SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 1

Subject: Statistics and Numerical Analysis in Construction

Subject Code	18CIM11	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Develop analytical capability and to impart knowledge in Statistical methods
- Utilize knowledge of statistical methods & its applications in real world construction problems

Modules

Module 1

Various Statistical Measures: basic probability, sample space, events, axioms of probability conditional probability, independent events.
Random variables, continuous/Discrete random variables, exception, valance, Convenience, conditional distributions, moment generating functions.

Module 2

Multiple regressions: Distributions, Bernoulli, Binomial, Poisson, Uniform, Normal, Exponential, Chi-square T and F.

Module 3

Sample statistics, empirical distributions, and goodness of fit, sampling from normal populations.
Parameter estimation: moment method, maximum likelihood, interval estimated. Hypothesis Testing, Significance Intervals.

Module 4

Basics: Summary of basic concepts from Linear algebra and numerical analysis, Matrices, Operation counts, Matrix Norms, Type of Errors in Numerical computation.

Module 5

Matrix Factorization and Linear System: Cholesky Factorization, QR factorization by House holder matrices Lu-factorization and Gaussian elimination, partial pivoting, error Analysis (statement of result) soling triangular system by substitution, solving full systems by factorization. Lu-factorization for banded and sparse matrices, storage schemes, Iterative Methods, Jacobi, Gauss – Seidal and SOR Iterations, Conjugate gradient method, preconditioning.

Course outcomes:

After studying this course, students will be able to:

- Use statistical tools to express the data for better interpretation.
- Apply probability concept to understand the behavior helping the planners to enable better planning.
- Use appropriate statistical testing tools to check the degree of accuracy in the data analysis.
- Test the hypothesis and assess the error involved in the data analysis.
- Use software tools, for analysis of data and also use curve fitting techniques for predicting the performance trends.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Miller, Freund Hall, 'Probability and Statistics for Engineers', Prentice India Ltd.
2. Pipes and Harvill, "Applied Mathematics for Engineers and Physicists", McGraw Hill International Edition.

Reference Books:

1. Sampling techniques Cochran, Wiley Series.
2. Numerical methods, E. Balaguruswami, McGraw Hill publication.
3. Numerical Methods: Problems & Solutions, Jain M K, Iyengar S R K, Jain R K, Wiley Eastern Ltd.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
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SEMESTER – 1

Subject: Advances in Concrete Technology

Subject Code	18CIM12	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- To study the properties of constituent elements of concrete.
- To study the properties of fresh and hardened concrete.
- To study properties of special types of concrete.

Modules

Module 1: Brief review on concrete and reinforcement

Brief Review of Conventional Concrete and Constituent Materials: Brief Introduction of Concrete including composite cement and properties.

Types of Reinforcements: Corrosion of Reinforcing Steel - Electro-chemical process, measures of protection. Polymers, fibres, adhesives and sealants - types and their uses.

Module 2: Fresh properties of concrete (Rheology of fresh concrete)

Rheology of Concrete: Introduction, Factor affecting the rheology of concrete, Constitute equation for measuring the rheological parameters and rheometer.

Module 3 : Hardened properties of concrete (by SEM/XRD)

Microstructure of the Aggregate Phase: General, Microstructure of the Hydrated Cement Paste: General, Interfacial Transition Zone (ITZ) in Concrete: Microstructure, Strength Influence of the interfacial transition zone on properties of concrete.

Quantitative Estimation of product of Hydration by Mercury Intrusion Porosimetry, X-Ray Diffraction Analysis (XRD Analysis) and Scanning Electron Microscopy(SEM).

Module 4: Special Concretes

High performance and High strength concrete: Definition, Fresh & Hardened Properties, Applications.

Bacterial Concrete: Definition, Fresh & Hardened Properties, Applications.

Ferro-cement: Definition, Fresh & Hardened Properties, Applications.

Module 5: Special Topics

Curing: Methods - Steam curing, water curing. Vacuum dewatering of concrete. Shotcrete: Definition, Wet mix and dry mix process, general use and advantages. Under water concreting: Introduction, Basic requirements, Strength, Workability. Introduction to formwork: Types, General, Formwork for Beams, Slabs (normal and flat slabs), Columns, Foundations (shallow), Shear Walls.

Course Outcomes:

After studying this course, students will be able to:

- Understand the constituents and properties of cement
- Understand the concept of Rheology of fresh concrete and its applications
- Understand the microstructure of aggregate phase and its importance in concrete
- Understand the properties of HPC/HSC and various curing methods and its importance on strength gain in concrete

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Neville A.M. “Properties of Concrete”- 5th Ed., Pearson Education Ltd., 2011.
2. Mehta P. Kumar & Monteiro, Paulo J.M., "Concrete Microstructure, Properties and Materials", M/S Indian Concrete Institute, Chennai.

Reference Books:

1. M. L. Gambhir , "Concrete Technology: Theory and Practice", Tata McGraw-Hill Education, 2004
2. Dr. Aminul Islam Laskar, "Concrete Technology", University Science Press.
3. John Newman and Ban Seng Choo, "Advanced Concrete Technology – Process", ISBN 0 7506 51059, Elsevier Ltd.
4. Dr. Edward G. Nawy, "Concrete Construction Engineering Handbook", CPC Press, 2nd Edition, ISBN- 9780849374920.
5. Raina V.K., "Concrete for Construction", Tata-McGraw Hill Publishing Co. Ltd. New Delhi.
6. IS: 10262:2009 - Guidelines for Concrete Mix Design proportioning, BIS.
7. Current Literatures.

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SEMESTER – 1

Subject: Contract Management

Subject Code	18CIM13	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:
This course will enable students to
• Understand the various types of contracts
• Understand the use and effect of contracts in construction industry

Modules

Module 1:
Introduction to contracts: Definitions, Essentials for a legally valid contract, Salient features of contract, Discharging of a contract, Documents for an Engineering Contract; Types of contracts: Classification Based on Tendering Process, Economic Consideration, Applicability of the various types of contracts in Construction.

Module 2:
Tendering process: Definitions, List of Documents, EMD, Security Deposit, Invitation for Tenders and sale of Documents, Preparation of Tender Documents and its submission, Receipt of Tender Documents and its opening, Evaluation of Tender and Award of contract–Letter of Award, Letter of Intent, Issues in tendering process: Pre - Registration, Pre-Qualification, Nominated Tendering, Rejection of Tenders, Repeat Orders, Revocation of Tenders, Unbalanced Bidding.

Module 3:
Administration/Performance of contract: Responsibilities (Duties and Liabilities) of Principal & Contractor, Monitoring and Quality control/assurance, Settlement of claims – Advances, Bills, Extension for time, Extras & Variations, Cost Escalations. Security Deposit, Retention Money, Performance Bond, Liquidated Damages, Penalties, Statutory Requirements.

Module 4:
Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages.

Module 5:
Dispute resolution: General, Methods for dispute resolution–Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation /Adjudication by courts. Conciliation – Appointment of Conciliator, Role of Conciliator, Special Features of Conciliation Dispute Resolution Boards (DRB), Constitution of DRB, Functioning of DRB, Procedure for Hearings, Status of Award.

Course outcomes:
After studying this course, students will be able to:
- The Students will be able to understand the need of contract management
- Steps involved in preparing contracts and types of contracts
- Importance of arbitration

Graduate Attributes (as per NBA)
- *Scholarship of Knowledge.*
- *Problem Analysis.*

- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Albett Robert W., (1961/Latest Edition) "Engineering Contracts and Specifications", John Willey and Sons, New York.
2. Patil B. S. (2009) "Civil Engineering Contracts and Estimates", University Press.

Reference Books:

1. John G. Betty (1993/ Latest Edition) "Engineering Contracts", McGraw Hills.
2. Vasavada B. J., (1997), "Engineering Contracts and Arbitration", (Self Publication by Jyoti B. Vasavada).
3. Vaid K.N., (1998) "Global perspective on International Construction Contracting Technology and Project Management", NICMAR, Mumbai
4. Prakash V. A., (1997) "Contracts Management in Civil Engineering Projects", NICMAR, Mumbai.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
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SEMESTER – 1

Subject: Highway Construction and Maintenance

Subject Code	18CIM14/18CHT14	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Understand the various equipment used for road construction and difficulties associated with highway drainage.
- Select suitable equipment for preparation of subgrade in cutting or filling and also the preparation steps for base and sub base layers.
- Characteristics of different types of bituminous layers and design of bituminous surfacing along with safety aspects needed for roads.
- Design the base course thickness and selection of materials as base layer for CC pavements.
- Analyse the defects in road construction and general pavement failures with remedies.

