction Industry
  CO2 Realize the various functions of construction activities
  CO3 Develop skills in facing and solving the problems experiencing in the Construction Management field
**Report Preparation**
**Presentation of work carried out in Practical Training**

**COs- PO's & PSO's MAPPING**

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**CN4312 PROJECT WORK I**

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

**SYLLABUS:**
The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialisation 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.

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

  - **CO1** Apply the knowledge gained from theoretical and practical courses in solving problems.
  - **CO2** Summarize the importance of literature review.
  - **CO3** Identify the problem
  - **CO4** Solve the identified problem based on the formulated methodology
  - **CO5** Interpret and present the findings of the work conducted.

**COs- PO's & PSO's MAPPING**

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

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

TOTAL: 360 PERIODS

OUTCOME:
• On completion of the course, the student will be able to
  CO1 Discover the potential research areas.
  CO2 Apply the knowledge gained from theoretical and practical courses to be creative, well planned, organized and coordinated.
  CO3 Identify the problem.
  CO4 solve the identified problem based on the formulated methodology
  CO5 Interpret and present the findings of the work conducted

COs- PO’s & PSO’s MAPPING

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CN4071 ADVANCED CONCRETE TECHNOLOGY

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

UNIT I CONCRETE MAKING MATERIALS

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

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

UNIT V TESTS ON CONCRETE

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to
  CO1 Develop knowledge on various materials needed for concrete manufacture
  CO2 Apply the rules to do mix designs for concrete by various methods
  CO3 Develop the methods of manufacturing of concrete.
  CO4 Explain about various special concrete
  CO5 Explain various tests on fresh and hardened concrete

REFERENCES:
2. Shetty M.S., Concrete Technology, S.Chand and Company Ltd, Delhi, 2019.
5. Job Thomas., Concrete Technology, Cencage learning India Private Ltd, New Delhi, 2015.

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CN4001 HUMAN RESOURCES MANAGEMENT IN CONSTRUCTION

OBJECTIVE:
- To understand the various aspects of manpower management and to help the student further develop their management, team building and leadership skills so as to increase their effectiveness in their job performance on international projects.

UNIT I MANPOWER PLANNING

UNIT II ORGANISATION
UNIT III
HUMAN RELATIONS AND ORGANISATIONAL BEHAVIOUR
Basic individual psychology – Approaches to job design and job redesign – Self managing work teams – Intergroup – Conflict in organizations – Leadership-Engineer as Manager –aspects of decision making – Significance of human relation and organizational – Individual in organization – Motivation – Personality and creativity – Group dynamics, Team working – Communication and negotiation skills.

UNIT IV
WELFARE MEASURES

UNIT V
MANAGEMENT AND DEVELOPMENT METHODS

TOTAL: 45 PERIODS

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

CO1 Demonstrate practices and techniques for evaluating performance, structuring teams, coaching and mentoring people.

CO2 Explain the role of the leader and leadership principles and attitudes

CO3 Demonstrate an understanding of professional and ethical responsibilities; and

CO4 Demonstrate commitment to quality, timeliness, and continuous improvement.

CO5 Interpret their future managerial role, with emphasis on the management of the human resources and with a multi-cultural perspective

REFERENCES

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OBJECTIVE:
- To study the various management techniques for successful completion of construction projects.

UNIT I  FUNDAMENTALS OF CONSTRUCTION PROJECT MANAGEMENT  9

UNIT II  PLANNING AND ORGANIZING CONSTRUCTION PROJECT  9
Construction Project organization – Planning Project work Scope and integration Processes - Defining Project Activities - Scheduling Project - CPM, PERT, Precedence Network Analysis – Planning and organizing project resources such as manpower, material, equipment, Time and cost for construction site.

UNIT III  DESIGN AND CONSTRUCTION PROCESS  9

UNIT IV  PROJECT RESOURCES UTILIZATION  9

UNIT V  RISK MANAGEMENT AND PROJECT CONTROLLING  9
Risks management at construction site - Controlling resource productivity – Schedule and Cost Controlling system – Earned value management system – Project Management Information systems.

