VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

Scheme of Teaching and Examinations and Syllabus

M.Tech - Infrastructure Construction and Management (CIM)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination – 2020-21
M. Tech – Infrastructure Construction and Management (CIM)
Choice Based Credit System (CBCS)

FIRST SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory (T)	Practical (P)	Skill Development Activities (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20CIM11	Statistics & Numerical Analysis in Construction	03	--	02	03	40	60	100	4
2	PCC	20CIM12/ 20CHT12	Pavement Materials	03	--	02	03	40	60	100	4
3	PCC	20CIM13	Construction Project Management	03	--	02	03	40	60	100	4
4	PCC	20CIM14	Advances in Concrete Technology	03	--	02	03	40	60	100	4
5	PCC	20CIM15	Advances in Pre-Stressed Concrete	03	--	02	03	40	60	100	4
6	PCC	20CIML16	Material Testing Laboratory - 1	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	02	--	--	03	40	60	100	2
			TOTAL	**17**	**04**	**10**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Skill development activities:
Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.
The students should interact with industry (small, medium, and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.
The students shall
(1) Gain confidence in modelling of systems and algorithms.
(2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
(3) Handle advanced instruments to enhance technical talent.
(4) Involve in case studies and field visits/ field work.
(5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.
All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process.
(ii) Three credit courses are designed for 40 hours Teaching – Learning process.
(iii) Two credit courses are designed for 20 hours Teaching – Learning process.

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SECOND SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory (T)	Practical (P)	Skill Development Activities (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20CIM21	Special Concrete	03	--	02	03	40	60	100	4
2	PCC	20CIM22	Contract Management	03	--	02	03	40	60	100	4
3	PCC	20CIM23	Prefabricated Structures	03	--	02	03	40	60	100	4
4	PEC	20CIM24X	Professional Elective 2	04	--	--	03	40	60	100	4
5	PEC	20CIM25X	Professional Elective 3	04	--	--	03	40	60	100	4
6	PCC	20CIML26	Concrete Technology Laboratory - 2	--	04	--	03	40	60	100	2
7	PCC	20CIM27	Technical Seminar	--	02	--	--	100	--	100	2
			TOTAL	**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional Core, PEC: Professional Elective

Professional Elective 1		Professional Elective 2	
Course Code under 18CIM24X	**Course title**	**Course Code under 18CIM25X**	**Course title**
20CIM241/ 20CHT241	Construction Equipment and Safety Management	20CIM251	Introduction of Seismic Resistant Design
20CIM242	Bridge and Grade Separated Structures	20CIM252	Structural Masonry
20CIM243/ 20CHT243	Ground Improvement Techniques	20CIM253	Highway Construction Technology
20CIM244/ 20CHT244	Soil Mechanics for Pavement Engineers	20CIM254/ 20CHT254	Low volume Roads Engineering

Note: "Question Paper Pattern"
1. **TEN** questions, such that **Two** questions are set from EACH MODULE. **Each question will carry 20 marks.**
2. Final SEE Examinations conducted for 100 marks and it will be converted to equivalent 60 marks.

Note:
1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide in any and a senior faculty of the department. Participation in seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.
The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.
2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination will be conducted during III semester and prescribed credit shall be included in the III semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as failed and have to complete during subsequent University examination after satisfying the internship requirements.

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THIRD SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical / Mini project / Internship	Skill Development Activity (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20CIM31	Infrastructure Construction Methods	03	--	02	03	40	60	100	4
2	PEC	20CIM32X	Professional Elective 3	03	--	--	03	40	60	100	3
3	PEC	20CIM33X	Professional Elective 4	03	--	--	03	40	60	100	3
4	Project	20CIM34	Evaluation of Project Phase - 1	--	02	--	--	100	--	100	2
5	PCC	20CIM35	Mini Project	--	02	--	--	100	--	100	2
6	INT	20CIMI35	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
			TOTAL	**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional Core, PEC: Professional Elective

