SYLLABI

AND

SCHEME OF TEACHING

MASTER OF ENGINEERING

IN

CIVIL ENGINEERING

(CONSTRUCTION TECHNOLOGY & MANAGEMENT)

MODULAR & REGULAR PROGRAMME

(2014 – 15)

CIVIL ENGINEERING DEPARTMENT
NATIONAL INSTITUTE OF TECHNICAL TEACHERS' TRAINING & RESEARCH
CHANDIGARH
Instructions to Paper Setter

1. The question-paper should be fairly distributed over the whole course of study and not concentrated on any one or a few portions only.

2. The question-paper is to be set strictly according to the syllabus and not according to the last years question paper, which is being sent just as a sample only.

3. Special instruction if any, in regard to the paper should be followed.

4. Paper setter will set eight questions covering the whole syllabus. The candidate will be required to attempt any five questions out of eight questions.

5. For University examination the maximum marks are 50 and duration of examination is 3 hours.
## TABLE – I

STUDY & EVALUATION SCHEME OF
M.E. IN CIVIL ENGINEERING (CONSTRUCTION TECHNOLOGY & MANAGEMENT)

**REGULAR PROGRAMME**

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>SCHEDULE FOR TEACHING</th>
<th>Credits</th>
<th>Marks</th>
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<tr>
<td>MCT 6101</td>
<td>Construction Management</td>
<td>3</td>
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<td>MCT 6102</td>
<td>Concrete Construction Technology</td>
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<tr>
<td>MCT 6103</td>
<td>Foundation Design and Construction</td>
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<tr>
<td>MCT 6105</td>
<td>Construction Costing and Financial Management</td>
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<td>Foundation Engineering Lab.</td>
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<td>MCE 6171</td>
<td>Computer Application Engg.</td>
<td>2</td>
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<td>MCT 6106</td>
<td>Advanced Structural Design and Detailing</td>
<td>3</td>
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<td>MCT 7103</td>
<td>Design of Pre-stressed Concrete Structures</td>
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<td>MTE 7103</td>
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**TOTAL**

21 250 300 550
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<td>MCT 6201</td>
<td>Environmental Engineering &amp; Management</td>
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<td>MCT 6204</td>
<td>Green Buildings and Services</td>
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TABLE-I Continued

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Note: Requirement for the award of M.E. degree in Civil Engineering (Construction Technology and Management) is 75 credits in theory/practical papers with minimum CGPA of 6.0 and successful completion of thesis work.
### TABLE – II

**STUDY & EVALUATION SCHEME OF**

**M.E. IN CIVIL ENGINEERING (CONSTRUCTION TECHNOLOGY & MANAGEMENT)**

**MODULAR PROGRAMME**

<table>
<thead>
<tr>
<th>S. No.</th>
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<th>Scheme Of Teaching</th>
<th>Credits</th>
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<td>MCT 6201: Environmental Engineering &amp; Management</td>
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</table>

**SPELL – VI**
| 12. | MCT 6208: Pavement Design Construction and Maintenance | 3 | 2 | 5 | 4 | 50 | 50 | 100 |
| 13. | MCT 6106: Advanced Structural Design and Detailing MCT 6204: Green Buildings and Services | 4 | --- | 4 | 4 | 50 | 50 | 100 |
|      | Any One | 3 | 2 | 5 | 4 | 50 | 50 | 100 |
| 14. | MCT 6209: Pavement Lab. | - | 4 | 4 | 2 | - | 50 | 50 |
| 12. | MCT -7151 Preliminary Thesis | - | 20 | 20 | 10 | --- | --- | --- |
|      | Total: | | | | | 20 | | 250 |

**SPELL – VII**

| 15. | MCT-7251 Thesis | - | 30 | 30 | 15 | --- | --- | --- |
|      | Total: | | | | | 15 | | 1300 |

*Note: Requirement for the award of M.E. degree in Civil Engineering (Construction Technology and Management) is 75 credits in theory/practical papers with minimum CGPA of 6.0 and successful completion of thesis work.*
MCE- 6171 COMPUTER PROGRAMMING AND APPLICATIONS
(Anonymous 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:
Since no field has remained untouched with the impact of `Information Technology, therefore this subject is introduced to enable the professionals to find the applications of computers in Civil Engineering. This subject will enable students to understand the fundamentals of computers, computer language like C & application of computers in various fields like CAD, System Simulation, Measurement & Control etc.