Modules

Module 1:

Components of road and pavement structure including subgrade, drainage system, functions, requirements and sequence of construction operations

Plants and equipment for production of materials - crushers, mixers, bituminous mixing plants, cement concrete mixers – various types, advantages and choice.

Drainage – Assessment of drainage requirements for the road and design of various components, drainage materials, Construction of surface and subsurface drainage system and design of filter materials for roads. Drainage of urban roads, problems

Module 2:

Pre-construction surveys and marking on ground - Specifications and steps for the construction of road formation in embankment and cut, construction steps for subgrade (preparation of subgrade) in cutting, filling and at grade. Construction steps for granular sub-base, quality control tests.

Module 3:

Different types of granular base course – WMM, CRM, WBM, specifications, construction method and quality control tests.

Different types of bituminous layers for binder and surface courses, their specifications (as per IRC and MORTH), construction method and quality control tests. Special structural courses like stone matrix asphalt and mastic asphalt and construction of porous asphalt.

Module 4:

Different types of sub-base and base course for cement concrete (CC) pavement and construction method. Construction of cement concrete (PQC) pavements and joints, quality control during construction. Construction of special Cement concrete pavements like interlocking concrete block pavements (ICBP), Continuously reinforced cement concrete pavements (CRCP), Fibre reinforced cement concrete pavements (FRCP), white topping, Ultra thin white topping etc.

General Aspects: Quality assurance, statistical approach, quality system for road

construction. Safety aspects during road construction and maintenance works. Installation of various traffic safety devices and information system Principle of construction planning, application of CPM and PERT(Problems not included)

Module 5:

Road maintenance works – day to day and periodic maintenance works of various components of road works and road furniture. Preventive maintenance of road drainage system, pavements and other components of road. Preparation of existing pavement – patching, profile correction, Special measures to deal with reflection cracks in pavement layers, slipperiness of surface, etc. Requirements for rehabilitation, recycling and re-construction.

Course outcomes:

After studying this course, students will be able to:

- Gain the knowledge on the equipment used for road construction and difficulties associated with highway drainage.
- Select suitable equipment for preparation of subgrade and preparation stages for base and sub base layers.
- Design bituminous surfacing and other layers along with safety aspects needed during construction.
- Design the base course thickness and select materials for base layer in CC pavements.
- Analyse the defects in road construction and general pavement failures and propose suitable remedies.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Peurifoy, R.L., and Clifford, JS “Construction Planning Equipment and Method”- McGraw Hill Book Co. Inc.
2. Sharma S.C., “Construction Equipment and its Management”- Khanna Publishers.

Reference Books:

1. Freddy L Roberts, Prithvi S Kandhal et. al., “Hot Mix Asphalt Materials, mixture design and construction”- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA
2. National Asphalt Pavement Association “Hot Mix Asphalt Paving Hand book”- 5100 Forbes Boulevard, Lanhm, Mary Land, USA
3. “Hand Book on Cement Concrete Roads”- Cement Manufacturers Association, New Delhi
4. MoRTH “Specifications for Roads and Bridge Works”- 2001,fourth revision, Indian Roads Congress
5. MoRTH “Manual for Construction and Supervision of Bituminous Works”- 2001, Indian Roads Congress
6. MoRTH “Manual for Maintenance of Roads”- 1989, Indian Roads Congress
5. IRC: 42-1994, IRC:15-2002, IRC SP :11-1988, , 55-2001, 57-2001,58-2001, IRC 19-1977, 27-1967, 29-1988, 34- 1970, 36-1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94-1986, 95-1987, 98-1997, 105-1988.

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SEMESTER – 1

Subject: Advances in Pre-Stressed Concrete

Subject Code	18CIM15	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:
This course will enable students to
• Understand basic concepts of pre-stressing systems and methods;
• Understand the different types of losses in pre-stressing and its assessment
• Understand analysis and design of pre-stressed concrete elements (members)

Modules

Module 1: Introduction – Theory, Behaviour and Materials
Introduction: Basic concept of pre-stressing (including advantages and disadvantages), Basic Definitions; Pre-stressing methods - Thermo elastic, chemical , Electrical; Material Properties - Concrete and Pre-stressing steel; Pre-stressing Systems - Pre-tensioning and Post-tension systems.

Module 2: Losses in Pre-stress
Purpose of calculating losses – Elastic loss, creep, shrinkage, relaxation and anchorage losses; Friction loss in pre-stress, Force variation diagram in friction loss.

Module 3: Analysis and Design For Flexure
Analysis of stresses by stress method, force method and load balancing method; Pre-Basic assumptions for calculating flexural stresses, permissible stresses in steel and concrete as per IS 1343 Code; Design of sections of Type II and Type III Post-tensioned (PT) Beams/slabs;Check for strength limit based on IS 1343; Layout of cables in PT -beams/slabs.

Module 4: Deflection and Design of Anchorage Zone
Factors influencing deflections – Short term deflections of un-cracked members; Prediction of long term deflections due to creep and shrinkage; Check for serviceability limit state of deflection, estimation of crack width.
Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and IS 1343 method; design of anchorage zone reinforcement, Check for transfer bond length in pre-tensioned beams.

Module 5: Special Topics
Continuous beams - concepts; Composite Construction of Pre-stressed and in situ Concrete; Pre-stressed Concrete Poles Piles Sleepers –concepts; Construction of Pre-stressed Concrete Structures.

Course outcomes:
After studying this course, students will be able to:
- Identify various pre-stressed structural elements
- Apply analytical skills to evaluate performance of pre-stressed structural elements
- Analyze pre-stressed structural elements with various considerations
- Design and detail pre-stressed structural elements for various loading conditions

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. T. Y. Lin, "Design of Pre-stressed Concrete Structures", John Wiley & Sons, 3E, 2010.
2. N Krishna Raju, "Pre-stressed Concrete", Tata McGraw Hill Publishing Co. Ltd, New Dehi, 6E, 2018.

Reference Books:

3. Raja Gopalan N, "Pre-stressed Concrete", Narosa Publishing House, New Delhi, 2E, 2010.
4. Pandit and Gupta, “Pre-stressed concrete”, CBS, 2009.
5. Sinha N.C. & Roy, “Fundamentals of Pre-stressed Concrete”, S. C & Co, 1985.
6. Precast/Pre-stressed Concrete Institute Manual, "Fundamentals of pre-stressed concrete design", ISBN-0-937040-02-9.
7. IS: 1343-1987, IS: 1343-2012

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SEMESTER – 1

Subject: Concrete Technology Laboratory - 1

Subject Code	18CIML16	CIE Marks	40
Course	PCC	Credits	02
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	38	Exam Hour	03

Course objectives:
This course will enable students to
• Make students to learn principles of laboratory experiments.
• Understand the importance of laboratory testing of materials.

Modules

- To determine the physical properties of Cement as per BIS Codes.
- To determine flakiness and elongation index of coarse aggregates.
- To determine silt in fine aggregate.
- Determination of specific gravity, moisture and water absorption of aggregates.
- Determination of bulk density and voids of aggregates.
- Determination of particle size distribution of fine, coarse aggregate by sieve analysis (grading of aggregate).
- To determine necessary adjustment for bulking of fine aggregate.
- Basic physical properties of tests - cement and filler materials.
- To determine workability by slump test.
- Compaction factor test for workability.
- Flow table test
- Tests for compressive strength of concrete cubes/cylinder; Split Tensile strength of concrete cylinder; Flexural Strength of concrete beam.

Course outcomes:
After studying this course, students will be able to:
- Determine the physical properties of cement, fine aggregate and coarse aggregates in laboratory through experiments
- Determine the fresh properties of concrete like Slump value, compaction factor etc.,
- Determine the hardened properties of concrete like Compression, Split tensile strength and Flexural Strength of concrete

Graduate Attributes (as per NBA)
- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Reference Books:
1. Properties of Concrete by A. M. Neville, ELBS publications.
2. Concrete Technology by A. K. Santhakumar, Oxford Press.
3. Concrete Technology by M. S. Shetty, S. Chand& Co.
4. Relevant IS Codes / standards
5. Concrete Testing Manual

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SEMESTER – 2

Subject: Special Concrete

Subject Code	18CIM21	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Marks per module)	Exam Hour	03

Course objectives:
This course will enable students to
- To study the properties of constituent elements of concrete.
- To study properties of special types of concrete.