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  
  CO1  Explain the stages involved in a project and analyze the obligatory services to be taken up while performing a construction activity.
  
  CO2  Apply the scheduling techniques for planning construction project.
  
  CO3  Develop the ability to integrate design and construction Process
  
  CO4  Analyzing Resources utilization and resource productivity.
  
  CO5  Assess the risk and controlling systems using project management Information system.

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CN4003 SUSTAINABLE CONSTRUCTION

OBJECTIVE:
- To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.

UNIT I INTRODUCTION 9
Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO₂ contribution from cement and other construction materials.

UNIT II MATERIALS USED IN SUSTAINABLE CONSTRUCTION 9
Construction materials and indoor air quality - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.

UNIT III ENERGY CALCULATIONS 9
Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use

UNIT IV GREEN BUILDINGS 9
Control of energy use in building - ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling - Performance ratings of green buildings - Zero energy building

UNIT V ENVIRONMENTAL EFFECTS 9
Non-renewable sources of energy and Environmental aspects – energy norm, coal, oil, natural gas - Nuclear energy - Global temperature, Green house effects, global warming - Acid rain: Causes, effects and control methods - Regional impacts of temperature change.

TOTAL: 45 PERIODS

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

  CO1 Summarize the various sustainable materials used in construction.
  CO2 Explain the method of estimating the amount of energy required for building.
  CO3 Interpret the features of LEED, TERI and GRIHA ratings of buildings.
  CO4 Relate the concept and performance of zero energy buildings.
  CO5 Select less carbon emission materials for construction.

REFERENCES:
5. New Building Materials and Construction World magazine

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CN4072 ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION L T P C

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
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CN4004 DESIGN OF ENERGY EFFICIENT BUILDINGS

OBJECTIVE:
- To understanding the concept of energy consumption in buildings and design a energy efficient building

UNIT I INTRODUCTION

UNIT II PASSIVE SOLAR HEATING AND COOLING

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING

UNIT IV HEAT CONTROL AND VENTILATION

UNIT IV DESIGN FOR CLIMATIC ZONES


TOTAL: 45 PERIODS

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

CO1 Explain environmental energy supplies on buildings
CO2 Explain the passive solar heating, cooling system
CO3 Discuss the various aspects of day-lighting and electrical lighting in a building
CO4 Predict and design building ventilation and heat control for indoor comfort
CO5 Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations

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CN4005 PROJECT SAFETY MANAGEMENT

OBJECTIVES:
- To study and understand the various safety concepts and requirements applied to construction projects.

UNIT I CONSTRUCTION ACCIDENTS

UNIT II SAFETY PROGRAMMES
UNIT III  CONTRACTUAL OBLIGATIONS  9

UNIT IV  DESIGNING FOR SAFETY  9

UNIT V  OWNERS’ AND DESIGNERS’ OUTLOOK  9

TOTAL: 45 PERIODS

OUTCOME:
• On completion of the course, the student is expected to be able to
  CO1 Develop knowledge on accidents and their causes.
  CO2 Develop knowledge about safety programs and job-site safety assessments.
  CO3 Apply the knowledge of contractual obligations.
  CO4 Explain about designing for safety and safety procedures.
  CO5 Develop the knowledge of owners’ and designers’ responsibilities.

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CN4006  COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING  L T P C  3 0 0 3

OBJECTIVE:
• To study and understand the optimization techniques, inventory models and scheduling techniques applied to construction engineering.

UNIT I  INTRODUCTION  9
UNIT II OPTIMIZATION TECHNIQUES
Linear, Dynamic, and Integer Programming - Branch and Bound Techniques – Application to Production Scheduling, Equipment Replacement, Material Transportation and Work Assignment Problems – Software applications.

UNIT III INVENTORY MODELS
Deterministic and Probabilistic Inventory Models - Software applications.

UNIT IV SCHEDULING APPLICATION
PERT and CPM - Advanced planning and scheduling concepts – Computer applications – Case study.

UNIT V OTHER PROBLEMS
Sequencing problems – Simulation – Enterprises – Introduction to ERP systems.