Implementation:
This subject shall be conducted through Lecture-cum-discussion session, expert lectures by working professionals, tutorials/practical assignments.

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. Introduction to Computers:
An overview of the functioning of computer, block diagram of computer system, I/O and auxiliary storage devices, machine, assembly and high level languages, assemblers, compliers, interpreters.

Representation of information: Number systems-binary, octal, hexadecimal systems, character and codes-ASCII and EBCDIC.

Need for operating system, concepts of operating system, disk storage and its characteristics.

(07)

2. Programming Language C:
Introduction: History of C, Variable, Constants & Keywords in C, Operators in C, data types in C, instruction in C.
Control structures-Decision control structures, Loop control structures, case control structures.

Functions - Scope rule of functions, parameter passing techniques.

Storage Classes in C

Introduction to C preprocessor-features of C, preprocessor, macro expansion, file inclusion, conditional compilation.

Introduction to Pointers
Arrays - Initialization, arrays in terms of pointers, passing array to a function, multidimensional arrays, array of pointers.
Strings- standard library string functions, two dimensional array of characters.
Structures - accessing structure elements, representation of structures in memory.

Enumerated data types
Fundamentals computer graphics
Points plotting, lines, curves, circles, fill in C.

3. Simulation:
Basic concepts of simulation and modelling. Types of simulations - deterministic and stochastic and continuous and discrete simulations and their application. Monte-Carlo simulations, design methodology of a simulation system. Overview of simulation languages.

4. Measurement and Control:
Overview of measurement system- transducer, signal conditioning and display/recording sub-systems. Output standards of signal conditioning systems. Basic principles of digitising the analog signals, facilities available and specifications of analog to digital converter cards in PC environment, programming for data acquisition and processing, outlines of digital control.

5. CAD:
Familiarization with the use of drafting tool.

Laboratory work:
1. Exercises on C programming.
2. Exercise on Graphics programming.
3. Design of Simulation for an Engineering System
4. Interfacing equipment for measurement of standard physical parameters.
5. Programming for data acquisition and analysis.

Assignments:
1. Assignments involving programming of problems of relevance to the respective disciplines.

2. Developing a simple data acquisition or control setup for parameters of relevance.

Reference Books:

1. P.K. Sinha; Computer Fundamentals, BPB Publications
3. Byron S. Gottfried; Programming with C - Schaum's Outline Series, Tata McGraw Hill
4. Geoffrey Gordon; System Simulation -
5. Mikell T. Groover; CAD/CAM -
MCT- 6106  ADVANCED STRUCTURAL DESIGN AND DETAILING  
(Elective Course)

Maximum marks : 50                             L   P / T 
Time Allowed : 3 hours                          3     2 

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

Rationale:

All civil engineers must be familiar with structural design and detailing for effective implementation of projects involving construction of different types of structures. The subject of structural design and detailing is included in the Construction Technology and Management course to give an insight to the student about analysis and design of complex structures in concrete and steel. While the different types of structures being constructed are many, it is hoped that this introduction to common types of structures will enable them to get a good understanding of structural design and detailing.

Implementation:

Instruction in the subject will be imparted with focus on BIS codes of practice wherever available and will be done through lecture-cum discussion sessions, tutorial classes where the students will be asked to analyze and design practical structures. The students will also be required to give seminars on different design aspects. Case studies of designs will be discussed by internal and visiting faculty.

Evaluation Strategy:

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

1. Introduction:

   Introduction to limit state method of design; provisions in the Indian Standard codes for loading, wind loads and seismic loads, design and detailing of concrete structures.

