RATIONALE:

The construction industry plays a significant role in the development of national economy of our country. Nearly 50% of total outlay in any Five Year Plan is attributed towards construction activities which in turn constitutes an integral part of development projects. During the last five decades, construction industry in India has undergone large scale mechanization with rapid changes and advancements in construction practices as well as in its management. In order to bring professionalism in construction, the subject of ‘Construction Management' has been introduced in post-graduate level. This will enable them to understand the concepts and principles of modern day construction, planning tools, network analysis and effective management of construction works.

Implementation:

This subject shall be conducted through lecture-cum-discussion sessions, expert lectures by working professionals, field visits, practice tasks/assignments and educational films.

Evaluation Strategy:

1. Two class test of 15 marks each (regular) : 30
   (One class test for Modular)
2. Assignments, seminars & quizzes : 20
3. Final Examination : 50
4. Total Marks : 100

CONTENTS:

1. Introduction:
   Definition, functions and scope of construction management; scientific methods of management; construction team.
2. **Construction Contracts and Specifications:**
   Types of construction contracts; contract documents; specifications; general and special conditions; contract management; arbitration and settlement.

3. **Construction Planning and Network Techniques:**
   Pre-tender planning; contract planning; planning and scheduling construction jobs by bar charts; Planning and scheduling construction jobs by critical path network techniques; allocation of resources; techniques of development and analysis of PERT/CPM networks for building project, bridge project and industrial shed constructions; updating of network; examples and case studies; Computer software for network analysis.

4. **Time-cost Optimization:**
   Direct cost, indirect cost, total cost; purpose, stages and methods of cost control techniques of time cost optimization; examples and case studies.

5. **Site Layout:**
   Principles governing site lay out; factors effecting site lay out; preparation of site lay out.

6. **Supervision, Inspection and Quality Control:**
   Supervisor's responsibilities; keeping records; control of field activities handling disputes and work stoppages; storage and protection of construction materials and equipment; testing and quality control.

   Purpose of inspection: Inspection of various components of construction; reports and records; statistical quality control.

7. **Safety in Construction:**
   Safety: importance of safety, accident-prone situations at construction site i.e, safety measures for excavation, drilling/blasting, scaffolding/formwork, hoisting & erection demolition and hot bituminous work.

   Fire Safety:
   Safety record of construction industry, safety campaign.
8. Labour Laws and Acts:

9. Project Management:
   Feasibility study; project reports; progress reports; monitoring and controlling project activities.

Practical Exercises:

i) Identification of distinct activities in a building project, allocation of resources and time durations as per constraints in IS: 7272.

ii) Preparation of bar charts and material schedules.

iii) Preparation of CPM Network and project completion time for a single storey house, multi-storeyed building, bridge construction, highway construction, industrial structure etc.

iv) Allocation of resource and resource leveling for a small construction project.

v) Time cost optimization and crashing of project time for a small project.

vi) Preparation of different kinds of reports.

vii) Preparation of contract documents.

viii) Use of computer software for scheduling and related applications.

Books and Reference Materials:

3. Douglas and Manager: Construction Management, Prentice Hall
6. Challahan, M.T., Construction Project Scheduling.
MCT -6102  CONCRETE CONSTRUCTION TECHNOLOGY  
(Core Course)

Maximum marks : 50  
Time Allowed : 3 hours  

Note: Examiner shall set eight questions covering the whole syllabus. The candidate will be required to attempt any five questions.

RATIONALE :

Properly constructed and supervised concrete structures serve functionally well for the designed life span of 50 to 100 years. It is, therefore, essential for engineers and technicians to undergo education and training in concrete construction for:

(i) Understanding the principles of concrete technology and apply them during construction supervision and testing.

(ii) Supervising and managing concrete manufacture and construction.

(iii) Developing skills in selecting and testing concrete ingredients and concrete for certain specific requirements.

(iv) Interpreting the test results.

(v) Planning for quality and economy in concrete construction.

Implementation:

The course shall be mainly dealt with, through lecture sessions practical work, field visits and self-study. The practical work shall include testing of cement and aggregates, non-destructive testing of concrete, analysis of structure using profo-meter, and concrete mix design. The lab work shall also include the chemical analysis of concrete for verifying the proportions of various ingredients of hardened concrete.