Modules

Module 1
Brief Review of Conventional Concrete and Constituent Materials: Different types of blended cement & their salient properties, including cement binding materials (fly ash, condensed silica fumes, GGBS and other fine fillers), concrete aggregates-classification, Salient features of concrete mix design as per Indian standard (IS:10262:2009).

Module 2
Light Weight and High Density Concrete: Definition, Proportioning, Properties and Applications.
Pumped concrete: Introduction, Types of concrete pump, Requirements of a concrete for pumping, Effects of aggregates, cement and admixtures on the pumpability of concrete, Workability of Pumpable of Concrete - Rheology of Concrete- Introduction, measuring the rheological parameters and techniques.

Module 3
Self-compacting concrete: Introduction, Materials, Mix design of SCC, Fresh and Hardened Properties of SCC.
Geo-polymer Concrete: Brief history of development, Definition, Reaction chemistry, material characterization, mix proportioning, properties and applications

Module 4
Fiber-reinforced Concrete: Brief Introduction on FRC, Mix design of FRC, Behaviour of hardened FRC under compression, tension flexure and impact, SIFCON, Ductal Concrete.
Concrete Fracture Mechanics - Brief introduction, Fracture Mechanics in Concrete - Concept.

Module 5
Recycled concrete: Introduction, properties of recycled aggregate, Methods of recycling and quality, Applications.
Waste Materials in Concrete: Introduction, waste material, waste glass, waste plastic and waste rubber. Brief introduction on low strength mortars and its applications.

Course outcomes:
After studying this course, students will be able to:
- Identify ingredient of concrete material characteristics and different types of concrete for their appropriate use in construction.
- Design special concrete mixes like Self-compacted concrete and Geo-polymer concrete mixes and asses the fresh and hardened properties using various

guidelines.

- Determine the compressive strength of concrete structures by Non Destructive Methods.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. A. M. Neville, Properties of Concrete, Pearson Education (Singapore) Pvt. Ltd.
2. P. Kumar Mehta and Paulo J. M. Monteiro, Concrete Microstructure, Properties, and Materials.

References:

1. John Newman and Ban Seng Choo, Advanced Concrete Technology, ISBN 0 7506 5105 9, Elsevier Ltd.
2. Concrete Construction Engineering Handbook by Dr. Edward G. Nawy, CPC Press, 2nd Edition, ISBN 9780849374920.
3. Joseph A. Daczko, Self-Compacted Concrete by-Applying what we know, CPC Press, ISBN-13: 978-0-203-84422-9

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SEMESTER – 2

Subject: Construction Project Management

Subject Code	18CIM22	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Marks per module)	Exam Hour	03

Course objectives:
This course will enable students to
- Understand the various management techniques for successful completion of Construction projects.
- Understand the effect of management for project organization

Modules

Module 1
Scope, Meaning and Definition of Construction Project, Project Categories, Characteristics of Project, Project Life Cycle and Phases, Project Management Functions, Roles of Project Manager

Module 2
Planning for Construction Projects, Principles of Planning, Objectives, Resource Planning, Scheduling, Productivity chart, Project tracking

Module 3
Project Management through Networks, AOA and Precedence Networks, CPM, Pert, Critical Path, Slack, Floats, Probability of completion, Resource smoothening and resource levelling

Module 4
Earned Value Management- meaning and definition, Earned value, cost performance index, schedule performance index, cost variances, schedule variance, Final Cost, Final Project Duration

Module 5
Crashing of networks, direct cost, Indirect Cost , Normal cost, crash cost, cost-time optimization, Use of application software for Project Management

Course outcomes:
After studying this course, students will be able to:
- Importance of project management, its uses and benefits
- Management tools, its uses and control measure for a construction project
- Resources management, schedule, cost importance and control

Graduate Attributes (as per NBA)
- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Punmia B.C. and Khandelwal K. K., (1989), "Project Planning and Control with PERT and CPM", Laxmi Publication II Edition
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition.

References:

1. George 1. Ritz, (1994), "Total Construction Project Management", McGraw - Hill Inc.
2. Sengupta B., Guha M, (1998), "Construction Management and Planning", McGraw Hill Companies.
3. P S Gahlot, B M Dhir, “Construction Planning and Management”

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SEMESTER – 2

Subject: Pre-fabricated structures

Subject Code	18CIM23	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Understand types and design principles of RC Prefabricated structures and its design principles
- Understand method of analysis and design of structural elements

Modules

Module 1

Basic Definitions - Types of prefabrication - prefabrication systems and structural schemes-Prefabricated Elements – columns, beams, floor, roof, footing and wall panels.

Module 2

Functional Design Principles: Modular coordination – Standardization - Disuniting, Diversity of prefabricates – Material properties-Production – Transportation – Erection - Codal provisions- Safety factors - Deflection control - Lateral load resistance - Location and types of shear walls.

Module 3

Precast concrete Floors: Types of floor slabs – flooring arrangements, Serviceability limit state of flexure- Ultimate strength calculations in shear and flexure.

Module 4

Precast concrete Beams: Introduction-Non composite and composite R C beams-Detailing of RC precast concrete beams.

Walls: Types of wall panels -load bearing wall- stability of wall panels.

Different Types of joints-their behavior and design – Leak prevention, Joint sealants.

Module 5

Designing and detailing of precast unit for factory structures –Purlins, Principal rafters, roof trusses, gable frames – Single span single storeyed frames –Single storeyed buildings – slabs, beams and columns.

Course outcomes:

After studying this course, students will be able to:

- Distinguish pre-engineered buildings from conventional units.
- Understand general principles of pre-fabrication.
- Plan simple buildings using various types of prefabricated elements.
- Design simple prefabricated elements.
- Outline the various phases involved in precast/pre-fabricated technology.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Hass, A.M. “Precast concrete design and Applications”, Applied Science

Publishers, 1983.
2. “Handbook on Precast concrete for buildings”, ICI Bulletin 02, Indian Concrete Institute, 2016.

References

1. “National Building Code of India”, BIS, New Delhi, 2016.
2. Kim S Elliott, "Precast concrete structures", Butterworth Heinemann Publications, ISBN-0750650842, 2002.
3. Hubert Bachmann and Alfred Steinle, “Precast Concrete Structures”, Berlin: Ernst & Sohn, 2011. ISBN 9783433029602

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SEMESTER – 2

Subject: Construction Equipment and Safety Management

Subject Code	18CIM241	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Understand the importance of safety in construction industry.
- Understand different types of equipment used in construction and its economic consideration.

Modules

Module 1

Plants and Equipment for production of materials: Crushers, mixers, bituminous mixing plants, concrete mixing plants, advantages, choice,

Module 2

Construction Equipment: Operations, applications and performance of dozers, excavators, graders, compactors, pavers, haulers, crawler, wheel tractors, power shovels, Cranes, hauling equipment's.

Module 3

Selection of Construction Equipment: Task considerations, cost considerations, engineering considerations, equipment acquisition options, Maintenance of Equipment: Repairs, log maintenance, safety during operation, economical life of equipment

Module 4

Safety in Use of Construction equipment's: Human Factors in Construction Safety management Motivation: Management, Supervisors, Workers, Motivational schemes

Module 5:

Safety Management: Role of first line supervisors, Role of middle managers, Role of workers, top management practices, safety audit, Safety in site preparation, Design, safety culture, Top Management, Company Activities and Safety - Safety Personnel, Sub-contractual Obligation - Project Coordination and Safety Procedures

Course outcomes:

After studying this course, students will be able to:

- Identify and understand use of equipment and its benefits.
- Understand necessity of safety management.
- Identify importance of safety with respect to Client, contractor and sub-contractors.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Peurifoy, R.L., Ledbette. W.B., Construction Planning, Equipment and Methods, McGraw Hill Co.,
2. Antil J.M., Civil Engineering Construction, McGraw Hill Book Co.

