NAGARJUNA COLLEGEOFENGINEERING & TECHNOLOGY

(An Autonomous College under VTU) (NAAC Accredited with *'A'* Grade, NBA Accredited)

Syllabus – I to IV Semester
M.Tech (Construction Technology)
Outcome Based Education Curriculum

2020-2021

Department of Civil Engineering
NAGARJUNA COLLEGE OF ENGINEERING & TECHNOLOGY
Mudugurki Village, Venkatagiri Kote Post,
Devanahalli Taluk,
Bangalore district - 562 164

NAGARJUNA
COLLEGE OF ENGINEERING & TECHNOLOGY

An Autonomous College under VTU

DEPARTMENT OF CIVIL ENGINEERING

VISION

To transform the students as leaders in Civil Engineering to achieve professional excellence in the challenging future.

MISSION

M1: To provide the Civil Engineering knowledge and skills for students through an excellent academic environment.

M2: Adopting innovative teaching techniques using modern engineering tools for designing, modeling and analyzing the societal and environmental problems.

M3: Developing Communication skill, leadership qualities through teamwork and skills for continuing education among the students.

M4: To inculcate moral, ethical and professional values among students to serve the society.

M5: Validate engineering knowledge through innovative research projects to enhance their employability and entrepreneurship skills.

Program Educational Objectives (PEOs)

- **PEO1**: Graduates in Civil Engineering will apply the technical knowledge for sustainable societal growth.
- **PEO2**: Graduates of civil Engineering will demonstrate designing, modeling and analyzing skills.
- **PEO3**: Graduates in Civil Engineering will demonstrate good communication skills, dynamic leadership qualities with concern for environmental protection.
- **PO4**: Civil Engineering graduates will be capable of pursuing higher studies, take up research and development work blended with ethics and human values.
- **PO5**: Civil engineering graduates will have the ability to become entrepreneurs thereby switching over from responsive engineering to creative engineering.

Program Outcomes (POs)

- **PO-1**: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and Civil Engineering principles to the solution of complex problems in Civil Engineering.
- **PO-2**: Problem Analysis: Identify, formulate, research literature and analyze complex Civil Engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.
- **PO-3**: Design/Development of Solutions: Design solutions for complex Civil Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal and environmental considerations.
- **PO-4**: Conduct Investigations of Complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions related to Civil Engineering problems.
- **PO-5**: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering tools such as CAD, FEM, GIS, etc. including prediction and modeling to complex Civil Engineering activities with an understanding of the limitations.
- **PO-6**: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Civil Engineering practice.
- **PO-7**: Environment and Sustainability: Understand the impact of the professional Civil Engineering solutions in societal and environmental contexts and demonstrate the knowledge and the need for sustainable development.
- **PO-8**: Ethics: Apply ethical principles and commit to professional ethics and responsibilities while following the Civil Engineering practice.
- **PO-9**: Individual and Team work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
- **PO-10**: Communication: Communicate effectively on complex Civil Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO-11**: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage Civil Engineering projects and in multidisciplinary environments.
- **PO-12**: Life Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO)

- **PSO1**: To carryout surveying, prepare layout plans, maps for structures and alignments for canals and roads.
- **PSO2**: To specify, analyze, design, estimate and supervise construction activities such as, test and evaluate foundations and superstructures for buildings, industries, irrigation and hydraulic structures, highways, railways, airports, docks and harbors.
- **PSO3**: To understand the impact of water, air and noise pollution; the methods of waste collection, disposal and processing; specify, design and analyze water supply system, sewerage and industrial effluent conveying and treatment systems.

First Semester M. Tech (Construction Technology) - Scheme

Sl. No	Course Code	Course	Teaching Department	L-T-P-S (Hrs/week)	Total Credits	Marks
1	20CCT11	MECHANIZATION IN CONSTRUCTION	CE	4-0-0-0	4	100
2	20CCT12	ADVANCES IN CONSTRUCTION MATERIALS	CE	4-0-0-0	4	100
3	20CCT13	CONSTRUCTION PROJECT MANAGEMENT	CE	4-0-0-0	4	100
4	20CCT14	RISK AND MATERIAL MANAGMENET	CE	4-0-0-0	4	100
5	20CCT15X	ELECTIVE - I	CE	3-0-0-0	3	100
6	20CCT16	MATERIAL CHARACTERIZATION LABORATORY	CE	0-0-2-0	2	100
7	20CCT17	RESEARCH METHODOLOGY & IPR	CE	2-0-0-0	2	100
Total				21-0-2-0	23	700

Elective – I		
Sl. No	**Course Code**	**Course**
1	20CCT151	INFRASTRUCTURE PLANNING
2	20CCT152	REPAIR AND REHABILITATION OF STRUCTURES
3	20CCT153	DESIGN OF ENERGY EFFICIENT BUILDINGS

IC – Integrated Course	L - Lecture	T - Tutorials	P - Practical	S - Self Study

Second Semester M. Tech (Construction Technology) - Scheme

Sl. No	Course Code	Course	Teaching Department	L-T-P-S (Hrs/week)	Total Credits	Marks
1	20CCT21	CONSTRUCTION QUALITY AND SAFETY	CE	4-0-0-0	4	100
2	20CCT22	CONSTRUCTION ECONOMICS & FINANCE	CE	4-0-0-0	4	100
3	20CCT23	CONSTRUCTION CONTRACT MANAGEMENT	CE	4-0-0-0	4	100
4	20CCT24X	ELECTIVE - II	CE	4-0-0-0	4	100
5	20CCT25X	ELECTIVE – III	CE	4-0-0-0	4	100
6	20CCT26	PROJECT MANAGEMENT LAB	CE	0-0-2-0	2	100
7	20CCT27	TECHNICAL SEMINAR-I	CE	0-0-0-2	1	50
Total				20-0-2-2	23	650

Elective – II		
Sl. No	**Course Code**	**Course**
1	20CCT241	PRE ENGINEERED CONSTRUCTION TECHNOLOGY
2	20CCT242	ADVANCED CONSTRUCTION TECHNIQUES
3	20CCT243	SOIL EXPLORATION & GROUND IMPROVEMENT TECHNIQUES

Elective – III		
Sl. No	**Course Code**	**Course**
1	20CCT251	LEAN CONSTRUCTION AND SUPPLY CHAIN MANAGEMENT
2	20CCT252	QUANTITY SURVEYING AND BILLING
3	20CCT253	SPECIAL CONCRETE

IC – Integrated Course	L - Lecture	T - Tutorials	P - Practical	S - Self Study

Third Semester M. Tech (Construction Technology) – Scheme

Sl. No	Course Code	Course	Teaching Department	L-T-P-S (Hrs/week)	Total Credits	Marks
1	20CCT31	SUSTAINABLE CONSTRUCTION	CE	4-0-0-0	4	100
2	20CCT32X	ELECTIVE – IV	CE	4-0-0-0	4	100
3	20CCT33X	ELECTIVE – V	CE	4-0-0-0	4	100
4	20CCT34	DISSERTATION-PHASE 1	CE	0-0-4-4	3	100
5	20CCT35	MINI PROJECT	CE	0-0-2-0	2	100
6	20CCT36	INTERNSHIP	CE	0-0-4-0	4	100
7	20CCT37	TECHNICAL SEMINAR-II	CE	0-0-0-2	1	50
Total				**12-0-10-6**	**22**	**650**

Elective – IV		
Sl. No	**Course Code**	**Course**
1	20CCT321	CONSTRUCTION METHOD STATEMENT PROCEDURES
2	20CCT322	PAVEMENT DESIGN AND CONSTRUCTION
3	20CCT323	BUILDING SERVICES AND MAINTENANCE

Elective – V		
Sl. No	**Course Code**	**Course**
1	20CCT331	CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
2	20CCT332	QUANTITATIVE METHODS IN CONSTRUCTION
3	20CCT333	FORMWORK DESIGN OF STRUCTURES

IC – Integrated Course	**L - Lecture**	**T - Tutorials**	**P - Practical**	**S - Self Study**

Fourth Semester M.Tech(Construction Technology) - Scheme

Sl. No	Course Code	Course	Teaching Department	L-T-P-S (Hrs/week)	Total Credits	Marks
1	20CCT41	Project Phase-II	CE	-	5	50
2	20CCT42	Project Phase-III	CE	-	5	50
3	20CCT43	Dissertation Evaluation	CE	-	5	100
4	20CCT44	Project Viva voce	CE	-	5	100
Total					20	300

FIRST SEMESTER

MECHANIZATION IN CONSTRUCTION				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20CCT11	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- Learn the importance of the mechanization in construction.
- Understand the characterization and operations of construction equipment.
- Learn about the equipment use for aggregate production process.
- Analyze the procedures involved in production of materials/products used in construction.
- Understand the environmental issues related to construction activities.

Syllabus

Module – I

Introduction to mechanization: Definition, advantages and limitations of mechanization, Indian scenario and Global scenario, Need of mechanization in construction industry, Classification of construction equipment, Factors affecting selection of equipment. 10 hr.

Module – II

Planning for Earthwork Construction, Mechanization through construction equipment: Equipment cost, Machine Power, Production cycle - Dozers, scrapers, Excavators, Finishing equipment, Draglines and Clamshells, Trucks and Hauling equipment, Hoisting equipment. 10 hr.

