FIRST SEMESTER

Course Description

Title: Construction Techniques **Code:** CE531

L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite:

Objective:

To learn the effective, economic and speedy construction techniques by adopting the innovative construction practices which will ensures the safety with minimum energy requirement.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** construction techniques associated with innovative construction practices
CO2	**Identify** the masonry construction, curtain walls, building insulation and interior and exterior finishes.
CO3	**Analyze** the concrete formwork design, construction techniques for high rise buildings
CO4	**Describe** the cost Effective Construction Technique (CECT), repair techniques.
CO5	**Determine** the innovative construction techniques.
CO6	**Apply** the prefabrication and pre-casting, modular construction, in-situ pre-fabrication techniques.

Course Content:

Unit-1 Construction techniques associated with steel and reinforced concrete framing; floor systems; roof systems.
Unit-2 Masonry construction; curtain walls; building insulation; and interior and exterior finishes.
Unit-3 Concrete formwork design, construction techniques for high rise buildings, fire resistant construction techniques.
Unit-4 Cost Effective Construction Technique (CECT), repair techniques, innovative construction techniques.
Unit-5 Prefabrication and pre-casting, modular construction, in-situ pre-fabrication, lift slab and tilt up construction

Teaching Methodology:

- At the start of course, the course delivery pattern, importance of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.

- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides and study materials on Construction Techniques (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Jerry Irvine, Advanced Construction Techniques, CA Rocketr,1984.
2. Peter. H. Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd.,2001.Press,2008.
3. Sankar,S.K. and Saraswati, S., “Construction Technology”,Oxford University.

Course Description

Title: Estimating & Costing **Code:** CE532
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisites: Nil

Objective: To learn the fundamentals of estimating and costing, at the end of the course student can able to estimate various types of infrastructure components and its cost as well.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the various methods used in estimation, schedule of rates.
CO2	**Describe** the variations in costs during construction period. Cost escalations , providing lists of quantities of all the items of materials
CO3	**Develop** various equipment necessary to complete a project, maintenance cost estimation techniques for minor and major projects
CO4	**Identify** the methods to estimate the probable cost of construction projects including direct and indirect costs,
CO5	**Apply** the concepts of computer based techniques in the preparation of the estimate, Parametric Cost estimating techniques
CO6	**Demonstrate** various types of Labor and equipment costs considering productivity factors, work hours, wages

Course Content:

Unit 1: Different types of estimates and their uses, various methods used in estimation, schedule of rates

Unit 2: Quantity takeoffs, unit rates, variations in costs during construction period. Cost escalations , providing lists of quantities of all the items of materials

Unit 3: Equipment necessary to complete a project, maintenance cost estimation techniques for minor and major projects, the drawings and specifications of a project

Unit 4: Estimate the probable cost of construction projects including direct and indirect costs, variations in rates, labour rates, factors controlling project costs

Unit 5: Use of computer to assist in the preparation of the estimate, Parametric Cost estimating techniques, project life cycle assessment and its cost, cost controlling techniques

Unit 6: Labor and equipment costs considering productivity factors, work hours, wages, and preparation of documents related to cost estimation. Store keeping, cost variations due to time.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizzes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 and Unit-2 syllabus
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Estimating & Costing (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. B. N. Dutta, Estimating and Costing In Civil Engineering, Ubs Publishers Distributors Ltd. 2. S. C. Rangwala, Estimating And Costing, Charotar Publishing House, Anand
3. G. S. Biridi, Textbook of Estimating & Costing, Dhanapat Rai & Sons. Delhi.
4. M.Chakroborti, Estimating, Costing, Specification and Valuation.Calcutta.
5. P.W.D. Hand Book Is Codes

Reference Books:

1. Patil, B.S., Civil Engineering Contracts, Vol. – I, Orient Longman Publication, 1998.
2. Rangwala, S.C., Elements of Estimating and Costing, Professional practice, Charotar Publishing House, Anand.
3. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing &Valuation, S.K Kataria & Sons, New Delhi.
4. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication

Course Description

Title: Construction Planning & Control

Code: CE533

L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: NIL

Objective:
Construction planning & control develops the project's procedures of initiation, planning, execution, regulation and closure as well as the guidance of the project team's operations towards achieving all the agreed upon goals within the set scope, time, quality and budget standards.

Course Outcome	Description
CO1	**Outline** effectively and collaborate on construction project
CO2	**Identify** construction and procurement activities
CO3	**Analyze** the networks prepare and presenting schedule information
CO4	**Describe** performance time/cost trade-off analysis
CO5	**Determine** the computerized scheduling package
CO6	**Apply** the various delivery systems used in the construction industry

Learning Outcomes:

Construction planning & control provides direction and standards of performance. It also helps to know about the risks and opportunities coming ahead. In this phase, a plan is made and strategies are set by considering the company's rules, procedure and policies.

Course Content:
Unit 1: Conversion of a Scope of Work into scheduling activities.

Unit 2: Developing a building plan including preconstruction, construction, and procurement activities.

Unit 3: Preparing, analyzing, and updating Bar Charts and Critical Path Method Networks; prepare and presenting schedule information.

Unit 4: Assigning and analyzing resource requirements of a project; performing time/cost trade-off analysis.

Unit 5: Justifying claims for additional time; processing schedule information in a computerized scheduling package.

Unit 6: Controlling cost by applying the Earned Value Analysis and other progress metrics.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.

- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Construction Planning & Control (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Project Management, Planning and Control: Managing Engineering, Construction and Manufacturing Projects to PMI, APM and BSI Standards. Book by Albert Lester (2006)
2. Project Management: Planning and Control Techniques. Book by Rory Burke (1993)
3. Project Management: A Systems Approach to Planning, Scheduling, and Controlling. Book by Harold Kerzner (1979)
4. Project planning, scheduling & control. Book by James P. Lewis (1991)

References:

1. Project Planning and Control with PERT and CPM. Book by B.C. Punmia and K. K. Khandelwal
2. Project Planning and Control. Book by Albert Lester (1982)
3. Planning and Control Using Oracle Primavera P6 Versions 8 to 19 PPM Professional. Book by Paul E. Harris (2008)

Course Description

Title: Construction Safety and Health **Code:** CE534
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisites: None

Objective:

The objective of this course is that students will learn about minimum safety and health requirements related to construction activities.

Learning Outcomes:

CO1	**Outline** the concepts of safety, factors affecting safety
CO2	**Identify** and plan for safety provisions and techniques for construction safety management,
CO3	**Analyse** the need for demolition and management of accidents and injuries.
CO4	**Describe** the roles of organizations and personnel involved in major construction projects and explain how each affects site safety.
CO5	**Demonstrate** construction safety in an increasingly challenging and changing environment
CO6	**Explain** the legal aspects including liability and regulatory requirements of construction safety.

COURSE OUTLINE:

Unit-1: Concept of safety, factors affecting safety: psychological and technological,

Unit-2: Planning for safety provisions, techniques for construction safety management, safety considerations during construction,

Unit-3: Demolition and use of equipment; management of accidents/injuries, site management with regard to safety recommendations, training for safety awareness, implementation of health & safety plans, construction hazards & solutions, formulation of safety manuals, safety legislation, standards/codes with regard to construction safety, case studies,

Unit-4: Construction safety management – fundamentals, measuring performance & recording information, health hazard in construction, personal protective and lifesaving equipment, the safety policy; assessing the risks, control strategies for construction work; fire safety, the health and safety plan,

Unit-5: Training; meetings, understanding people, access to information, environment, health and safety issues - construction and the environment, construction health and safety law

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.

- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on the Theory of structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:
1. Safety, Occupational Health and Environmental Management in Construction by S C Sharma & Vineet Kumar

TEXT BOOKS / REFERENCES:

1. Hill, Darryl C. (2004) Construction Safety Management and Engineering. American Society of Safety Engineers, Des Plaines, Illinois.

Course Description

Title: Construction Capstone Project **Code:** CE631
L-T-P scheme: 0-0-4 **Credits:** 2

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:

1. An ability to function on multidisciplinary areas.
2. To understand the engineering applications in a global, economic, environmental, and societal context.

Learning Outcomes:

Course Outcome	Description
CO1	Develop advanced skills of technical communication in English.
CO2	Communicate confidently and competently in English language on specified topic.
CO3	Develop theory based ideas on particular topic and its importance in engineering.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content

UNIT-1 Identification of Innovative work based upon Literature survey.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Student is expected to do literature survey and carry out development and/or experimentation.

UNIT-4 Student has to exhibit both analytical and practical skills.

UNIT-5 Demonstrate deployment and basic maintenance skills of the respective design project

Teaching Methodology: Seminar is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage

P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
Supervisor marks for performance and attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

SECOND SEMESTER

Course Description

Title: Construction Contracts and Laws **Code:** CE535

L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite:

Objective:

To prepare the contract and bidding documents for various construction work. This course will enhance the knowledge of liability, mechanics liens, litigation and arbitration through the Indian and

international contracts act.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** various contracts and bidding documents for any proposed construction work.
CO2	**Identify** the disputes and disputes resolutions according construction laws.
CO3	**Analyze** features-suitability-design of contract documents
CO4	**Describe** tendering and bidding-accepting-evaluation of tender, formation and interpretation, potential contractual problems.
CO5	**Determine** arbitration, comparison of actions and laws, agreements, conditions of arbitrations, powers and duties of arbitrator, rules of evidence.
CO6	**Apply** legal requirements, insurance and bonding, laws governing sale, purchase and use of urban and rural land, land revenue codes and taxes.

Course Content:

Unit-1

Basics of the legal system including contracts, torts, land zoning and property ownership, bonds and insurance, bidding, subcontracting, contractor liability, mechanics liens, litigation and arbitration,

Unit-2

Indian and international construction law, hazardous waste issues and labor laws, disputes and disputes resolutions, case studies.

Unit-3

Indian contract act, elements, types, features-suitability-design of contract documents, international contract document, law of torts;

Unit-4

Tenders: prequalification bidding-accepting-evaluation of tender, formation and interpretation, potential contractual problems, world bank procedures and guidelines;

Unit-5

BOT projects, arbitration, comparison of actions and laws, agreements, conditions of arbitrations, powers and duties of arbitrator, rules of evidence, Dispute Redressal Boards(DRB),

Unit-6

Laws: legal requirements, insurance and bonding, laws governing sale, purchase and use of urban and rural land, land revenue codes, tax laws, income tax, sales tax, excise and customs duties, legal requirements for planning, property law, agency law, local government laws for approval, statutory regulations.

Teaching Methodology:

- At the start of course, the course delivery pattern, importance of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.

- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2,3, & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides and study materials on contracts and tender documents (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Gajaria G.T.,"Laws Relating to Building and Engineering" Contracts in India.
2. Jimmie Hinze,"Construction Contracts", McGraw Hill,2001.
3. Joseph T. Bockrath, "Contracts and the Legal Environment for Engineers and Architects",McGraw Hill, 2000.
4. Kwaku, A. Tenah, P.E. Jose M.Guevara, P.E., "Fundamentals of Construction Management and Organisation,",Printice Hall, 1985.M.M> Tripathi Private Ltd., Bombay,1982.
5. Patil, B.S.,"Civil Engineering Contracts and Estimates",Universities Press (India) Private Limited,2006.

Course Description

Title: Heavy/Civil Construction Equipment, Methods, and Management **Code:** CE536
L-T-P scheme: 3-0-0 **Credits:** 3

Prerequisite: Nil.

Objective:

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

Learning Outcomes:

Course Outcome	Description
CO1	Develop advanced skills of technical communication in English.
CO2	Communicate confidently and competently in English language on specified topic.
CO3	Develop theory based ideas on particular topic and its importance in engineering.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content

UNIT-1 Planning of equipment – Selection of Equipment - Equipment Management in Projects - Maintenance Management – Equipment cost – Operating cost – Cost Control of Equipment - Depreciation Analysis – Replacement of Equipment- Replacement Analysis - Safety Management

UNIT-2 Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

UNIT III Equipment for Dredging, Trenching, Drag line and clamshells, Tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition.

UNIT IV Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment

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

Teaching Methodology:

- At the start of course, the course delivery pattern, importance of the subject will be discussed.

- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides and study materials on Construction Equipment, Methods, and Management (will be added from time to time): Digital copy will be available on the JUET server.

Text Book/Reference Books:

1. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.
2. Dr.Mahesh Varma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi. 1983.
3. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006.
4. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 1988.

Course Description

Title: Construction Cost Analysis **Code: CE537**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisites: Estimation & costing

Objective: To learn the fundamentals of Construction Cost and its Analysis in the life of the projects, at the end of the course student can able to estimate various types of infrastructure components and its cost as well.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the Cost-Benefit analysis, economic performance analysis, direct costs and indirect costs.
CO2	**Describe** the concepts of Incremental analysis, economic feasibility analysis
CO3	**Develop** the advanced conceptual estimating techniques, quick methods of determining approximate costs of a project
CO4	**Identify** the Life cycle cost parameters and its analysis, time duration of project and its influence on costs
CO5	**Apply** various concepts and technique of economic evaluation, costs of initial investments, replacements, operations
CO6	**Demonstrate** various types of Maintenance and repair investments, case studies, interests, methods of funding

Course Content:

Unit 1: Cost-Benefit analysis, economic performance analysis, direct costs and indirect costs

Unit 2: Incremental analysis, economic feasibility analysis, the coding system in the projects

Unit 3: Advanced conceptual estimating techniques, quick methods of determining approximate costs of a project, quantity rates and cost escalations, cost analysis in the major projects

Unit 4: Life cycle cost analysis, time duration of project and its influence on costs, public investments in the projects, projects on public private partnership mode

Unit 5: Technique of economic evaluation, costs of initial investments, replacements, operations, role of banks in the projects, role of management and employees in projects

Unit 6: Maintenance and repair investments, case studies, interests, methods of funding, various funding agencies

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizzes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 and Unit-2 syllabus
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Construction cost analysis (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Construction Cost Analysis and Estimating, Prentice-Hall International Series in Civil engineering, by Phillip Ostwald
2. Construction Cost Estimating Process and Practices, by Holm Leonard , E. Schaufelberger John and Griffin Dennis
3. B. N. Dutta, Estimating and Costing In Civil Engineering, Ubs Publishers Distributors Ltd. 2.
4. Maintenance Costs and Life Cycle Cost Analysis , by Diego Galar, Peter Sandborn, Uday Kumar, CRC Press

Reference Books:

1. Construction Cost Analysis by by Phillip .F, Pearson Publication
2. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication
3. Life Cycle Costing for the Analysis, Management and Maintenance of Civil Engineering Infrastructure by John W. Prof Bull (Editor), Whittles Publishing house
4. Life-Cycle Cost Models for Green Buildings: With Optimal Green Star Credits
by I M Chethana S Illankoon, Vivian W Y Tam, Khoa N Le

Course Description

Title: Construction Financial Management **Code:** CE538

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:

Objective:

1. Introduce the concepts of construction financial management.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the construction accounting and engineering economics.
CO2	**Identify the** time value of money and rate of return.
CO3	**Analyze** the cost-benefit analysis and risks and uncertainties
CO4	**Describe** the Employing risk analysis, constructability, bidding, cost and quality control, and contract management skills.
CO5	**Enumerate** and Communicate effectively and collaborate on the construction project
CO6	**Design** and Recognizing and applying the various delivery systems used in the construction industry

Course Content:

Unit-1:
Introduction, modern financing theory, real estate development & finance, construction accounting systems,

Unit-2:
analysis of financial statements, managing costs, determining labor burden, managing general overhead costs,

Unit-3:
setting profit margins for bidding, profit center analysis, cash flows for construction projects & construction companies

Unit-4:
time value of money, risks & uncertainties and management decision in capital budgeting, taxation and inflation

Unit-5:
financing a company's financial needs, tools for making financial decisions, interest factors, amortization schedule.