Evaluation Strategy :

1. Two class test of 15 marks each (regular) : 30  
   (One class test for Modular)

2. Practice tasks, assignments, seminars & quizzes & Lab Work : 20

3. Final Examination : 50

4. Total Marks : 100
CONTENTS

1. Principles of concrete mix design:
   Concrete materials; mix proportioning and early age properties, strength, permeability and durability. (12)

2. Concrete mix design procedures by:
   IS/ACI British Standards, mix design procedures using fly ash, fibers and design of high performance concrete. (20)

3. Concreting operations –
   Practices and equipment, batching; mixing; transporting; shuttering and staging; placing and compacting; curing, accelerated curing; finishing and jointing. (04)

4. Properties and techniques of construction for concrete,
   Admixtures, polymers, epoxy resins, pozzolanic materials and fly ash, fibre reinforced concrete, light weight concrete, heavy weight concrete, foam concrete, high performance concrete. (04)

5. Special concrete
   Operations, shotcrete, grouting, guniting, under water concreting, hot and cold weather concrete, pumpable concrete, ready mixed concrete. (02)

6. Construction techniques for reinforced concrete
   Elements - materials, principles and procedures for beams, slabs, columns, foundations, walls and tanks, design and fabrication of formwork for R.C.C elements, features of slip forming and precautions, details of special shuttering required for lining of tunnel, procedures and precautions. (06)

7. Pre-stressed concrete construction-
   Principle, methods, materials, tools and equipment for the construction of a pre-stressed concrete. (04)

8. Inspection and quality control of concrete construction –
   Stages, principles, Checklist, statistical controls, procedures. (02)
Practical Exercises:

1. Testing of aggregates - fine and coarse as per BIS procedure.
2. Testing of cement with reference to IS specifications and cement grade.
3. Concrete mix design for desired grade from given materials.
4. (a) Design and testing of workability of concrete for a given C.C proportion.
   (b) Design and determination of cube strength with given materials and proportions.
   (c) Design of concrete mix proportions.
5. Study of effect of compaction on strength of concrete
6. Study the effect of plasticizers on workability of concrete.
7. Study the permeability of concrete.
8. Conduct chemical analysis of hardened concrete to determine the cement content.
9. Inspection of a concrete construction site and preparation of report showing correct and incorrect practices.

Reference Books

3. Neville, Brooks, Concrete Technology, Addison – Wesley, England
MCT- 6103 FOUNDATION DESIGN AND CONSTRUCTION
(Core Course)

Maximum marks : 50
Time Allowed : 3 hours

Note: Examiner shall set eight questions covering the whole syllabus. The candidate will be required to attempt any five questions.

RATIONALE:
Foundations form integral part of all civil engineering structures viz buildings, bridges, chimneys etc. Understanding behaviour of soil-foundation interaction is essential for safe distribution of structural load and stability. The subject is intended to impart the following knowledge and skills:

(i) estimate bearing capacity for different types of shallow foundations under different soil conditions and placement of footing.

(ii) know construction aspects of various types of shallow foundations and their suitability under various conditions.

(iii) know various types of pile foundations and estimate the carrying capacity of pile(s) or design pile/pile group.

(iv) explain various methods of improvement of soils and select a suitable method for given conditions.

(v) describe various methods of rectification of foundations.

Implementation:
The subject involves instruction through various methods e.g. lecturer cum discussion, tutorial work, laboratory work, educational films, field work and site visits.

Evaluation Strategy:

1. Two class test of 15 marks each (regular) (One class test for Modular) : 30
2. Practice tasks, assignments, seminars & quizzes & Lab Work : 20
3. Final Examination : 50
4. Total Marks : 100
CONTENTS

1. **Principles of Foundation Design** :

   Functions of foundations, essential requirements of a good foundation, types of foundations, principal modes of failure, estimation of allowable bearing pressures, calculation of ultimate bearing capacity by theoretical and empirical methods: Terzaghi's Method, Skempton's analysis for clays, Mayerhof's analysis BIS Method (IS:6403), Settlement of foundations. Factors to be considered for foundation design, numerical problem based on BIS method. (09)

2. **Shallow Foundations** :

   Introduction, essential requirements, types and depth of footing like Strip footing, Isolated footing, Combined footing, Strap footing, Raft footing, electrically loaded footings; design features and construction details related to size and depth of footing problem of frost heave, its causes and prevention, effect of ground water and environmental considerations; Numerical problems related to size and depth of footings (08)

3. **Pile Foundations** :

   Purpose/uses of pile foundations, Classification of piles based on different criteria, Brief details of timber, concrete, steel piles their advantages and disadvantages, selection of pile type, pile action, behaviour of pile and pile groups under load, definition of failure load.