References:

1. SC Sharma 'Construction equipment'
2. Hand Book on Construction Safety Practices, SP 70, BIS 2001.
3. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997
4. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health

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SEMESTER – 2

Subject: Bridge and Grade Separated Structures

Subject Code	18CIM242	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:
This course will enable students to
1. Understand the constructions sequence of bridges
2. Understand the construction methods

Modules

Module 1
Introduction to Bridges: Basic Elements of a Bridge.
Types of bridges and grade separated structures for highways, standard specifications for road bridges and grade separated structures to fulfill traffic and Structural and Hydraulic design requirements.

Module 2
Caissons or well foundations: Caisson construction and sinking methods,- bed preparation, supporting structures, excavation method, de-watering for freeing a 'hanging' caisson, pneumatic sinking of caissons, methods of staining and bottom plugging

Module 3
Superstructure: Economics of reinforced concrete superstructure, pre-stressed concrete superstructure - composite and steel superstructure, special superstructures. Slab, T-beam and Box girder deck slab construction: Slab type, T-beam and box-girder bridges Decks Construction methods. Span lengths -deck and stiffening system.

Module 4
Segmental Construction, Cantilever Construction and Successive Launching: Introduction to Precast segmental construction for long-span bridges- cables and their profiling – deck section - soffit surface -deflection and pre-camber - expansion joint - bearings - aesthetics. Cable-stayed bridge construction - Construction methods - cable configuration - towers – multi span cable stayed bridges - stay tendons - aerodynamic stability.

Module 5
Composite Construction: Steel - concrete composite construction - theory of composite structures -Introduction to steel - concrete - steel sandwich construction.
RE Panel Structures - Geosynthetics, functions and applications, reinforced retaining walls, construction methods, benefits

Course outcomes:

After studying this course, students will be able to:

- To study the various types of bridge and typical loadings on the road bridges.
- They can get the basic idea of various type of construction technology adopted in Bridges.
- They can able to design the retaining wall panels.
- At the end of the course the student will understand the basic constructional methods for super structure and substructure of bridges

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Chew Yit Lin, Michael, "Construction Technology for Tall Buildings", Singapore University Press, World Scientific, Hong Kong,
2. Victor. D. J, "Essentials of Bridge Engineering", Oxford IBH

References:

1. Ponnuswamy. S, "Bridge Engineering", Tata McGraw Hill
2. Raina V. K. "Concrete Bridge practice", Tata McGraw Hill Publishing Co.
3. Derrick Beckett, "An Introduction to Structural Design of Concrete Bridges", Surry University Press, Oxford Shire.
4. Fleming. W.G.K., et al., "Piling Engineering", Surrey University Press, London.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Ground Improvement Techniques

Subject Code	18CIM243/18CHT243	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:
This course will enable students to:

- Introduce the various types of improvement methods of engineering properties soils
- Introduce the application of engineering methods to ground improvement projects
- Basic knowledge on various ground improvement techniques and their suitability for various types of soil conditions
- The skills of implementation of geotechnical knowledge in field situations

Modules

Module 1
Introduction - Need and objectives of ground improvement, classification of ground modification techniques, trends in ground improvement, Engineering properties of soft, weak and compressible deposits; Principles of treatment; **Methods of compaction:** Blasting, dynamic consolidation, pre-compression and compaction piles.

Module 2
Methods of dewatering: Open sumps and ditches, well point system, electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains.
Stabilization: With admixtures like cement, lime, calcium chloride, fly ash and bitumen. Methods of soil improvement-lime stabilization and injection; thermal, electrical and chemical methods.

Module 3
Soil reinforcement: Reinforcing materials, concept of confinement, Gabbion walls; Dynamic consolidation, Vibroflotation, Pre-consolidation with vertical drains, Granular piles, Soil nailing, Anchors & Thermal methods.

Module 4
Improvement of Foundation Soils
(a) Improvement of granular soils: Terms 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.
(b) Improvement of cohesive soils: Preloading, or dewatering, methods of installing: sand drains, drain wicks, electrical and thermal methods.

Module 5
Grouting: Materials of grouting, grouting techniques and control; purpose, functions, types of grouts; soil bentonite - cement mix; Emulsions & solutions; grout injection methods; Geo-synthetics: types, functions & Classification of geo-textiles. Specific Applications: Bearing capacity improvement, reinforcement, Retaining walls, embankment etc.

Course outcomes:

After studying this course, students will be able to:

- Analyse the need for ground improvement in weak and soft soils with likely modifications to improve their performance.
- Decide on suitable dewatering method in soils to improve their performance as highway material.
- Apply appropriate soil strengthening by stabilization techniques.
- Evaluate the strengthening techniques by reinforcing bars or anchoring methods depending on the type of soil.
- Use ground improvement techniques such as geo-synthetics or grouting for cohesive soils.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Manfred R. Hansmann, "Engineering principles of ground modification", McGraw Hill pub. Co., New York.
2. Robert M. Koerner, "Construction and Geotechnical methods in Foundation Engineering", McGraw- Hill Pub. Co., New York.

References

1. Winterkornand Fang, "Foundation Engineering Hand Book" - Van Nostrand Rein hold Co., New York.
2. Aris C. Stamatopoulos & PanaghiotisC.Kotzios,"Soil Improvement by Preloading", John Wiley & Sons Inc. Canada.
3. P. Purushothama Rao, "Ground Improvement Techniques", Laxmi Publications.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Soil Mechanics for Engineers

Subject Code	18CIM244/18CHT244	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:
This course will enable students to

- Understand the properties and behavior as a highway material under the application of wheel loads.
- Understand and compare the shear strength of soil and stability of slopes when used as subgrade soil and embankment fills or cut slopes
- Understand the permeability characteristics of soils to design proper drainage system and various investigations required to assess the soil properties.
- Understand the type and soil composition affecting the surface runoff and sub-surface water flow in order to design proper drainage system.
- Analyse lack of strength or instability problems in soils due to soil formation or any other reasons and propose suitable strengthening methods for the same.

Modules

Module 1
Introduction: Soil Mechanics applications to Highway / Infrastructure Engineering. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems on these.
Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure & Engg behavior of compacted cohesive soil, Field compaction specifications, Field compaction control, Different types of Equipments used for compaction, their choice.

Module 2
Shear strength of soil: Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus.
Stability of slopes: Introduction, Types, Different methods of analysis of slopes for Øu+0 & C-Ø soil, Location of most critical circle, Earth dam slopes stability, Taylor's stability number. Effect of Earthquake Force, problems on above.

Module 3
Permeability of soil: Darcy's Law, Validity, Soil-water system, Types, Determination of permeability, problems.
Site Investigation: Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

Module 4
Highway Drainage: Introduction, Importance, Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system, Road construction in water logged areas, Landslides – definition, classifies, factors producing.

Module 5
Reinforced Earth structures Introduction, Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses.

Course outcomes:

After studying this course, students will be able to:

- Analyse the wheel load effects on pavement materials
- Evaluate and compare the shear strength of soil and stability of slopes when used as pavement component.
- Design proper drainage system by knowing the permeability characteristics of soils.
- Design surface runoff and sub-surface drainage system as per field conditions
- Propose suitable strengthening methods for soil from the knowledge of lack of strength or instability in soils.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age International Publishers.
2. "Soil Mechanics & Foundation Engineering", B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 16th edition.
3. "Highway Engineering", S.K. Khanna, C.E.G. Justo, 5th edition.

Reference Books:

1. "Soil Mechanics & Foundation Engineering" – K.R. Arora Standard Publishers Distributors.
2. "Soil Mechanics for road Engineers" – HMSO, London.
3. IRC – Relevant Codes.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Planning and Design of Rural Roads

Subject Code	18CIM251 /18CHT251	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to:

- To understand the factors affecting pavement design and performance of Rural Roads.
- To relate the concepts of Highway Geometric design to that of Rural roads
- To design the Special pavements which form alternatives for Rural Roads.
- To understand the concepts of design of drainage, CD works and small bridges which form essential structures of Rural roads

Modules

Module 1

Planning of rural road, planning data base, concept of network planning
Rural roads plan, guidelines laid down in recent 20 year plans and in PMGSY
Road alignment and surveys, governing factors for route selection
Factors controlling alignment; obligatory points, traffic, geometric designs, economy, special considerations in hilly areas.