Professional Elective 3		**Professional Elective 4**	
Course Code under 18CIM32X	**Course title**	**Course Code under 18CIM33X**	**Course title**
20CIM321	Foundation Technology	20CIM331	Construction Quality and Material Management
20CIM322	Maintenance and Rehabilitation of Structures	20CIM332	Building Services and Maintenance
20CIM323/ 20CHT323	Special Problems in Road construction	20CIM333/ 20CHT333	Transportation Planning
20CIM324/ 20CHT324	Sustainable Construction	20CIM334/ 20CHT334	Construction & Demolition Waste Management

Note:
1. Project Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document and present a seminar.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.
SEE (University examination) shall be as per the University norms.
2. Internship: Those, who have not pursued /completed the internship shall be declared as failed and have to complete during subsequent University examinations after satisfying the internship requirements.
Internship SEE (University examination) shall be as per the University norms.

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FOURTH SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours / Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
1	Project	20CIM41	Project Work Phase - 2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any and a Senior faculty of the department. The CIE marks awarded for project work phase - 2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

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	20CIM11	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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

Introduction to statistical methods: Definition, Scope, and Limitations of Statistics. Variables and their types. Types of data – Primary and Secondary data, sources of secondary data. Scales of measurement of data. Methods of collection of data. Reliability and Accuracy of data.

Presentation of data -Tabular methods (Frequency distribution for both discrete and continuous data) and Graphical methods (Bar diagrams, Pie diagrams, Histogram – location of mode using Histogram, Frequency curves and polygons, Line graph, Ogive curve – location of median using ogives, Scattered diagram. Advantage and disadvantage of both tabular and graphical methods. Summarizing data. Measure of central tendency and Measures of dispersion/ variation. Merits and Demerits of measures of central tendency and dispersion. Measures of Skewness and Kurtosis.

SDA: Group based assignment using excel to solve problems on frequency distribution, graphical methods, measures of central tendency and dispersion

Module 2

Probability & Probability distribution for Traffic Engineering Design: Definition of Sample space, mutually exclusive, equally likely, independent outcomes, favorable events, Definitions of different types of probability, addition and multiplication rule of probability, conditional probability, Bayes theorem. Random variables, Definition of probability mass function (pmf) based on discrete random variable and probability density function (pdf) based on continuous random variable. Expected value and Variance of discrete and continuous random variables. Cumulative distribution function.

Joint probability distribution. Special discrete probability distributions like Bernouli, Binomial and Poisson. Special continuous probability like Normal distribution and Standard normal distributions. Problems based on probability distributions.

SDA: Group based assignment on finding probabilities of different distribution using excel

Module 3

Sampling Techniques: – Definition of basics concepts of sampling, advantages and disadvantages of sampling, Probability and non-probability sampling techniques, Sampling variation. Definition of sampling distribution, sampling distribution of the sample mean (t-distribution), sample variance (Chi-square distribution), sample proportion (Z-distribution), ratio of sample two sample variance (F-distribution) Central limit theorem, Sampling error, Sample size distribution.

Module 4

Statistical Inference: Basics of testing of hypothesis.
Parametric tests: Z-test for mean and proportion, Students' t-test, F-test, Analysis of Variance
Non-parametric tests: Chi-square test, Fisher's exact probabilities, Mann-Whitney U test, Wilcoxon signed rank test, Kruskal-Wallis test
SDA: Group based assignment on Students' t-test and ANOVA using excel

Module 5

Basics: Summary of basic concepts of Matrices, Matrix Operations, Matrix inverse, Solutions of system of linear equation using Gaussian elimination, Gaussian-Jordan, Gauss – Seidal methods
Matrix Factorization: Cholesky Factorization, LU-factorization.
Numerical Integration: General quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule

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: Pavement Materials

Subject Code	20CIM12/20CHT12	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	Exam Hour	03

Course objectives:

This course will enable students to

- Understand the basic construction materials and their suitability as road materials.
- Analyze the aggregates and design aggregate gradation for construction of pavement layers.
- Characterize the binder material for bituminous roads and provide an optimum bituminous mix design.
- Understand mix design using different materials for various components of a CC pavement.
- Understand and propose soil stabilization techniques for highway construction using locally available materials.

Modules

Module 1:

Soil Mechanics:

Basic soil properties, methods to determine strength of soil, Soil compaction for use in fill and subgrade of roads, compaction studies in laboratory and field, properties of compacted soils; strength characteristics of soil; field testing and applications.

