# CIVIL ENGINEERING DEPARTMENT

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


## Visvesvaraya National Institute of Technology, Nagpur

**JULY 2017**

**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.

| **Program** | **Description** |
|---|---|
| **UG in Civil Engineering** | Started with 60 seats in 1956<br>Intake increased to 71 in 2008<br>Intake increase to 82 in 2009<br>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 Management | 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**

| **Postgraduate Core (PC)** | | **Postgraduate Elective (PE)** | |
|---|---|---|---|
| Category | Credit | Category | Credit |
| Departmental Core (DC) | 37 | Departmental Electives (DE) | 15 |
| Basic Science (BS) | 00 | Other Courses (OC) | 00 |
| **Grand Total PC + PE** | | | 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 (3x2 + 1x1 + 0x1 = 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:

$$\boldsymbol{SGPA} = \frac{\sum_{semester}(Course\ credits \times Gradepoints)\ for\ all\ courses\ except\ audit}{\sum_{semester}(Course\ credits)\ for\ all\ courses\ except\ audit}$$

$$\boldsymbol{CGPA} = \frac{\sum_{Allsemester}(Course\ credits \times Gradepoints)\ for\ all\ courses\ with\ pass\ grade\ except\ audit}{\sum_{Allsemester}(Course\ credits)\ for\ all\ courses\ except\ audit}$$

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 Members | Designation | Qualifications | Areas of specialization |
|---|---|---|---|
| Mhaisalkar V.A. | Professor | B.E, M.Tech , Ph.D | Environmental Engg |
| Gupta R. | 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. | Professor | B.E, M.Tech, Ph.D | Environmental Engg |
| Ghare A.D. | Professor | B.E, M.Tech, Ph.D | Hydraulic Engg |
| Latkar M.V. | Associate Professor | B.Sc., M.Sc, Ph.D | Environmental Biochemistry |
| Lataye D.H. | Associate 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. |
| Landge V.S. | Associate Professor | B. E., M.E, Ph.D | Traffic Engineering |
| Mandal 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 A. | 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. |
| Madurwar M. | Assistant Professor | B.E, M.E, Ph.D | Building Materials |
| Adhikary S. | Assistant Professor | B.E, M.Tech, Ph.D | Soil Dynamics |

**Program Outcomes (PO)**

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:

1. Work in Civil Engineering sector which is involved with various aspects of planning, design, construction and operation of structures and systems.
2. Design and analyze the complex problems and provide state of the art solutions.
3. Contribute to the academic and research in the broad field of civil engineering.
4. 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 posses 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)
## (For 2015 onwards batches)

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

| **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* | 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 | | | | |
| CEL558 | Building Services | 3-0-0 | 3 | | | | |
| | Core Credits = 16 | | | | Core Credits = 7 | | |
| **ELECTIVE (Any One)** | | | | **ELECTIVE (Any Three)** | | | |
| 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 Investigation 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 |
| | | | | CEL510 | Environmental Management | 3-0-0 | 3 |
| | | | | CEL 542 | Introduction to Climate Change | 3-0-0 | 3 |
| | **5 DC + 1 DE = 19/20 Credits** | | | | **3 DC + 3 DE = 16 Credits** | | |
| **III Semester** | | | | **IV Semester** | | | |
| CED501 | Project Phase-I | - | 3 | CED502 | Project Phase-II | - | 9 |
| CEP564 | Soft Computing in Construction Management | 0-0-4 | 2 | | | | |
| **ELECTIVE (Any One)** | | | | | | | |
| 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 | | | | |
| | **1 DC + 1 DE = 8 Credits** | | | | **1 DC = 9 Credits** | | **9** |

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

**CEL 406 ADVANCED CONCRETE TECHNOLOGY [(3-0-0); Credits: 3]**

**Course Outcomes:**

1. Preparing a Concrete Mix Design with using environmental friendly materials such as Fly ash, Silica Fumes, Metakaolin & GGBS.
2. Carrying out Non Destruction Testing of Concrete using Core Test, UPV and Rebound Hammer

**Syllabus:**

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 behavior 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**.**

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**REFERRENCE:**


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]**

**Course Outcomes:**

Laboratory work comprises 8 practical related with syllabus

**CEL 409 QUALITY AND SAFETY IN CONSTRUCTION [(3-0-0); Credits: 3]**

**Course Outcomes:**

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

**Syllabus:**

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.