TOTAL : 45 PERIODS

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

CO1 Use of software’s in construction Industry.
CO2 Apply various optimization techniques.
CO3 Apply Deterministic and Probabilistic Inventory Models.
CO4 Analyze the scheduling concepts.
CO5 Solve problems using simulation and ERP systems.

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CN4007 QUANTITATIVE TECHNIQUES IN MANAGEMENT

OBJECTIVE:
- To study the various quantitative methods applied to the elements of management, the effect of production management, finance management, decision theory, and managerial economics.
UNIT I OPERATIONS RESEARCH 9
Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post–Optimality Analysis – Transportation and Assignment Problems.

UNIT II PRODUCTION MANAGEMENT 9

UNIT III FINANCIAL MANAGEMENT 9

UNIT IV DECISION THEORY 9

UNIT V MANAGERIAL ECONOMICS 9

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Apply the knowledge of science and engineering fundamentals in learning the concept of operations research and its practical applicability for solving challenges in construction.
  CO2 Identify, formulate, plan and schedule construction engineering projects.
  CO3 Apply the knowledge of financial management and cost concepts.
  CO4 Design the required man, material, equipment, cost and time as per needs by proper decision rules.
  CO5 Analyze the cost by break-even analysis and modern construction management software.

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OBJECTIVE:
- To impart the concepts of resource planning
- To impart the concepts of labor management.
- To impart the concepts of material and equipment.
- To impart the concepts of time management.
- To impart the concepts of resource allocation and resource leveling in construction.

UNIT I RESOURCE PLANNING 9
Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

UNIT II LABOUR MANAGEMENT 9
Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

UNIT III MATERIALS AND EQUIPMENT 9
Material: Time of purchase, the quantity of material, sources, Transportation, Delivery, and Distribution Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source, and handling.

UNIT IV TIME MANAGEMENT 9
Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control.

UNIT V RESOURCE ALLOCATION AND LEVELLING 9

TOTAL : 45 PERIODS

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

  CO1 Identify the different types of resources in a construction industry
  CO2 Evaluate the labour productivity and the influencing factors
  CO3 Calculate the equipment output and the operation condition of construction equipment
  CO4 Describe the terms of cash inflow, cash outflow, and balance sheet
  CO5 Categorize the time and cost-related information in a construction sector.

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OBJECTIVE:
- To disseminate knowledge about detailed planning.
- To impart knowledge about materials used in formwork.
- To learn design of formwork and shores.
- To disseminate knowledge about erection of form work.
- To impart knowledge about design of formwork for domes, shells, and tunnels.

UNIT I  PLANNING, SITE EQUIPMENT & PLANT FOR FORM WORK
Introduction - Forms for foundations, columns, beams walls etc., General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples. Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork - Formwork accessories.

UNIT II  MATERIALS ACCESSORIES PROPRIETARY PRODUCTS & PRESSURES

UNIT III  DESIGN OF FORMS AND SHORES
Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs length behaviour of wood shores - Form lining Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.

UNIT IV  BUILDING AND ERECTING THE FORM WORK
Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

UNIT V  FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SCAFFOLDS
Hemispherical, Parabolic, Translational shells - Typical barrel vaults Folded plate roof details - Forms for Thin Shell roof slabs design considerations - Building the forms - Placing concrete - Form removed - Strength requirements - Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - Form construction - Shafts. Slip Forms - Principles - Types - advantages - Functions of various components - Planning -Desirable characteristics of concrete - Common problems faced - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold - Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

TOTAL: 45 PERIODS

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

CO1  Explain detailed planning of formwork, plant, and site equipment.
CO2  Select material accessories for formwork connection and analyze pressures on formworks.
CO3  Design the forms and shores.
CO4  Apply the knowledge of erecting forms for beams, slabs, columns, walls, and causes of failures.
CO5 Apply the knowledge of forms and their erection for domes and tunnels, types of slip forms, and scaffolds.