Unit-6
computerized accounting systems, international financial management, practical problems & case studies

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.

- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Construction Financial management (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Risk and Financial Management in Construction Book by Simon Burtonshaw-Gunn3.
2. Financial Management in Construction Contracting Book by Andrew Ross and Peter Williams

Reference Books/Material:

1. Cost Accounting and Financial Management for Construction Project Managers Textbook by Len Holm

Course Description

Title: Mechanical and Electrical Systems in Buildings **Code:** CE733
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite:

Objective: This course is designed to explain various building services including residential and commercial buildings.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** Design residential buildings from the point of view of grouping and circulation, lighting and ventilation and fire protection
CO2	**Identify** residential and commercial plumbing systems.
CO3	**Analyze** fire protection, storm water and natural gas utilities.
CO4	**Describe** HVAC fundamentals, pumps, ventilation & cooling, air conditioners, and heating systems.
CO5	**Determine** requirements of power systems and equipments, general requirements & planning of electrical and communication and testing of installations.
CO6	**Apply** concepts for service and distribution, grounding, branch circuits and feeders, lighting, fire alarm system, and low voltage systems.

Course Content:

Unit 1 - Site utilities (water, sewer, gas, and storm).

Unit 2 - Residential and commercial plumbing systems.
Unit 3 – Specialty topics of fire protection, storm water, and natural gas.

Unit 4 – HVAC fundamentals, pumps, ventilation & cooling, air conditioners, and heating systems.

Unit 5 - Introduction to electricity, power systems and equipments, general requirements & planning of electrical and communication installations, inspection and testing of installations.

Unit 6 - lightning protection of buildings, boxes and conduit, service and distribution, transformers, grounding, branch circuits and feeders, motors and motor controls, lighting, fire alarm system, and low voltage systems.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Mechanical and Electrical Systems in Buildings (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. National building code of India, BIS, 2016.
2. Building construction, Arora and Bindra, Dhanpatrai &Sons,2012.
3. Hand book of Housing Statistics,NBO 2003

Course Description

Title: Sustainable Design and Construction **Code: CE734**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisites: None

Objective:

The objective of this course is that students will learn about basic sustainable construction methods for common building elements.

Learning Outcomes:

CO1	**Outline** the concepts sustainability and challenges in sustainable construction,

CO2	**Identify** different design concepts for sustainable design and sustainable construction practices,
CO3	**Analyse** the buildings for energy efficiency
CO4	**Recognise** and address the impact of key environmental challenges facing the construction industry.
CO5	**Demonstrate** a broad understanding and critical appreciation of the key issues affecting sustainability and the circular economy.
CO6	**Explain** the systems of delivery of green buildings.

COURSE OUTLINE:

Unit-1: Sustainability, challenges in sustainable construction,

Unit-2: Design, construction and equipment, materials and systems, maintenance and conservation, waste materials, site waste management, re-use and recycling of materials,

Unit-3: Energy efficient buildings, concepts of green and sustainable buildings, natural lighting, rainwater harvesting, solar panels and solar HVAC systems,

Unit-4: Sustainable building design, rating system,

Unit-5: Delivery of green buildings

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	

Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on the Theory of structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:
1. Sustainable Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008.

TEXT BOOKS / REFERENCES:

1. The Philosophy of Sustainable Design by Jason F. McLennan, Ecotone Publishing Co., 2004.
2. Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010.

Course Description

Title: Construction Capstone Project **Code:** CE632
L-T-P scheme: 0-0-4 **Credits:** 2

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:
1. Students will be able to identify/formulate research the problem for M. Tech. dissertation.
2. Students will be able to write a review paper in the format of standard journal/transactions related to a particular topic.
3. Students will be able to write dissertation/thesis after completion of the work for the degrees of M. Tech.

Learning Outcomes:

Course Outcome	Description
CO1	Interpret data from research papers
CO2	Analyze seminar and presentations
CO3	Development of the theoretical model and computational analysis of the planned work.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Write Dissertation on the basis of research carried out

Course Content

UNIT-1 Literature survey and review, the process of research, Formulation of a research problem, Experimental design –Classification. Theoretical research, Formulating a problem, verification methods, modelling and simulations, ethical aspects, IPR issues, Copyrights and Patenting etc.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Research Problem identification, Probable solutions, verification of the proposed methodology, conclusions. Meaning, Need and Types of research design, Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment

UNIT-4 Quantitative Techniques Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation.

UNIT-5 Research Communication, Writing a conference paper, Journal Paper, Technical report, Dissertation/thesis writing. Presentation techniques, Patents and other IPRs, software used for report writing such as WORD, Latex etc

Teaching Methodology: Dissertation is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

THIRD SEMESTER

Course Description

Title: Quantitative Methods in Construction Management **Course Code: CE731**

L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: Nil

Objective: To impart knowledge on statistical tools, linear and dynamic programming.

Learning Outcomes:

CO1	**Outline** the concept of construction management
CO2	**Identify** the Statistical tools.
CO3	**Analyse** programming Transportation and assignment problems
CO4	**Describe** and theory and programming.
CO5	**Demonstrate** the various effects of construction simulation.
CO6	**Explain** CPMPERT techniques.

Course Content:

Unit-1: Introduction and concepts of probability.