**REFERRENCE:**


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 SamelsonConstruction Safety Management Amazon Second edition.
4. Grant E.L. and Leavensworth Satistical 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.

**CEL 413-PRE-STRESSED CONCRETE STRUCTURE [(3-1-0); Credits: 4]**

**Course Outcomes:**

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.

**Syllabus:**

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 unbounded 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.

**REFERRENCE:**


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. Phillps 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.

**CEL 418 ENERGY CONVERSION AND ENVIRONMENT [(3-0-0); Credits: 3]**

**Course Outcomes:**
This course provides a broad conceptual and analytical understanding of the engineering aspects of energy generation, storage and conversion with an emphasis on sustainable energy use

**Syllabus:**
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 form 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, bricquetiation, 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.

**REFERRENCE:**

1. Fowler J. M. Energy and the Environment McGraw Hill New York 2nd edition.
2. B.H. Khan, Non Conventional Energy Resources, 2nd 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, 1st edition.
5. W. C. Turner, Energy Management Handbook Wiley Newyork 1st edition.
6. P. Meier, Energy System Analysis for Developing countries, Sringer Verlag 1st edition.
7. Dorthy J De Renzo, Energy from Bioconversion of Wate materials, Noyes data Corporation USA 1st edition.
8. Francis A.Domino Energy from Solid Waste – Recent Development, Noyes data Corporation USA 1st edition.
9. Oliver S. Owen , Daniel D. Chiras, Natural Resource Conservation – Management for Sustainable Future Prentice Hall Publications 6th edition.
10. McGraw Hill George Tachonobanoglous, Hilary Thesin, Samuel Vigil 1st International Edn.

**CEL 425 FINANCIAL AND BUSINESS MANAGEMENT [(3-0-0); Credits: 3]**

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

**Syllabus:**
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.

**REFERENCES:**

1. Peterson, H.C., Lewis, W.C. Managerial Economics, Prentice Hall of India Pvt. Ltd., 2001
2. Parkin, M. & Bade R., Modern Macroeconomics 4th 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 10th Edition, 2000
6. Baumel, W.J., A.S. Blinder and W.M. Scarth, Economics: Principles and policy, Academic Press Canada, Tornoto, 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,

**CEL 519 CONSTRUCTION PLANNING AND CONTROL [(3-0-0); Credits: 3]**

**Course Outcomes:**

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

**Syllabus:**

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.

**REFERRENCE:**


1. Harold Kerzner Project Management CBS Publisers & Distributors 2nd Edition.
2. Frank Harris & Ronald Mc CafferModern Construction ManagementBlackwell science4th Edition.
3. Roy PilcherPrinciples of Construction ManagementMc 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]**

**Course Outcomes:**
The construction materials engineering undergraduate curriculum provides a broad understanding of the composition, microstructure, and engineering behavior of various materials used in civil engineering applications.

**Syllabus:**
Construction Materials: 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 composties. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

**REFERRENCE:**

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.

**CEL 552 CONSTRUCTION CONTRACTS AND SPECIFICATIONS [(3-0-0); Credits: 3]**

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

**Syllabus:**
Construction Contract: 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.

**REFERRENCE:**

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

**CEL 553 CONSTRUCTION EQUIPMENT AND METHODS [(3-0-0); Credits: 3]**

**Course Outcomes:**

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

**Syllabus:**

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.

**REFERENCE:**


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

**CEL 554-PROJECT APPRAISAL AND CONSTRUCTION FINANCE [(3-1-0); Credits: 4]**

**Course Outcomes:**

Student shall be able to

1. To Prepare Capital budgeting of a Construction site.
2. To Prepare a Performance statement of a company'
3. To estimate various financial instrumental such as IRR, Break even analysis
4. To prepare a Job Cost report of a Construction Site.