Module – III

Mechanization in aggregate manufacturing: Natural aggregates and recycled aggregates, Mechanization in rebar fabrication, Mechanization in prefabrication 10 hr.

Module – IV

Mechanization in concrete production and placement, Mechanization through construction: formwork and scaffolding-types, materials and design principles. 10 hr.

Module – V

Mechanization through construction methods/technologies: segmental construction of bridges/flyovers, box pushing technology for tunneling, trench-less technology, Safety and Environmental issues in mechanization 10 hr.

Course Outcomes:

On completion of this course, students are able to get

- Exposure to mechanized construction in Indian scenario and Global scenario
- Can select construction equipment appropriate to tasks.

- Estimate productivity and cost data for construction equipment.
- Knowledge of contemporary issues pertaining to construction methods, equipmentusage and management.
- Learn about environmental issues related to use of equipment.

Reference Books:

1. Peurifoy R L, "Construction Planning, Equipment and Methods", 6th Edition, McGraw Hill, 2001
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers, Delhi, 1988
3. Dr. Mahesh Varma, Construction Equipment and its planning and application, 3rd Edition, Metropolitan Book Company, New Delhi 1983
4. James F Russell, "Construction Equipment", Prentice Hall, 1985.
5. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers Delhi, 1988
6. BMPTC. (2001). BMTPC directory of construction equipment and machinery manufactured in India. BMTPC, New Delhi.
7. Collier A., Ledbetter B. (1982). Engineering cost analysis. Harper and Row Publishers, New York.

E-Resource:

http://cmac.co.in/wp-content/uploads/2013/02/Mechanisation-in-Construction-Scope- Applicability-Value.pdf

ADVANCES IN CONSTRUCTION MATERIALS				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT12	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- Acquire the knowledge on concrete making ingredients.
- Recognize the importance of rheology, mechanical properties, durability propertiesand microstructure of concrete.
- Apprehend the principles of concrete mix design and to understand the role of special concrete in construction sector.
- Study the importance and types of reinforcement used in RCC structures.
- Understand the importance of advanced materials utilized in construction sector.

Syllabus

Module – I

Concrete making materials- Cement: Chemical composition, hydration of cement, Types of cement. Aggregates: Types, properties and tests on aggregates. Admixtures: Types, Mechanism and their effect on concrete property in fresh and hardened state.

10 hr.

Module – II

Microstructure of concrete, Fresh concrete and its rheology, Mechanical, deformational behaviour of hardened concrete. Creep and Shrinkage of Concrete, Durability of Plain and Reinforced Concrete.

10hr

Module – III

Special Concrete: High Strength/Performance Concrete, Fibre Reinforced Concrete, Reactive Powder Concrete, Roller Compacted Concrete, Self-Compacting Concrete, Geo-polymer Concrete and Decorative Concrete, Proportioning of Mixes.

10 hr

Module – IV

Types of Reinforcements. Corrosion in concrete and its protection, Corrosion of rebars in concrete, Influence of fly ash on the corrosion steel bar in concrete. Electro-chemical process, measures of protection. 10 hr.

Module – V

Advanced Materials: Polymers, fibres, adhesives and sealants- types and their uses. Adhesives in construction industry, Bridge bearings, Moisture Barriers, Structural glazing. 10 hr.

Course Outcomes:

On completion of this course, students are able

- To describe and summarize the importance of admixtures on fresh and hardened concrete.
- To comprehend the various factors affecting the engineering properties of concrete.

- To design and conceptualize concrete mixes for structural components.
- To understand the effects of corrosion in concrete and its protection.
- To know the various applications of advanced materials used in construction sector.

Reference Books:

1. Metha P.K and Monteiro.P.J.M, " CONCRETE - Microstructure, Properties and Materials", Fourth Edition, Tata McGraw- Hill Publishing company Limited, New Delhi, 2006
2. Shetty .M.S., "Concrete Technology, Theory and Practice", 7th Edition, S. Chand & company Ltd., New Delhi 2006
3. Neville. A.M. , " Properties of Concrete", 5th Edition, Prentice Hall, 2011.
4. Ashby, M., Jones, D. (2005). Engineering materials – An introduction to properties, applications and design. Elsevier Ltd, USA.
5. Berge, B. (2009). Ecology of building materials. Architectural Press, London.
6. Chudley, R. (1994). Construction technology. Volume 2. Pearson Education, Malaysia.
7. Illston, U. (2001). Construction materials, their nature and behaviour. E & FN Spon, London.

E-Resource:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/283886/ep10-new-and-advanced-materials.pdf

CONSTRUCTION PROJECT MANAGEMENT				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT13	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able :

- To understand the principles of construction project management
- To learn the principles through different methods and to apply the same for preparing project plan and scheduling techniques.
- To provide knowledge about the Trade-off analysis of Time-Cost.
- To demonstrate the knowledge of different scheduling technique.
- To understand the evaluation of the project strategies and optimizing the characteristics of project.

Syllabus

Module – I

Introduction: Project Organization, Types, structure and practices. Stages of construction project, Delays. Construction schedule - Preparation, uses and types of construction schedule. Job layout, Work Breakdown Structure, Project planning, Scheduling, Monitoring and Updating. 10 hr

Module – II

CPM & PERT: Introduction to CPM and its applications, Network fundamentals, Numerical on Fulkerson's rule. Introduction to PERT and its uses and importance, Numerical on Time estimates. 10 hr

Module – III

Cost & Network: Time-Cost Trade-off, Direct cost, Indirect cost, Total project cost, Cost optimization, Cost Control in Construction, Numerical on crashing of network. 10 hr.

Module – IV

Introduction to Line of Balance Scheduling, construction and prepare of LOB, Need and methods, Numerical on LOB. 10 hr.

Module – V

Resource Allocation: Introduction, Resource usage profiles, Project updating, Planning-levelingand Allocation, Numerical on Resource allocation, Introduction to Building Information Model (BIM). 10 hr.

Course Outcomes:

On completion of this course, students are able to

- Apply knowledge on preparing project plans, schedule of construction, and project organization.
- Identify, formulate and solve problems on construction network and time estimates.
- Identify and apply time cost tradeoff principles and cost control in construction

. Interpret construction data and presenting in graphical form, perform variance analysis on balancing resource and scheduling activities for repetitive work.

- Design information system on men, material, machine and money for managing various

activities of projects.

Reference Books:

1. Peurifoy. R L, "Construction Planning, Equipment and Methods"- 6th Edition, McGraw Hill. 2001.
2. Chitkara K K, Construction Project Management, 10th Reprint, Tata McGraw Hill, 2006.
3. Srinath L.S, "PERT and CPM", 3rd Edition, East West Press Pvt. Ltd. New Delhi. 2001.
4. Antill J M &Woodhead R W, Critical Path Methods in Construction Practice, 4th Edition John Wiley and Sons, 1990.
5. Harris R B, Precedence & arrow networking techniques for construction, John Wiley, 1978.
6. Jerome, D., Ferdinand K. (2007). A management guide to PERT/CPM. Prentice-Hall of India, New Delhi.

E-Resource:

http://www2.aku.edu.tr/~icaga/kitaplar/fundamentals-of-construction-management.pdf

RISK AND MATERIAL MANAGMENET				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT14	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- Understand various aspects of Risk Management.
- Obtain Knowledge about Quantitative Risk Analysis and Risk monitoring and Control.
- Acquaint students with the knowledge and skills necessary for the efficient managementof construction materials especially in project execution.
- To study about the different purchasing methods.
- Demonstrate the knowledge of Stores and Inventory Management

Syllabus

Module – I

Introduction to Risk Management: Project Risk Management Overview-Plan Risk Management:Inputs, Tools and Techniques and output. Identifying Risks– various methods for RiskIdentification and outputs. Performance of Qualitative Risk Analysis – Risk Probability and ImpactAssessment, Probability and Impact Matrix, Risk Register. 10hr

Module – II

Quantitative Risk Analysis and Risk Response: Introduction and Review – Quantitative Risk Analysis - Inputs, Tools and Techniques and output. Risk Response Planning – Risk Avoid, Risk Transfer, Risk Mitigation and Risk Acceptance. Risk Monitoring and Control - Inputs, Tools and Techniques and output. 10hr

Module – III

Material management_ introduction, importance, scope, objectives and function of materials management; Integrated approach to materials management; Classification of construction materials; Codification and Standardization, Source selection, Estimating of material requirement; ABC Analysis 10hr

Module – IV

Purchasing Management- Creative Purchasing, purchase system, price forecasting, buying seasonal commodities, purchasing under uncertainty, purchasing of capital equipment, international purchasing, public buying, legal aspects. 10hr

Module – V

Warehousing and Stores Management: Store Management - Store system and procedures, Incoming Materials Control and Store Accounting and Verification. Scrap Management, Material Handling and Value Analysis. Inventory / stock control - importance, classification, models, EOQ its drawback ascertaining the EOQ and costs, safety stock. 10hr

Course Outcomes:

On completion of this course, students will be able to:

- Summarize the Risk Management as a tool to Construction Management.
- Applying various tools of Quantitative Risk Analysis.
- Understand the concepts of efficient management of construction materials .
- To know the ways of purchasing in construction and its legal terms.
- Application of Store and Inventory Management.