2. BIS handbook for design : Examples of design using handbook

3. Structural Analysis and Design for :

   * Columns with biaxial moments.
   * Curved beams
* Intze tank and underground water tanks [10]

* Silos and bunkers [8]

* Concrete Chimneys [6]

* Multi-storey building frame design [8]

* Use of computer software for analysis and design [6]

**Practice tasks:**

i) Analysis and design of beams using the BIS handbook for design

ii) Complete analysis and design of an underground water tank

iii) Analysis and design of a silo

iv) Analysis and design of a concrete chimney using design tables.

v) Analysis and design of a 10-storey building using a computer programme.

**Reference Books:**

1. Dayaratnam, P: Reinforced Concrete Structures.


4. Jain and Jaikrishna: Plain and Reinforced Concrete Vol II.

5. STAAD Pro- (Software)
MCT 7103  DESIGN OF PRESTRESSED CONCRETE STRUCTURES
(Elective 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
Pre-stressed structures are important in construction of Heavy Sections. To reduce dead weight of the concrete sections and also to reduce construction time, pre-stressed construction plays an important and vital role. This course will help the students to understand the concepts of pre-stressing design and construction of various pre-stressed structures using modern techniques.

Implementation
Instruction will focus on relevant knowledge on Basic concepts of Pre-stressing, Design of various members using Pre-stressing technique. 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 : 20
3. Final Examination : 50
4. Total Marks : 100

CONTENTS

1. Design of Symmetrical sections: Unsymmetrical Sections and composite sections as per elastic procedures- tension allowed and tension not allowed. Ultimate load design of sections,. Cracking load as basis of design: Design of Bridges/Long span structure of Pre-stressed concrete. (12)
2. Limiting zones. Cable profile and cable layout. Calculations of stresses due to sequence of tensioning. Calculations of deflections. (6)
3. Design for shear-elastic and ultimate. Design for bond, Transfer length in pretension members. Discussion of codal provisions and provision of web reinforcement. (6)
4. Various theories for design of End Block., Practical design of end block for a typical I section. (4)
5. Design of continuous beams, Concordant and non-concordant cables, Location of steel for a practical design problem. (6)
6. Partial pre-stress and use of ordinary mild steel and high tensile steel in the tension zone as ordinary reinforcement. (5)

7. Method of load balancing and its applications to particular problems of slabs, beams and portals. (6)

8. Design of pre-stressed members subjected to tension and compression, Circular pre-stressing. (5)

9. Discussion of various provisions in the code for pre-stressed concrete members. (4)

**Reference Books**

1. N. Krishna Raju, Pre-stressed Concrete, Tata McGraw Hill, New Delhi
2. Nebhrain A.T., Pre-stressed Concrete, Basic Principles and Design Consideration
3. Dayaratnam, Pre-stressed Concrete Structures
4. Grawick Ben C., Construction of Pre-stressed concrete structures
5. Ramamurtham S., Pre-stressed concrete.
MTE- 7103 TECHNOLOGY MANAGEMENT
(Elective 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.

1. Introduction to Technology Management
3. Technology Forecasting: Techniques of Forecasting, Technology Forecasting- Relevance, Strategic alliance and Practicality, and Technology transfer.
4. Management of Research, Development and Innovation: Technology mapping, Comparison of types of R&D Projects and development approaches- radical platform and incremental projects, innovation process.
5. Management of Intellectual Property Rights
   Strategic value of patents, trade secrets and licensing
7. Management Roles and Skills for New Technology
8. Technology for Managerial Productivity and Effectiveness, Just-in-Time
9. Venture Capital & Technology Development

Practice Tasks:
- Technology forecasting and Technology mapping
- Technology Strategy Development
- Exercise on Just-in-Time
- Cases on Venture Capital

Reference Books
1. Technology and Management, Cassell Educational Ltd., London
2. John Humbleton Elsevier ; Management of High Technology Research and Development
5. Richard M.Burton & Borge Obel Elsevier Innovation and Entrepreneurship in organizations
MCT- 6203 CONSTRUCTION EQUIPMENT
(Elective 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 five questions.

Rationale:

Construction work is being carried out in a large scale all around the world and construction equipment happens to be its integral part. Due to extensive use of different types of equipment in modern day construction, this subject has been introduced at the post-graduate level of degree programme. During the last over five decades, rapid growth has taken place in the advancement of construction equipment. The subject will give them a deep insight into the different types of construction equipment, their efficiency, uses, operations and maintenance costs and procedures.