   Carrying capacity of piles on rocks.

   Piles in fills - negative skin friction

   Carrying capacity of pile groups in cohesive soil and cohesion less soils, Efficiency of pile group.

   Piles subjected to horizontal or inclined loads.

   Mode of failure of piles

   Equipment for Installation of Piles by Driving and Boring and cast in place method (16)
4. **Soil Stability:**

Retaining walls – Introduction, types, Principles of design, Modes of failure, drainage of the back fill, problems related to design of gravity retaining wall and stability of retaining walls.

Unbraced excavations, braced excavations.
Sheet piles - types anchors and tie backs.
Shoring and Underpinning - necessity and methods

5. **Improvement of Foundation Soils**

Purpose :

Improvement of granular soils: term used to describe degree of compactness – relative density, density ratio and degree of compaction;

Methods - Vibration at ground surface, factors influencing roller compaction; deep dynamic compaction, vibro-compaction impact at depth.

Improvement of cohesive soils: preloading, or dewatering, methods of installing sand drains, drain wicks, electrical and thermal methods.


Geo-synthetics : types, functions, manufacturing of geo-textiles, Classification of geo-textiles.

Specific Applications: Bearing capacity improvement, reinforcement, retaining walls, embankment etc. testing of geo-synthetics, usage in India and a case study.

6. **Special Considerations in Foundation Design and Construction:**

Elementary principles of design and construction of foundations subjected to earthquake or dynamic loads, special measures for foundations constructed under water.

**Reference Books**

1. Tomlinson MJ, Foundation Design and Construction , ELBS-Longman, 6e,.  
5. Koerner, Robert M, Construction and Geotechnical Methods in Foundation Engineering , McGraw Hill,  
MCT 6105 CONSTRUCTION COSTING AND FINANCIAL MANAGEMENT  
(Core Course)

Maximum marks : 50  
Time Allowed : 3 hours  

Note: Examiner shall set eight questions covering the whole syllabus. The candidate will be required to attempt any five questions.

RATIONALE:

Estimating construction costs using different methods is a first step in financial costing and cost control. In addition to conventional cost estimates based upon detailed engineering drawings and specifications, it will also be necessary to determine costs in terms of components like materials, labours, plant and equipment etc. at different stages of construction. Cost control and cost monitoring will also need instant access to such data for revision of costs, cost forecasting and cost control.

It is also necessary for students to be familiar with budgeting and accounting procedures in both government and private sectors and to prepare cash flow statements, balance sheets etc. They also need to be familiar with various methods of financial analysis and cost-benefit analysis.

The subject of construction costing and financial management deals with these aspects of construction, which are very important for quality and economy in construction.

Implementation:

The course shall be conducted mainly through lecture-cum-discussion sessions, expert lectures from guest faculty, screening of educational films and practice tasks/assignments/seminars.

Evaluation Strategy:

1. Two class test of 15 marks each (regular) (One class test for Modular) : 30
2. Assignments, seminars & quizzes : 20
3. Final Examination : 50
4. Total Marks : 100
CONTENTS

1. **Construction Costing:**

Costing of construction Works; different methods of costing, cost elements in a projects; analysis of rates; non-scheduled items of work; cost estimation for a small construction job; purpose, methods and stages of cost control; cost monitoring; cost forecasting methods; variations in individual items of work and their effect on total contract price; valuation of variations. Methods of measurement of earthwork, RCC, Brickwork, Woodwork joinery, steel and iron work plastering/painting and white/colour washing & painting

2. **Cash Flow:**

Determining the funds required for a construction job; preparing cash flow statements; cash inflow and outflow during contract period; project expectations.

3. **Cash and Payment of Works:**

Precautions in custody of cash, imprest account and temporary advance; maintenance of temporary advance; and advance account; different types of payment, first, running, advance and final payments.

4. **Material Management:**

Objectives and scope of material management classification, codification, ABC analysis, standardization and substitution; introduction to inventory control; stores management; organization and lay out; receipt, inspection and issue; care and safety; store records and store accounting.

5. **Financial Management**

Meaning and scope; financial statement analysis; funds flow analysis; capital budgeting; cost-benefit analysis.