Module 2

Geometric design standards: classification of rural roads, terrain classification, design speed, basic principles of geometric design cross sectional elements, camber, sight distances.
Horizontal alignment: general guidelines, super elevation, transition curve, widening and set back distances, vertical alignment: gradient, grade compensation at curves, valley curves, alignment compatibility, lateral and vertical clearances.

Module 3

Soil and material surveys, soil investigations for low embankment, high embankment, cut sections, subgrade,
Survey for marginal materials and aggregates/ low grade materials
Artificial aggregates, waste materials, new materials and stabilizers
Design parameters, pavement components
Design of flexible pavement: pavement thickness, pavement surfacing
Design of semi rigid pavement: dry lean concrete / lime flyash concrete bases
Design of rigid pavement: cement concrete pavement
Design of special pavements: concrete block pavement , interlocking concrete block pavement
Choice of pavement type and materials

Module 4

Types of road drainage, requirements of surface drain; road side drains, shoulder drains, catch water drains.
Requirements subsurface drain.
Cross drains; types, requirements, choice of different types of cross drains.
Standard designs of culverts.
Standard design of small bridges.

Module 5

Selection of materials and methodology, construction techniques, machinery and tools. Construction of Embankment / subgrade; materials, requirements and construction operations. Choice and requirements of coarse sand subbase, gravel

roads

Course outcomes:

After studying this course, students will be able to:

- Get the knowledge of factors affecting pavement design and performance of rural roads
- The student will be able to differentiate the design and construction of Low volume rural roads with that of the Highways.
- The students will be able to infer and review the DPRs prepared for construction of Rural Roads such under PMGSY

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A.,`Highway Materials and Pavement Testing', Nem Chand and Bros, Roorkee

Reference Books:

1. IRC SP 20 Rural Roads Manual
2. Ministry of Rural Road Development

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Pavement Management System

Subject Code	18CIM252 /18CHT252	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to:

- Make students learn evaluation and prediction of pavement performance
- Learn Ranking and economic optimization of pavement maintenance and rehabilitation and management

Modules

Module 1

Introduction: Components & principals of pavement management systems, pavement maintenance measures, planning investment, research management.

Pavement Performance Evaluation: general concepts, serviceability, pavement distress survey systems, performance evaluation.

Module 2

Pavement Performance Prediction: Concepts, modeling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models. Functional condition deterioration models, unevenness prediction models and other models, comparison. Modeling in rehabilitation budget planning, case studies, Problems.

Module 3

Ranking and Optimization Methodologies: Recent developments, sample size selection, economic optimization of pavement maintenance and rehabilitation

Module 4

Design alternatives and Selection: Design objectives and constraints, basic structural response models, physical design inputs, alternate pavement design strategies and economic evaluation, reliability concepts in pavement engineering, life cycles costing, analysis of alternate pavement strategies based on distress and performance, case studies and Problems.

Module 5

Expert systems and Pavement Management: Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge – based expert systems, case studies. Implementation of Pavement Management Systems.

Course outcomes:

After studying this course, students will be able to:

- Design alternate pavement management systems based on life cycle cost analysis

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Ralph Hass, Ronald Hudson and Zanieswki, "Modern Pavement management"- Krieger Publications.
2. W. Ronald Hudson, Ralph Haas and Waheed Uddin, 'Infrastructure Management'- Mc Graw Hill

Reference Books:

1. Proceedings of North American Conference on Managing Pavement.
2. Proceedings of International Conference on Structural Design of Asphalt Pavements.
3. NCHRP, TRR and TRB Special Reports.
4. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Structural Masonry

Subject Code	18CIM253	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to:

- Understand masonry materials and its mechanical properties
- Analyze the behavior of structural masonry
- Demonstrate testing, analysis and design methodologies
- Summarize construction practices, specifications and inspection of masonry buildings

Modules

Module 1

Introduction, Masonry units, materials and types: History of masonry, historical buildings, Masonry arches, domes and vaults: Components, classification and construction procedure.

Module 2

Characteristics of masonry constituents: Types of masonry units such as stone, bricks, concrete blocks, clay blocks and stabilized mud blocks. Properties of masonry units like strength, modulus of elasticity and water absorption. Masonry mortars – Classification and properties of mortars, selection of mortars.

Module 3

Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, factors influencing of compressive strength masonry, Effects of slenderness and eccentricity, water absorption, curing, ageing and workmanship on compressive strength. Prediction of strength of masonry in Indian context.

Module 4

Shear and Flexure Behavior of Masonry : Bond between masonry unit and mortar, test methods for determining flexural and shear bond strengths, test procedures for evaluating flexural and shear strength, factors affecting bond strength, effect of bond strength on compressive strength, flexure and shear strength of masonry. Concept of Earthquake resistant masonry buildings.

Module 5

Design of load bearing masonry buildings: concept of basic compressive stress, Permissible compressive stress, reduction factors. Increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 to 8 storeys using BIS codal provisions.

Course outcomes:

After studying this course, students will be able to:

- Identify various materials for masonry and understand its engineering properties.
- Explain the parameters influencing masonry properties.
- Develop an expression to understand the behavior of masonry under compression, shear and flexure.
- Design masonry elements under different loads.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Hendry A.W., "Structural Masonry"- Palgrave Macmillan Macmillan Education Ltd., 2nd edition, ISBN 10: 0333733096 ISBN 13:9780333733097.
2. Jagadish K S, "Structural Masonry", I K International Publishing House Pvt. Ltd., 2015, ISBN 10 - 9384588660, ISBN 13: 978-9384588663.

Reference Books:

1. W. Robert G Drysdale; Ahmad A Hamid, Masonry structures: Behavior and Design. Boulder, CO: Masonry Society, 2008. 3E, ISBN 1929081332 9781929081332
2. Sven Sahlin, "Structural Masonry"- Prentice Hall Publisher: Prentice Hall, 1971, ISBN-10: 0138539375, ISBN-13: 978-0138539375

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Introduction to Seismic Resistant Design

Subject Code	18CIM254	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to,

- Acquire knowledge of fundamentals of structural dynamics.
- Understand: engineering seismology & concepts for earthquake resistant design.
- Understand design & detailing aspects to achieve ductility in structures.

Modules

Module 1

Introduction to engineering seismology, plate tectonics, seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales; seismic instruments. Study of response of buildings and structures during past earthquakes.

Module 2

Introduction to Theory of Vibration – Single degree of freedom systems, period, frequency, resonance, damping, response spectrum, seismic design philosophy, ductility, base shear calculation by seismic coefficient method (Numerical based on fundamentals only).

Module 3

Site planning, building forms, horizontal and vertical irregularities, mass and stiffness irregularities; Soft-storey effects; Architectural design concepts for earthquake resistance; Shear walls; setbacks, effects of torsion in buildings, pounding – IS 1893 provisions (No Numerical).

Module 4

Ductility and energy absorption in buildings; Reinforced concrete for earthquake resistance; confinement of concrete for ductility; ductility of columns and beams – codal provisions – Relevant IS codes.

Module 5

Behaviour of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, concepts for earthquake resistant masonry buildings – IS codal provisions.

Course outcomes:

After studying this course, students will be able to:

- Understand engineering seismology
- Understand basic concepts of theory of vibrations
- Understand and interpret the nuances of site planning, building forms etc.,
- Understand the behavior of masonry buildings during earthquake

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. P Agarwal and M Shrikande, “Earthquake Resistant Design of Structures”, Prentice Hall (India) Ltd, New Delhi, 2006.
2. S. K. Duggal, (2007), “Earthquake Resistant Design of Structures”, Oxford University Press, New Delhi 2007.

References:

1. Damodaraswamy S. R and Kavitha. S, “Basics of Structural Dynamics and Aseismic Design”, PHI Publication, 1st Edition, 2009, ISBN: 978-8120338432
2. IS 1893 (Part I): 2016, IS 13920-2016, IS 4326: 1993, IS 13828: 1993 and other relevant codes

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Concrete Technology Laboratory - 2

Subject Code	18CIML26	CIE Marks	40
Course	PCC	Credits	02
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	38	Exam Hour	03

Course objectives:
This course will enable students to
• Make students to learn principles of laboratory experiments.
• Understand the importance of laboratory testing of materials.