Module 2:

Aggregates:

Origin, classification, Equipments, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation problems on Rothfutch's and Critical Sieve methods and Shape factor in mix design.

Module 3:

Bituminous Binders:

Different types, properties and uses, physical tests on bitumen, Rheological and pavement performance related properties, Modified binders, ideal pavement binders, characteristics and applications in road construction, criteria for selection of different binders, characterization of bituminous binders.

Bituminous mixes, types, requirements, properties, tests, Marshall Method of mix design, Criteria, and super pave mix design, Additives & Modifiers in Bituminous mixes, problems on mix design. Performance based mix design.

Module 4:

Portland Cement and Cement Concrete for Use in Road Works:

Requirements, design of mix for CC pavement as per BIS/PCA, use of additives, IRC specifications & Tests, joint filler and sealer materials and their testing.

Module 5:

Soil stabilization:

Principle, methods, and tests, proportioning of materials and mix design, application of Rothfutch's method. Marginal and waste materials in road construction, their properties and scope in road construction.

Use of Fly-ash in road embankment and cement concrete mixes, use of chemical stabilizers in road construction. Use of Natural stabilizers; characterization of stabilized mixes.

Course outcomes:

After studying this course, students will be able to:

- Identify and select based on their characteristics the basic construction materials for road construction.
- Design aggregate gradation for construction of pavement layers keeping in mind the density and strength parameters.
- Characterize the binder material for bituminous roads and provide an optimum bituminous mix design.
- Provide mix design procedure and the base layer for a CC pavement.
- Propose soil stabilization techniques for highway construction using locally available materials.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem Analysis.*
- *Usage of modern tools.*
- *Ethical practices and social responsibility.*

Text Books:

1. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee,2015. ISBN-13:9788185240770.
2. E. Ray Brown, Prithvi S. Kandhal, Freddy L. Roberts, Y. Richard Kim, Dah-Yinn Lee, Thomas William Kennedy, "Hot Mix Asphalt Materials, Mixture Design and Construction", 2nd Edition, National Asphalt Pavement Association Research and Education Foundation, Maryland, USA, 2009. ISBN-0692786465, 9780692786468.
3. Prithvi Singh Kandhal, "Bituminous Road Construction in India", PHI Publications,2016, ISBN: 978-81-203-5258-2.
4. Bituminous materials in Road Construction- HMSO Publication.

Reference Books:

1. MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress.
2. Relevant IRC/ASTM codes and specifications
3. Delatte N. J., Concrete Pavement Design, Construction and Performance, CRC Press, Taylor & Franscis Group, 2014.
4. Peter C. Taylor, Steven H. Kosmatka, Gerald F. Voigt, et al., Integrated Materials and Construction Practices for Concrete Pavement: A State of the practice Manual Report No. FHWA HIF-07 – 004, 2007. Available online at https://intrans.iastate.edu/app/uploads/2019/05/IMCP manual pdf, Accessed on March 17, 2020.
5. Neville, A.M., Properties of Concrete, Fifth edition, Pearson, 2012.
6. Mehta, P. K., and Monterio, P. J. M., Concrete: Microstructure, Properties and Materials, Mc Graw Hill, Fourth Edition, 2013.
7. Shin-Che Huang and Herve Di Benedetto., Advances in Asphalt Materials: Road and Pavement Construction, First edition, April 2015.
8. S. K. Khanna and C.E.G Justo., "Highway Materials Testing"- Nem Chand and Bros., Roorkee.
9. "Soil Mechanics for Road Engineers" - HMSO Publication.
10. Highway Handbook ny FAW, Publication from NUS, Singapore.
11. Road and Pavement Construction, Editors: Shin-Che Huang Herve Di Benedetto, Hardcover. ISBN: 9780081002698, eBook ISBN: 9780081002711, Imprint: Woodhead Publishing, Published Date: 1st April 2015, Page Count: 492

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

Subject: Construction Project Management

Subject Code	20CIM13	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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

SDA: Group based assignment on learning project types, its structures and organisational charts.

Module 2

Planning for Construction Projects, Principles of Planning, Objectives, Resource Planning, Scheduling, Productivity chart, Project tracking, Risk Management

SDA: Group based assignment on preparing plan, schedules, productivity charts manually and through software.