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) (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. Introduction:

Construction economy; Factors affecting the selection of construction equipment; rolling resistance, effect of grade on required tractive effort, effect of altitude and temperature on the performance of internal combustion engines, drawbar pull, rimpull and acceleration, owning and operating cost of equipment.

(4)

2. Earth Moving Equipment:

Crawler and wheel tractors-their functions, types and specifications; grade-ability, bull dozers and their use; tractor pulled scrapers, their sizes and output; effect of grade and rolling resistance
on the output of tractor pulled scrapers; earth loaders; placing and compacting earth fills.
(8)
Power shovels - functions, selection, sizes, shovel dimensions and clearances, output, Draglines – functions types, sizes, output, Clamshells; Safe lifting capacities and working ranges of cranes; Hoes, trenching machines, types and production rates calculation of production rates of equipment; examples.

(8)

3. Hauling Equipment:

Trucks; capacities of trucks, balancing the capacities of hauling units with the size of excavator; effect of grade and rolling resistance on the cost/performance of hauling equipment.

(6)

4. Drilling, Blasting and Tunneling Equipment:

Definition of terms, bits, jackhammers, drifters, wagon drills, churn drills, piston drills, blast hole drills, shot drills, diamond drills; Tunneling equipment; selecting the drilling method and equipment; selecting drilling pattern; rates for drilling rock, air compressors.

(6)

5. Piling Equipment:

Pile hammers, selecting a pile hammer loss of energy due to impact, energy losses due to causes other than impact.
Equipment for bored and cast in-situ piles

(4)

6. Pumping Equipment:

Pumping equipment in construction, Classification of pumps; Selection of pumps – Air-operated centrifugal type sump pumps; performance of centrifugal pumps; well point system.

(8)

7. Compaction Equipment:

Roller class: sheep's foot rollers, pneumatic tyre rollers, steel wheel rollers, vibrating rollers, grid type rollers-their applications.

(4)

8. Economic Considerations in the procurement and use of construction equipment; Time value of money; ROR and IROR analysis; depreciation; costing of construction equipment operation;

Reference Books:

1. Verma, Mahesh Construction equipment and its planning and applications, Metropolitan Book Co. Ltd.


3. Jagman Singh : Heavy construction Planning, Equipment and Methods, Oxford and IBH


6. Frank Harris, Modern Construction Equipment and Methods, John Wiley and Sons.
RATIONALE

Buildings account for a large amount of land use, water and energy consumption causes air and atmospheric pollution. Considering the statistics, reducing the amount of national resources buildings consume and the amount of pollution given off is seen as crucial for future sustainability as per EPA. Green buildings bring together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of buildings on environment and human health. Hence, this subject is introduced in the curriculum of ME (Modular) Construction Technology and Management.

Implementation

The subject involves introduction through various methods of lecture-cum-discussion, tutorial work, educational video films, laboratory, 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. Introduction to Green Buildings

2. **Design Features for Green Building Construction**

Site selection strategies, landscaping, building form, orientation, building envelope and fenestration – material and construction techniques, roofs, walls, fenestration and shaded finishes, advanced passive heating and cooling techniques, Waste reduction during construction.

3. **Water and Waste Water Management**

Compliance, fixtures, rainwater harvesting and techniques, water and waste water management, solid waste management.

4. **Energy Management**

Appliances, compliance energy performance, solar water heating system, use of renewable energy options. High performance glass, other energy saving options, provisions of ECBC, insulating materials.

5. **Eco-friendly Materials**

- Various types of eco-friendly materials, use of recycled materials like: flyash bricks, recycled ceramic tiles, recycled glass tiles, porcelain tiles, natural terracotta tile, wood, steel, aluminium and renewable materials, agrifibre, linoleum, salvaged material – properties and applications.
- Recycling of aggregate, use of plastic, recycled material

6. **Indoor Air Quality**

Natural air ventilation systems, different types of low VOC materials, day lighting.