Reference Books::

1. Carl L. Pritchard : "Risk Management – Concept and Guidelines" Special Indian Edition. ESI International. Nutech Photolithographers, New Delhi.
2. Langford, J. (1995). Logistics principles and practices. McGraw-Hill Book Co., NewYork.
3. P. Gopalakrishnan and M. Sundaresan: "Material Management - An Integrated Approach" PHI learning Private Limited. New Delhi -2012.
4. A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Fourth Edition. Project Management Institute, Newtown Square, PA 19073-3299.USA
5. Datta, A. (2006). Materials management- procedures, text and cases. Prentice-Hall of India, New Delhi.
6. Barkley, B. (2005). Project risk management: TataMcGraw-Hill, New Delhi.
7. Chapman, C., Ward S. (1997). Project risk management-Processes, techniques and insights. John Wiley & Sons,New Jersey.

E-Resource:

1. https://www.ndma.gov.in/en/
2. www.nrdms.gov.in/natural_disaster.asp
3. https://www.ksndmc.org/Default.asp

INFRASTRUCTURE PLANNING				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT151	**3-0-0-0**	**3**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- To study the necessity of infrastructure & its management.
- To learn the principles of infrastructure planning.
- To provide knowledge about the finance in construction.
- To understand the principles of economics in infrastructure project
- To know the evaluation of the project strategies and optimizing the characteristics of project

Syllabus

Module – I

Infrastructure: Definitions of infrastructure; typical infrastructure planning steps, Governing Features, Historical overview of Infrastructure development in India. Infrastructure Organizations & Systems. 10hr

Module – II

Infrastructure Planning: Infrastructure Project budgeting and funding; Regulatory Framework; Sources of Funding, Procurement strategies; Scheduling and management of planning activities. Financial Management Fundamentals: Time value of money, cash flow, Inflation - depreciation, taxes, inflation, Personnel cost - Equipment costs – overheads.

Financial Evaluation- Investment criteria, Project cash flows – elements and basic principles of estimation, financial estimates and projections, Cost of capital, Rate of return. 10hr

Module – III

Construction Finance Management: Procurement and Efficient use of resources – Statement of Changes in Financial Position (SCFP), Preparation of SCFP on Working Capital Basis, Cash Basis, and Total Resources Basis – SCFP usefulness. 10hr

Module – IV

Economic Analysis– Concepts and Applications, Principles of methodologies for economic analysis of public works, Social welfare function, indifference curves and tradeoffs, Demand curves and price elasticity. 10hr

Module – V

Evaluation Techniques: Net present value method, Benefit-cost ratio and internal rate of return; Shadow pricing; Accounting for risk and uncertainty. 10hr

Course Outcomes:

On completion of this course, students will be able to:

- Achieve Knowledge of Planning and development of problem solving skills in management.
- Gain Information on planning of infrastructure project.
- Understand the principles of financial fundamentals.
- Summarize the solution of economic evaluation techniques.
- Identify and apply the concepts of financial and Economics management.

Reference Books:

1. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
2. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
3. P. Chandra, Projects: Planning, analysis, selection, financing, implementation, and review, Tata McGraw-Hill, New Delhi, 2009. learning Private Limited. New Delhi - 2012.
4. J. D. Finnerty, Project financing - Asset-based financial engineering, John Wiley & Sons, New York, 1996.
5. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
6. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
7. L. Squire and H. G.van der Tak, Economic analysis of projects, John Hopkins University Press, London, 1975.
8. T. J. Webster, Managerial economics: Theory and practices, Elsevier, New Delhi, 2003.

E-Resource:

http://linlspringer.com

REPAIR AND REHABILITATION OF STRUCTURES				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20CCT152	**3-0-0-0**	**3**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

The students will be able to:

- Identify the cause of deterioration of concrete structures.
- Understand the importance of maintenance of structures.
- Strategies different repair and rehabilitation of structures.
- Evaluate the performance of the materials for repair.
- Study various repair techniques for damaged structures corroded structures.

Syllabus

Module – I

General: Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. 10Hrs

Module – II

Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection. **1**0Hrs

Module – III

Maintenance and Repair Strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques. 10Hrs

Module – IV

Materials for Repair: Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete. Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning. 10 Hrs

Module – V

Examples of Repair to Structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure, engineered demolition techniques for dilapidated structures - case studies. 10 Hrs.

Course Outcomes:

Students will be able to

- Assessing the damage of corroded structures.
- Understands the concept of Serviceability and Durability.
- Summarize damage assessment and Rapid Visual inspection of a building showing signs of deterioration.
- Apply the importance of quality control in concrete construction and significance of protection maintenance of structures.
- Use of repair materials and techniques for the damaged structures.

Reference Books:

1. Dr. B Vidivelli "Rehabilitation of Concrete Structures". 1st edition. Standard Publisher Distributors. 2009.
2. Sidney, M. Johnson "Deterioration, Maintenance and Repair of Structures". Krieger Publishing Co. 1980.
3. Denison Campbell, Allen & Harold Roper, "Concrete Structures – Materials, Maintenance and Repair"- Longman Scientific and Technical. 1991.
4. R.T. Allen, S.C. Edwards and D N Shaw, "Repair of Concrete Structures"-Blakie and Sons, CRC Press, 1992.
5. Raiker R.N., "Learning for failure from Deficiencies in Design, Construction and service"- R&D Center (SDCPL)., 1987.

E-Resources:

- http://linlspringer.com
- http://crcnetbase.com

DESIGN OF ENERGY EFFICIENT BUILDINGS				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT153	**3-0-0-0**	**3**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- Exposure to climatic factors and requirements for health.
- To provide the fundamentals of passive heating and cooling.
- Understand the Principles of day lighting in buildings
- To study the design of energy efficient buildings which balances all aspects of energy, lighting, space conditioning and ventilation by providing a mix of passive solar designstrategies and to learn the use of materials with low embodied energy.
- To design the building based on various climatic zones.

Syllabus

Module – I

Introduction: Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction –Thermal Storage – Measurement of Radiation – The Green house Effect – Convection –Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies. 10hr.

Module – II

Passive solar heating and cooling: General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain –Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds – Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations –Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation andehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odour removal. 10hr.

Module – III

Day lighting and electrical lighting**:** Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones–Power Adjustment Factors.
10 hr

Module – IV

Heat control and ventilation: -Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings– Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples.

Ventilation – Requirements – Minimum
standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed. 10 hr

Module – V

Design for climatic zones**:** Energy efficiency – An Overview of Design Concepts and Architectural Interventions Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite –Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design. 10hr

Course Outcomes:

On completion of this course, students will be able to:

- Know about climatic factors and requirements for health and mechanisms.
- Assess the fundamentals of passive solar heating and cooling.
- Use the Principles of day lighting in the design of buildings
- Apply knowledge about heat control and ventilation.
- To design energy efficient building of various climatic zones

Reference Books:

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 2001
2. Norbert Lechner –- Heating, Cooling, Lighting: Sustainable Design Methods for Architects -4th Edition, Wiley Publisher,
3. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002
4. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi,2007.
5. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995
6. Moore, F., Environmental Control System, McGraw Hill Inc. 2002.
7. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2000. ISBN 13-9781118582428

E-Resource:

http://linlspringer.com
http://crcnetbase.com

MATERIAL CHARACTERIZATION LABORATORY				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT16	**0-0-2-0**	**2**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- To provide an exposure to modern techniques to test concrete properties related tocivil engineering problems.
- The students will be capable of testing the dynamic behaviour of the building.
- Exposed to Non-Destructive testing methods.

Syllabus

1. Design of self compacting concrete (SCC) mix proportion testing and validation of results.
2. Determining stress-strain behaviour of concrete specimen.
3. Determine the failure of reinforced flexural beam in bending by two-point and single point loading
   using IS-456.
4. Identify curing mechanism of concrete using X-ray powder diffraction (XRD) results.
5. Conduct bending test for steel reinforced sample as per IS-1786.
6. Impressed voltage test for checking the coating quality of the steel reinforcement.
7. Test the bond strength of steel reinforcement.
8. In situ testing of concrete structures, Surface hardness methods- Rebound Hammer equipment, calibration, and interpretation of results.

Course Outcomes:

On completion of this course, students are able

- To appreciate how modern instruments are helpful for the experimentation on concrete parameters.
- Gain the importance of experiments on Non Destructive Testing of concrete.
- Analyse the corrosion study due to applied potential difference.

Reference Books:

1. Indian Standard code for concrete mix design 10262: 2009.
2. Indian Standard code for high strength steel bars 1786: 2008.
3. Indian Standard code for plain and reinforced concrete 456: 2000.
4. Indian Standard code methods of tests for strength of concrete 516: 1959
5. Harry G Harris and Gajanan M Sabnis, “Structural Modeling and Experimental Techniques”, 2nd Edition, CRC Press, Boca Raton, 1999.
6. Dally and Riley, “Experimental stress analysis”, 3rd Edition, McGraw Hill, 1991.