Unit-2: Statistics-Probability Theory-Statistical tools.

Unit-3: Linear programming Transportation and assignment problems.

Unit-4: Dynamic programming, Queuing theory, Decision theory, Games theory.

Unit-5: Simulations applied to construction, Study of various effects.

Unit-6: Modifications and improvement on CPMPERT techniques.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry

marks.

- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Quantitative Methods in Construction Management: Digital copy will be available on the JUET server.

Books and references:

1. Freund, J.E. and Miller, I.R., Probability and statistics for engineers, 5th edition, prentice hall of India, New Delhi, 1994.
2. Goel B.S and mittal. S.K., Operation Research, pragati Prakashan, Meerut, 2000.
3. Gupta. S.C. and Kapur, V.K., Fundamentals of mathematical statistics, sultan chand and sons New Delhi, 1999.
4. Taha, H.A., Operations research An introduction, 8th edition, prentice hall India, New Delhi, 2010.

Course Description

Course: Construction Practices and Equipment **Code: CE732**
L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: CTM

Objective: This course is designed to introduce post graduate students to concepts and applications of Construction Practices and Equipment.

Learning Outcomes:

CO1	**Outline** Introduction to Construction Process , Codes and Regulations
CO2	**Identify** the use of Mass Diagram, Excavating and Lifting, Hydraulic Excavators, Trenching and Trenchless Technology
CO3	**Analyze** the principles of Compaction, Compaction Equipment and Procedures, Ground Modification Grading and Finishing, Rock Excavation
CO4	**Describe** the drilling, Blasting, Rock Ripping. Paving and Surface Treatments, Compressed Air and Water System
CO5	**Demonstrate** the protecting Excavations and Workers, Dewatering Excavations Pressure Grouting, Frame Construction, Concrete Construction, Quality Control
CO6	**Explain** the Construction Safety in the site, Equipment Maintenance, Work Improvement

Course Content:

Unit-1:. Introduction to Construction Process, Codes and Regulations, Earthmoving and Heavy Construction equipments, Spoil Banks, Estimating Earthwork Volume

Unit 2: Use of the Mass Diagram, Excavating and Lifting, Hydraulic Excavators, Trenching and Trenchless Technology, Estimating Equipment Travel Time

Unit 3: Principles of Compaction, Compaction Equipment and Procedures, Ground Modification Grading and Finishing, Rock Excavation, Stability of Excavations

Unit 4: Drilling, Blasting, Rock Ripping. Paving and Surface Treatments, Compressed Air and Water Systems

Unit 5: Protecting Excavations and Workers, Dewatering Excavations Pressure Grouting, Frame Construction, Concrete Construction, Quality Control, Form Design, Steel Erection, Planning and Scheduling, Bar Graph Method

Unit 6: Scheduling and Resource Assignment Using CPM, Rent-Lease-Buy Decision, Bidding and Contract Award, Plans and Specifications, Construction Safety in the site, Equipment Maintenance, Work Improvement

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit 2
Test-2	25 Marks	Based on Unit-3 and Unit 4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and Unit-6, around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Construction Practices and Equipment (will be added from time to time): Digital copy will be available on the JUET server.

Books:

1. Construction Methods and Management, by S. W. Nunnally, Pearson Prentice Hall, 2005

2. Construction Planning, Equipment and Methods by Robert Peurifoy, Clifford J. Schexnayder, Tata Mc graw hills, 1999.

3. Fundamental of Building Construction Materials and Methods by Edward Allen, Pearson Publishers, 2006.

References

1. Construction Equipments and Methods, by Robert L and Clifford , Mc Graw hills publishers, 2004.
2. Construction Equipment and Methods: Planning, Innovation, Safet, by Leonhard E. Bernold, John Wiley And Sons Inc, 2001

Course Description

Title: Advances in Construction materials **Code: CE735**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Building materials and construction

Objective:
To introduce the advanced building materials used in the construction industry or being studied at the research level.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the physical, chemical and micro-structural properties and uses of newer construction materials.
CO2	**Describe** the structural behavior of ingredients of construction materials.
CO3	**Develop** the concepts of processing and effective utilization of materials for appropriate field applications.
CO4	**Identify** the requirements of construction materials as per relavant codes of practice.
CO5	**Demonstrate** the structural aspects of materials and the technicalities involved in construction methods.
CO6	**Apply** the concepts of geo-textiles in practical issues posed in construction industry.

Course Content:
Unit 1: Newer and improved materials of construction

Unit 2: steel having greater ductility, tensile strength and corrosion resistance

Unit 3: high performance concrete

Unit 4: self compacting concrete

Unit 5: chemicals, epoxies, latexes and bonding agents for repairs

Unit 6: geotextiles and geomembranes

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.

- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Recent advances in Construction materials (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Interscience Publication by Broutman.A Wiley John Wiley & sons New York, 1996.
2 Engineering Materials by Rangwala S C Charotar Publishing house , Anand, 1985.
3. Weather Head R G "FRP Technology" Applied Science Publishers Ltd , London ,1998.
4. Civil Engineering Materials by Raina K B Tata McGraw- Hill Publishing Company Ltd, New Delhi, 1999.
5. Engineering Materials .by Budinski KG, Prentice Hall of India, New Delhi, 1985.

