

# **CIVIL ENGINEERING DEPARTMENT**

## **Course Book for M. Tech. in Construction Technology & Management**



**Visvesvaraya National Institute of Technology, Nagpur**

**JULY 2015**

## **Brief about Civil Engg Department:**

Civil Engineering Department is the oldest department in this institute right from the establishment of Government College of Engineering in Nagpur 1956. The department offers the undergraduate course of B.Tech in Civil Engineering and Four Postgraduate Courses of M.Tech as given below.

<b>Program</b>	<b>Description</b>
<b>UG in Civil Engineering</b>	Started with 60 seats in 1956 Intake increased to 71 in 2008 Intake increase to 82 in 2009 Intake increase to 92 in 2010

### **PG in Civil Engineering Department**

1. Environmental Engineering	Started in 1966 (32 seats )
2. Water Resources Engineering	Started in 2005 (20 seats )
3. Construction Technology and Mgt	Started in 2010 (20 seats )
4. Transportation Engineering	Started in 2012 (20 seats )

### **VISION:**

To contribute effectively to the National Endeavour of producing quality human resource of world class standard in Civil Engineering by developing a sustainable technical education system to meet the changing technological needs of the Country incorporating relevant of social concerns and to build an environment to create and propagate innovative technologies for the economic development of Nation.

### **MISSION:**

The Mission of the undergraduate Civil Engineering program is to develop students into capable civil engineering graduates by imparting appropriate high quality education in Civil Engineering so that they could be readily adapted by the service sector to meet the challenges faced by the Nation. The program strives for excellence in engineering education and profession. It also aims to promote all round development of the personality of students by suitably involving them in Co-curricular and extra-curricular activities.

**TABLE 1. CREDIT REQUIREMENTS FOR POST GRADUTE STUDIES**

<b>Postgraduate Core (PC)</b>		<b>Postgraduate Elective (PE)</b>	
Category	Credit	Category	Credit
Departmental Core (DC)	37	Departmental Electives (DE)	15
Basic Science (BS)	00	Other Courses (OC)	00
<b>Grand Total PC + PE</b>			52

The number of credits attached to a subject depends on number of classes in a week. For example a subject with 3-1-0 (L-T-P) means it has 3 Lectures, 1 Tutorial and 0 Practical in a week. This subject will have eight credits ( $3 \times 2 + 1 \times 1 + 0 \times 1 = 8$ ). If a student is declared pass in a subject, then he/she gets the credits

associated with that subject. Depending on marks scored in a subject, student is given a Grade. Each grade has got certain grade points as follows:

Grades	AA	AB	BB	BC	CC	CD	DD	FF
Grade Points	10	09	08	07	06	05	04	Fail

The performance of a student will be evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. SGPA and CGPA are:

$$\mathbf{SGPA} = \frac{\sum_{\text{semester}} (\text{Course credits} \times \text{Grade points}) \text{ for all courses except audit}}{\sum_{\text{semester}} (\text{Course credits}) \text{ for all courses except audit}}$$

**CGPA**

$$= \frac{\sum_{\text{All semester}} (\text{Course credits} \times \text{Grade points}) \text{ for all courses with pass grade except audit}}{\sum_{\text{All semester}} (\text{Course credits}) \text{ for all courses except audit}}$$

Students can Audit a few subjects. i.e., they can attend the classes and do home work and give exam also, but they will not get any credit for that subject. Audit subjects are for self enhancement of students.

### Details about Faculty members of Civil Engineering Department

Name of Faculty Member	Designation	Qualifications	Areas of specialization
Mhaisalkar V.A	Professor	B.E, M.Tech , Ph.D	Environmental Engg
Gupta Rajesh	Professor	B. E, M.Tech., Ph.D.	Environmental Engg.
Katpatal Y.B	Professor	B.Sc, M.Tech, MBA, Ph.D	Remote Sensing and GIS
Tembhurkar. A.R.	Associate Professor	B.E, M.Tech , Ph.D	Environmental Engg
Latkar M.V	Associate Professor	B.Sc., M.Sc, Ph.D	Environmental Biochemistry
Lataye.D.H	Assistant. Professor	B.E, M.Tech , Ph.D	Environmental Engg
Ralegaonkar R.V	Associate Professor	B.E, M.E, Ph.D	Energy Efficient Building, Disaster Management, Construction Technology & Mgt.
Ghare A.D	Associate Professor	B.E, M.Tech , Ph.D	Hydraulic Engg
Landge.V.S	Associate Professor	B. E., M.E, Ph.D	Traffic Engineering
Mondal .A	Associate Professor	B. E., M.E, Ph.D	Soil Mechanics and Foundation Engg
Vasudeo. A.D.	Assistant. Professor	B.E, M.Tech , Ph.D	Water Resources Engg
Patel Anjan	Assistant. Professor	B.E, M.Tech , Ph.D	Soil Mechanics and Foundation Engg
Dongre.S.R	Assistant. Professor	B.E., M.Tech, Ph.D	Environmental Engg.
Wanjari. S. P.	Assistant. Professor	B.E., M.Tech, Ph.D	Construction Technology and Management, Concrete Technology
Tawalare.A.G	Assistant. Professor	B.E., M.Tech	Structural Engg, Construction Technology & Mgt.
Mirajkar A.B	Assistant Professor	B.E, M.E, Ph.D	Water Resources Engg.