Modules

- Mix design of concrete as per IS, ACI & BS methods for concrete.
- Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability and strength.
- Self-Compacting Concrete – Fresh and hardened properties
- Test on Recycle aggregates – basic material characterisation
- Permeability tests on hardened concrete – Demonstration.
- Geo-polymer Concrete – Fresh and hardened properties
- Non-destructive test on concrete by: (Demonstration)
  (a) Rebound Hammer Test
  (b) Ultrasonic Pulse Velocity Test
  (c) Profometer

Course outcomes:
After studying this course, students will be able to:

- Determine the physical properties of cement, fine aggregate and coarse aggregates in laboratory through experiments.
- Determine the fresh properties of concrete like Slump value, compaction factor etc.,
- Determine the hardened properties of concrete like Compression, Split tensile strength and Flexural Strength of concrete.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

References:

1. Properties of Concrete by A. M. Neville, ELBS publications.
2. Concrete Technology by A.K. Santhakumar, Oxford Press.
3. Concrete Technology by M. S. Shetty, S. Chand & Co.
4. Relevant IS Codes / Standards
5. Concrete Testing Manual
6. Advanced Concrete Technology –Process by John Newman and Ban Seng Choo, ISBN 07506 5105 9, Elsevier Ltd.
7. Concrete Construction Engineering Handbook by Dr. Edward G. Nawy, CPC Press, 2nd Edition, ISBN 9780849374920.
8. "Self-Compacted Concrete by-Applying what we know" By Joseph A. Daczko, CPC Press,ISBN-13:978-0-203-84422-9

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Infrastructure Construction Methods

Subject Code	18CIM31	CIE Marks	40
Course	PCC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Understand types and methods of construction of RC structures.
- Understand types and methods of long span structures construction.
- Understand types and methods of construction of Underground structures.

Modules

Module 1: Design of Formwork and Tall Structures Construction

Basic Concepts in Formwork design - Beam formulae: Allowable stresses, Deflection, Bending, Lateral stability, Shear, Bearing; Design of Wall forms; Slab forms; Beam forms; Column forms.

Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections launching techniques - Slip form techniques- suspended form work - erection techniques of tall structures.

Module 2: Long-span structures, Segmental Construction and Cantilever Construction

Economics of RC and PSC superstructure, Deck Slab, T-beam and Box girder deck slab construction: Slab type, T-beam and box-girder bridges Decks Construction methods.

Introduction to Precast segmental construction for long-span bridges – Cable-stayed bridge construction.

Module 3: Composite Construction

Steel - concrete composite construction: concepts of composite structures (fundamentals), Introduction to steel-concrete - steel sandwich construction.

RE Panel Structures – Geo-synthetics, functions and applications, reinforced retaining walls - construction methods, benefits.

Module 4: Underground Construction

Tunnel Construction and methodologies: Types of Tunnels - Tunnel Form - Loads- Mountain Tunnel - Shallow-buried Tunnel or Soft Soil Tunnel - Underwater Tunnel. (concepts and construction methodology only)

Rehabilitation of Structural Elements for underground structures: Short Term Repairs, Long Term Repair, Reconstruction and New Construction.

Module 5: Special Structure Construction

Top and down construction Methods: General construction sequence for Building tower constructions. Construction procedure of lattice towers and rigging of transmission line structures.

COMMON STRENGTHENING TECHNIQUES

Mud Jacking grout through slab foundation - micro piling for strengthening floor - under pinning. Explosives and its classification. Sequence in demolition and dismantling.

Course outcomes:

After studying this course, students will be able to:

- They can able to design the formwork for beam, column, slab elements.
- They can get the basic idea of various type of construction techniques adopted in Bridge constructions.
- They can able to address the special problems in underground constructions.
- At the end of the course the student will understand the basic constructional methods for bridge segmental, composite constructions and special construction methods like top and bottom constructions.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996.

References:

1. Jaafar Mohammed, "Engineering Geology & Tunnels Engineering", 2015.
2. Raina V. K. "Concrete Bridge practice", Tata McGraw Hill Publishing Co.
3. Chew Yit Lin, Michael, "Construction Technology for Tall Buildings", Singapore University Press, World Scientific, Hong Kong,
4. Ponnuswamy. S, "Bridge Engineering", Tata McGraw Hill.
5. Roy Chudley and Roger Geeno,"Advanced Construction Technology" Latest Edition, 2005.
6. Sankar S. K. And Saraswati .S, "Construction Technology", Oxford University Press, New Delhi, 2008.
7. Gahlot. P. S and Sanjay Sharma, "Building repair and maintenance management", CBS Publications, 2006

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Foundation Technology

Subject Code	18CIM321	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- To learn about types and purposes of different foundation systems and structures.
- To provide students with exposure to the systematic methods for designing foundations.
- To discuss and evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behavior.
- To build the necessary theoretical background for design and construction of foundation systems.

Modules

Module 1: Bearing Capacity

Definition and terms used related to bearing capacity; Bearing capacity theories and empirical methods - Terzaghi's Method, Skempton's analysis for clays, Mayerhof's analysis, BIS Method (IS: 6403) – (Excluding Numerical Problems) Effects of water table fluctuation and eccentric foundation base in calculating ultimate bearing capacity; Test procedure for determination of Bearing Capacity from field tests - Plate Load Test, Standard Penetration Test, Cone Penetration Test: advantages and limitations (excluding numerical problems); Factors influencing Bearing Capacity.

Module 2: Shallow Foundations

General types of Foundation – Classification and Types; Construction Aspects; Choice of foundation type and Preliminary Selection;

Design features and construction details related to size and depth of footing; (numerical problems excluded)

Raft Foundations: Common types of Raft foundations; General considerations in design of rafts; construction aspects of raft; (numerical problems excluded)

Coefficient of sub-grade reaction – importance, application;

Environmental considerations - Frost heave: effects, its causes and prevention;

Module 3: Deep Foundations

Types of deep foundations – Piles, Piers and Cassions; Piles: Classification of piles – Based on Function – End Bearing, Friction, Tension, Compaction, anchor, fender, sheet, batter, laterally loaded pile etc.; Based on Composition and material – timber, steel, Concrete; Based on Method of installation – Driven, cast-in-situ, driven and cast in- situ - Brief details, advantages and disadvantages; Installation of Pile: Equipment for installation of piles by driving and boring, cast in situ place method.

Module 4: Deep Foundations

Pile Capacity: Load transfer mechanism (only concept); Methods of determining ultimate load bearing capacity (only methods; no theoretical aspect / problems); Piles in group – concept of pressure isobars and typical arrangement only; Concept of negative skin friction and uplift capacity of piles (only concept);

Drilled Piers: Types - Straight-shaft end-bearing piers, Straight-shaft side wall

friction piers, Combination of straight shaft side wall friction, Belled or under reamed piers; Advantages and disadvantages; Methods of Construction – The dry, casing and slurry methods;
Cassions: Introduction, Types – Open, Pneumatic & Floating Cassions – Components, Advantages and disadvantages.

Module 5 : Soil Stability

Retaining walls: Introduction, Types of earth retaining structures, Modes of failure of retaining walls, drainage of backfill, Types of earth pressure – Active, passive, earth pressure at rest (only concept, no earth pressure theories); Stability considerations for retaining walls; (numerical problems excluded) Braced and Un-braced Excavations; Sheet Piles: Introduction, Sheet Pile Structures – Cantilever, anchored, braced sheeting, single cell cofferdams, cellular cofferdams; (only types, numerical problems excluded) Shoring and Underpinning: Necessity and Methods;

Course outcomes:

After studying this course, students will be able to:

- An ability to identify & design various types of foundations according to field conditions.
- To build the knowledge on soil behaviour and introduce to design issues pertaining to different types of foundations.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Book:

1. V N S Murthy, "Geotechnical Engineering"–Principles and Practices of Soil Mechanics and Foundation Engineering, Marcel Dekker Inc., New York
2. C. Venkatramaiah, "Geotechnical Engineering", 3e, New Age International (P) Ltd., 2006.