**Practical/Assignment Exercises:**

i) Preparation of cost estimates for a small project. (18)

ii) Filling up of prescribed treasury challan form and imprest account form with given data.
iii) Preparation of cash flow statement for a small construction project with given data and cost benefit analysis.
iv) Filing up of daily labour report on prescribed form with given data.
v) Preparation of analysis of rates for different items of work.
vi) Material statement and material analysis.
vii) Carry out financial statement analysis, ratio analysis and funds flow analysis for projects from given case studies.
viii) Exercise on software applications.

Reference Books:

ii) Gobourne: Cost control in the construction industry.
iii) Schedule of rates, specification manuals etc. from PWD
iv) Chris Hendrickson and Tung Au: Project Management for Construction
v) Datta : Material Management Procedures, Text and Cases, 2e Prentice Hall
RATIONALE:

Evaluation of soil properties is important in order to determine bearing capacity of soil. In-situ determination has distinct advantages, as the behaviour of soil under loading can be predicted better. The subject is primarily intended to develop skills and competencies in measurement of various engineering properties of soil in field and lab.

IMPLEMENTATION:

The subject involves instruction mainly through tutorial work, laboratory work, and field work. In addition education films may be used for demonstration purpose and teaching correct practices. Attempts shall be made to conduct visits to sites of relevant nature.

EVALUATION STRATEGY :

1. Lab Work, field work : 30
2. Site visit and report, lab record, internal viva : 20
3. Total Marks : 50

No theory examination shall be conducted.

PRACTICAL EXERCISES:

2. Determination of shear strength characteristics by field tests like in situ vane shear test, pocket penetrometer etc.
3. Determination of shear strength characteristics by laboratory tests (Direct Shear Test).
4. Determine unconfined compression strength of cohesive soil.
5. Recommend a field investigation programme to obtain design data.
6. Computation of bearing capacity and settlement for given conditions of soil, depth and type of foundation and loading.
8. Visit to construction site and preparation of report.
MCT- 6201  ENVIRONMENTAL ENGINEERING & MANAGEMENT
(Core Course)

Maximum marks : 50  
Time Allowed : 3 hours

Note: Examiner shall set eight questions covering the whole syllabus. The candidate will be required to attempt any five questions.

RATIONALE:

Environment and development are two sides of the same coin. Environmental degradation due to social-economic developmental activities and fast growing industry has created the need of environmental awareness among planners, builders and managers of various engineering project. The significance of threat to our `Environment' and the urgent need to respond appropriately to the same is widely recognized. The environmental pollution is threatening the health and quality of life of people. The quality of built environment and provision of infrastructure services are adversely affected by the pace of development and inadequate human response. It is necessary that the engineers should be aware of harmful effects of pollution and should be able to take preventive steps for controlling the pollution. This subject will help the students to acquire knowledge with reference to various sources of pollution and planning of remedial measures to control pollution.

IMPLEMENTATION:

The course shall be mainly dealt with through lecture sessions, field visits, practical work and self study, students will prepare case studies on the pollution aspects of nearby Industries/Cities. The lab work shall include determination of level of pollutants of air and water samples, vehicular emission and determination of concentration of metals in industries effluents. Field visits and submission of report on features of effluent treatment plants will be part of instructions.

EVALUATION STRATEGY :

1.  : 30
2.  Practice tasks, assignments, seminars & quizzes & Lab Work : 20
3.  Final Examination : 50
4.  Total Marks : 100
CONTENTS

1. Environment & Ecology

Definition and understanding of concepts, ecosystem, energy flow in ecosystem, water, carbon and nitrogen cycle, community’s inter-relationships in an ecosystem. (2)

2. Type of Pollutants and Protection of Environment

2.1 Water Pollution:
Sources, causes and measurement of water pollutants in surface and ground water, water quality criteria for various uses of fresh water, river basin studies for surface water pollution control, biochemical oxygen demand, effect of oxygen demanding wastes on rivers.

2.2 Domestic and industrial Pollution:
Sources, Standards for disposal of waste water and industrial effluents, basic unit operations in control of waste water pollution, C.P.C.B./M.O.E.F. for abatement of Industrial Pollution and Pollution Control/Treatment methods and technologies.

2.3 Air Pollution:
Definition, principle materials causing pollution, types of air contaminants, their sources and ill effects on living and nonliving materials, permissible limits. air pollution control - basic principles, natural self cleaning, pollution control methods and various engineering devices to control particulate and gaseous pollutants, controlling air pollution from automobiles.