## **Program Outcomes**

The program outcomes are as follows. Parameters on which the PO's of the program are based are given as below and aim of PO's is to enable students to:

- a. Work in Civil Engineering sector which is involved with various aspects of planning, design, construction and operation of structures and systems.
- b. Design and analyse the complex problems and provide state of the art solutions.
- c. Contribute to the academic and research in the broad field of civil engineering.
- d. Develop knowledge and skills in the area of broad domain of civil engineering including construction technology, water resources, environmental engineering, geotechnical engineering, geospatial technology and transportation engineering.

### **Program outcomes adopted for correlation to course outcomes.**

Graduates Attributes (GA's) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The GA's are indicators of the attributes expected of a graduate from an accredited program. The Graduates of this program must acquire:

- a. An ability to apply knowledge of mathematics, science, and engineering to solve Civil engineering problems
- b. An ability to identify, formulate, design and conduct experiments, as well as to analyze and interpret data
- c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, safety, and sustainability
- d. An ability to understand engineering and management functions and to be able to function on multidisciplinary teams
- e. An ability to identify, formulate, and solve civil engineering problems
- f. An understanding of professional and ethical responsibility to extend the social benefit of the civil engineering project
- g. An ability to communicate effectively to handle complex engineering activities with the engineering community and the society at large, and should possess the skill of technical writing and effective presentation.
- h. The broad education necessary to understand the impact of engineering solutions in a global, economic, and societal context
- i. A recognition of the need for, and an ability to engage in independent life-long learning to incorporate technological innovations
- j. A knowledge of contemporary issues and environment,
- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

## Scheme of Instructions for M Tech (Construction Technology & Management)

Program Core(PC)		Program Elective (PE)	
Category	Credit	Category	Credit
Departmental Core(DC)	37	Departmental Elective(DE)	15
		Total	52
Grand total PC+PE			

I Semester				II Semester			
CORE				CORE			
Code	Course	L-T-P	Cr	Code	Course	L-T-P	Cr
CEL406	Advanced Concrete Technology	3-0-0	3	CEL553	Construction Equipment and Methods	3-0-0	3
CEP 406	Advanced Concrete Technology Practical*	0-0-2	1	CEL554	Project Appraisal and Construction Finance	3-1-0	4
CEL409	Quality and Safety in Construction	3-0-0	3				
CEL519	Construction Planning and Control	3-0-0	3				
CEL552	Construction Contracts and Specifications	3-0-0	3				
CEL588	Building Services	3-0-0	3				
	Core Credits = 16				Core Credits = 7		
<b>ELECTIVE (Any One)</b>				<b>ELECTIVE (Any Three)</b>			
CEL559	Energy Efficient Building	3-0-0	3	CEL425	Financial and Business Management	3-0-0	3
CEL413	Pre-stressed Concrete Structures	3-1-0	4	CEL551	Advanced Construction Materials	3-0-0	3
CEL 442	Geotechnical Investigations for Construction Projects	3-0-0	3	CEL561	Risk Analysis and Decision Making	3-0-0	3
				CEL562	Sustainable Construction Engineering	3-0-0	3
				MAL409	Application of Operation Research Techniques in Construction	3-0-0	3
				CEL563	Infrastructure Planning	3-0-0	3
	<b>5 DC + 1 DE = 19/20 Credits</b>				<b>3 DC + 3 DE = 16 Credits</b>		
<b>III Semester</b>				<b>IV Semester</b>			
CED501	Project Phase-I	-	3	CED502	Project Phase-II	-	9
CEP555	Soft Computing in Construction Management	0-0-4	2				
<b>ELECTIVE (Any One)</b>							
CEL560	Precast And Composite Structures	3-0-0	3				
CEL582	Advanced Construction Technology	3-0-0	3				
CEL 557	Maintenance and Rehabilitation of Structures	3-0-0	3				
CEL418	Energy Conversion and Environments	3-0-0	3				
	<b>1 DC + 1 DE = 8 Credits</b>				<b>1 DC = 9 Credits</b>		<b>9</b>

\* Student must register both for practical and Theory of a course.

## **CEL 406 ADVANCED CONCRETE TECHNOLOGY**

**[(3-0-0); Credits 3]**

### **Course Objective:**

Students will be able to

- a. Prepare a Concrete Mix Design with using environmental friendly materials such as Fly ash, Silica Fumes, Metakaolin & GGBS.
- b. Carry out Non Destruction Testing of Concrete using Core Test, UPV and Rebound Hammer

Review of properties of cement, their physical and chemical properties, special purpose cements, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction, thermal properties of aggregates, Importance of shape and Surface area and grading, gap graded and aggregates. Admixtures & construction chemicals, Use of Fly Ash, Silica Fumes, Metakaolin & GGBS in concrete.

Rheological behavior of concrete, requirements of workability of concrete, Effect of environmental conditions, Strength properties of hardened concrete, Impact, Dynamic and fatigue behaviour of concrete, shrinkage and creep of concrete, behaviour of concrete under fire.

Permeability and Durability of concrete, Parameters of durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing of concrete, Hot weather and cold weather concreting, Guniting (Shotcreting)/

Concrete mix design, Basic considerations and choice a mix proportions, various methods of mix designs including IS Code method. Quality control and quality assurance of concrete, Acceptance criteria, Quality management in concrete construction, Inspection and testing of concrete. Non-destructive testing of concrete, core test and load test.

Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete. Mass concrete, high performance concrete, Pumpable concrete, Self Compacting concrete, Air entrained concrete, Ferro cement, fiber reinforced concrete, Polymer impregnated concrete. Jet concrete. Deterioration and repair technology of concrete, Distress and type of repairs, crack sealing techniques.

### **REFERENCE:**

1. Gambhir M.L: Concrete Technology Tata McGraw Hill (Second Edition) 1995.
2. M.S.Shetty, Concrete Technology S.Chand & Company New Delhi 2005 .
3. P.Kumar Mehata, Paulo & J.M. Monteiro, Concrete microstructure, properties & materials, Prentice Hall INC & Mcgraw Hill USA.
4. Short & Kenniburg, Light Weight Concrete, Asia Publishing House, Bombay 1963.
5. Orchard D.F.; Concrete Technology -Vol I. & II Applied Science Publishers (Fourth Edition) 1979.
6. Neville A.M., J.J.Brook Properties of Concrete Addison Wesley 1999.

## **CEP 406 ADVANCED CONCRETE TECHNOLOGY**

**[(0-0-2); Credits 1]**

Laboratory work comprises 8 practical related with syllabus

**Course Objectives:**

1. To introduce the students about quality and safety related challenges in construction industry
2. To make students aware about the globally recognized guidelines/theories for quality and safety in construction
3. To make students self efficient to audit quality and safety related challenges in construction

Total quality management concepts; ISO9000; QA/QC systems and organizations, Quality Audits; Problem solving techniques; Statistical Quality Control; Quality Function Deployment; Material Quality Assurance; Specifications and Tolerances.

Safety issues; Injury accidents and their causes; Safety program components; Role of workers, Supervisors, Managers and Owners; Safety Procedures for various construction operations; Safety audits; Safety laws.

Safety Organization and Management: Safety policies, safety organization, safety committees, safety representatives, outside agencies – Govt. intervention, international agreements.

**REFERENCE:**

1. Levitt, R.E. and Samelson, N.M., Construction Safety Management, Mc. Graw Hill Book Company, Inc., N.Y. 1991.
2. Juran Frank, J.M. and Gryna, F.M., Quality Planning and Analysis Tata McGraw Hill 1982.
3. Raymond Elliot Levitt & Nancy Morse Samelson Construction Safety Management Amazon Second edition.
4. Grant E.L. and Leavensworth Statistical quality Control McGraw Hill 1984.
5. Hutchins G, ISO 9000, Visa Books, New Delhi, 1993.
6. Ron Baden Hellard, Total Quality in Construction Projects, Thomas Telford, London.



**Course Objectives:**

1. To bring the civil engineers to such a level so to as enable them, to take the appropriate decision in respect of choice of Prestressed section over R.C.C .
2. To make the learners to be aware of such a highly mechanized technology in civil engineering construction.
3. To imbibe the culture of entrepreneurship in precast prestressed industry in mass housing .railway sleepers, electric transmission poles etc.
4. To understand the basic design considerations in prestressed concrete structures in relation to its applications.
5. To employ & develop new techniques in rehabilitation of distressed structures like buildings , Bridges & infrastructures.

Design of high strength concrete mixes. Loss of prestress in single span and continuous beams. Use of IS 1343-1980, Analysis Limit State Design of beams for Tension Type II and III problems, Cracking moment, untensioned reinforcement, Partial prestressing, Stress Corrosion.

Transfer of prestress by bond, Transverse tensile stresses, End zone reinforcement. Behaviour of Bonded and unbonded prestress concrete beams.

Deflection of Prestressed concrete members, short and long term, control of deflections. Crack width considerations. Flexural strength of prestressed concrete sections: Types of flexural failures, Limit state concept.

Shear resistance of prestressed concrete members: Principal stresses and ultimate shear Resistance, Design of shear reinforcement, prestressed concrete, members in Torsion, Design of reinforcement in torsion shear and bending.

Stress distribution in end block, Analysis and Anchorage Zone reinforcement. Composite Construction of prestressed precast and cast in situ concrete. Statically Indeterminate structures: Continuous beams, primary and secondary moments, Continuity, concordant cable profile, Analysis and Design of continuous beams.

Prestressed concrete pipes and poles.Design of Prestressed concrete tanks. Prestressing of dams and bridges: Method of construction. Stage prestressing, Dynamic and Fatigue behaviour of prestressed concrete.

**REFERENCE:**

1. Nigel R Hewon Prestressed Concrete Bridge, Design and construction Thomas Telford London 2003.
2. Plan Cast Precast and Prestressed concrete(A Design Guide ) Devid A.Sheppard & William R. Phillips Mcgraw Hill Publication Co. 1989.
3. N. Krishnaraju Prestressed Concrete Tata McGraw Hill (Third Edition) 1981.
4. Lin T.Y,Burns N.H. Design of Prestressed Concrete Structures. John Wiley & sons (Third Edition).1982.