7. **Rating Systems and Certification for Green Building**

Different rating of rating like lead, systems and their special features. Criteria, compliance, appraisal for rating systems. Case study on rating of green buildings.

**Practical Tasks/Tutorials**

2. Project on rating of Green Buildings
3. Design of Green Building
4. Field visits for study of green building construction and design features.

**Reference Books**

Rationale:

In the coming five year plan there is heavy emphasis on infra-structure development including the construction of highways of which construction of bridges forms an integral part. The subject of bridge engineering aims at providing knowledge concerning the standard specifications for road bridges, general arrangement and suitability of various types of RCC, PRC and steel bridges, design of substructure, construction details of shallow foundations, pile and well foundation for bridges, details of bearings, expansion joints, footpaths and handrails and construction and maintenance of bridges. The study of the subject will enable the students to acquire relevant knowledge for construction and maintenance of bridges.

Implementation:

Instruction will focus on providing relevant data and construction and maintenance aspects of foundation, sub-structure and super-structure of bridges. The instructional strategies will include lecture-cum-discussion sessions, field visits, screening of educational film 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 : 20
3. Final Examination : 50
4. Total Marks : 100

CONTENTS

1. Introduction
   Definition; components of a bridge; classification; importance of bridges.
   (03)

2. Standard Specifications for Road Bridges:
   Indian Roads Congress Bridge Code; width of carriageway; clearances; loads to be considered; dead load; I.R.C. standard live load; impact effect; application of live load on decks; wind load; longitudinal forces; centrifugal forces; horizontal forces due to water current; Buoyancy effect; earth pressure; temperature effects; seismic force.
   (12)

3. Reinforced concrete Bridges: General arrangement and suitability; T-beam bridges; Balanced cantilever bridges; Continuous girder bridges; Rigid frame bridges; Arch
bridges; Steel bridges (Familiarization with MOST specifications and drawings) (15)

4. Sub-Structure : Design of piers and abutments (Masonry & R.C.C). (04)

5. Foundations : Types of foundations; Open; Piled and Well foundations; including construction details. 
   Pile Foundations: Suitable Pile types for bridges, Pile Installation, Carrying capacity of bored and cast-in-situ pile (No numericals) 
   Well Foundations various Components and brief description, Well Cap, Stability of a single well. (07)

6. Bearings, Joints, and Handrails : Different types of bearings, joints and handrails. (04)

7. Construction and Maintenance of Bridges. (09)
   Quality Assurance, Construction Method (brief) Steel bridges, Long span concrete bridge, 
   Traditional method, Incremental Push launching method, Cantilever method, Maintenance, 
   Maintenance of Bearings, Expansion Joints.

Reference Books

3. Rangwala; Bridge Engg
4. Rowe, R.E., Concrete Bridge Design, John Wiley & Sons, Inc. New York
5. Raina, V.K., Concrete Bridges Practice Book, Tata McGraw Hill, New Delhi
The construction of hydraulic structures ranks with the earliest and most fundamental of civil engineering activities. The proper and timely utilization of water resources is one of the basic issues connected with the development. Prosperity health and material progress are linked to the ability to use various water resources in an effective way. The subject of "Design & Construction of Hydraulic Structures" aim at providing knowledge concerning construction of various types of dams, lining of irrigation channels, construction of wells, provision of various energy dissipation works and construction river training works etc. The study of the subject will enable the students to acquire relevant knowledge for construction of various types of hydraulic structures.

**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. **Elements of Dam Engineering:**

   Embankment dam types and characteristics, concrete dam types and characteristics spillway types, site selection for dams.

2. **Coffer Dams:**

   Types of coffer dams, suitability criteria, design considerations, and construction of different types of cofferdams.

3. **Concrete Dams:**
Gravity dams, loading and forces on gravity dams, Considerations and design aspects of basic profile of gravity dam, stability criteria, galleries in dams, instrumentation in dams, temperature control, control of cracking, raising and strengthening of existing dams.

4. **Mass Concreting of Dams:**

Concrete mixes, ad-mixtures, batching, mixing, transportation and placing and compaction and curing of concrete, heights of lifts, Joints and tests on concrete.