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RESEARCH METHODOLOGY & IPR				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT17	**2-0-0-0**	**2**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- Understand research problem formulation
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus

Module – I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. 5 hr

Module – II

Effective literature studies approaches, analysis, Plagiarism, Research ethics. 5 hr

Module – III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. 5hr

Module – IV

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International co-operation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. 5hr

Module – V

Patent Rights:

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR:

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

5 hr

Course Outcomes:

On completion of this course, students will be able to:

- Analyse research related information
- To know the various literature and identify the gap
- Able to write technical papers

- Understand the process in filing of patent
- To file patent for their work

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction
2. for science & engineering students"
3. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Model Curriculum of Engineering & Technology PG Courses [Volume -II] [15]
4. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
5. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
6. Mayall , "Industrial Design", McGraw Hill, 1992
7. Niebel , "Product Design", McGraw Hill, 1974
8. Asimov , "Introduction to Design", Prentice Hall, 1962
9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016
10. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

E-Resource:

http://linlspringer.com
http://crcnetbase.com

SECOND SEMESTER

CONSTRUCTION QUALITY AND SAFETY				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT21	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able :

- To learn the importance of quality and process of certification of ISO 9000 in construction
- To provide the concept of TQM
- To provide quality related aspects of construction projects and the tools and techniques of quality management.
- To learn the importance of safety in construction industry.
- To study the of construction accidents, safety programmes, contractual obligations, and design for safety.

Syllabus

Module – I

Construction Quality, Definition of quality as given by Deming, Juran, Crosby, Inspection and Testing, Quality control, Quality Assurance, PDCA Cycle. Quality aspects in every phase in the life cycle of Construction project, Study of ISO 9000 - Quality System Standards, Purpose of ISO Standards, Certification process for ISO 9001. Eight Principles of ISO. 10hr

Module – II

Total Quality Management - Total quality control (TQC) and Total Quality Management (TQM), Need for TQM in construction industry. Critical factors of TQM, TQM in Projects, Benchmarking, concepts of quality policy, standards, manual, Third Party Certification. 10hr

Module – III

Statistical Quality Control, Quality Measurement: Attributes and Variables, Statistical Process Control (SPC) Methods Control Charts for Attributes: p-Charts - Proportion Defective, c-Charts - Number of Defects Per Unit Control Charts for Variables Other Types of Attribute-Sampling Plans, Acceptance Sampling. Quality control of grouts in ducts of post tensioned PC members. Quality control issues in concrete. Sampling of fresh concrete in each batch and quality distribution in a structure. 10 hr.

Module – IV

Construction Safety-meaning and scope, Safety in construction- Technological aspects, organizational aspects and behavioral aspects, Safety in Project management, Education and training. Safety legislation and Standards, Contract conditions on safety in Civil Engineering projects. 10 hr

Module – V

Safety in construction: Causes, classification, cost and measurement of an accident, accident report. Safety information systems, safety programme for construction, Safety in the use of construction equipment, Ergonomics, Accident Prevention and safety, Safety budgeting, Factors affecting safety, Strategic Planning for safety provisions, SOPs, PPE. 10 hr.

Course Outcomes:

On completion of this course, students will be able to:

- Apply techniques of total quality assurance and quality control programme and implement of ISO 9000 in construction.
- Gain the knowledge of different aspects of quality related tools.
- Apply the statistical concepts in taking decisions.
- Know the importance of various aspects of safety during construction activity.
- Apply principles of environmental safety to construction projects.

Reference Books:

1. N. Logothetis, "Management for Total Quality",8th Edition, Prentice Hall New Delhi, 2003.
2. David Gold Smith, "Safety Management in construction and Industry", McGraw Hill, 1987.
3. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
4. K N Vaid, "Construction Safety Management", 3rd Edition, Aspen Publishers New York, 2006
5. D S Rajendra Prasad, "Quality Management System in Civil Engineering", Sapna Book House, Bangalore. 2000
6. "The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996, Universal Law Publishing Co. Pvt. Ltd.
7. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.

E-Resource:

http://www.docs.csg.ed.ac.uk/EstatesBuildings/HealthandSafety/Managing_health_and_safety_in_construction.pdf

CONSTRUCTION ECONOMICS & FINANCE				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT22	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able :

- To understand study the role of economics and financial concepts applied to construction business and Time – value of money
- To study the concepts of comparing various alternatives
- To know the concepts of evaluating public projects based on alternative investments
- To educate different methods of depreciation and budgeting
- To learn about financial management like construction accounting, financial statements, ratios and working capital management

Syllabus

Module – I

Engineering economics, Basic principles, Time value of money, Nominal and Effective Interest, Discounted cash flow, Cash flow diagrams Equivalence – Single payment Compound amount factor, Uniform annual series payments – Derivations and problems. 10 hr.

Module – II

Comparision of Alternatives - Basis of comparison and methods of comparision – Present worth, Future worth and Annual worth methods, ROR and Incremental analysis. 10 hr.

Module – III

Public project evaluation - Benefit-Cost analysis and Equipment economics - Replacement analysis Breakeven analysis – project economics. 10 hr.

Module – IV

Capital budgeting, Taxation and Inflation Depreciation – methods of depreciation, purpose of depreciation 10 hr

Module – V

Financial management–Working capital management, Sources of finance, Long term and short term Finance Construction accounting – Basic concepts and principles, Income statement, Financial statements – Profit and Loss, balance sheets and financial ratios 10 hr

Course Outcomes:

On completion of this course, students are able to

1. Calculate the different values of money at different periods of time.
2. Select the best alternative from the available options while purchasing equipment using different methods of comparison considering time – value of money
3. Evaluate construction project economics, cost-benefit analysis and break-even analysis
4. Apply the concepts of depreciation while purchasing equipment
5. Prepare and manage working capital management, sources of funds, budgeting and control. by keeping accounts, balance sheets and financial statements.

Reference Books:

1. Courtland A. Collier and William B. Ledbetter," Engineering Economics and CostAnalysis", Harper & Row. 2005.
2. Kuchal S.C, "Financial Management" 16th Edition, Chethanya Publication House, Allahabad 2005
3. Van Horne J.C, "Fundamentals of Financial Management", 12th Edition, Prentice Hall. 2001.
4. Harris F and McCaffer R. "Modern Construction Management", 7th Edition, BSP Professional Books, 2013.
5. Chitkara. K. K. "Construction Project Management", 3rd Edition, Tata McGraw Hills, 2014

E-Resource:

https://iimtstudies.files.wordpress.com/2014/03/finance_and_eco.pdf
https://www.openstaxcollege.org/files/textbook_version/low_res_pdf/21/principles-of- economics.pdf

CONSTRUCTION CONTRACT MANAGEMENT				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT23	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able :

- To learn the role and concepts of construction and contract management
- To study the process of tendering in construction industry
- To educate the concepts of alternate dispute resolution techniques
- To understand the concepts of arbitration and conciliation as per Indian act 1872 and Arbitration and Conciliation Act 1996
- To learn the value engineering in contract management

Syllabus

Module – I

Construction contracting, Definition of contract, Types of contracts, contract documents, Pre-contract requirements, International contracts, Conditions and specifications of contract. Definition of tender, types of tenders, tendering procedure, tendering documents. 10 hr.

Module – II

Standard forms of contracts, methods of inviting tenders, pre-bid meetings, pre-qualification system, scrutiny of tenders and comparative statement. Law of contracts, essential elements of valid contracts, The Indian Contract Act 1872 - Definition of the contract as per the ACT. Valid, Voidable, Void contracts, Objectives of the act, Contingent of contracts, Breach of contracts and its consequences. 10 hr.

Module – III

Contract administration, Construction Claims - Extra items and causes of claims, Types of construction claims, documentation, settlement of claims, extension of time, compensation and disputes. Alternate Dispute resolution techniques – negotiation, mediation, litigation, conciliation and arbitration, Dispute review board (DRB), FIDIC. 10hr

Module – IV

Modern Trends in dispute resolution, Provision of Arbitration act 1940, Arbitration and Conciliation Act 1996 – case studies, Difference between 1940 Act and 1996 Act Extent of application of 1996 Act, Objectives. Composition of the arbitral tribunal, jurisdiction of arbitral tribunal, duties, power of arbitrators. 10 hr.

Module – V

Project cost estimation, rate analysis-labour, materials and equipment production, Overhead charges, Bidding models and strategies. Professional ethics, Duties and responsibilities of parties, Management Information systems, Risk analysis, Value engineering. 10 hr.

Course Outcomes:

On completion of this course, students are able to

1. Prepare Contract Schedules, Notice Inviting Tender And Contract Documents.
2. Understand The Indian Contract act 1872 as applied to construction.
3. Understand Laws Of Construction Contract.

4. Implement Dispute Resolution.
5. Prepare Contract Management Plan As Per Standards

Reference Books:

1. Roshan Namavathi, "Professional Practice"
2. Gajaria GT, "Law Relating to Building & Civil Engg. Contracts in India" Lexis Nexis Butterworths India, 2000
3. Collier, Kieth, "Managing Construction Contracts" 2nd Edition, Reston Publishing Co., 1982.
4. Civil Engineering Contracts and Estimates - B. S. Patil – Universities Press- 2006 Edition reprinted in 2009.
5. The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
6. The Arbitration and Conciliation Act,(1996), 1996 (26 of 1996)- 2006 Edition, Professional Book
7. Publisher.
8. FIDIC Document (1999) and current literature

E-Resource:

http://www2.aku.edu.tr/~icaga/kitaplar/fundamentals-of-construction-management.pdf

http://osp.mans.edu.eg/elbeltagi/CM%20CH1%20Introduction.pdf

PRE ENGINEERED CONSTRUCTION TECHNOLOGY				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT241	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able :

- To know the importance of pre engineering construction technology in construction industry.
- To learn the modular coordination in pre engineering construction technology.
- To educate the concept of prefabricated elements.
- To understand the production process in pre engineering elements/products.
- To study the concepts and design criteria of pre engineering buildings.