Significance of Energy Conversion and Environment, Overview of Global and Indian Energy Scenario; Environmental Impacts of Energy Conversion, Principles of Waste Minimization and Energy Recovery, Renewable and Non- Renewable Energy Sources; Estimation of Potential of Energy Recovery from various Sources, Energy economics; Energy Conversion Methods: Thermal, hydro, nuclear, solar, wind, tidal etc their principles and application, Waste to Energy options: physical, thermo chemical and bio chemical processes: pelletization, briquetting, Combustion, Gasification, pyrolysis; Fuels Derived anaerobic digestion, Biogas Technology, Future Technologies for Waste to Energy Systems; Introduction to Microbial Fuel cell, Gas generations and collection in landfills, Measurements and Control; Energy and Resources Conservation Strategies and Policies; Environmental Appraisal, Energy audit, Carbon Foot prints, Sustainable Energy-Efficient systems, Intelligent Green Building, Case studies of sustainable Energy Projects in the field of Water Resources, Infrastructure and Environmental System.

**REFERENCE:**

1. Fowler J. M. Energy and the Environment McGraw Hill New York 2<sup>nd</sup> edition.
2. B.H. Khan, Non Conventional Energy Resources, 2<sup>nd</sup> Edition, McGraw Hill Companies.
3. G.D.Rai, Non Conventional Energy Source, Standard Publishers Distributors.
4. D. O. Hall, G. W. Barnard and P. A. Moss, Biomass for Energy in the Developing Countries, Current Roles, Potentials, Problems, Prospects, Pergamon Press Ltd, 1<sup>st</sup> edition.
5. W. C. Turner, Energy Management Handbook Wiley Newyork 1<sup>st</sup> edition.
6. P. Meier, Energy System Analysis for Developing countries, Sringer Verlag 1<sup>st</sup> edition.
7. Dorothy J De Renzo, Energy from Bioconversion of Waste materials, Noyes data Corporation USA 1<sup>st</sup> edition.
8. Francis A. Domino Energy from Solid Waste – Recent Development, Noyes data Corporation USA 1<sup>st</sup> edition.
9. Oliver S. Owen, Daniel D. Chiras, Natural Resource Conservation – Management for Sustainable Future Prentice Hall Publications 6<sup>th</sup> edition.
10. McGraw Hill George Tachonobanoglous, Hilary Thesin, Samuel Vigil 1<sup>st</sup> International Edn.

**Course Objectives:**

To make Civil Engineering students able to prepare business plan by analyzing the economic and market situations.

Principles of management and Personnel management: Economic environment of business, Introduction to managerial economics, ; Role of a Manager: Tasks and responsibilities of a professional manager, Human Resource development systems Organization structure & design, manpower planning Processes Managerial skills and Management Systems, techniques and processes, SWOT Analysis.

Business Policy and Strategic Management; Assessment of capital requirement and sources of capital planning the establishment and development of business, fixed and current assets, liquid resources, Forecasting of business, cash flow, effect of taxation, Public and private sources of finance, methods of obtaining finance from external sources and internal sources, cost of capital, forms of capital structures.

Value engineering and quality assurance, marketing planning & organization, marketing research & Marketing strategies, determinants of consumer behaviour, Models of consumer behaviour, Pricing & promotion strategies., Business forecasting. Modern Control Systems, Total quality Management (TQM), JIT, DSS, ERP, Strategic Management, Technological innovation & creativity.

Financial Management; Meaning and Scope, Economics and Scope, Supply and Demand Mechanism, analysis and forecasting. balance sheet, profit & loss account, fund flow statement; Production and Cost theory, analysis. Pricing; objectives, determinants, absorption, marginal costing. Financial analysis, Decisions. Capital Budgeting, budgetary control, standard costing and variance, investment appraisal.

Construction Finance: Accounting information and application, Financial versus economic evaluation, financial statements and project appraisal. Project yield, taxation and inflation, risk and uncertainty, Turnkey activities; finance and working capital, depreciation and amortization; cost control, performance budgeting, equipment rentals. Bidding and awards, work pricing, cost elements of contracts, letters of credit, financing plans, multiple sources of finance. Qualifying, bidding, bidders, comparing the bids, under-writing. unforeseen revisions, costs and rates escalation, cost progress reporting. Legal aspects.

**TEXT / REFERENCES :**

- 1) Peterson, H.C., Lewis, W.C. Managerial Economics, Prentice Hall of India Pvt. Ltd., 2001
- 2) Parkin, M. & Bade R., Modern Macroeconomics 4<sup>th</sup> Edition, Prentice Hall, 1996
- 3) Werther & Davis, Human Resources & Personnel Management, McGraw Hill, 1996
- 4) Edwards, John et.al., 1983 Manpower planning, John Wiley: New York
- 5) Anthony, R.N. Govindrajan, V., Irwin, Management control systems, McGraw Hill 10<sup>th</sup> Edition, 2000
- 6) Baumel, W.J., A.S. Blinder and W.M. Scarth, Economics: Principles and policy, Academic Press Canada, Toronto, 1985
- 7) Anthony & Reece, accounting Principles, AITBS, Sixth Edition, 1998
- 8) Koontz O'Donnel : Essentials of Management; Tata McGraw Hill, 1982
- 9) Monappa A., Personnel Management, Tata McGraw Hill,

**Course Objective:**

- a. Students shall be able to Plan Bar Chart, CPM chart, PERT chart material requirement schedule, Manpower schedule, Machinery Schedule
- b. Student shall be able to carry out manpower resources leveling and smoothing.
- c. Overview of Construction Management and Present Status of Construction Industry.
- d. Student shall be prepare Project management reporting documents.
- e. Student shall be able to frame a labour law for their project site.