5. **Earth Dams:**

Factors influencing design, criteria for safety, design aspects of earth dams, seepage control, methods of construction of earth dams and bonding dam to foundation, building embankment, compaction protection of u/s slope, top and d/s slope, rip rap and concrete lining of slopes.

6. **Rockfill Dams:**

Design consideration and various forces in rock fill dam, rubble backing of impervious face, impervious u/s facing, settlement and sluicing.

7. **Lining of Irrigation Channels:**

Types of lining, design considerations of concrete lining for channels, concrete lining, shotcrete lining, brick lining, tiles, asphaltic lining, stone and concrete block lining, lining of earth materials, comparative water tightness of different types of lining, use of Geo-textiles in canal works. Provision of filters for canals in areas having high sub surface water level.

8. **Well Design and Construction:**

Material selection, design of well & selection of site, drilling methods, methods of sampling, selection and lowering of well assembly, plumbness and alignment, methods of gravel packing, placing cement seal and grout, well development methods and pump selection.

9. **Introduction to Miscellaneous Structures:**

River training works, flow measuring structures, river improvement, scale models in hydraulic engineering, Model Investigations, Similitude model laws.

**Practice Tasks:**

1. Practical exercises relating to design considerations and construction of hydraulic structures
2. Field visits to dam sites to be conducted for practical training and preparation of report.

**Reference Books:**


6. Bharat Singh, Engineering for Embankment Dams Oxford & IBH.
MCT 7101 STEEL CONSTRUCTION TECHNOLOGY
(Elective 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

Steel is versatile material for structural and other construction uses. It is used in construction of bridges, buildings and other structures as major material or as reinforcing material. All Civil Engineers must be familiar with construction of steel structures.

This subject will help the students to do analysis of various steel structures, carryout erection and fabrication of different steel structures and their maintenance. The subject deals with the selection of proper material, proper sizes, proportions and shape of each member and its connection details for fabrication of structures.

Implementation

Instruction will focus on providing the knowledge of steel sections, their behavior construction and fabrication. The instructional strategies will include lecture-cum-discussion sessions, field visits and practical exercises/assignments/seminars etc.

Evaluation Strategy:

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

CONTENTS

1. Materials, classification and properties (2)
2. Structural steel sections and data (4)
3. Behaviour of steel structures:
   Steel water tanks, Chimneys and Stacks, Bridge Structures, Building Frames, Steel Space grids. (8)
4. Structural Steel Detailing:
   Symbols, layout drawings, shop detail drawings, assembly marking. (4)
5. Structural steel fabrication:
Methods, tools, equipment and practices, Punching, Reaming and drilling, cutting operations, fittings, fasteners, bolting, riveting and welding, Assembly, inspection, cleaning, sand blasting and painting: Transportation of fabricated components, Storage and handling. (12)

6. Erection of steel structures
Erection equipment, erection tools, methods of erection, section sequence field connections, detailing to facilitate erection. (6)

7. Specifications, Estimating and costing steel work. (8)

8. Fire protection of steel construction (2)

9. Maintenance and repair of steel structures (4)

**Practical Exercises:**
1. Structural detailing exercise for an industrial building
2. Practical exercises on cutting, drilling, bolting, welding, riveting
3. Study and demonstration of erection of steel components in a construction site.

**Reference Books:**

2. Bryan E.R., ‘The stressed skin design of steel buildings’
3. Malhotra M.M. ‘Design of Steel Structures’
4. Bresker Boro, ‘Design of steel Structures’
5. Dayaratnam, ‘Design of Steel Structures’.
RATIONALE