Syllabus

Module – I

General Principles of Fabrication: Introduction **-** Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication - Economy of prefabrication – Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns – Symmetrical frames. 10hr.

Module – II

Modular Construction Practices: Introduction to Modular Construction, Modular coordination, Modular Standardization, Modular System Building, Limitation and Advantages of Modular Construction **-** Standardization – Planning for Components of prefabricated structures – Disuniting of structures. 10 hr.

Module – III

Prefabricated Elements: Roof and floor panels, ribbed floor panels – wall panels – footings – Joints for different structural Connections – Effective sealing of joints for water proofing – Provisions for non-structural fastenings –Expansion joints in pre-cast construction. Designing and detailing of precast unit for factory structures –Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single storied frames –Single storied buildings – slabs, beams and columns. 10hr

Module – IV

Production and Hoisting Technology: Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening. Equipments for hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns – Vacuum lifting pads. 10 hr.

Module – V

Pre-Engineered Buildings: Introduction – Advantages **-** Pre Engineered Buildings Vs Conventional Steel Buildings – Concept of Pre Engineered Buildings (PEB) – Design criteria of PEB – Applications. 10 hr.

Course Outcomes:

On completion of this course, students are able to

1. Apply the concept and limitations of pre engineering construction techniques.

2. Implement modular construction practices.
3. Gain the knowledge about production of the pre engineering elements.
4. Have the awareness of reliable proportioning concepts in construction techniques.
5. Design the criteria for pre engineering building.

Reference Books:

1. L. Mokk, Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. T. Koncz, Manual of Precast Concrete Construction, Vol. I, II, III & IV, Berlin, 1971.
3. B. Lewicki, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam, London, New York, 1998.
4. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.
5. Hass, A.M. Precast concrete design and Applications, Applied Science Publishers, 1983.

E-Resource:

http://www.slideshare.net/hlksd/96382022-preengineeredbuildings-46415441

http://nptel.ac.in

ADVANCED CONSTRUCTION TECHNIQUES				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT242	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

The students will be able to:

- Study the latest techniques adopted for the substructure construction
- Understand about the various techniques super structure construction for building.
- Learn the concepts of construction techniques used for special structures.
- Apply the concept of rehabilitation and strengthening techniques beams and columns.
- Study the techniques used for demolition of structures.

Syllabus

Module – 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.

10Hrs

Module – 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.

10 Hrs

Module – III

Construction of special structures: Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, 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.

10 Hrs

Module – IV

Rehabilitation and strengthening techniques : Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of 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.

10 Hrs

Module – 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.

10Hrs

Course Outcomes:

On completion of this course, students will be able to

- Know the modern construction techniques to be used in the construction of buildings

- Summarize the techniques to be adopted in special structures.
- Emphasis of rehabilitation and strengthening techniques.
- Utilize special and significant demolition techniques.
- Apply the concept of demolition techniques for structures.

Reference Books:

- Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984
- Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
- Peter.H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008.
- Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
- Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.

E-Resources:

- https://www.cosmosim.org/cms/documentation/database.../substructures/
- www.ncbi.nlm.nih.gov › NCBI › Literature › PubMed Central (PMC)
- www.pmrjournal.org/article/S1934-1482(12)01050-7/references
- www.controlled-demolition.com/
- www.debunking911.com/pull.htm

SOIL EXPLORATION & GROUND IMPROVEMENT TECHNIQUES				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT243	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able:

- To Prepare the students to understand and analyze the field data
- To assess the knowledge of improving the properties locally available soils.
- To introduce the various types of improvement methods of engineering properties soils.
- To introduce the application of engineering methods to ground improvement projects**.**
- To understand the concept of reinforced earth and ground anchors for soft soil improvement.

Syllabus

Module – I

Principles of exploration: Geophysical and sounding methods, Modern methods of boring and sampling, Preservation and transportation of samples, Sampling records, Soil profiles, various types of field tests - Methods of Boring, Augering and Drilling. Machinery used for drilling, types of augers and their usage for various projects. 10hr

Module – II

Instrumentation - Rollers, Pressure meters, Piezometer, Pressure cells, Sensors, Inclinometers, Strain gauges etc. Investigation below sea/river bed, offshore investigation, interpretation of exploration data and report preparation, economics of field testing & lab testing, engineering properties of soft & weak and compressible deposits. 10 hr

Module – III

Need and objectives for ground improvement, principles of ground improvement, classification of improvement techniques, suitability, feasibility & desirability, Mechanical Modification: Principles of densification, Compaction – shallow & deep compaction, properties of compacted soils. Hydraulic Modification: Objectives, techniques, dewatering methods. 10hr.

Module – IV

Methods of soil improvement-lime stabilization and injection; thermal, electrical and chemical methods; Dynamic consolidation; vibroflotation; compaction by blasting; pre-consolidation with vertical drains; Granular piles; soil nailing; Grouting; Electro-osmosis; Soil freezing; Vacuum consolidation; Case histories Soil confinement. 10 hr.

Module – V

Reinforced Earth Technology: Concept of soil reinforcement, Reinforcing materials, Backfill criteria, Art of reinforced earth technology, Design and construction of reinforced earth structures. Ground Anchors: Types of ground anchors and their suitability, Uplift capacity of anchors. 10 hr.

Course Outcomes:

On completion of this course, students are able to

1. Identify difficult ground conditions in engineering practice.
2. Implement various exploration methods in soil and rock.
3. Interpret field and laboratory data and prepare soil investigation report.
4. Identify different ground improvement techniques.
5. Understand the concept of reinforced earth and ground anchors for soft soil improvement.

Reference Books:

1. Hvorslev MJ, "Subsurface Exploration and Sampling of Soils for Civil Engg. Purposes" 3rd Edition, Elsevier Pub. Co., 2010
2. Manfredd RH, "Engineering Principles of Ground Modification",3rd Edition, McGraw Hill Publishing Co. 2008
3. J. E. Bowles, "Foundation Analysis and Design", 3rd Edition, McGraw Hill Companies, 2001.
4. M. D., Desai, "Ground Property Characterization from In-Situ Testing", 3rd edition, Published by IGS-Surat Chapter,2005.
5. Head KH, "Manual of Soil Laboratory Testing". 3rd Edition, 2006.
6. Purushotham Raj, "Ground Improvement Techniques", 3rd Edition, University Science Press,2009.
7. Ingles O.G. and Metcalf J.B., " Soil Stabilization – Principles and practice", 3rd Edition, Butterworths, London, 1972

E-Resource:

http://theconstructor.org/geotechnical/site-investigation-or-soil-exploration/312/
http://elearning.vtu.ac.in/10/enotes/06CV64/Unit1-HBN.pdf

LEAN CONSTRUCTION AND SUPPLY CHAIN MANAGEMENT

Course Code	L-T-P-S (Hrs/week)	Credits	Exam Marks	Exam Duration
20 CCT251	4-0-0-0	4	CIE: SEE Marks 50 : 50	3 Hours

Course Objectives:

Students will be able:

- To provide exposure to students on the concepts of lean construction and productivity
- To acquire knowledge on lean concepts and its application
- To learn lean design, tools and technique in engineering and construction projects.
- To acquaint students with the fundamentals of various issues related supply chain management in projects.
- To understand the design of SCM and its logistics in projects.

Syllabus

Module – I

Introduction to Lean: Definition, Productivity basics, levels of Productivity, Productivity models, factors influencing productivity, Productivity measurement system, Productivity measurement concepts, tools for productivity- flow diagram and process chart, Crew balance chart, work sampling, case studies. 10 hr.

Module – II

Lean theory, principles of lean production; Elements of Toyota production system; Applying lean thinking to construction, lean project delivery system, relational Contracting. 10hr

Module – III

Lean design, tools and techniques- last planner, kaizen, value stream mapping; Case studies. 10 hr.

Module – IV

Definition, types of channel relationship, objectives, goals, characteristics, activities; Synergies of all organisational functions for effective Supply chain management; Drivers and strategies, framework, obstacles; Bullwhip effect; Supplier relationship management. 10hr

Module – V

Design of effective supply chain, cost benefit analysis of links; Role of logistics , basics, networks,3-PL, 4-PL, reverse logistics, logistic capabilities and competitive advantage; Information technology in SCM, role and importance, solutions, e-logistics. 10hr

Course Outcomes:

On completion of this course, students are able to

1. Identify the productivity and its tools.
2. Gain the knowledge about the theory behind lean.
3. Implement lean tools and its application
4. Apply the concepts of lean theory in Practice
5. To design effective of SCM and its logistics.

Reference Books:

1. Brown, D., Kusiak, J. (2007). Creative thinking techniques. IRM Training, Melbourne, Australia
2. Forbes, L., Ahmed, S. (2011). Modern construction- Lean project delivery and integrated

practices. CRC Press, NewYork.
3. Plenert, G. (2007). Reinventing lean- Introducing lean management into the supply chain. Elsevier / Butterworth-Heinemann Publishers, Amsterdam.
4. Howell, G. (1999). What is lean construction? Proceedings, 7th annual conference of international group for leanconstruction. Berkeley, C.A., July 26-28, 1999.
5. Chopra, S., Meindl, P. (2012). Supply chain management. Prentice- Hall, USA.
6. Coyle, J., Langley, C. (2009). Logistics approach to supply chain management. Cengage Learning, New Delhi.
7. Mentzer, J. (2001). Supply chain management. Sage Publications, Thousand Oaks.