Understanding Project Management, Project manager, Organization structures, Stages of Construction, organizing and staffing the project office and team

Construction Planning : Project planning, milestone schedules, WBS, Network techniques, CPM , PERT and Prima Vera , Line of Balancing Techniques, Critical Chain Method, Resources leveling and smoothing.

Project Management Information system : MIS reporting, Daily , Weekly and monthly reporting, Actual vs. Planned reporting, Planning & Cost control document . Quality and safety documents at site.

Material management- purchases management and inventory control, ABC analysis.

Management: Introduction for Management, History of Management theory, Leadership, Motivational Theories, Project controls.

Construction Labour : Payment of wages Act, Workmen's Compensation Act, Minimum Wages Act.

**REFERENCE:**

1. Harold Kerzner Project Management CBS Publisers & Distributors 2<sup>nd</sup> Edition.
2. Frank Harris & Ronald Mc Caffer Modern Construction Management Blackwell science 4<sup>th</sup> Edition.
3. Roy Pilcher Principles of Construction Management Mc Graw Hill London.
4. Kumar Neeraj Jha, Construction Project Management, Pearson Publication.
5. Project Management Body of Knowledge, 5th Edition, PMI Global Standard
6. Harvey Maylor, Project Management, 3rd Edition, Pearson
7. K.K. Chitkara, Construction Project Management, 2nd Edition, McGraw Hill Publication
8. P G. Gahoit & B.M. Dhir, Construction Management New age international (p) Ltd.
9. Srinath L, CPM & PERT, East-West Press Pvt. Ltd New Delhi.
10. N.D. Vora, Quantitative Techniques in Management, Tata McGraw Hill, New Delhi, 3rd Edition.
11. Daniel Halpin, Construction Management, 3rd Edition, John Wiley & Sons, Inc.

## **CEL 551- ADVANCED CONSTRUCTION MATERIALS**

**[(3-0-0); Credits 3]**

Classifications of Construction Materials. Consideration of physical, Mechanical, thermo-physical Properties, characteristics behaviour under stress, selection criteria for construction materials, green building materials, waste products, reuse and recycling.

Materials for making Mortar and concrete: Lime manufacture, properties, hardening of lime, types of lime, lime concrete uses, cement, aggregates, water, characteristics, properties and uses of Pozzolana materials, Types of mortars, special mortars, properties and applications, admixtures

Ceramic Materials: Classification, Refractories, glass, glass wool, mechanical, thermal and electrical properties, fire resistance materials, Uses and application.

Polymeric Materials: Polymerization mechanism and depolymerisation. Rubber and plastics, properties, effect of temperature on mechanical properties. Uses and application.

Types of structural steels, special steel, alloy steel, stainless steel, light gauge steel, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Electro-chemical process, measures of protection.

Ferro-cement, material and properties. Polymers in Civil Engineering Polymers, fibres and composites, Fibre reinforced plastic in sandwich panels, modeling. Architectural use and aesthetics of composites.

Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

### **REFERENCE:**

1. Rangawala S.C. Engineering Materials Chortor Publications 1991.
2. S.K. Duggal Building Materials, New Age International Publications 2006.
3. Bruntley L.R Building Materials Technology Structural Performance & Environmental Impact McGraw Hill Inc 1995.
4. R Chudley Construction Technology, Vol I - IV Longman Group Construction Ltd. 1973.

**Course Objective:**

To make Civil Engineering students able to analyze, evaluate and design construction contract documents.

**Syllabus:**

Agreement, Contract, essential conditions, Indian Contract Act 1872, types of contract, terminology of contract.

Construction Specifications: standard specifications, general specification, development, interpretation.

Tender and tender documents: types of bidding, tender notice, tendering procedure.

Construction claims: extra item, excess quantity, deficit quantity, price escalation.

Dispute resolution mechanism: litigation, arbitration, conciliation, mediation, dispute resolution board.

Contractual Problems: possible contractual problems, creation of claims, development of disputes.

Contract document: drafting of clauses, development, and interpretation, CPWD conditions of contract, FIDIC conditions of contract.

BOT contract: types of contract, PPP framework, types of risk, concession agreement, drafting of clauses, development, and interpretation.

Laws affecting Engineers: Labour Law, Sales Tax, VAT, Service Tax, Excise Duty.

Relational Contract: partnering, alliancing, key elements, processes.

**REFERENCE:**

1. L.S. Ranaga Rao Contract Management and Dispute Resolutions Engineering staff College of India January 2008.
2. C. J. Schexnayder and R. E. Mayo, Construction Management Fundamentals, McGraw Hill, New Delhi. 2003
3. General Conditions of Contract, Central Public Works Department, New Delhi, 2010
4. S. Ranaga Rao, Contract Management & Dispute Resolutions, Engineering staff College of India, January 2008
5. D.S. Berrie and B.c. Paulson, Professional construction management including C.M., Design construct and general contracting, McGraw Hill International, Third Edition 1992..
6. V. K. Raina, Construction & Contract Management Practices, SPD, New Delhi

**Course Objective :**

- a. Student should able to decide which types and capacity of construction equipment can be used for excavating, compacting grading, dozing , concreting operation.
- b. Student should able to prepare mass diagram for excavation particularly useful for road project.
- c. Student should able to prepare cost analysis for Excavating and concreting equipments.