References:

1. Tomlinson M J, "Foundation Design and Construction", Pearson Education, 7e, 2001.
2. Bowles Joseph E, "Foundation Analysis and Design", McGraw Hill.
3. Braja M. Das, "Principles of Foundation Engineering", 6e, Thomson, 2007.
4. B C Punmia, "Soil Mechanics and Foundations", 16e, Laxmi Publications (P) Ltd., 2005.
5. IS 6403: 1981 (Reaffirmed2002) Determination of bearing capacity of Shallow foundations, Bureau of Indian Standards, New Delhi.
6. IS 8009:1980 – Part I & II Calculation of Settlement of Foundation, Bureau of Indian Standards, New Delhi.
7. Tomlinson M J, "Pile Design and Construction Practice", Taylor & Francis, 5e, 2008.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Maintenance and Rehabilitation of Structures

Subject Code	18CIM322/18CHT322	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Learning the structural properties for causing failures
- Identification of failure phenomenon; New approach in the design aspects
- Understanding the concept of serviceability and durability

Modules

Module 1

Maintenance, Repair and Rehabilitation: Facets of maintenance - Assessment procedure for evaluating a damaged structure; Inspections, study of soil report, existing as built drawings, variation in design loads etc.

Causes of distress - foundation, floor, walls, roof etc.

Durability of materials - types of problems in components such as foundations, roofs, floors, walls, etc., Safety evaluation of existing structures - failure patterns and controls. Causes of Deterioration, preventive measurements and maintenance.

Module 2

Investigation and Diagnosis: General Considerations - Observation - Characteristics of materials; Diagnosis of construction failures;

Field and Laboratory Testing: Destructive Testing; Non-Destructive Testing – Rebound Hammer, Ultrasonic Pulse Velocity, Pachometer; Semi-Destructive Testing: Probe Test, Pull-Out Test, Pull-Off Test, Break-Off Test, Core Test, Half-Cell Potential Measurements, Resistivity Measurements, Carbonation Depth Testing, Tests for determining cement content, chloride content and sulphate content.

Module 3

Repair Materials: Dealing with cracks; Methods of repair in concrete; Corrosion damage of reinforced concrete, repair and prevention measures.

Corrosion of steel reinforcement: Factors influencing corrosion, corrosion protection.

Masonry deterioration - Surface deterioration, Efflorescence, causes, prevention and protection.

Module 4

Grouting - Strengthening of existing structures; Special repair methods;

Patching Materials - Resurfacing Materials, Sealing Materials, Water Proofing Materials, Substrate Preparation.

Refurbishment and Protection Techniques - Routing and Sealing, Stitching, External Stressing, Resin Injection, Overlays, Sprayed Concrete, Pre-packed Concrete, Dry packing, Jacketing, Plate Bonding, Protective Coatings, Vacuum Impregnation; Chloride Extraction; Cathodic Protection.

Module 5

Maintenance: Detection methods and remedial measures; Concrete pavement maintenance measures and preservation techniques. Examples of repair (case studies) - Strengthening of flexural members (slabs & beams), compression members (column), deflection and cracking.

Course outcomes:

After studying this course, students will be able to:

- They can able to understand the mechanisms of degradation of concrete structures and design durable concrete structures.
- They can learn how to conduct field monitoring and non-destructive evaluation of concrete structures.
- They can formulate a strategy for repair and rehabilitation by selecting appropriate repair materials and techniques.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Peter H. Emmons, "Concrete Repair and Maintenance", Galgotia Publishers.
2. S. Champion, "Failure and Repair of Concrete Structures", John Wiley &Sons.

References:

3. Ted Kay, "Assessment and Renovation of Concrete Structures", Longman Scientific & Technical
4. R. T. L. AIlen and S. C. Edwards, "Repair of Concrete Structures", Blackie & Son,1987
5. Sidney M. Johnson ," Deterioration, Maintenance and Repair of Concrete Structures", McGraw- Hill Book
6. P. H. Perkins, "Repair, Protection and Water proofing of Concrete Structures", E & FN Spon
7. R. N. Raikar, "Diagnosis and Treatment of Structures in Distress" ,Structwel D & C Pvt. Ltd
8. Ransem W. H, "Building Failures", E & F.N, SPON Ltd, 1981.
9. Ralph Haas, Ronald Hudson and Zaneiswki, "Modern Pavement Management", Kreiger Publications.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Construction Demolition and Waste Management

Subject Code	18CIM323 / 18CHT323	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Focus on the principles of sustainable construction and demolition waste management and resource efficiency
- Examining the environmental impact of building materials;
- Formulating and designing pre−construction and site waste management plans

Modules

Module 1

Environmental Impact of Building Materials Embodied energy of materials; impact on the local environment; toxicity of the material; life cycle assessment. Nature and Source Direct and indirect waste; site types and origins; composition; quantity; current recycling/reuse potential of building materials.

Module 2

Construction and Demolition Waste Management Plans International good practice; planning requirements; DoEHLG guidance document; company policy; demolition plans; site implementation; supplier agreements; sub−contractor management; role of waste management contractor; training; auditing; skip management; current markets; current disposal options; health and safety; reporting to local authorities.
Treatment of Construction and Demolition Waste, waste permits; waste licenses; waste transfer facilities; landfills; treatment technologies; hazardous waste facilities; reporting to EPA

Module 3

Designing for Waste Prevention and Minimisation Waste prevention and minimization; client, contractor and designer attitudes; proper maintenance of existing buildings; reuse of existing building structure; design flexibility; design for reuse and recycling; dimensional co−ordination and standardization; modular design; material selection and control.

Module 4

Waste Forecasting Tools Application of WRAP's designing out waste tool for buildings and civil engineering; WRAP net waste tool; BRE SMART Waste; WRAP Site Waste Management Plan Tracker

Module 5

Future developments Potential future markets; 'smart' materials; use of eco−materials.

Course outcomes:

After studying this course, students will be able to:

- They can able to understand the basic concept of embodied energy of construction materials.
- Understand the application of construction and demolition waste to various concrete structures.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Springer, "Recycling and Resource Recovery Engineering", Springer – Verlag, Berlin Heidelberg (1996)
2. Greg Winkler, "Recycling Construction and Demolition waste: A LEED - Based Toolkit (Green Source) (Google ebook), McGraw Hill Professional

References:

1. V M Tam, Chi Ming Tam, "Reuse of Construction and Demolition Waste in Housing Development", Nova Science Publishers, 2008.
2. Current Literature.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Sustainable Constructions

Subject Code	18CIM324	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Demonstrate competent knowledge of Sustainability, their potentials, their relation, pros and cons;
- Identify specific actions that can be taken to conserve energy and to promote the development and use of renewable energy

Modules

Module 1

Sustainable Construction Materials - Marginal materials, recycled materials, design aspects, construction practices using non-conventional materials and methods, milling and recycling techniques

Module 2

Energy Savings in Construction - Fundamentals of energy - Energy production systems, Energy and resource conservation, Energy efficient design strategies, Renewable energy sources – advantages and disadvantages; Energy management and conservation: electrical equipment - Improvement of power factor -maximum energy demand

Module 3

Energy savings in electrical appliances used in buildings (pumps, fans, Compressed air systems, lighting systems, Air conditioning systems):
Energy in building materials, energy efficient and environment friendly building: Thermal comfort and solar radiations

Module 4

Green building rating system: Introduction to IGBC and LEED rating systems – various criteria for building rating

Module 5

Pollutions and Management: air, water, noise pollutions and reduction measures during planning, design and construction;

Course outcomes:

After studying this course, students will be able to:

- Identify principles of sustainability and its role in construction sector
- Compute the life cycle energy of a typical building
- Develop recycling process for various types of marginal materials
- Characterize marginal materials
- Evaluate recycled products made from marginal materials
- Assess sustainability through rating systems

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

References

1. Moore F: Environmental Control System McGraw Hill, Inc., 1994.
2. K S Jagadish, B V Venkataramana Reddy, K S Nanjunda Rao: Alternative Buildings Materials and Technologies, New Age International Publishers, New Delhi, 2007

Brown, G Z, Sun, Wind and Light: Architectural design strategies, John Wiley, 1985

SYLLABUS FOR M Tech., Infrastructure Construction and Management
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SEMESTER – 3

Subject: Construction Quality and Material Management

Subject Code	18CIM331	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Understand the various types Quality Management, uses, effect and its importance
- Understand the effect of material management for project organization

Modules

Module 1

Evolution of quality management, importance of quality, quality tree, benefits of quality, types of quality, customer driven definitions of quality, quality in production system

Module 2

Cost of quality, quality control: objectives of qc, inspection, quality at source, Quality control strategy and policy, Quality Assurance, Quality assurance system, principles of total quality control

Module 3

Meaning , definition, uses and drawbacks : Total Quality management, ISO Certification, SIX Sigma, Quality Circles, Causes and Effect Diagram

Module 4

Material Management: importance, Integrated material Management, classification of Material, ABC analysis, standardization, purchase management, codification types and its uses, Price forecasting benefits and its methods: Average method, moving average method, weighted
Average method, exponential smoothening.