2.4 Noise Pollution:
Definition, sources of noise and its units, adverse effects of noise pollution, sound pressure level and its measurement, octave band and its importance; noise pollution control measures.

2.5 Solid Waste Pollution:
Sources, public health aspects, solid waste management and disposal methods including E-waste.

3. Degradation of Land Resources:

3.1 Deforestation: Forest land, deforestation and its effects on land use and environmental quality, wetland and their importance in environment, causes and extent of wasteland, Soil degradation problems, erosion, salinization, water logging, land use management & planning. (8)
4. **Global Environmental Problems**

Global warming, green house effect, ozone depletion, acid rain, oil pollution, radiation hazard and control, global climate change.

5. **Environment Impact Assessment**:  

Definition and its importance for environment management, constituents of environment impact assessment, project data for EIA study, prediction of impacts, EIA methodologies, constraints in implementation of EIA, impact prediction on water resources projects and other relevant case studies. Environment pollution.

6. **Environmental Management System; International cooperation and Laws:**  

Main clauses and basic steps for EMS certification. Environmental Laws/Acts.

7. **Cleaner Production Technologies**

Need and benefits, cleaner production techniques and options, zero impact manufacturing initiatives CDM and carbon credits/case studies.

**Laboratory Work/Field Tasks**

1. Analysis of water for various parameters using spectrophotometer and flame photometry.
2. Determination of BOD for domestic waste/industrial waste.
3. Determination of MPN of given sample.
4. Air sampling and determination of standard particulate matter and other gaseous contaminants.
5. Measurement of CO$_2$, CO, NO$_X$ levels in ambient air by gas analyzer.
7. Determination of noise levels for indoor and outdoor noise.
8. Use of Atomic Absorption spectroscopy (Demonstration only).
REFERENCE BOOKS:

5. GN Panday, GC Carney Environmental Engineering, Tata McGrawHill.
MCT- 6202           BUILDING MAINTENANCE
(Core Course)

Maximum marks :  50                                                         L    P/  T
ụ 2

Note: Examiner shall set eight questions covering the whole syllabus. The candidate will be
required to attempt any five questions.

Rationale:

The modern structures though built to better standards with present day materials and
techniques show deterioration in structure, and service they provide, due to poor
maintenance. Generally the planned maintenance of structures is forgotten. It is only when
a problem occurs, usually requiring crisis maintenance, that it is realized how important
is to have planned maintenance to avoid the risk due to failure of structure. Hence Estate
Managers, Engineers responsible for maintenance of structures require careful planning
to prevent and remove the defects in structures before a failure occurs. The course in
"Building Maintenance" is intended to create awareness among participants about the
principles of maintenance, diagnosis of defects and special repairs required for structures.
The course aims at exposing the participants to the methods of repairs and maintenance of
structures and enable them to:

(i) become aware about the principles of maintenance
(ii) diagnose the causes of various types of defects in structures.
(ii) plan and schedule the maintenance of structures as per maintenance
management techniques.
(iv) develop capabilities in field practices for repairs of structures.

Implementation :

The course shall be mainly dealt with through lecture sessions, field visits, practical work
and self study. The practical work shall include use of non-destructive method in
investigation of causes application of modern repair materials and field visits to
rehabilitation sites. The lab work shall include determination of extent of dampness,
carbonation, efflorescence and their analysis to determine the extent and cause of
damage in structures.

Evaluation Strategy :

1. Two class test of 15 marks each (regular) : 30
   (One class test for Modular)
2. Practice tasks, assignments, seminars & quizzes & Lab Work : 20
3. Final Examination : 50
4. Total Marks : 100
CONTENTs

1. Principles of Maintenance:
Importance of maintenance, deterioration and durability, factors affecting decision to carryout maintenance, maintenance and GNP, agencies causing deterioration, effect of deterioration agencies on materials. (4)

2. Design and Economic Consideration in Maintenance
Factors to reduce maintenance at design stage, consideration of maintenance aspects in preparing tender document and specifications, sources of error in design which enhances maintenance, importance of working drawings and schedules, provision of access for maintenance and its importance at design stage.