**Excavating Equipments:** Different types of Excavator such as Front shovel, hoes. Their selection, calculation of shovel production, height & cut of shovel, angle of swing effect on shovel production., calculation of hoe production, Type of loaders their bucket attachments, loader production rates , calculation of wheel loader production

**Compacting and Stabilization Equipment :** Compaction of soil and rock, types of compacting equipment, roller production estimating, Dynamic compaction, Soil stabilization- Lime stabilization and Cement stabilization.

**Planning for Earthwork Construction :** Graphical presentation of earthwork, earthwork quantities, Mass Diagram, Estimation of Cost production.

Study of equipments with reference to available types and their types and their capacities, factors affecting their performance

Earthmoving Equipment :- Tractors and attachments, dozers and rippers, scrapers , shovels, draglines, trenching machines, clamshell, hoes, trucks and wagons, dumpers, rollers and compactors

Pile driving equipments:- Types, pile driving hammers, single acting and double acting, differential acting hammers, hydraulic and diesel hammers, vibratory drivers

Pumping equipments:- Reciprocating, diaphragm & centrifugal pumps, well point system

Concrete manufacture, transport, placing and compacting equipment, mixers, central batching and mixing plants, pavers, transit mixers, concrete pumps shotcrete Air Compressor Equipments for moving materials, builder's hoists, forklifts , cranes, belt-conveyors, cableways, ropeways

**References:**

1. Construction planning, Equipments and methods. R.L.Peurify, TMH, 1996
2. "Construction Equipment and its Planning and Applications", Mahesh Varma, Metropolitan Book Co.(P) Ltd., New Delhi. India.
3. Construction Machinery and Equipment in India". (A compilation of articles Published in Civil Engineering and Construction Review) Published by Civil Engineering and Construction Review,New Delhi, 1991.

**Course Objective:**

Student shall be able to

- a. To Prepare Capital budgeting of a Construction site.
- b. To Prepare a Performance statement of a company'
- c. To estimate various financial instrumental such as IRR, Break even analysis
- d. To prepare a Job Cost report of a Construction Site.

Project Appraisal : Project appraisal, government and private project evaluators, significance of social benefit – cost analysis, commercial profitability, national economic profitability, measurement of direct and indirect benefit and costs. Calculation of benefit cost ratio.

Engineering economics - Time value of money, discounted cash flow, decision making among the alternatives, replacement analysis, break even analysis.

Project capital: Cash flow of a project, estimation of minimum capital required, internal rate of return (IRR), Multiple IRR, estimation of annualized cost.

Depreciation : importance, classification, types – straight line, sum of year method, double rate declining balance method

Capital Budgeting: element of budgeting – men, materials, equipment, overhead, profits – preparation of capital budget.

Cost Control : Understanding control, operating cycles, cost account codes, Job cost report, Projected Cost Estimates, status reporting, variance and earned value

Performance statement: capital gearing ratio, shares, debentures, PBT, PAT, PBIT, Earning per share, preparation of company's performance statement, Inflation.

**REFERENCE:**

1. I. M Pandey, Financial Management, Vikas Publishing house pvt ltd 9<sup>th</sup> Edition.
2. Donald Newnan, Engineering Economics analysis, Oxford University Press
3. R Panneerselvam, Engineering Economics, PHI Learning Pvt. Ltd.
4. Frank Harris & Ronald Mc Caffer Modern Construction Management Blackwell science 4<sup>th</sup> Edition.
5. Roy Pilcher Principles of Construction Management, Mc Graw Hill London.
6. United Nations Guidelines for Project Evaluation Oxford & IBH Publishing Co. Pvt. Ltd.
7. A.H. Taylor & H Shearing, Financial & Cost Accounting for Management Mac Donald & Evans Ltd, London 8<sup>th</sup>.



**Course Objective:**

Student shall be able

- a. To prepare Capital Budgeting of a Construction project in excel sheet.
- b. To use time value of money formulae such as IRR, CRF, PV,FV in the excel sheet.
- c. To prepare a Construction programme for Town ship, Road Project, Bridge project etc with using Prima Vera Software.

Spreadsheet applications for calculation of Present worth, future worth, IRR, CRF etc.

Project management software such as Prima vera software, Microsoft project- Preparation of project and feed data into the software for various projects. Study of Statistical Software such SPSS.

**REFERENCE:**

1. Project Management using Primavera, Eastwood Harris Publications.
2. M.S. Project Microsoft Press.

**CEL 557 : MAINTENANCE AND REHABILITATION OF STRUCTURES [(3-0-0) Credit -3]**

Performance of construction materials and components in services; Causes of deterioration; preventive measurements and maintenance ; Principles of assessment of weathering and durability; Characteristics of materials; Diagnosis of construction failures; Dealing with cracks; Methods of repair in concrete, Steel and timber structural components; Corrosion damage of reinforced concrete and its repair and prevention measures; Surface deterioration, Efflorescence , causes, prevention and protection; Surface coatings and painting; Water proofing; Grouting; Strengthening of existing structures; Special repairs, maintenance Inspection and planning, Budgeting and management.

Conservation & energy efficiency concepts-overview of significance of energy use and energy processes in buildings.

Solar energy fundamentals & practices in building design- solar astronomical relations and radiation physics and measurements, design decision for optimal orientation of building, shadow analysis.

Heating and ventilation design- Human thermal comfort, climatological factors, material specifications and heat transfer principles, Thermal performance evaluation, Heat loss from buildings, design of artificial ventilation system, design of insulators.

Design audits & economic optimization- Concept of cost/benefit of energy conservation & carbon footprint estimation.