**Syllabus:**

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.

**REFERRENCE:**


1. M Pandey, Financial Management, Vikas Publishing house pvt ltd9th Edition.
2. Donald Newnan, Engineering Economics analysis, Oxford University Press
3. R Panneerselvam, Engineering Economics, PHI Learning Pvt. Ltd.
4. Frank Harris & Ronald Mc CafferModern Construction ManagementBlackwell science4th Edition.
5. Roy PilcherPrinciples 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 8th.

**CEP564 SOFT COMPUTING IN CONSTRUCTION MANAGEMENT [(0-0-4); Credits: 2]**

**Course Outcomes:**

Student shall be able to

1. Prepare Capital Budgeting of a Construction project in excel sheet.
2. Use time value of money formulae such as IRR, CRF, PV,FV in the excel sheet.
3. Prepare a Construction programme for Town ship, Road Project, Bridge project etc with using Prima Vera Software.
4. Spreadsheet applications for calculation of Present worth, future worth, IRR, CRF etc.
5. Project management software such as Primavera software, Microsoft project- Preparation of project and feed data into the software for various projects. Study of Statistical Software such SPSS.

**REFERRENCE:**


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]**

**Course Outcomes:**
The course seeks to recognize the mechanisms of degradation of concrete structures, provide the students with the knowledge of available techniques and their application for strengthening or upgrading existing structural systems. It also provides how to conduct field monitoring and non-destructive evaluation of concrete structures.

**Syllabus:**
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.

**REFERENCE:**

1. Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.
2. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006
3. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, 2002.
4. Denison Campbell, Allen and Harold Roper , Concrete Structures, materials, maintenance and repair , Long man, Scientific and Technical UK 1991.

**CEL 559 ENERGY EFFICIENT BUILDINGS [(3-0-0); Credits: 3]**

**Course Outcomes:**
On completion of this course, the students would:

1. Have acquired an understanding of the concept and theoretical background of low energy building design.
2. Be able to demonstrate their learning about use of simulation tools to achieve energy efficiency.

**Syllabus:**
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.

**REFERRENCE:**


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.

**CEL 560 PRECAST AND COMPOSITE STRUCTURES [(3-0-0); Credits: 3]**

**Course Outcomes:**

The learning outcomes of the course are:

1. Give knowledge of factors to be considered in the design of prestressed concrete structures
2. Understand the difference between pre- and post-tensioned systems for structural
3. behaviour
4. Learn to design and analyse prestressed concrete and concrete composite structures
5. Understand the roles of different limit states in the design of prestressed structures
6. Learn to consider the influence of time-dependency of materials on structural reliability.
7. Learn to consider specific features of precast concrete structures: connections, stability and prevention of progressive collapse, ductility
8. Give knowledge of the design and manufacturing of Finnish precast concrete products

**Syllabus:**

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.

**REFERRENCE:**


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. Phillps Mcgraw Hill Publication Co. 1989.

**CEL 561 RISK ANALYSIS AND DECISION MAKING [(3-0-0); Credits: 3]**

**Course Outcomes:**

1. Learn decision and risk analysis (D&RA) concepts & terminology that are most used in industry
2. Understand the impact of uncertainty in decision-making
3. Learn specific tools & processes for analyzing & making decisions - useful both professionally and personally
4. Learn to evaluate and interpret the output of D&RA tools and processes - to make the best decision
5. Develop a critical-thinking, problem-solving, value-creating approach to decision-making
6. Understand how people often actually make decisions as opposed to how they should

**Syllabus:**

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

**REFERRENCE:**


1. Melvin W. Lifson, Edward F. Shaifer, Decision and Risk Analysis for Construction Management, John Wiley & Sons1st.
2. Ian Cameron, Raghu Raman, Process Systems Risk managementElseveir Academics Press2005.
3. Chris MarrisonFundamentals of Risk MeasurementsTata McGraw Hill2002.
4. Han Buhliman, Mathematical Methods in Risk TheorySpringler- Verlang Berlin Heidelberg1970.
5. Calow PHand book of Environmental Risk Assessment and MnagementBlackwell Science Ltd. Oxford, Uk1998.