E-Resource:

https://www.lean.org/whatslean/\
http://elearning.vtu.ac.in/10/enotes/06CV64/Unit1-HBN.pdf

QUANTITY SURVEYING AND BILLING

Course Code	L-T-P-S (Hrs/week)	Credits	Exam Marks	Exam Duration
20 CCT252	4-0-0-0	4	CIE: SEE Marks 50 : 50	3 Hours

Course Objectives:

Students are able to:

- Carryout quantity surveying of residential buiding.
- Do quantity surveying of water tank.
- Understand quantity surveying of bridges.
- Prepare the billing of a given project.
- Understand the qualities of materials used in the construction work.

Syllabus

Module – I

Residential structure : Earth work, foundation, superstructure, flooring, finishing, woodwork, colour wash, aesthetic finish, water plumbing line, septic tank , sewage system. 10 hr.

.

Module – II

Bridges : caisson foundation, Pier supports, Bearings, assembly and launching of super structure, post tensioning operation, pavement finishes. 10hr

Module – III

Water tank : Earth work, foundation, building base forms and staging, Column beam frames, Base and vertical structure. Sealing and covering, constructing a roof. Erection of pumping system. 10 hr.

Module – IV

Steel structure : Grillage Foundation, column base, steel column construction, roof truss, girder. 10hr

Module – V

Work done and billing report : Methods, techniques and examples for Completion report. Checking of Plan, Details of various works and issue of completion report of the project. QA and QC certification, government schedule of rates, CPWD, SPWD. Preparation of bills for payment, measurement book, mode of payment, running account bill. Ledger and Cash book details. 10hr

Course Outcomes:

On completion of this course, students are able to

1. Prepare the quantities of work for a multistoried building.
2. Evaluate the quantities of material for bridges and water tanks.
3. Estimate the water tanks.
4. Carryout quantity surveying of the steel structures.
5. Develop the detailed bills for the on-going project and certify the valuation report on existing structures.

Reference Books:

1. Peurifoy R L, "Construction Planning, Equipment and Methods", 6th Edition, McGraw Hill, 2001.
2. James F Russell, "Construction Equipment", Prentice Hall, 1985.
3. Sharma S.C. Construction Equipment and Management, Khanna Publishers, Delhi, 1988
4. Dr. Mahesh Varma, Construction Equipment and its planning and application, 3rd Edition, Metropolitan Book Company, New Delhi 1983
5. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers Delhi, 1988

SPECIAL CONCRETE				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT253	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able:

- Achieve Knowledge of design and development of problem solving skills.
- Understand the principles of Concrete mix design.
- Design and develop analytical skills.
- Summarize the Light Weight concrete, Ferro cement, Fibre reinforced concrete.
- Understand the concepts of high Performance concrete.

Syllabus

Module – I

Modern Concrete: Components of modern concrete and developments in the process and constituent materials: Role of constituents, Development in cements and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates, chemical admixtures. Mix proportioning of Concrete: Principles and methods 10 hr.

Module – II

Light Weight concrete: Introduction, classification, properties, strength and durability, mix proportioning and problems. High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods 10hr

Module – III

Ferro cement: Ferrocement materials, mechanical properties, cracking of ferrocement, strength and behaviour in tension, compression and flexure, Design of ferrocement in tension, ferrocement constructions, durability, and applications. 10hr

Module – IV

Fibre reinforced concrete: Fibre materials, mix proportioning, distribution and orientation,interfacial bond, properties in fresh state, strength and behavior in tension, compression and
flexure of steel fibre reinforced concrete, mechanical properties, crack arrest and toughening mechanism, applications.. 10hr

Module – V

High Performance concrete: constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Ready Mixed Concrete, Self Compacting Concrete, Reactivepowder concrete, bacterial concrete. 10hr

Course Outcomes:

On completion of this course, students are able to

- Achieve Knowledge of design and development of problem solving skills.
- Understand the principles of Concrete mix design.
- Design and develop analytical skills.
- Summerize the Light Weight concrete, Ferro cement Fibre reinforced concrete and High Performance concrete.
- Understand the concepts of high Performance concrete.

Reference Books:

1. Sidney., M. Johnson "Deterioration Maintenance and Repair of Structures" 2nd Edition, 2006.
2. R.N. Raikar "Rehabilitation of Structures"- Edited by, Vol. 1, 2 and 3, Proc., Int. Symposium, Maharashtra Indian Chapter of ACI, Bombay Denison Campbell, Allen& Harold Roper," Concrete Structures– Materials, Maintenance and Repair"- Longman Scientific and Technical
3. CPWD Hand book on Repair and Rehabilitation of RCC Buildings, DG(W), Central Public Works Department, New Delhi, 2002.NewYork.

E-Resource:

www.majcon.com.au/Remedial-Engineering.htm

https://au.jora.com/Remedial-Engineer-jobs-in-Sydney-South-NSW

PROJECT MANAGEMENT LAB				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT26	**0-0-2-0**	**2**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- Prepare work break down plan and estimate resources required in a construction project.
- Prepare precedence diagram and network diagrams.
- Implement resource allocation and levelling using MSP.
- Study of linking multiple projects.
- To prepare the reports using MSP

Syllabus

Construction management software (MS-PROJECTS /PRIMAVERA).

1. Preparing Calendar for project.
2. Create Task and its relationship.
3. Planning and Scheduling.
4. Creating work break down structure.
5. Filters and groups.
5. Preparing the resource sheet.
6. Assign and levelling the resource.
7. Time Estimate for activities.
8. Splitting the activities, linking multiple activities, assigning , constrains, merging multiple projects, creating baseline project and updating the project (6 Hours).
9. Tracking.
10. Calculation for residential building.

Course Outcomes:

On completion of this course, students are able to

- Achieve Knowledge of design and development of soft skills.
- Understanding the concepts of construction project management.
- Apply the planning techniques in software.
- Creating the construction project reports.
- Planning the residential building project considering time and cost.

Reference Books:

1. Chitkara, K.K. “Construction Project Management: Planning, Scheduling and Control”, Tata McGraw- Hill Publishing Company, New Delhi, 1998.
2. Choudhury S, “Project Management”, McGraw-Hill Publishing Company, New Delhi, 1988.
3. Project Management Lab Manual

E-Resource:

https://mitseu.files.wordpress.com/2014/08/microsoft-project-2013-step-by-step.pdf

TECHNICAL SEMINAR-I				
Course Code	**L:T:P:S (Hrs/Week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT27	**0-0-0-2**	**1**	**CIE: SEE Marks: 50**	**20 m**

Course Objectives:

- To develop students written and oral communication competencies to enhance technical effectiveness.
- To provide students an opportunity to learn new concepts and to express theirpresentation skills
- Instill students with initiative, independence, reflection and knowledge transfer
- To develop students ability to think strategically and express their views without hesitation.

Syllabus

The student will have to give a presentation for 20 minutes on any current civil engineering topic chosen by him or her after discussion with guide.

Course Outcomes:

On completion of this course, students are able to

- Students get the awareness about the recent technology trends based on their field of interest
- Able to prepare an effective written technical report
- Able to plan and produce presentation materials which most effectively communicate the intended message for their technical oral presentation

THIRD SEMESTER

SUSTAINABLE CONSTRUCTION				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20CCT31	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able:

- To understand the importance of energy conservation.
- To know concepts of energy efficient building construction and development of Zero energy building
- To introduce concepts of embodied energy and life cycle energy of building
- To impart the concepts life cycle assessment of building
- To learn energy buildings concepts and ecological design concepts applicable to modern buildings

Syllabus

Module – I

Introduction -Overview of significance of energy use- Renewable and Non-Renewable, energy and their significance, Global energy and environmental resources, Impact of temperature change, Energy crises. Energy processes in buildings, sustainable construction
10hr

Module – II

Energy efficiency and Zero energy building: Energy efficiency ,energy monitoring, energy modeling, carbon reduction in buildings Zero Energy / carbon buildings- Zero energy/ carbon buildings, types of Zero, Development of Zero carbon buildings, Advantages & Disadvantages, Case studies 10hr

Module – III

Energy and models-Embodied energy, definition, types of embodied energy, factors affecting embodied energy, Life cycle energy, Economic Models, Computation of embodied energy, Case studies 10hr

Module – IV

Life cycle assessment – definition, Steps in LCA, Role of LCA towards Sustainable Development , types of LCA methods, Challenges in Life Cycle Assessment, • ISO standards for LCA, Software tools available for LCA, Case studies. 10hr

Module – V

Green building-Green building concepts, rating standards – case studies. Energy efficient materials and Technologies. 10hr

Course Outcomes:

On completion of this course, students are able to

1. Identify the various energy sources and conservation of energy
2. Design Zero energy building
3. Compute the embodied energy and life cycle energy of building
4. Apply the concepts of LCA in buildings
5. Understand various green rating systems

Reference Books:

1) Charles J. Kibert , Sustainable Construction: Green Building Design and Delivery 3rd Edition 2012 ,Wiley Publisher: ISBN-13: 978-0470904459
2) DejanMumovic and Mat Santamouris " A hand book of Sustainable Building Design & Engineering – An Integrated approach to energy, health and operational performance, Earthscan publishing house, 2009 ,ISBN-13: 978-1844075966
3) Watson Donald, Climatic Design: Energy Efficient Building- Principles & Practices, McGraw Hill, New York, 1983,ISBN-13: 978-0070684782
4) Koenigsberger, Ingersoll, Mayhew and Szokolay, Manual of Tropical Housing and Building- Part 1 Climatic Design, Orient Longman, Madras 1984. ISBN 9788173718458
5) MiliMajumdar, "Energy Efficient Buildings In India", The Energy Research Institute.
6) LalJayamaha Energy-Efficient Building Systems, McGraw Hill Publication

E-Resource:

- www.greenresourcecouncil.org/green-resources/reference-links

energy.gov/eere/buildings

- www.michigan.gov/documents/CIS_EO_Inside_ChurchManual..

energy.gov/energysaver/led-lighting

CONSTRUCTION METHOD STATEMENT PROCEDURES				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT321	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able:

- To study and understand the various components and materials specifications required for construction projects.
- To learn the method statement procedure for various sub and super structures of residential buildings.
- To study the method statement procedure of various components of bridges.
- To study the method statement procedure of various industrial structures
- To study the method statement procedure of miscellaneous topics considered for construction projects

Syllabus

Module – I

Introduction, Define components of Construction Procedures, Material Specifications, Construction Specifications, and Site conditions, Responsibilities, Site Safety Arrangements. 10 hr.