Module 5

Inventory Management, Store Accounting: LIFO, FIFO, Average cost and market cost, relevant cost of inventory.

Course outcomes:

After studying this course, students will be able to:

- Importance of Quality Management
- Different tools, certification and control methods
- Importance of material management, procurement, uses and control methods

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. K Sridhara Bhat, Total Quality Management, Himalaya Publishing House, 2014.
2. Bester Field, “Total Quality Management”, by Pearson Education.

References:

1. Juran Frank, J.M. and Gryna, F.M, Quality Planning and Analysis, Tata McGraw Hill, 1982.
2. Hutchins. G, ISO 9000, Viva Books, New Delhi, 1993.
3. Datta, Material Management Procedures, Text and Cases, 2e Prentice Hall
4. Gopalakrishnan , P, Sundaresan, “Material Management - an Integrated Approach”, Prentice Hall

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Building Services & Maintenance

Subject Code	18CIM332	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:
This course will enable students to
• Understand the concept of fire resistance in structures
• Understand quality policies in the construction industry
• Adopt proper maintenance methods for structures

Modules

Module 1
Standard fire, fire resistance, classification of buildings, means of escape, alarms, etc., provisions of NBC. Engineering services in a building as a system, Lifts, escalators, cold and hot water systems, waste water systems and electrical systems

Module 2
Building Maintenance: Preventive and protective maintenance, Scheduled and contingency maintenance planning, M.I.S. for building maintenance. Maintenance standards. Economic maintenance decisions

Module 3
Quality policy in construction industry: Consumer satisfaction, Ergonomics-Time of Completion-Statistical Tolerance-Taguchi's concept of quality.

Module 4
Contract and construction programming-Inspectional procedures. Total QA/QC Program and cost implication.

Module 5
Different aspects of quality - Appraisals - failure mode analysis, Stability methods and tools, Influence of drawings, detailing, specification, Standardization - Bid preparation. Construction activity, Environmental safety, Social and environmental factors

Course outcomes:
After studying this course, students will be able to:
- Interpret the physical phenomenon of weather on buildings.
- Identify and analyze materials suitable for optimal environmental performance on buildings.
- Design integrated systems to optimize building performance.

Graduate Attributes (as per NBA)
- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Clarkson H. Oglesby, Productivity Improvement in Construction, McGraw Hill.
2. James, J.O Brian, Construction Inspection Handbook - Quality Assurance and Quality Control, Van No strand, New York, 1989.

References:

1. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, Tata McGraw Hill, 1982
2. NBC," Relevant Parts: BIS New Delhi
3. Jain V K," Services in Building Complex and High Rise Buildings", Khanna Pub.
4. Pchelinstev V. A., Fire Resistance of Buildings

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[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Airport Planning and Design

Subject Code	18CIM333/18CHT333	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:

This course will enable students to

- Understand the various components of an airport and aircraft characteristics affecting the design of airports.
- Design the runway and taxiway geometrics based on the likely aircrafts using the airport.
- Plan the requirements of terminal area and suggest an optimum layout for the terminal area based on passenger and baggage volume.
- Provide a suitable method of grading and leveling work involved in the area along with drainage provisions for surface and subsurface water flows.
- Understand the various air traffic control aids required for safe landing and take-off of aircrafts at the airport.

Modules

Module 1

Introduction: Growth of air transport, airport organization and associations, Classifications of airports airfield components, airport traffic zones and approach areas.

Aircraft Characteristics Related to Airport Design: Components, size turning radius, speed, airport characteristics.

Module 2

Airport planning, surveys and Design: Airport Site Selection, Runway length and width, sight distances, longitudinal and transverse grades, runway intersections, taxiways, clearances, aprons, numbering, holding apron, noise control, Problems.

Module 3

Planning and Design of the Terminal area: Operational concepts, space relationships and area requirements, vehicular traffic and parking at airports.

Capacity and Delay: Factors affecting capacity, Determination of runway capacity related to delay, gate capacity and taxiway capacity.

Module 4

Airport Grading and Drainage: Grading of airport area, hydrology, design of drainage systems, construction methods, layout of surface drainage and subsurface drainage system, Problems.

Module 5

Air Traffic Control and Aids: Runways and taxiways markings, day and night landing aids, airport lighting, ILS and other associated aids.

Course outcomes:

After studying this course, students will be able to:

- Analyse the various components of an airport and aircraft characteristics affecting the design of airports.
- Design the runway and taxiway geometrics based on the likely aircrafts using the airport.

- Plan the requirements of terminal area and suggest an optimum layout for the terminal area based on passenger and baggage volume.
- Provide a suitable method of grading and leveling work involved in the area along with drainage provisions for surface and subsurface water flows.
- Understand the various air traffic control aids required for safe landing and take-off of aircrafts at the airport.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. "Planning and Design of Airports" - Robert Horenjeff, 2nd edition, McGraw Hill Book Co.
2. "Airport Engineering" - G. Glushkov, V.Babkov, Mir Publuishers, Moscow.
3. "Airport Planning and Design"- Khanna, Arora and Jain, Nem Chand and Bros., Roorkee

Reference Books:

1. Harry.R.Cedergern. "Drainage of Airfield pavements" - John Wiley and Sons.
2. Virender Kumar and Satish Chandra, "Airport Planning and Design"- Galotia Publication press.

SYLLABUS FOR M Tech., Infrastructure Construction and Management
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 3

Subject: Advanced Design of Concrete Structures

Subject Code	18CIM334	CIE Marks	40
Course	PEC	Credits	04
Number of Lecture Hours/week	04	Exam Marks	60
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hour	03

Course objectives:
This course will enable students
• To learn to design the advanced reinforced concrete structures.
• To learn to design the miscellanies RCC structures like deep beams, corbels etc.

Modules

Module 1: Introduction
Review of Basic Concepts -Behaviour and Design of Reinforced Concrete members considering flexure, Torsion, combined with flexure and flexural shear, axial compression, deflection and crack width as per IS Comparative study with BS 8110 and ACI - 318.

Module 2: Flat Slabs and Flat Plates
Design of flat slabs and flat plate - According to IS 456 method - Design of shear - Reinforcement and Edge (Spandrel) beams - yield line theory.

Module 3: Design of special R.C. Elements
Behaviour and Design of Slender Columns - Design of RC Walls - Ordinary and Shear walls - Design of Corbels - Deep beams.

Module 4: Design of Special type of foundations
Introduction to Limit State Design of reinforced concrete in foundations; Soil pressure for structural design; Conventional structural design of Spread footings, isolated footings, column Pedestals and design of Combined footing.

Module 5: Analysis and Design of Multi-storey Building (G+4)
Analysis of Multi-Storey Buildings with Moment resistant Joints for Gravity loads (Vertical Loads), Detailing of R.C elements as per SP-34.

Course outcomes:
After studying this course, students will be able to:
- Understand and analyse the behaviour and design RC members under flexure, torsion etc.,
- Design flat slabs and flat plate as per relevant IS method
- Design slender column, RC Walls, shear wall and corbels
- Design different types of Foundations (LSM) including Spread footings, isolated footings and column pedestals
- Analyse multi-storey buildings with moment resistant joints

Graduate Attributes (as per NBA)
- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Design / development of solutions (partly).*
- *Ethical practices and social responsibility*

Text Books:

1. Varghese P.C, "Advanced Reinforced Concrete", Prentice Hall of India.
2. N Subramanian, "Design of Reinforced Concrete Structures", Oxford University Press, 2013.

Reference Books:

1. P C Varghese, "Limit State Design of Reinforced Concrete", Vol-II, Prentice Hall of India (P) Ltd, New Delhi.
2. Jain A.K, "Limit State Design of Reinforced Concrete", Nemchand & Bros., Roorkee.
3. BIS Codes: IS: 456, IS: 875, SP: 16, SP: 34.
4. H.J. Shah, "Reinforced Concrete", Charoatr Publishers.
5. A Park and Paulay, “Reinforced Reinforced and Pre-stressed Concrete”-John Wiley & Sons