**CEL 562 SUSTAINABLE CONSTRUCTION ENGINEERING [(3-0-0); Credits 3]**

**Course Outcomes:**

1. Create new engineering materials to improve the performance of infrastructure
2. Characterize and mitigate natural and man-made hazards
3. Improve fundamental knowledge of the inter-relationships between the built environment and natural systems.
4. Develop the technological innovations needed to safeguard, improve, and economize infrastructure and society.

**Syllabus:**

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-Various aspects related to construction cost, present value analysis, life cycle stages, cost calculation & measures, evaluation criteria, uncertainty assessment, sensitivity analysis, break even analysis.

**REFERRENCE:**


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 $CO_2$ and Energy Taylor & Francis, 2010.
5. LEED for India: Reference Guide, 2011.

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

**Course Outcomes:**
Students will be familiar with the technology of major construction as outlined in the listed topic headings. Students will be able to describe, analyze, compare and evaluate the technology of high-rise construction and be aware of some of the problems that can be associated with poor management of construction projects.

**Syllabus:**
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, jack down 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.

**REFERENCE:**

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

**CEL 588 BUILDING SERVICES** **[(3-0-0); Credits: 3]**

**Course Outcomes:**

1. Apply logical, critical and creative thinking to analyse, synthesise and apply theoretical knowledge, and technical skills, to formulate evidenced based solutions to industry problems or issues
2. Collaborate effectively with others and demonstrate intellectual independence and autonomy to solve problems and/or address industry issues and imperatives.

**Syllabus:**

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.

**REFERRENCE:**


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]**

**Course Outcomes:**

1. Gather background information and research and describe its impact on the project.
2. Apply the basic principles of project appraisal and evaluation, and determining feasibility of projects to procedures using methods such as Cost-Benefit Analysis.
3. Describe and explain the principles of financial planning and cost planning of a civil infrastructure project.
4. Describe and explain the basic features of risk and quality management of a project, and the extent that these management areas need to be implemented.
5. Understand the concepts of financial, economic, social and environmental impact and describe and explain how these are undertaken in an infrastructure project.
6. Describe and explain the main features of project evaluation.

**Syllabus:**

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 elasticises; 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.

**REFERRENCE:**


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 INVESTIGATIONS FOR CONSTRUCTION PROJECTS**

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

**Course Outcomes:**

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 programs, 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, labeling and transportation of samples, sampler design, influence on properties.

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

**MAL409 APPLICATION OF OPERATION RESEARCH TECHNIQUES IN CONSTRUCTION**

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

**Course Outcomes:**

1. Identify and develop operational research models from the verbal description of the real system.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

**Syllabus:**

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:**

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

**CEL510 ENVIRONMENTAL MANAGEMENT [(3-0-0); Credits: 3]**

**Course Outcomes:**

1. Understand the environmental, social and economic framework in which environmental management decisions are made understand the life cycle perspective, systems approach and environmental technologies for converting process, products and service related industrial environmental problems into opportunities to improve performance
2. Anticipate, recognize, evaluate, and control environmental issues in a variety of sectors and industries and liaison with federal, state, and local agencies and officials on issues pertaining to environmental protection
3. Recognize, evaluate, and control factors in the workplace and the environment that cause health and environmental hazards and utilize quantitative knowledge and skills and modern tools and technologies to assess, analyze, plan, and implement environmental management systems
4. Obtain, update, and maintain plans, permits, and standard operating procedures.
5. Prepare, review, and update environmental monitoring and assessment Reports and Monitor progress of environmental improvement programs

**Syllabus:**

Environmental problems and issues at global and national level, sustainable development ( SD), Indicators of sustainable development, regional carrying capacity based planning, National Environmental Policy (NEP), Climate change, its impacts, adaptation and mitigation.