Module – II

Method Statement Procedure for Foundation Excavation, Isolated Footing, Column casting, Roof Slab, Flooring, Staircase, Colour Wash, Painting. 10 hr

Module – III

Method Statement Procedure for Caisson foundations, Pier, Girder casting, Bearings and Post tensioning operation. 10 hr

Module – IV

Method Statement Procedure for Pre-Engineered Steel structures such as Column, Truss, Industry roofing, foundation laying and erection. 10 hr

Module – V

Method Statement Procedure for Shoring ,Soil Stabilization, Ground anchorages, Raft foundation, Water supply system, Sewage Disposal. 10hr

Course Outcomes:

On completion of this course, students are able to

1. Understand components of construction procedures and also how to take safety andresponsibilities in the construction site.
2. Write the method statement procedure for various sub and super structures.
3. Prepare method statement procedure of various foundations.
4. Generate method statement procedure of various industrial structures.
5. Write the method statement procedure of miscellaneous topics considered for constructionprojects.

Reference Books:

1. Estimation and costing in civil engineering by B.N.Dutta published by UBS publisher distributors Pvt Ltd(2007), ISBN:978-81-7476-611-3

2. Construction Safety Management by Raymond Elliot Levitt, Nancy Morse Samelson Publishedby Mcgraw-Hill (1987) 2nd Edition, ISBN 13:9780070372986
3. Estimation, Costing, Specification and Valuation in Civil Engineering byChakbrborti.M(2010) 9th Edition , ISBN:9788185304366, 818530436X.
4. Construction Planning and Mangement by Dr.Shrivastava.U.K published bygalgotia Publication Pvt Ltd, (2014) 3rd Edition, ISBN:978-81-7515-246-5.
5. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
6. Modern Construction Project Management, Second Edition by S.L. Tang, S.W. Poon, Syed M. Ahmed, Francis K.W. Wong. ISBN 9622095674.
7. Building, Construction and Material by Gurucharan Singh published by Rajsonspublished Pvt Ltd,(2012) , 12th Edition , ISBN:978-81-89401-21-4.

E-Resource:

1. https://www.designingbuildings.co.uk/wiki/Method_statement_for_construction.
2. https://www.rbkc.gov.uk/idoxWAM/doc/Other-1387323
3. https://www.hsdirect.co.uk/free-info/method-statement.html
4. http://www.businesssafety.ie/health-and-safety-consultants/method-statements/

https://www.scribd.com/document/339178672/Method-Statement-for-a-construction-project-pdf

PAVEMENT DESIGN AND CONSTRUCTION				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20CCT322	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

The students will be able to:

- Understand the selection appropriate pavement and surfacing materials, types, layer thicknesses and configurations.
- Design the flexible pavements with various methods.
- To study the general design consideration used for rigid pavement design using westergards and stress equation for wheel loads.
- Ensure that the pavement performs adequately and requires minimal maintenance under the anticipated traffic loading for the design life adopted.
- Preparequalityassuranceandqualitycontrolplansinanattempttoconstruct better performingpavements.

Syllabus

Module – I

Introduction: Highway and airport pavements, Types and component parts of pavements, their differences – Factors affecting design and performance of pavements. Stresses and deflections in homogeneous masses, wheel load stresses, various factors in traffic wheel loads, ESWL and EWL factors. **10Hrs**

Module – II

Design of Flexible Pavements: Empirical methods of Group index method, Plate load test, CBR method – Testing as per IRC, AASHTO, CRV method –Design of pavement by Equivalent C-Value and R-Value method, Triaxial test– Kansas method, McLeod's method, Burmisters layered system concepts and Numerical on above. **10 Hrs**

Module – III

Design of Rigid Pavements: General design considerations, Westergaards design and stress equations for wheel loads, Types of stresses - Wheel load stresses, Temperature stresses ,warping stresses, frictional stresses and combination of stresses, Numerical on above. Design of joints in cement concrete pavements and their functions, joint spacing. Design of Dowel bars and Design of Tie bars. **10 Hrs**

Module – IV

Equipment in Highway Construction: Various types of equipment for excavation, grading and compaction – their working principle, Advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction. **Subgrade:** Earthwork grading and construction of embankments and cuts for roads. Preparation of subgrade, quality control tests. **10 Hrs**

Module – V

Flexible Pavements: Specifications of materials, construction method and field control checks for various types of flexible pavement layers – WBM-BM- SDBCBC

Cement Concrete Pavements: Specifications and method of cement concrete pavement construction and Quality control tests. **10Hrs**

Course Outcomes:

On completion of this course, students will be able to

1. Focus on the design of Highway pavement.
2. Understand the Concepts of pavement components in flexible and rigid pavement.

3. Concepts of stress strain in flexible pavements based on the layered elastic and viscoelastic solution
4. Identify, formulate and design the stresses and deflections in rigid pavements.
5. Evaluate pavement performance, failure criteria, and pavement condition rating

Reference Books:

1. Khanna and Justo, "Test Book of Highway Engineering"- 3rd Edition, Nemchand brothers, Roo 2006
2. Yoder, E.J., and Witczak, "Principles of Pavement Design"- 2nd ed. John Wiley and Sons, 1975.
3. Yang, "Design of Functional Pavements"- 3rd Edition, McGraw Hill Book Co. 2006
4. Huang, "Pavement Analysis"- 3rd Edition, Elsevier Publication, 2006.

E-Resources:

- http://civildigital.com/pavement-design-road-construction-design-parameters/
- http://civildigital.com/pavement-design-examples/

BUILDING SERVICES AND MAINTENANCE				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20CCT323	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able:

- To understand the concept of building services and maintenance.
- To gain knowledge the different types of building services.
- To learn about the air-conditioning of building
- To expose the fire protection system of building.
- To study the concept of green building in building services and maintenance

Syllabus

Module – I

Introduction to Building Services – Definitions, Objective and uses of services, Applications ofservices for different types building considering, Classification of building services, Types of services and selection of services. 10hr.

Module – II

Mechanical Services in Buildings – Introduction, Lift: Definition, Types of Lifts, Design Considerations, Location, Sizes, Component parts of Lift. Elevators & Escalators: Different types of elevators and Escalators, Freight elevators, Passenger elevators, Hospital elevators, Usesof different types of elevators Escalators. 10hr

Module – III

Air Conditioning: Definition, Purpose, Principles, Temperature Control, Air Velocity Control, Humidity Control, Air Distribution system, Cleaners, Filters, Spray washers, Electric preceptors, Types of Air Conditioners, (Central type, Window Type, Split Unit), Preventive and protective maintenance, Scheduled and contingency maintenance planning. 10hr

Module – IV

Fire Protection, Acoustic and Sound Insulations – Introduction, Causes of fire and Effects of fire,General Requirements of Fire Resisting building as per IS and NBC 2005, Characteristics of Fireresisting materials, Requirement of good Acoustic, Various sound absolvent, Factors to be followed for noise control in residential building 10hr

Module – V

Miscellaneous Services and Green Buildings Provisions- Rain water Harvesting for buildings, Concept of GREEN buildings, Components of GREEN building, M.I.S. for building maintenance, Maintenance standards, and Economic maintenance decisions. 10hr

Course Outcomes:

On completion of this course, students are able to

1) Apply various types of services as per needs of building.
2) Plan various types of mechanical services as per requirements of building.
3) Apply various types of fire services as per requirements of building.
4) Apply Green Building technology aspects .

5) Implement the Services and maintenance in residential buildings.

Reference Books:

1. S. M. Patil "Building Services" Seema Publication, Mumbai Revised second edition. ISBN no : 8175259805
2. R. Udaykumar "Building Services" 'Eswar Press -Chennai , ISBN NO-9788178740638
3. "NBC" Relevant Parts: BIS New Delhi,ISBN NO-81-7061-026-5
4. Jain V K," Services in Building Complex and High Rise Buildings",Khanna Publishers, ISBN NO-. 978-81-7409-245-8
5. "Current literature"

E-Resource:

http://civildigital.com/pavement-design-road-construction-design-parameters/
http://civildigital.com/pavement-design-examples/

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

Course Code	L-T-P-S (Hrs/week)	Credits	Exam Marks	Exam Duration
20 CCT331	4-0-0-0	4	CIE: SEE Marks 50 : 50	3 Hours

Course Objectives:

Students will be able to:

- Focus on the principles of sustainable construction and demolition waste managementand resource efficiency.
- Study on the planning of waste managements
- To understand the design of waste prevention
- Learn about the waste forecasting tools
- Examine the environmental impact of building materials, formulating and designingpre−construction and site waste management plans.