REFERENCES:
2. Hurd, M.K., Formwork for Concrete, Seventh Edition, American Concrete Institute, Detroit, 2016
5. Kumar Neeraj Jha, Formwork for Concrete Structures, 2017

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CN4010 SYSTEM INTEGRATION IN CONSTRUCTION

OBJECTIVE:
- To understand how the various systems that constitute a building design which are interwoven and integrated with a view to achieving a high-performance building;
- To understand about the various environmental factors.
- To understand about the various services.
- To understand about the various maintenance.
- To understand various concepts in safety planning.

UNIT I STRUCTURAL INTEGRATION

UNIT II ENVIRONMENTAL FACTORS
Qualities of enclosure necessary to maintain a specified level of interior environmental quality – weather resistance – Thermal infiltration – Acoustic Control – Transmission reduction – Air quality – Illumination – Relevant systems integration with structural systems.

UNIT III SERVICES

UNIT IV MAINTENANCE
Component longevity in terms of operation performance and resistance to deleterious forces - Planning systems for least maintenance materials and construction – access for maintenance – Feasibility for replacement of damaged components – equal life elemental design – maintenance free exposed and finished surfaces.

UNIT V SAFETY PLANNING
Ability of systems to protect fire – Preventive systems – fire escape system design – Planning for pollution free construction environmental – Hazard free Construction execution for High Rise Buildings.

TOTAL: 45 PERIODS
OUTCOME:

- On completion of the course, the student is expected to be able to
- Integrate the various construction techniques and incorporate into the building process
- Appreciate the requirements and elements of HVAC, mechanical, electrical, hydraulic and transportation services in buildings
- Design and integrate services into high-rise buildings
- Interpret the intricacies of physical installation of services and their critical sequence in the construction process.
- Adopt an approach relating systems to aim for a high performance building in various categories of major use

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CN4011 ADVANCED DATA ANALYSIS

OBJECTIVE:

- To learn concepts of data for construction management.
- To learn concepts of various data analysis.
- To learn concepts of regression and factor analysis.
- To learn concepts of discriminant and cluster analysis.
- To learn concepts of advanced multivariate data analysis techniques

UNIT I STATISTICAL DATA ANALYSIS


UNIT II BASIC CONCEPTS

Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques – Types of multivariate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation – Approaches to multivariate model building.

UNIT III REGRESSION AND FACTOR ANALYSIS

Simple and Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function – Validation of the model. Factor Analysis: Definition – Objectives – Approaches to factor analysis – methods of estimation – Factor rotation – Factor scores - Sum of variance explained – interpretation
of results. Canonical Correlation Analysis - Objectives – Canonical variates and canonical correlation – Interpretation of variates and correlations.

UNIT IV DISCRIMINANT AND CLUSTER ANALYSIS 9

UNIT V ADVANCED TECHNIQUES 9

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Describe the different statistical analysis techniques.
  CO2 Students will be able to formulate hypothesis
  CO3 Explore the basic concepts of statistical analysis
  CO4 Develop regression and factor analysis model and its interpretation
  CO5 Create discriminant and cluster analysis model and its interpretation

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CN4012 ENVIRONMENTAL IMPACT ASSESSMENT FOR CONSTRUCTION ENGINEERS 3 0 0 3

OBJECTIVE:
- To impart the knowledge and skills required for understanding the various impacts of infrastructure projects on the environment.
- To impart knowledge about prediction and assessment of EIA.
- To impart the knowledge of health and socio-economic impact assessment.
- To impart the knowledge and expose the students to the various methodologies available to assess.
- To impart the knowledge to develop the skill to prepare Environmental Impact Assessment report.
UNIT I  INTRODUCTION  9
Sustainable Development challenges and needs - Key approaches for Impact Assessment – EIA approach: historical development - Legal and Regulatory aspects in India - Types and Objectives, Components, Process of EIA.

UNIT II  PREDICTION AND ASSESSMENT  9

UNIT III  HEALTH AND SOCIO-ECONOMIC IMPACT ASSESSMENT  9

UNIT IV  INTEGRATED ANALYSIS  9

UNIT V  IMPACT OF INFRASTRUCTURE AND ENVIRONMENTAL SERVICES  9
Case Studies: EIA for Mining, extraction of natural resources and power generation - Primary Processing and Material Production - Material Processing, Manufacturing/Fabrication - Service Sectors - Physical Infrastructure including Environmental Services - Building and Construction Projects - Area Development Projects and Townships - Strategic Environmental Assessment, Technological Assessment, and Risk Assessment.