The need of the vulnerable section of society will continue to be attended to, through government and non-government organizations as part of implementation of National Agenda for Governance, "Shelter for All". The Agenda envisages provision of 20 lakh additional houses every year out of which 13 lakhs will be in Rural areas. Moreover according to recent survey, it has been brought about that as on April, 1998 out of total 14.3 lakh habitations 62,964 habitations do not have any source of drinking water and another 3,13,265 have only partially covered drinking water facilities i.e. less than 40 liters per capita per day. According to National Sample Survey, about 89.04% rural households don't have access to sanitary facilities. Out of 5,67,000 villages in the country, according to a recent survey conducted by IRC, 54 percent do not have all-weather road/fair-weather road connectivity. Irrigation potential targeted under minor irrigation, having culturable Command Area (CCA) up to 2,000 hectares individually, for the year 1997-98 was targeted to be 0.80 M.ha. In all the above area of development, the civil engineers have a direct and vital role to play. In fact in other areas of development also the civil engineers have indirect role. So the students of Master of Engineering in Construction Technology must be given appropriate knowledge and skills in this field where there is a lot of scope for self/wage employment in the years to come. Through the subject of Rural Construction Technology, the students will be given exposure related to appropriate technology in the area of housing, water supply Sanitation, Rural roads construction and minor irrigation works etc.

Implementation:

Instruction strategy will focus on providing relevant knowledge in construction of rural housing, water supply and sanitary schemes, all weather roads and minor irrigation facilities through use of appropriate technologies for rural areas. Lecture-cum-discussion sessions, field visits, practical exercise/assignments, seminars and video film shows will be part of the instruction strategy for providing knowledge and skills to the students.

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. Rural Development Planning and Concept of Appropriate Technology:

   Scope; development plans; various approaches to rural development planning; concept of appropriate technology. Rural development programme/projects.
2. **Rural Housing:**

   Low cost construction materials for housing; Architectural considerations for individual and group housing; Composite material - ferro-cement & fly ash, autoclaved calcium silicate bricks and soil-stabilized un-burnt brick; Plinth protection of mud walls; design consideration and construction of: non-erodable mud plaster, Water-proof and fire-retardant roof treatment for thatch roofs. Pre-cast stone masonry; rat-trap bond for walls; Panels for roof, ferro-cement flooring/roofing units, Thin R.C. ribbed slab for floors & roofs, pre-cast R.C. channel, Unit for flooring/roofing scheme, pre-cast R.C. flooring/roofing scheme-Pan roofing scheme; manual & power scaffold hoist, lifting device for prefab components; Earthquake resistant measures for low cost houses.

3. **Water Supply and Rural Sanitation:**

   Sources of water. BIS & WHO water standards. Quality, Storage and distribution for rural water supply works; basic design principles of treatment-low cost water treatment technologies; Hand pumps-types, installation operation, and maintenance of Mark-II hand pumps; conservation of water; rainwater harvesting; drainage in rural areas, design of low cost waste disposal systems; design and construction of low cost latrines: 2 pit pour flush water seal, VIP latrines, septic tank etc; Biogas technology; low cost community & individual Garbage disposal systems, Ferro-cement water storage tanks.

4. **Low Cost Roads and Transport:**


5. **Low Cost Irrigation:**

   Design Consideration and construction of tube-well, drip & sprinkler irrigation systems. Watershed and catchments area development - problems and features of watershed management, watershed structures.

   i) Field visits to any 3-4 of the following to be arranged and prepare the report of the visit.

   - CBRI Roorkee, UP.
   - CDC, Govt. Polytechnic, Sundernagar, HP.
   - CDC, Thapar Polytechnic, Patiala, Pb;
   - Bunga Villages and Sukhomajri villages (HR);
- Central Soil-Water Management Research and Training Institute, Sector 27, Chandigarh, UT;
- Central Road Research Institute (CRRI), Mathura Road, Delhi, UT;
- SERC, Ghaziabad, UP;
- Villages around Chandigarh.

ii) Drawing Exercises on the following to be done:

- Rural Housing;
- Water Supply Project (Safe drinking water treatment, storage and distribution scheme);
- Rural Latrines;
- X-sections of Rural Roads;
- Methods of Irrigation and Water shed Projects.
- Testing of construction materials for Housing.
- Testing of construction materials for Roads;
- Testing of construction materials for Ferro-cement
Reference Books:

2. CBRI, Roorkee, Advances in Building Materials and Construction.
4. K.Park Preventive and Social Medicine, M/s. Banarsi Das Bhnot.
5. Yash Pal Bedi, A Handbook of Preventive and Social Medicine; Atam Ram & Sons, Delhi.
6. Document on Rural Road Development in India Volume 1 & 2; Central Road Research Institute, New Delhi.