Syllabus

Module – I

Introduction, Nature and Source of Direct and indirect waste; site types and origins; composition; quantity; current recycling/reuse potential of building materials. 3R' principle-Zero waste concept, 3 R' s Principle, (Reuse ,recycle, Reduce) with examples, sustainability, misplaced resource, waste minimization techniques, Governmental role in waste Management, citizen role in waste management.

10hr

Module – II

Construction and Demolition Waste Management Plans, International good practice; planning requirements; demolition plans; site implementation; supplier agreements; sub−contractor management; role of waste management contractor; training; auditing; current disposal options; health and safety; reporting to local authorities.

Treatment of Construction and Demolition Waste, waste permits; waste licenses; waste transfer facilities; landfills; treatment technologies; hazardous waste facilities; reporting to EPA. 10hr

Module – III

Designing for Waste Prevention and Minimization. Client, contractor and designer attitudes; proper maintenance of existing buildings; reuse of existing building structure; design flexibility; design for reuse and recycling; dimensional co−ordination and standardization; material selection and control. 10hr

Module – IV

C & D waste recycled materials – Process of recycling C & D waste, Grading of finished recycled products, inventorying the finished products, cost analysis in waste processing, Case study – C & D waste recycling plant, Lessons for future plants, Methods to improve the quality of recycled materials. Tests on recycled materials

10 hr

Module – V

Future developments and potential future markets; Production of precast elements using demolished wastes. Significance of partial replacement or substitution of construction materials, Smart materials; Properties, components, classification, advantages and applications. Use of eco−materials; Properties and types.

10 hr

Course Outcomes:

On completion of this course, students are able to:

1) Formulate, design, evaluate and review pre−construction and construction phase resource efficient waste management plans.
2) Plan various types of waste management and its treatment.
3) Evaluate, assess and recommend potential reuse/recycling/disposal options
4) Apply the waste forecasting tools
5) Implement existing and potential future markets/uses of C&D waste.

Reference Books:

1) Stessel, R. I. Recycling and resource recovery engineering: principles of waste processing. Springer Science & Business Media, (2012).
2) Greg Winkler, "Recycling Construction and Demolition waste: A LEED-Based Toolkit (Green Source) McGraw Hill Publishers
3) V M Tam, Chi Ming Tam, "Reuse of Construction and Demolition Waste in Housing Development", Nova Science Publishers, 2008.
4) Nováková, I., &Mikulica, K. (2016). Properties of concrete with partial replacement of natural aggregate by recycled concrete aggregates from precast production. Procedia Engineering, 151, 360-367.
5) Xiao, J. (2018). Reclaim of Waste Concrete. In Recycled Aggregate Concrete Structures (pp. 15-37). Springer, Berlin, Heidelberg.

E-Resource:

https://vikaspedia.in/energy/environment/waste-management/environment-ministry-notifies- construction-and-demolition-waste-management-rules-for-the-first-time

QUANTITATIVE METHODS IN CONSTRUCTION				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT332	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able to:

- To study the various quantitative methods applied to the elements of management.
- To learn the effect of probability distribution and linear programming,
- To understand the concept of decision making under uncertainty
- To study and understand the concepts of Statistical methods and its applications in Engineering.
- To study the effect of dynamic programming, travelling salesman problem.

Syllabus

Module – I

Averages and Dispersion: Data collection, presentation of data, measures of central tendencies,measures of dispersion and coefficient of variation. 10hr

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Module – II

Probability Distributions and Sampling: Definition of probability, axioms of probability, conditional probability, Baye's theorem, one dimensional random variable, expectation and variance, curve fitting-linear, non-linear and exponential, correlation and regression. 10hr

Module – III

Probability Distributions: Normal and exponential distributions, two dimensional random variables, marginal distributions, conditional distributions, expectation, covariance and correlation, moments, relation between raw and central moments, skewness, kurtosis and central limit theorem 10 hr

Module – IV

Linear Programming: Introduction to linear programming, formulation of LPP, solution of LPP-Graphical method, Simplex method, big-M method, two-phase method, transportation problem and assignment problem. 10hr

Module – V

Markov Chains: Probability vectors, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probabilities, stationery distribution of regular Markov chains and absorbing states.

Dynamic Programming: Introduction to dynamic programming, traveling salesman problem and simulation applied to construction. 10hr

Course Outcomes:

On completion of this course, students are able to:

- Formulate and solve deterministic optimization problems.
- Model risk and uncertainty in construction industry.
- Apply stochastic optimization techniques for decision making under uncertainty.
- Formulate and solve linear programming.
- Plan and manage activities using simulation, queuing and game theory.

Reference Books:

1. Dr.B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,ISBN NO-8174091955, 9788174091956
2. Hamdy A. Taha, Operations Research, 5th Edition, PHI. Prentice Hall of India Private limited, 2004 Publisher, ISBN- 8120322355
3. William Feller, An Introduction to Probability Theory and its Applications, Vol.1, 3rd Edition. ISBN-978-81-265-1805-0
4. James J. Adrian,P.E. "Quantitative methods in construction management",American Elsevier. ISBN NO- 0444001344, 9780444001344
5. 2.Alfredo,H.S. and Wilson,H.Tang, "Probability concepts in Engineering, Planning and Design",Vol.1,John Willy& sons. 0471032018, 9780471032014
6. Rao S.S., Engineering Optimization, New Age International. 81-7061-026-5
7. R.E.Walpole and R.H. Myers, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education. 0073529575, 9780073529578

E-Resource:

- evlab.mit.edu/sites/default/files/documents..
- www.worldcat.org/title/quantitative-methods-in...
- mef.med.ufl.edu/files/2009/03/qualitative-research.pdf
- https://books.google.co.in/books?isbn=0471032018
- https://books.google.co.in/books?isbn=8122411495

FORMWORK DESIGN OF STRUCTURES				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT333	**4-0-0-0**	**4**	**CIE: SEE Marks 50 : 50**	**3 Hours**

Course Objectives:

Students will be able:

- To study and understand the overall and detailed planning of formwork, plant and site equipment.
- To understand the Design for various elements such as slabs, beams, columns, walls, shells and tunnels.
- To attain the knowledge of design of Decks and False works
- To know different forms of and Erecting the Formwork Building
- To know the latest methods of form construction.

Syllabus

Module – I

Introduction: Formwork and false work, Temporary work systems, Construction planning and site constraints, Materials and construction of the common formwork and false work systems, Special and proprietary forms. 10hr .

Module – II

Formwork – Design: 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, Concrete pressure on forms, Design of timber and steel forms, Loading and moment of formwork10hr

Module – III

Design of Decks and False works: Types of beam, decking and column formwork, Design of decking, False work design, Effects of wind load, Foundation and soil on false work design. 10hr

Module – IV

Building and Erecting the Formwork: 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 Multiplex - 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. 10hr

Module – V

Special Forms and Safety in use of Formwork: The use and applications of special forms, Safety use of formwork and false work. 10hr

Course Outcomes:

On completion of this course, students are able to:

- Understand the sequence of construction of civil engineering structures.
- Appraise a right material for manufacturing false work and form work suiting specific requirements.
- Design decking, form work and false work.
- Understand the safety steps involved in the design of form work and false work

Reference Books:

1) Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 1996
2) Michael P. Hurst, Construction Press, London and New York., 2003
3) Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996.
4) Tudor Dinescu and ConstantinRadulescu, Slip Form Techniques, Abacus Press, Turn Bridge Wells, Kent, 2004.

E-Resource:

- www.atkinsglobal.com/.../Concrete...
- www.worldcat.org/…mwork-for-concrete-structures/...
- http://www.Webcrawler.com
- thacampbell.typepad.com/…lass_handouts/Formwork.pdf
- www.okorder.com/Formwork+Design

MINI PROJECT				
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT35	**0-0-2-0**	**2**	**CIE Marks 100**	**3 Hours**

Course Objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Syllabus

Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course Outcomes:

At the end of the course the student will be able to:

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

TECHNICAL SEMINAR-II				
Course Code	**L:T:P:S (Hrs/Week)**	**Credits**	**Exam Marks**	**Exam Duration**
20 CCT37	**0-0-0-2**	**1**	**CIE: SEE Marks: 50**	**20 m**

Course Objectives:

- To develop students written and oral communication competencies to enhance technical effectiveness.
- To provide students an opportunity to learn new concepts and to express theirpresentation skills
- Instill students with initiative, independence, reflection and knowledge transfer
- To develop students ability to think strategically and express their views withouthesitation.

Syllabus

The student will have to give a presentation for 20 minutes on any current civil engineering topic chosen by him or her after discussion with guide.

Course Outcomes:

On completion of this course, students are able to

- Students get the awareness about the recent technology trends based on their field of interest
- Able to prepare an effective written technical report
- Able to plan and produce presentation materials which most effectively communicate the intended message for their technical oral presentation