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 Apply the knowledge of science and engineering fundamentals to sustainable development challenges.
  CO2 explain the identification, prediction, and evaluation of impacts that will be caused by projects or industries on biodiversity.
  CO3 Identify the legal requirements of environmental impact assessment for projects.
  CO4 develop the ability to perform integrated analysis by considering environmental, social, and health impacts.
  CO5 select appropriate methods for environmental impact assessment for infrastructure and environmental service.

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CN4091   LEAN CONSTRUCTION CONCEPTS, TOOLS, AND PRACTICES     L T P C

3003

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

TOTAL : 45 PERIODS

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

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ST4073 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES L T P C 3 0 0 3

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

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9
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

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

TOTAL: 45 PERIODS

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

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

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

COs- PO’s & PSO’s MAPPING

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CN4013 QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION  L T P C

OBJECTIVE:
- To study the concepts of quality management in construction.
- To study the concepts of quality systems.
- To study the concepts of quality planning.
- To study the concepts of quality assurance and control techniques in construction.
- To study the concepts of quality improvement techniques.
UNIT I QUALITY MANAGEMENT 9

UNIT II QUALITY SYSTEMS 9

UNIT III QUALITY PLANNING 9

UNIT IV QUALITY ASSURANCE AND CONTROL 9
Objectives – Regularity agent, owner, design, contract, and construction-oriented objectives, methods – Techniques and needs of QA/QC – Different aspects of quality – Appraisals – Sampling techniques – Sampling plan – Sampling Terms – AQL, LTPD, AOL - Factors influencing construction quality – Critical, major failure aspects and failure mode analysis, – Stability methods and tools, optimum design – Reliability testing, reliability coefficient and reliability prediction – Failure rate – Mean time to failure – Mean time to repair – Mean time between failures.

UNIT V QUALITY IMPROVEMENT TECHNIQUES 9
Selection of new materials – Influence of drawings, detailing, specification, standardization – Bid preparation – Construction activity, environmental safety, social and environmental factors – Natural causes and speed of construction – Life cycle costing – Value engineering and value analysis.

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
- CO1 Achieve the knowledge of quality management guidelines, and quality circles.
- CO2 Apply the quality standards for preparing Quality system documents.
- CO3 Explain the skill of preparing inspection procedures for quality planning.
- CO4 Select the techniques and tools for Quality Assurance and Control in Construction Industry.
- CO5 Achieve the knowledge of quality improvement techniques

REFERENCES:

COs- PO’s & PSO’s MAPPING

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OBJECTIVE:
- To learn basic concepts of BIM for construction.
- To learn and acquire knowledge in the BIM-based construction design process.
- To understand the challenges in BIM implementation
- To learn and acquire knowledge in BIM-based construction automation technologies.
- To learn and acquire knowledge in Modern Digital Technologies in Construction

UNIT I INTRODUCTION TO BIM FOR CONSTRUCTION 9
Fundamentals of BIM – terminology, CAD & BIM. IFCs, schemas, interoperability, parametric modeling.

UNIT II DEVELOPMENT OF DESIGN PROCESS 9
BIM-based design process and analysis - design coordination. BIM-based construction process – 4D, 5D, nD BIM.

UNIT III CHALLENGES IN BIM IMPLEMENTATION 9
BIM-based operation issues – facility management. Drivers and barriers in BIM adoption, BIM global practices.

UNIT IV CONSTRUCTION AUTOMATION 9
Automation in design and construction, virtual experiments – augmented reality, virtual reality, use of sensors in construction.

UNIT V MODERN DIGITAL TECHNOLOGIES IN CONSTRUCTION 9
Robots in construction, autonomous robots, and 3D printing technology in construction. Drones for Construction monitoring, Internet of Things, Smart Manufacturing, etc.