Economic consideration in maintenance: physical life, functional life, economic life of different types of buildings, discounting technique for assessment of economic life. (8)

3. Maintenance Management:
Definition, organization structure, work force for maintenance, communication needs, building inspections, maintenance budget and estimates, property inspections and reports, specification for maintenance jobs, health and safety in maintenance, quality in maintenance, maintenance manual and their importance. (4)

4. Materials for Maintenance:
Compatibility of repair materials, durability and maintenance, types of materials, their specification and application, criteria for selection of material, use of commercial available materials in maintenance. (4)

5. Investigation and Diagnosis for Repair of Structures:
Basic approach to investigations, physical inspection, material tests, non destructive testing for diagnosis, estimation of actual loads and environmental effects, study of design and construction practices used in original construction, retrospective analysis and repair steps. (4)

6. Maintenance Problems and Root Causes:
Classification of defects, need for diagnosis, type of defects in building elements and building materials defect location, symptoms and causes. (4)
7. **Remedial Measures for Building Defects:**

- Preventive maintenance and special precautions - considerations, preventive maintenance for floors, joints, wet areas, water supply and sanitary systems, termite control, common repair techniques, common methods of crack repair. (4)

- Repair of existing damp proofing systems in roofs, floors and wet areas. (2)

- Protection, repair and maintenance of RCC elements. (2)

- Repair, maintenance of foundations, basements and DPC. (2)

- Repair of finishes. (4)

- Repair of building joints. (2)

- Repair of water supply and sanitary systems, under ground and over head tanks. (2)

- Common strengthening techniques. (2)

- Maintenance of Industrial Floors (2)

8. **Maintenance of Multistorey Buildings:**

Specials features for maintenance of multi-storeyed buildings, including fire protection system, elevators booster pumps, generator sets. (2)

**Practical Work/Field Tasks**

1. Conduct of non destructive tests in diagnosis of cracks, strength, moisture level, corrosion rate, depth, cover and spacing of steel reinforcement.

2. Testing of properties of repair materials

3. Determination of extent of carbonation in concrete by phenolphthalein test

4. Determination of efflorescence in bricks in laboratory.

5. Preparation of report

- On maintenance of fire fighting equipment after visiting Fire Station
- On maintenance aspects of treatment plants.
- Special repair work sites for rehabilitation of structures.
Reference Books


3. W.H. Ransom; Building Failures : Diagnosis and Avoidance , New Age Publications (P)Ltd.


RATIONALE:

With the rapid growth in the automobile industry there has been a tremendous variation and deviation in the vehicular load and traffic volume on the road. With the increase in the axle load for carrying heavy loads depending upon the need of the industry in the urban and rural sector, it is important that the emphasis at post-graduate level be made on the design, construction and maintenance of national and state highways. The subject of pavement design, construction and maintenance will enable the students to design the flexible and rigid pavements, by different methods, airport pavements by LCN method, construction of highways which involves selection of materials & constructional procedures for different types of roads and maintenance of highways which shall include the causes of failures and their remedial measures.

IMPLEMENTATION:

The course shall be conducted mainly through lecture-cum-discussion sessions, expert lectures from guest faculty, screening of educational films and practice tasks/assignments/seminars.

EVALUATION STRATEGY:

1. Two class test of 15 marks each (regular) : 30
   (One class test for Modular)
2. Practice tasks, assignments, seminars & quizzes & Lab Work : 20
3. Final Examination : 50
4. Total Marks : 100

CONTENTS

1. Introduction:

Types of pavement structure, Functions of pavement components. Factors affecting pavement design.

(04)
2. Design of Pavements:
2.1 Methods for design of flexible pavements: CBR, Group Index Method, California Bearing Ratio method, Triaxial test method, Burmister method, McLeod's method. Design guidelines as per IRC-37 (latest)
2.2 Design considerations in Rigid Pavements, Methods for design of rigid pavements: Westergaard's method, F.A.A. method, types of joints and their design in cement concrete pavements.
2.3 Airport pavements: Thickness design, FAA method for Flexible and Rigid pavements, ESWL Concept, CBR method (USACE), LCN system of pavement design, problem solving on all these methods.