Reference Books/Material:

1. Concrete, Prentice-Hall, by P. K. Mehta, P J M Monteiro, New Jersey
2 Handbook of Concrete Mixes, Special Publications No 24 BIS New Delhi
3. EFNAARC Guidelines on SCC
4. ACI Special Publications
5. IS Specifications
6. Advances in Construction Materials 2007 by Christian U. Grosse.
7.Advanced Civil Infrastructure Materials Science, Mechanics and Applications by H Wu

Course Description

Title: Principles of Affordable Housing **Code: CE736**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:

Objective:

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the current trends in affordable housing and policy
CO2	**Identify the** project feasibility
CO3	**Analyze** the issues in the housing development process
CO4	**Describe** the site planning and practice in affordable housing
CO5	**Enumerate** the cost of new and rehabilitated affordable housing,
CO6	**Design** the future of affordable housing production

Course Content:
Unit-1:
Introduction and overview, current trends in affordable housing,
Unit-2:
project feasibility, affordable housing policy, practice, and issues
Unit-3:
the affordable housing development process
Unit-4:
financing affordable housing, site planning,
Unit-5:
architecture and cost of new and rehabilitated affordable housing,
Unit-6
nonprofit housing development, future of affordable housing production

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on principles of affordable housing (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Developing affordable housing Book by Bennett L. Hecht
2. Affordable Housing for Smart Villages Book by Hemanta Doloi and Sally Donovan

Reference Books/Material:

1. Business Planning for Affordable Housing Developers: Version 2.2 Book by R. M. Santucci

Course Description

Title: Seminar **Code:** CE633
L-T-P scheme: 0-0-2 **Credits:** 2

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:

1. An ability to function on multidisciplinary areas.
2. To understand the engineering applications in a global, economic, environmental, and societal context.

Learning Outcomes:

Course Outcome	Description
CO1	Develop advanced skills of technical communication in English.
CO2	Communicate confidently and competently in English language on specified topic.
CO3	Develop theory based ideas on particular topic and its importance in engineering.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content

UNIT-1 Identification of Innovative work based upon Literature survey.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Student is expected to do literature survey and carry out development and/or experimentation.

UNIT-4 Student has to exhibit both analytical and practical skills.

UNIT-5 Demonstrate deployment and basic maintenance skills of the respective design project

Teaching Methodology: Seminar is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage

P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

Course Description

Title: Dissertation Part-I **Code:** CE634
L-T-P scheme: 0-0-24 **Credits:** 12

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:
1. Students will be able to identify/formulate research the problem for M. Tech. dissertation.
2. Students will be able to write a review paper in the format of standard journal/transactions related to a particular topic.
3. Students will be able to write dissertation/thesis after completion of the work for the degrees of M. Tech.

Learning Outcomes:

Course Outcome	Description
CO1	Interpret data from research papers
CO2	Analyze seminar and presentations
CO3	Development of the theoretical model and computational analysis of the planned work.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Write Dissertation on the basis of research carried out

Course Content

UNIT-1 Literature survey and review, the process of research, Formulation of a research problem, Experimental design –Classification. Theoretical research, Formulating a problem, verification methods, modelling and simulations, ethical aspects, IPR issues, Copyrights and Patenting etc.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Research Problem identification, Probable solutions, verification of the proposed methodology, conclusions. Meaning, Need and Types of research design, Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment

UNIT-4 Quantitative Techniques Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation.

UNIT-5 Research Communication, Writing a conference paper, Journal Paper, Technical report, Dissertation/thesis writing. Presentation techniques, Patents and other IPRs, software used for report writing such as WORD, Latex etc

Teaching Methodology: Dissertation is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

FOURTH SEMESTER

Course Description

Title of the course: Maintenance Planning and Control **Course Code: CE737**
L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites:

Objective: This course is designed to introduce graduate students to concepts and applications of Maintenance planning and management.

Learning Outcomes:

CO1	**Outline** Maintenance planning with Preventive and Predictive maintenance
CO2	**Identify** Emerging trends in maintenance with productivity
CO3	**Analyse** Maintenance strategy and Maintenance organization
CO4	**Describe**. Fundamentals of planned maintenance system
CO5	**Demonstrate** Manpower planning, auditing and performance
CO6	**Explain** Repair, replacement decisions and structural reliabilty

Course Content:

Unit-1: Objectives of planned maintenance, Maintenance philosophies, Preventive and Predictive maintenance, Emerging trends in maintenance-Proactive Maintenance,
Unit-2: Reliability Centred Maintenance (RCM), Total Productive Maintenance (TPM), etc, Implementation of Maintenance strategy, Maintenance organization
Unit-3: Basis of planned maintenance system, Maintenance planning and scheduling, Maintenance control system and documentation.
Unit-4: Spares and inventory planning, Manpower planning, maintenance auditing. Human factors in maintenance and training, maintenance costing, Maintenance performance
Unit-5: Repair decisions- Repair, replacement and overhaul, Computer applications in maintenance
Unit-6: Expert systems applications, maintenance effectiveness, Case studies

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry

marks.

- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Maintenance Planning and Control (will be added from time to time): Digital copy will be available on the JUET server.