TOTAL: 45 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to
  CO1 To create a BIM model
  CO2 To develop the construction design process using BIM
  CO3 To identify the challenges in BIM implementation
  CO4 To use automation techniques in construction
  CO5 To implement modern digital technologies in construction

REFERENCES:

COs- PO’s & PSO’s MAPPING

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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

UNIT II   INDIVIDUAL BEHAVIOUR
9

UNIT III   GROUP BEHAVIOUR
9

UNIT IV   LEADERSHIP AND POWER
9

UNIT V   DYNAMICS OF ORGANIZATIONAL BEHAVIOUR
9

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:
CN4092  SUPPLY CHAIN MANAGEMENT AND LOGISTICS IN CONSTRUCTION  L T P C
3 0 0 3

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

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

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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

AX4092 DISASTER MANAGEMENT L T P C 2 0 0 0

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
• Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
• Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

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

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

UNIT V RISK ASSESSMENT 6

TOTAL : 30 PERIODS

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.
UNIT I

1. நற்றமிழ் இலக்கியம் – முதல் புதினம், முதல் பாகம்
   - முதல் பாகம் (82)
2. அகநொனூறு (4)
   - இலக்கியம் பகுதிகள் முழுக்காகினை
3. திருத்தக்க பராந்த முழுக்காகினை
4. புடாக்காக (95,195)
   - இலக்கியம் பகுதிகள் முழுக்காகினை

UNIT II

1. அருள்நரிதா தமிழ்
   - அங்கினை முழுக்காகினை
2. பிராமநநறி முழுக்காகினை
   - அங்கினை முழுக்காகினை

UNIT III

1. காப்பியங்கள் முழுக்காகினை
   - இணைக்கப்பட்ட முழுக்காகினை
2. புறநொனூறு முழுக்காகினை
   - புறநொனூறு முழுக்காகினை

UNIT IV

1. அருள்நரிதா தமிழ்
   - முதல் புதினம், முதல் பாகம்
2. தூரகநொனூறு புனொன்
   - புனொன் புனொன் விளக்கம்
3. திருமந்திரம் (617, 618)
   - புனொன் புனொன் விளக்கம்
4. புறநொனூறு வறியிலிங்க விளக்கம்
5. புறநொனூறு
   - புறநொனூறு வறியிலிங்க விளக்கம்
6. அகநொனூறு (4)
   - முதல் பாகம்
   - முதல் பாகம் (11)
   - முதல் ொன்
   - முதல் பாகம் (11)
   - புறநொனூறு, புறநொனூறு
   - புறநொனூறு (50,27)
   - புறநொனூறு வறியிலிங்க விளக்கம்

UNIT V

1. நற்றிகண தமிழ்
   - நற்றிகண தமிழ்
1. ரமினுடைப் பெக்கு நிகாகற்று,  
2. ரமினுடைப் பறுகும் கீழ்த்,  
3. பதுமை இல்லாங்கள் பைப்பாட்டு தமிழ் இலக்கியம்,  
4. குழாய் பெரும்படகுமார் விளைக்கிரதை வடமப்பொருட்கள் தமிழ் இலக்கியம்,  
5. உரோதலைப் பெரும்பொருட்கள்,  
6. துருதைப் பெரும்பொருட்கள்,  
7. புதுதுமை பெரும்பொருட்கள் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய விளைப்பிட்டுகள் / புத்தகங்கள்
1. ரமினுடைப் பெரும்பதம் விளைப்பிட்டு (Tamil Virtual University) - www.tamilvu.org  
2. ரமினுடைப் பெரும்பதம் விளைப்பிட்டு (Tamil Wikipedia) - https://ta.wikipedia.org  
3. ரமினுடைப் பெரும்பதம் விளைப்பிட்டு  
4. பமப்பொருட்கள் விளைப்பிட்டு - ரமினுடைப் பமப்பொருட்கள் விளைப்பிட்டு, குழாய்  
5. ரமினுடைப் பமப்பொருட்கள் விளைப்பிட்டு - ரமினுடைப் பமப்பொருட்கள் விளைப்பிட்டு (thamilvalarchithurai.com)  
6. உரோதலைப் பமப்பொருட்கள் - உரோதலைப் பமப்பொருட்கள் விளைப்பிட்டு, குழாய்
OPEN ELECTIVES