3. Construction of Highways:
3.1 Types of Highway Construction and their selection, materials for construction, Types of binders and their grades e.g. Emulsion, Bitumen, CRMB, Cut-back PMB, NRMB etc.
3.2 Construction procedure of different layers: G.S.B., WBM and W.M.M.,
3.3 Introduction to various Equipment used for highway construction. Hot mix plant, Paver, Rollers.
3.4 Bituminous pavements, Constructional features for Pre-Mix Carpet, Mix Seal Surfacing, B.M., SDBC. Other higher quality pavement layers – DBM, BC (introduction only).
3.5 Cement concrete pavements, Joints in cement concrete pavements,

4. Maintenance of Highways:
4.1 Pavement failures, their causes and remedial measures typical flexible and rigid pavement failures, types of highway maintenance: routine, periodic and special type.
4.2 Defects/ Failures in Flexible Pavement- their types and causes: Surface defects, Cracks, Deformation, disintegration,
Surface Defects: Fatty Surface, Polishing, Hungry Surface
Deformation: Rutting, shallow Depression, settlement & upheaval
Distintegration: Loss of Aggregate, Stripping, pot-hole.
Remedial Measures Slurry Seal, Liquid Seal, Fog Seal, Patching, Ready mix patch
4.3 Rigid Pavement: Various stresses, types of defects, cracking, spalling, slab rocking and settlement, joint sealant failure.
Methods of Repair Rectification: Repair of Spalled Joints, Full Depth Reconstruction, Replacement of Dowel Bar.
Evaluation of Pavement Strength: Purpose of evaluation. Various methods and brief introduction Benkelman, Falling Weight Deflectometer, Dynamic Cone Penetrometer.
Reference Books:

1. Khanna and Justo; Highway Engineering, Nemchand & Bros. Roorkee
3. Khanna and Arora.; Airport Planning and Design
5. Vaswani, Highway Engg  Roorkee Publishing House, Roorkee
RATIONALE:
In the construction of various civil engineering activities construction technology plays an important role. During the last five decades, construction industry has undergone large scale mechanization with rapid changes and advancements in construction practices. In order to bring professional in construction the subject of "Advanced Construction Technology" has been introduced at post graduate level. This subject will enable student to understand the concepts and principles of modern day construction in Earthen Dams, special foundations, High Rise Buildings, Prefabricated construction and Applications of Geo-synthetics.

Implementation:
This subject shall be conducted through lecture cum discussion session, expert lectures by working professionals, tutorial/assignments, educational films and field visits.

Evaluation Strategy:
1. Two class test of 15 marks each (regular) : 30
   (One class test for Modular)
2. Assignments, seminars & quizzes : 20
3. Final Examination : 50
4. Total Marks : 100

CONTENTS
1. Earthen Dams:
   Introduction, types, design considerations/aspects to suit available materials, causes of failures, criteria for safe design, section, d/s drainage system, seepage analysis, stability analysis, stability of d/s slope during steady seepage, stability of u/s slope during sudden draw down, stability of u/s and d/s slopes during construction, stability of foundation against shear, seepage control measures, design considerations in earthquake regions, design of earthen dam.
   Quality control in construction of embankments - monitoring of post-construction behaviour and instrumentation.
2. **Special Foundations**:

Necessity for special foundations, Foundations for chimney, cooling towers, telecommunication/transmission towers, foundations for underground structures, coastal and off shore structures in different soil conditions, gravity platforms, raker pile foundations in expansive soils. dewatering and its various methods.

3. **High Rise Construction**:

High rise buildings; architectural & structural aspects; special features of construction; tall chimneys, components, design aspects; slip form method, lift slab method; special problems of high rise construction.

4. **Prefabricated Construction**:

Advantages of pre fabricated construction; selection of structural elements; design aspects; assembly of precast elements; jointing, modular co-ordination and tolerances; structural systems for buildings; single and multi- storey building systems; methods and equipments. For handling and placement.

5. **Advanced Construction Materials**:

Geo-synthetics: Various, types; geo-textiles, geo-grids, geo-membranes, geo-composites functions and general applications, advantages, properties of geo-textiles, epoxy resins, polymers, grouts and anchors, special flooring materials, sealants and adhesives, protective coatings.

**Practice Tasks:**

1. Prepare design and drawing of an Earthern Dam and specify the construction procedure, equipment and quality control measures.
2. Enumerate major design parameters and data requirements of any one type of special foundations.
3. Visit the construction site of multi storeyed building and prepare report on techniques employed and suggest further scope of improvement.