Waste minimization and pollution prevention strategies – Tools of corporate environmental management; ISO 14000, TC 207 structure, Environmental Management System (ISO: 14001), General requirements; Cleaner technology (CT) of production, waste management hierarchy implementation of CT, barriers for adoption of CT

Life cycle assessment, methodological framework. Environmental impact assessment, Methodologies for EIA, Environmental management plan (EMP), environmental monitoring plan, EIS, case studies of infrastructure and industrial projects

Indian environmental legislations and major environmental acts such as Water Act (1974), Air Act (1981), Environmental (Protection) Act (1986); International Environmental Treaties; Kyoto protocol, Montreal protocol, COP21, CDM. Ecomark, objectives, criteria, general and specific requirements. Design for Environment (DFE), strategy, implementation. Environmental audit, methodology, Benefits of EA to Industry. Overview of technologies, regulatory standards for industrial wastewaters and atmospheric emission.

**REFERENCES**


1. Richard Welford, Corporate Environmental Management Systems and Strategies, Universities Press (I) Ltd., Hyderabad, 1996.
2. Paul L. Bishop, Pollution Prevention: Fundamental and Practice, McGraw Hill, International, 2000. Freeman, H.M., Industrial Pollution Prevention Handbook, McGraw Hills 1995
3. Ministry of Environment, Forests and Climate Change( MoEFCC), Govt. of India web site

**CEL542 INTRODUCTION TO CLIMATE CHANGE [(3-0-0); Credits: 3]**

**Course Outcomes:**

The objective of this course to provide basic understandings of climate change, the causes of climate change and its effect on environment. This course is expected to provide the basic knowledge of important climate variables and the predictions of the changes in the climate system, policy issues and mitigation strategies.

**Course Syllabus:**

The Basics of Climate Change Science: The Earth's Energy Balance, negative entropy and mitigation, Greenhouse Gases, Aerosols and atmospheric brown cloud, Impact of $CO_2$ increase on climate change, Other Drivers of Climate Change, Adaptation strategy, Recent Climate Change impact at local and global scale, Sustainable Energy for All

Paleoclimatology: Glaciar Ice and Ice Core Dating, Other measurement techniques, Heinrich events, Dansgaard-Oeschger (D-O) events and their relevance in climate studies

Ecological Impacts of Climate change: Anthropogenic activities and climate change, Rising of sea level and consequences, Impact on biodiversity and extinction of endemic species, Changing of food chain, Agricultural shifts, Impact of climate change on health

Policy and Legislative issues in Climate Change: The UNFCCC, The Montreal Protocol, From Kyoto to Copenhagen, Towards COP21, ICMR, ICAR & IARI

Goal to Set Climate Change Prevention: Limiting the Mean Surface Temperature Increase below 2-Degrees Celsius vs. Pre-Industrial Levels, Global Emissions Reduction Pathway for the 2-Degree Limit, Potential Emissions from Fossil Fuel Reserves & Resources

Mitigation Strategy: Grid Management of Power Systems with High Penetration of Renewable Energies, Carbon Capture & Sequestration, Electric Vehicles and Advanced Biofuels, the Role of Technology Roadmaps and Roundtables, Introduction to Climate Modeling (GCM and RCM Models)

**REFERENCE:**


1. Climate Change and India – Vulnerability Assessment and Adaptation; Edited by P. R. Shukla, Subodh K. Sharma, N. H. Ravindranath, AmitGarg, Sumana Bhattacharya , Universities Press , 2003
2. Climate Change and India – Vulnerability Assessment and Adaptation; Edited by P. R. Shukla, Subodh K. Sharma, N. H. Ravindranath, AmitGarg, Sumana Bhattacharya , Universities Press , 2003
3. Climate Change and Chemicals Environmental and Biological, aspects; Golam Kibria, A. K. Yousef Haroon, Dayunthi Nugegoda and Gavin Rose, Published by New India Publishing Agency, 2010
4. Global Warming – The Complete Briefing, third edition; John Honghton, Cambridge University Press, 2004,
5. Climate Change- Causes Effects and Solutions; John T. Hardy, Wiley
6. Paleoclimatology, Third Edition, Reconstructing Climate of the Quaternary; Raymond S. Bradley, Elsevier Inc.