Energy efficient lighting system design: Basic terminologies and standards, daylighting and artificial lighting design, auditing.

Advances in computational energy conservation- implementation of computer energy simulation programs into building designs.

**REFERENCE:**

1. Energy Efficient Buildings In India by Mili Majumdar The Energy Research Institute.
2. Energy-Efficient Building Systems Lal Jayamaha McGraw Hill Publication.
3. Solar Energy and thermal processes J A Duffie & W A Beckman John Wiley.
4. Energy Conservation Building Code, 2007.
5. Handbook of functional requirement of buildings, SP: 41:1987.

History of Precast Concrete, Materials, Typical framing, Standard components, Scope and concept of prefabrication and methods, Principles & Design considerations, Modular coordination of elements, Selection ,casting and erection ,Prefabrication system for buildings, Walls floors, Precast shells, prefabrication and housing, limit state of stability and collapse, prefabrication of bridges

Need for Prestressing, Prestressing Methods, Analysis and Design, of elements, Composite construction, Reinforced and Prestressed Wall, Slab, Beam, Column Masonry elements. Precast sandwich Panels ,Prestressed concrete solid flat slabs, Hollow core slab/panels, Prestressed concrete Double “T”,Bridge, Precast segmental Box Girders, Specifications and Seismic considerations.

**REFERENCE:**

1. P.R Knowels, Composite steel and concrete Construction, Butterworth, London. 1971.
2. R.P.Johnson & R.J.buckby, Composite Structures of steel and concrete Granada Publishing LTd. 1979.
3. A.M.Hass, Precast Concrete Design and Application Applied Science Publishers London 1983.
4. Plan Cast Precast and Prestressed concrete(A Design Guide ) Devid A.Sheppard & William R. Phillips Mcgraw Hill Publication Co. 1989.

Need of Decisions and Risk analysis for construction management, Decision Models, Risk and Uncertainty, Theory and Techniques of Decision and Risk Analysis, Qualitative and Quantitative risk analysis tools /methods, Modelling Value Systems, Value Management for Construction, Competitive Bidding and Risk Sharing, Strategic and integral planning, Decisions making for site selection, construction , execution and operation of projects, Documentation, Project proposals, Economic Analysis, Legal Aspects of project management, Environmental appraisal, ISO 14000, Hazards identification, analysis and risk assessment, Accident and incident Analysis and control systems, IS 3786, S.H.E. Management IS15001, Training & Education Management Oversight and risk tree, Risk control and Treatment, Risk management and Internal control, Risk mitigation, Risk management plan, IT and IS for Risk management

**REFERENCE:**

1. Melvin W. Lifson, Edward F. Shaifer, Decision and Risk Analysis for Construction Management, John Wiley & Sons 1<sup>st</sup>.
2. Ian Cameron, Raghu Raman, Process Systems Risk management Elsevier Academics Press 2005.
3. Chris Marrison Fundamentals of Risk Measurements Tata McGraw Hill 2002.
4. Han Buhlman, Mathematical Methods in Risk Theory Springer-Verlag Berlin Heidelberg 1970.
5. Calow P Hand book of Environmental Risk Assessment and Management Blackwell Science Ltd. Oxford, UK 1998.

## CEL 562- SUSTAINABLE CONSTRUCTION ENGINEERING

[(3-0-0); Credits 3]

Fundamentals of Sustainable Construction Engineering- Sustainability and resources, need, present practices at national and international level, The Sustainability Quadrant- challenges & Issues, Government initiatives.

Construction Product, Process Design and Development- Sustainability of construction resources, process modifications, product performance evaluation.

Sustainability assessment using standard approaches- LEED/GRIHA rating evaluation process.

Socio-economic feasibility of sustainable construction products- Innovative & customized sustainable product design based on social constraints, tools & aids available for sustainable construction products.

Life Cycle Assessment and Costing-Variou aspects related to construction cost, present value analysis, life cycle stages, cost calculation & measures, evaluation criteria, uncertainty assessment, sensitivity analysis, break even analysis.

### REFERENCE:

1. Sustainable Engineering Practice ASCE Publication 2010.
2. Hagger Sustainable Industrial Design and Waste Management, Techniz Book 2010.
3. Helmut Rechberger, Practical handbook of Material Flow Analysis, Taylor & Francis. 2010.
4. Michael Z. Hou, Heping Xie, Jeoungseok Yoon Underground Storage of CO<sub>2</sub> and Energy Taylor & Francis, 2010.
5. LEED for India: Reference Guide, 2011.

**CEL 582 : ADVANCED CONSTRUCTION TECHNOLOGY****[(3-0-0) Credit -3]**

Concrete Construction methods: form work design and scaffolding, slip form and other moving forms, pumping of concrete and grouting, mass concreting (roller compacted concrete), ready mixed concrete, various methods of placing and handling concrete, Accelerated curing, Hot and cold weather concreting, Under water concreting, Prestressing.

Steel and composites construction methods: Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction, Modular coordination.

Erection Techniques : Major types of mobile crane, Lifting capacities of cranes, modification in cranes for heavy lifting, crane booms, Rated loads for lattice and telescopic boom cranes, Working ranges of cranes, Tower cranes: - classification, operation, tower crane selection,

Tunneling: Tunneling equipment, Tunnel boring machine, Pipe Jacking, selection of tunnel alignment, tunneling using Road Headers, Cut and fill techniques, jackdown techniques , box type tunneling techniques.