OIC431 BLOCKCHAIN TECHNOLOGIES

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

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

UNIT II BITCOIN AND CRYPTOCURRENCY

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

UNIT IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING

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

TOTAL: 45 PERIODS

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

REFERENCES:
OIC432 DEEP LEARNING L T P C 3 0 0 3

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

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

UNIT III  INSTRUMENTATION FOR VIBRATION MEASUREMENT

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

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

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

REFERENCES:
OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

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

UNIT I ENERGY SCENARIO

UNIT II HEATING, VENTILATION & AIR CONDITIONING

UNIT III LIGHTING, COMPUTER, TV

UNIT IV ENERGY EFFICIENT BUILDINGS

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

TOTAL: 45 PERIODS

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


## OME433 ADDITIVE MANUFACTURING

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**TOTAL: 45 PERIODS**
REFERENCES:

OME434 ELECTRIC VEHICLE TECHNOLOGY

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

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

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

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

UNIT V DESIGN OF ELECTRIC VEHICLES

TOTAL: 45 PERIODS

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

UNIT I  INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT

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:

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

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

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

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

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

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

TOTAL: 45 PERIODS

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

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT L T P C 3 0 0 3

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

UNIT I INTRODUCTION TO SMALL BUSINESS

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

UNIT II  ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS  9
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III  STAKEHOLDERS IN ETHICAL MANAGEMENT  9
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV  INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT  9
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V  PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS  9
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

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

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

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

UNIT II : IOT ARCHITECTURE

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

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

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.

TOTAL: 45 PERIODS

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 9
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II      NEURAL NETWORKS 9

UNIT III     MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV      DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS 9
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V       DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 9
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

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:
   Approach to Learning and Machine Intelligence, 2012, PHI learning
   9780262035613, 2016.
3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge

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
Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar
collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell-
characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-
Shading Impacts on I-V characteristics- Bypass diode -Blocking diode.

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 photovoltaic system and implement a maximum power point tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources.

REFERENCES:

PS4093 SMART GRID L T P C
3 0 0 3

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

UNIT I INTRODUCTION TO SMART GRID
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
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

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

TOTAL : 45 PERIODS

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

REFERENCES

CP4391 SECURITY PRACTICES

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

UNIT II NETWORK SECURITY

UNIT III SECURITY MANAGEMENT
UNIT IV  CYBER SECURITY AND CLOUD SECURITY

UNIT V  PRIVACY AND STORAGE SECURITY

TOTAL: 45 PERIODS

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

REFERENCES

MP4251  CLOUD COMPUTING TECHNOLOGIES

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

UNIT I  VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE
UNIT II  CLOUD PLATFORM ARCHITECTURE  12

UNIT III  AWS CLOUD PLATFORM - IAAS  9

UNIT IV  PAAS CLOUD PLATFORM  9

UNIT V  PROGRAMMING MODEL  9
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS

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

REFERENCES
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
L T P C
3 0 0 3

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
9

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
9
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:
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

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

UNIT I INTRODUCTION TO ROBOTICS 9
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

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

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

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

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

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

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

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**

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

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

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

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

**UNIT IV VISION SYSTEM**
- Fundamentals of Image Processing
- Filtering
- Morphological Operations
- Feature Detection and Matching
- Blurring and Sharpening
- Segmentation
- Thresholding
- Contours
- Advanced Contour Properties
- Gradient
- Canny Edge Detector
- Object Detection
- Background Subtraction

**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

**TOTAL: 45 PERIODS**
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:

CX4016 ENVIRONMENTAL SUSTAINABILITY

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

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

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

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

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

TOTAL : 45 PERIODS

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

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

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

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

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

TOTAL: 45 PERIODS

REFERENCES

NT4002  NANOCOMPOSITE MATERIALS  

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

TOTAL : 45 PERIODS

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

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UNIT I IPR

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

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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