MMT 6109: OPTIMIZATION TECHNIQUES

Maximum Marks: 50

L P/T
Rationale: Manufacturing Technologist needs to optimize the various manufacturing processes for the best utilization of men, materials and machines in any manufacturing activity.

DETAILED CONTENTS

1. Numerical Techniques
   1.1 Introduction to numerical techniques
   1.2 Numerical differentiation and numerical integration
   1.3 Eigen value problem
   1.4 Newton-Raphson’s method
   1.5 Computer based numerical analysis

2. Introduction to optimization
   2.1 Introduction and Engineering applications of optimization
   2.2 Optimal Problem Formulation; Design- Variables. Constraints, Objective function, Variable bounds.

3. Single-variable Optimization
   a. Optimality Criteria
   b. Bracketing Methods – Exhaustive search and Bounding phase methods
   c. Region- Elimination Methods-Interval halving method; Fibonacci search method, golden section search method.
   d. Point-Estimation Method: Successive Quadratic estimation method

4. Multivariable Optimization
   a. Optimality Criteria
   b. Unidirectional Search
   c. Direct Search Methods: Simplex, Hooks-Jeeves pattern search and Powell’s conjugate direction method.

5. Constrained Optimization
   a. Kuhn-Tucker Conditions
   c. Sensitivity Analysis
   d. Direct Search for Constrained Minimization: Variable elimination, Complex search and Random search methods.

6. Integer Programming

7. Geometric Programming
Books:

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:

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

2. Concrete mix design procedures by:
   IS/ACI British Standards, mix design procedures using fly ash, fibers and design of high performance concrete.
3. Concreting operations –
Practices and equipment, batching; mixing; transporting; shuttering and staging; placing and compacting; curing, accelerated curing; finishing and jointing.

4. Properties and techniques of construction for concrete,

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

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.

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

8. Inspection and quality control of concrete construction –
Stages, principles, Checklist, statistical controls, procedures.

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) : 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 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.

Estimation of carrying capacity: Single driven pile in cohesionless soils - methods based on SPT and CPT, ultimate load on driven and cast-in-place piles and bored
and cast-in-place piles in cohesionless soils. Factors affecting pile capacity.- Numerical
problems

Ultimate capacity of single pile driven in cohesive soils; modification for driven and
cast-in-place piles and bored and cast-in-place piles. Capacity of very long piles –
Numerical problems.

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

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.

Grouting : purpose, functions, types of grouts ; soil bentonite - cement mix, cement mix,
emulsions, solutions: grout injection 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.

(04)

**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,
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.

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

8. 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 cleansing, 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.

4. Global Environmental Problems

Global warming, greenhouse 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)

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

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

(6)

7. **Cleaner Production Technologies**

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

(6)

**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 CO₂, CO, NOₓ 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.
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.
(iii) 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 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) (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 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


2. R.Chudley; Building finishes,fittings and domestic services, Longman Technical Services

3. G.szechy,D.SC ; Foundation Failures, Concrete Publications limited 14 Dartmouth street, London

4. Whitney Clark Huntington Probert E.Mickadeit ; Building Construction materials and types of construction Allan Hancock College


6. W.H. Ransom; Building Failures : Diagnosis and Avoidance , New Age Publications (P)Ltd.
MCT- 6208 PAVEMENT DESIGN, CONSTRUCTION AND MAINTENANCE
(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 :

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. (22)

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, (18)

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
MCT- 6206  ADVANCED CONSTRUCTION TECHNOLOGY  
(Core Course)

Maximum marks : 50 L  P/ T
Time Allowed : 3 hours 3  2

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

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. (12)

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 (12)

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. (04)

**Practice Tasks:**

1. Prepare design and drawing of an Earthen 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


MCT- 6209     PAVEMENT LAB.
(Core Course)

Maximum marks :  50                                                 L   P/ T
-            3

RATIONALE :

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
sills 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
MCT- 7104 TRANSPORTATION ENGINEERING  
(Core Course)

Maximum marks : 50                                    L    P/ T
Time Allowed : 3 hours                               3     2

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

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.

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