Special construction methods: Construction in Marine environments, High rise construction, Bridge construction including segmental construction, incremental construction and push launching techniques, River valley projects.

**References:**

Purifoy, Schexnayder, Construction Planning, Equipment and Methods, Tata Mc Graw Hill  
Edward Nawy , Concrete Construction and engineering Handbook , CRC Press.

Classification of buildings, Importance of building services, Role of Construction Manager, Planning and designing of building services, Water supply and Distribution to Multi-storey buildings, De-centralized water Treatment units and Swimming pool for building complexes, storm water drainage and Rain Water Harvesting , sanitation services-Soil Pipe system, de-centralized waste water Treatment, Solid Waste Disposal System.

Lift and Escalators, Fire Fighting Services, HVAC systems and services, Building security and Access services, Acoustic and Integrated Services, Design of Parking systems, Lighting design, Electrical distribution, building automation, intelligent green buildings, Environmental Clearance for Buildings. Evaluation of Building Services, Integrated planning and Designing of Different services in Important Buildings viz. Multi-storeys/ High Rise Building, Institutional Building, Auditorium and stadiums, Office Complexes, Shopping complexes, Airport, storage and ware house, Hazardous Building.

**REFERENCE:**

1. National Building Code 2005, Part 0-10, Bureau of Indian Standards.
2. F. Hall (Author), Roger Greeno (Author), Building Services Handbook: Incorporating Current Building and Construction Regulations.
3. Building Services Research and Development Association Staff Building Services Materials Handbook - Heating, Sanitation and Fire Routledge
4. Willan T. Mayer Energy economics and building design.
5. E.C. Butcher and A.C. Parnell. Designing for Fire safety.
6. Peter R. Smith and Warden G. Julian, Building Services.
7. V.K. Jain, Handbook of Designing and Installation of Services in High Rise Building & Complexes, Khanna Publicaiton, New Delhi



## **CEL563 - INFRASTRUCTURE PLANNING**

**[(3-0-0); Credits 3]**

Definitions of infrastructures; Typical infrastructure planning steps; Planning and appraisal of major infrastructure projects; Screening of project ideas; Life cycle analysis; Multi criteria analysis for comparison of infrastructure alternatives; Procurement strategies; scheduling and management of planning activities.

Economic analysis – concept and applications, principles of methodologies for economic analysis of public works, social welfare function, Demand curves and price elasticities; Shadow pricing; Accounting for risk and uncertainty.

Financial evaluation; Financial estimates and projections; Project risk analysis; Political and social perspectives of infrastructure planning; Case studies.

### **REFERENCE:**

1. A.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.

## CEL 442- GEOTECHNICAL INVESTIGATION OF CONSTRUCTION PROJECTS

[3-0-0; ( Credit 3)]

### Course Objectives:

1. To make the students capable of solving real problems related to Geotechnical engineering, once he/she join industries as a fresh geotechnical engineer.
2. In this course all the topics will be taught from the application point of view with examples from case histories and a student will get a chance to apply his theoretical knowledge to solve real geotechnical challenges.
3. Introduction with advance methodology, techniques and tools related to geotechnical investigation
4. To discuss ground improvement with various methodologies.

### Syllabus:

Site Investigations: Planning of investigation programmes, Information required for planning different stages of investigations. Geophysical methods, Methods of site investigations: Direct methods, semi-direct methods and indirect methods, Drilling methods. Boring in soils and rocks, methods of stabilizing the bore holes, measurement of water table, field record. Field tests: In-situ shear test, in-situ permeability test, SPT, DCPT, SCPT, in-situ vane shear test, pressure meter test, plate load test.

Sampling techniques, Sampling disturbances, storage, labelling and transportation of samples, sampler design, influence on properties.

Geotechnical specification and proposal and report writing, boring log preparation, Safety measures, Geotechnical risks

Geotechnical Processes: Field compaction, field compaction techniques- static, vibratory, impact, Earth moving machinery, Compaction control in field.

In-situ stabilization with additives: Lime, flyash, cement and other chemicals and bitumen.

Deep Stabilization: sand column, stone column, sand drains, prefabricated drains, electro-osmosis, lime column. soil-lime column. Grouting: permeation, compaction and jet. Vibro-floatation, dynamic compaction, thermal, freezing. Dewatering systems

Geotechnical Engineering Case Histories: Earthen dam and reservoir, Industrial Structures, Ground Liquefaction, opencast coal mining, landslides, failure of geotechnical structures under critical natural hazards, debris flow, forensic geotechnical investigation.

### REFERENCES:

1. Raj Purushothama, Ground Improvement Techniques , Laxmi Publications
2. S. K. Saxena, S. A. Gill and R. G. Lukas , Subsurface Exploration and Soil Sampling , American Society of Civil Engineers

**MAL 409- APPLICATION OF OPERATION RESEARCH TECHNIQUES IN CONSTRUCTION  
[(3-0-0); Credits 3]**

Introduction, concepts in probability and statistics, linear programming, transportation and assignment problems. Dynamic programming waiting line models, Inventory Management, sequencing, Decision theory, Game theory, simulation as applied to construction. Modifications and improvements on CPM/PERT techniques.

**REFERENCES:**

Quantitative Techniques in Management, N.D.Vohra, The Mc. Graw Hill Companies, 3rd Edition