Books and references:

1. Planning and Control of Maintenance Systems Modelling and Analysis 2015 Edition by Salih O. Duffuaa, A. Raouf , Springer.
2. Maintenance Planning, Coordination and Scheduling Hardcover by DonNyman (Author), Joel Levitt
3. Building Maintenance Practice: A Construction Management Approach Paperback –Illustrated, 21 August 2012 by Belachew Asteray (Author)
4. Building Maintenance Processes and Practices by Abdul Lateef Olanrewaju, Abdul-RashidAbdul-Aziz

Course Description

Title: Construction Methods Improvement **Code: CE738**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Building construction

Objective: This course is designed to explain the possibilities of improvements in construction methods.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** methods analysis and work analysis.
CO2	**Identify** work methods improvement, productivity analysis and measuring productivity.
CO3	**Analyze** time study, standard data systems, predetermined time systems and work sampling.
CO4	**Describe** physiological work measurement, labor reporting and improving productivity.
CO5	**Determine** incentives to increase productivity and ergonomics.
CO6	**Apply** alternative methods for increasing productivity.

Course Content:
Unit 1 – Introduction to methods analysis and work analysis.

Unit 2 - Work methods improvement, productivity analysis and measuring productivity.
Unit 3 – Time study, standard data systems, predetermined time systems and work sampling.

Unit 4 – Physiological work measurement, labor reporting and improving productivity.

Unit 5 - Introduction to ergonomics and incentives to increase productivity.

Unit 6 - Alternative methods for increasing productivity and case studies.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.

- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Construction Methods Improvement (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. A Text Book of Building Construction" by Arora, S.P. & Bindra, S.P., Dhanpat Rai & Sons, Delhi.
2. Building Construction", by Jha, J. & Sinha, S.K., Khanna Publishers, Delhi.
3. A Text Book of Engineering Construction", by Kulkarni, C. J.Ahmedabad Book Depot, Ahmedabad.
4. Building Construction, by McKay W.B., "Vol.1 to 4, Orient Longman Ltd., Hyderabad, Bombay, Madras, Delhi, Vol.1 & 2 -1995, Vol. 3-1996, Vol. 4-1998.
5. A Text Book of Building Construction" by Punmia, B.C., Laxmi Publications, Delhi, Madras.

Course Description

Title of the course: Industrial Engineering Systems **Course Code: CE739**

L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: Nil

Objective: To acquaint the students to the tools and techniques of industrial engineering.

Learning Outcomes:

CO1	**Outline** the function and principle of industries
CO2	**Identify** the factors affecting layout of plant building
CO3	**Analyse** forecasting, routing and operations planning
CO4	**Describe** the Inventory Control
CO5	**Demonstrate** the control charts for variables and attributes
CO6	**Explain** ergonomics and its industrial applications.

Course Content:

Unit-1: Introduction to industrial engineering. Functions of organization, Elements of organization, Principles of organization, Types of organization and their selection.

Unit-2: Plant Layout and Material Handling: Site selection, types of layout, factors affecting layout, plant building, flexibility and expandability, Principles of material handling, types and selection of materials handling equipment's.

Unit-3: Production Planning and Control: Functions, forecasting, routing, operations planning; Gantt chart, work order, dispatching and follow-up; CPM and PERT techniques.

Unit-4: Inventory Control: Scope, purchasing and storing, economic lot size; ABC Analysis.

Unit-5: Quality Control: Statistical quality control, control charts for variables and attributes: X bar, R, p & c charts, Concepts &Scope of TQM and QFD.Acceptance Sampling: Consumers risk, Producers risk, LQL, AQL, OC curves, Types of sampling plans, AOQ, ATI.

Unit-6: Work Study: Scope, work measurement and method study, standard data, ergonomics and its industrial applications.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Industrial Engineering Systems: Digital copy will be available on the JUET server.

Books and references:

1. Mitra, A., "Fundamentals of Quality Control and Improvement", John Wiley & Sons, Inc, 2008
2. Russell, R.S., Taylor, B.W.,"Operations Management", Pearson Education, 2003
3. Jocobs, C.A., "Production and Operations Management", Tata McGraw Hill 1999.

Groover,M.P.,"Automation, Production Systems and ComputerIntegrated Manufacturing",Pearson Education, 2001

Course Description

Title: Value Engineering **Code: CE740**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: None

Objective: This course is designed to explain the value concept of methods, objects and planning.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** general techniques of Value Engineering in a business organization.
CO2	**Identify** special techniques in Value Engineering.
CO3	**Analyze** analytical and decision-making skills in the Value Engineering job.
CO4	**Describe** structured phases of Value Engineering and build teams.
CO5	**Determine** strategy for formulating Value Engineering Study Team, Value Engineering Study Procedure and the workshop approach to achieving value.
CO6	**Apply** Target setting, Time management, Assessment of Value Engineering Results and case study discussions.

Course Content:

Unit 1 - Concepts: Introduction, History of value engineering, Value, Function, Cost, Worth, Case Study Discussions.

Unit 2 - General Techniques in Value Engineering: The Gordon Technique, Feasibility Ranking, The Morphological Analysis Technique, ABC Analysis, Probabilistic Approach, Case Study Discussions.
Unit 3 - Special Techniques in Value Engineering: Function – Cost – Worth Analysis, Function Analysis
Unit 4 - System Technique - Technically oriented FAST and Customer-oriented FAST, Weighted Evaluation Method, Quantitative Method, Evaluation Matrix, Life Cycle Cost (LCC), Case Study Discussions.
Unit 5 - Applications of Value Engineering: Guidelines for formulating Value Engineering Study Team, Value Engineering Study Procedure, the workshop approach to achieving value.