**References:**

1. Bharat Singh and Varshney RS, Engineering for Embankment Dams - Oxford and IBH.
2) Sharma RK and Sharma TK; Dam Engineering - Oxford and IBH
3) RS Varshney, SC Gupta and RL Gupta. Theory and Design of Irrigation Structures
4) Naiman P Kurian, Modern Foundations - Introduction to Advanced Techniques
   Tata McGraw Hill
5) Kurian NP, Design of Foundation Systems, 3e, Narosa Publications
7) Sarkar & Sarwati Construction Technology Oxford University Published, 2012
MCT- 6209      PAVEMENT LAB.
(Core Course)

Maximum marks : 50

RATIONALITY :

The practical and field work is important to learn appropriate practices followed in construction of good pavements that shall be functional and durable. The subject is intended to develop following skills and practical competencies.

i) Appropriate machinery used in construction of highways and correct practices thereof.
ii) Evaluation of existing strengths of pavements.

IMPLEMENTATION :

The subject involves instruction mainly through tutorial work, laboratory work, and field work. In addition education films may be used for demonstration purpose and teaching correct practices. Attempts shall be made to conduct visits to sites of relevant nature.

EVALUATION STRATEGY :

1. Practice tasks : 15
2. Practice tasks in Field : 20
3. Quizzes/viva, Record & Presentation of Reports etc. : 15

Total Marks : 50

No theory examination shall be conducted.

CONTENTS

Practical Exercises:

i) Determination of CBR value of sub-grade soils.
ii) Determination of stripping value of road aggregate.
iii) Study of Sensor- paver and other construction machinery
iv) Study of batching and mixing plant for construction of roads (Hot mix plant/WMM planty)
vi) Evaluation of pavement strength by using Benkelman's Beam.
vii) Determination of strength of existing pavement by Dynamic Cone Penetration Test.
viii) Roughness measurement of road surface
RATIONALE

With the ever moving economy, faster transportation and communication are the need of the hour. It is very important to have a holistic approach towards the improvement and growth of various transportation modes. The highway sector has a special significance, as it is the only mode that provides door service. For sustainable development, the environmental considerations are to be borne in mind.

Implementation

Instruction will focus on relevant knowledge on Basic concepts of traffic flow characteristics and highway capacity, Design of various components e.g. intersections, and other highway facilities shall be learnt. The instructions strategies will include lecture-cum-discussion sessions, field visits and practical exercise/assignments/seminars etc.

Evaluation Strategy

1. Two class test of 15 marks each (regular) : 30
   (One class test for Modular)
2. Assignments, seminars & quizzes : 20
3. Final Examination : 50
4. Total Marks : 100

CONTENTS

1. Traffic Flow Characteristics :

   a) Nature of Traffic Flow
   b) Various Parameters e.g speed, rate of flow, density, spacing and headway, lane occupancy, clearance etc.
   c) Categories of traffic flow, uninterrupted and interrupted flow.
   d) Analysis of speed, flow and density relationship.
   e) General Model of Vehicle stream flow.

   (8)
2. **Highway Capacity :**
   a) Highway Capacity and level of Service
   b) Basic Freeway Capacity Studies
   c) Level of Service
   d) Criteria and Different Levels of Service
   e) Determination of level of Service

3. **Intersection Control and Design :**
   a) Design features & Installation of Road traffic signals as per IRC : 93
   b) Road – Rail Level Crossing IRC : 39
   c) Accommodation of underground utility services along and across roads in Urban Areas as per IRC : 98
   d) Interchanges in Urban Areas as per IRC : 92

4. **Urban Highway Utilities :**
   a) Design and layout of Cycle Tracks as per IRC : 11
   b) Recommended practice for Traffic Rotaries as per IRC : 65
   c) Provision of speed Breakers for Control of Vehicular speeds on Minor Roads as per IRC : 99

5. **Environmental Impact Assessment of Highway Projects as per IRC : 104**

**REFERENCES BOOKS**

1. **IRC Publications:**
   i. IRC : 93 - Design and Installation of Road traffic Signals
   ii. IRC : 39 - Road-Rail Level Crossing
   iii. IRC : 98 - Accommodation of underground utility services along and across roads in Urban Areas
   iv. IRC : 92 - Interchanges in Urban Areas
   v. IRC : 11 - Design and layout of Cycle Tracks
   vi. IRC : 65 - Recommended practice for Traffic Rotaries
   vii. IRC : 104 – E.I.A. of Highway Project

1. Kadiyali R, Traffic Engineering and Transportation Planning,
2. Khanna Publishers, Delhi, 2007