Unit 6 - Target setting, Time management, Assessment of Value Engineering Results, Case Study Discussions.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.

- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Value Engineering (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. Anil Kumar Mukhopadhyaya, Value Engineering Concepts, Techniques and Applications, Response Books, 2013.
2. Anil Kumar Mukhopadhyaya, Value Engineering Mastermind from Concept to Value Engineering Certification, Response Books, 2009.
3. Lawrence D. Miles, Techniques of Value Analysis and Engineering, McGraw-Hill Book Company, 2009.
4. M.R.S. Murthy, Cost Analysis for Management Decisions, Tata McGraw-Hill Publishing Company Ltd., 1988.
5. IS 1180: 2003 Indian Standard “Guidelines to establish a Value Engineering Activity” (First Revision)

Course Description

Title: Reliability Engineering **Code: CE741**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Structural Analysis, Design of Steel Structures

Objective:

- To comprehend the concept of Reliability and Unreliability
- Derive the expressions for probability of failure, Expected value and standard deviation of Binominal distribution, Poisson distribution, normal distribution and weibull distributions.
- Formulating expressions for Reliability analysis of series-parallel and Non-series parallel systems
- Deriving expressions for Time dependent and Limiting State Probabilities using Markov models

Learning Outcomes:

Course Outcome	Description
CO1	Apply fundamental knowledge of Reliability to modeling and analysis of series parallel and Non-series parallel systems
CO2	Solve some practical problems related to Generation and Transmission
CO3	Design and the Transmission and Utilization of Electrical Energy.
CO4	Identify and Understand the awareness of various failures
CO5	Discuss the causes of failures and remedies for failures in practical systems
CO6	Describe the importance of Reliability in Engineering

Course content:

Unit-1:

Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in the definition. Probability distributions: Random variables, probability density and

distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, weibull distribution.

Unit-2

Hazard rate, derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

Unit-3:

Classification of engineering systems: series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations. Reliability evaluation of Non-series-parallel configurations: Decomposition, Path-based and cutestbased methods, Deduction of the Paths and cutsets from Event tree.

Unit-4:

Discrete Markov Chains: General modelling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one repairable component model. Absorbing states. Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating time-dependent and limiting state Probabilities of one component repairable model. Evaluation of Limiting state probabilities of two-component repairable model.

Unit-5:

Approximate system Reliability analysis of Series systems, parallel systems with two and more than two components, and Network reduction techniques. Minimal cutest/failure mode approach.

Teaching Methodology: The course will be covered through lectures supported by tutorials. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from

		coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lectures notes, Tutorials,and slides (will be added from time to time), Digital copy will beavailable on the JUET server.

Text Books:

- "Reliability evaluation of Engineering systems", Roy Billinton and Ronald N Allan, BSPublications.
- "Reliability Engineering", Elsayed A. Elsayed, Prentice Hall Publications

Reference Books:

- "Reliability Engineering: Theory and Practice", By Alessandro Birolini, SpringerPublications.
- "An Introduction to Reliability and Maintainability Engineering", Charles Ebeling, TMHPublications.
- "Reliability Engineering", E. Balaguruswamy, TMH Publications.

Course Description

Title: Project Seminar **Code:** CE635
L-T-P scheme: 0-0-2 **Credits:** 2

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:

1. An ability to function on multidisciplinary areas.
2. To understand the engineering applications in a global, economic, environmental, and societal context.
3. Student may continue his work taken in Seminar-I or change the topic suitably.

Learning Outcomes:

Course Outcome	Description
CO1	Develop advanced skills of technical communication in English.
CO2	Communicate confidently and competently in English language on specified topic.
CO3	Develop theory based ideas on particular topic and its importance in engineering.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content

UNIT-1 Identification of Innovative work based upon Literature survey.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Student is expected to do literature survey and carry out development and/or experimentation.

UNIT-4 Student has to exhibit both analytical and practical skills.

UNIT-5 Demonstrate deployment and basic maintenance skills of the respective design project

Teaching Methodology: Seminar is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-rources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

Course Description

Title: Dissertation Part-II **Code:** CE636
L-T-P scheme: 0-0-24 **Credits:** 12

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:
1. Students will be able to identify/formulate research the problem for M. Tech. dissertation.
2. Students will be able to write a review paper in the format of standard journal/transactions related to a particular topic.
3. Students will be able to write dissertation/thesis after completion of the work for the degrees of M. Tech.
4. Student may continue his work taken in Dissertation Part-I or change the topic suitably.

Learning Outcomes:

Course Outcome	Description
CO1	Interpret data from research papers
CO2	Analyze seminar and presentations
CO3	Development of the theoretical model and computational analysis of the planned work.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Write Dissertation on the basis of research carried out

Course Content

UNIT-1 Literature survey and review, the process of research, Formulation of a research problem, Experimental design –Classification. Theoretical research, Formulating a problem, verification methods, modelling and simulations, ethical aspects, IPR issues, Copyrights and Patenting etc.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Research Problem identification, Probable solutions, verification of the proposed methodology, conclusions. Meaning, Need and Types of research design, Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment

UNIT-4 Quantitative Techniques Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation.

UNIT-5 Research Communication, Writing a conference paper, Journal Paper, Technical report, Dissertation/thesis writing. Presentation techniques, Patents and other IPRs, software used for report writing such as WORD, Latex etc

Teaching Methodology: Dissertation is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member