Module 3

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

SDA: Group based study on network like AOA, AON and allocating resources in project.

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

SDA: Group based study on effect of using Earned value Management in project and its interpretation on results generated by EVM.

Module 5

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

SDA: Group based study on crashing of network, its uses in construction projects and effects.

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.
3. S. Keoki Sears, Richard H. Clough, Glenn A. Sears, “Construction Project Management: A Practical Guide to Field Construction Management”, John Wiley & Sons, 2008.

References:

1. George.I.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”

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

Subject: Advances in Concrete Technology

Subject Code	20CIM14	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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

Cement – Fundamentals, production, tests, and types of cement. Brief review of Conventional Concrete, constituent materials, and admixtures (mineral and chemical).

Reinforcements: Manufacturing process, types, tests reinforcement steel as per IS Code.

SDA: Carryout experiments and prepare test reports on concrete and reinforcement using appropriate software/tools.

Module 2: Fresh properties of concrete

Rheology of Fresh Concrete: Introduction, Factor affecting the rheology of concrete, Measuring the rheological parameters.

Analysis of Fresh Concrete: Basic Concept - Buoyancy (old BS 1881) method - Constant volume (RAM) method.

SDA: Tests on rheology of fresh concrete using shear box.

Module 3: Hardened properties of concrete

Strength of Concrete: Relationship between cube and cylinder strengths, Relationship between compressive strength and tensile strength, Flexural strength of concrete, Concrete Bond Strength, Relation between compressive strength and modulus of elasticity.

Microstructure of Concrete: General, Basic Concept - Interfacial Transition Zone (ITZ) effect on strength of concrete.

SDA: Expose students to destructive and non-destructive tests on concrete cube and cylinder specimens and develop correlation between the values obtained using appropriate tools.

Module 4: Special Concrete

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

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

SDA: Develop the high-performance concrete mixes and prepare ferro-cement specimens in laboratory.

Module 5: Special Topics

Curing Methods: Steam curing, water curing.

Shotcrete: Definition, Wet mix and dry mix process, general use and advantages.

Under water concreting: Introduction, Basic requirements.

SDA: Group activity on accelerated strength methods of testing.

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”- 5e, Pearson Education India Ltd., ISBN: 978-0273755807, 2012.
2. Mehta P. Kumar & Monteiro, Paulo J.M., "Concrete Microstructure, Properties and Materials", 4e, McGraw Hill Education, ISBN: 978-9339204761, 2017

Reference Books:

1. M. L. Gambhir , "Concrete Technology: Theory and Practice", 5e, Tata McGraw-Hill Education, ISBN: 978-1259062554, 2017
2. Aminul Islam Laskar, "Concrete Technology", 1e, Laxmi Publications, ISBN:978-9381159620, 2013.
3. John Newman and Ban Seng Choo, "Advanced Concrete Technology – Process", ISBN: 0750651059, Elsevier Ltd. 2003.
4. John Newman and Ban Seng Choo, “Advanced Concrete Technology Testing and Quality”, Elsevier Ltd, ISBN 0750651067, 2003.
5. Edward G. Nawy, "Concrete Construction Engineering Handbook", 2e, CRC Press, ISBN – 9780849374920, 2008.
6. Raina V.K., "Concrete for Construction", 2e, Tata-McGraw Hill Publishing Co. Ltd. New Delhi, ISBN: 978-8184047530, 2009.
7. IS: 10262:2019 - Guidelines for Concrete Mix Design proportioning, BIS, New Delhi, 2019
8. N Krishna Raju, “Design of Concrete Mixes”, 5e, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-8123924670, 2018.
9. Current Literatures and relevant IS Codes.

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

Subject: Advances in Pre-Stressed Concrete

Subject Code	20CIM15	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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.
SDA: Group activity – Simple model preparation: Tendons, anchorage, strand, pre-stress concrete element.

Module 2: Losses in Pre-stress
Purpose of calculating losses – Elastic loss; creep; shrinkage; relaxation; anchorage losses and Friction loss.
SDA: Understand reasons for losses in PSC structures through digital resources.

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, Limit state of Serviceability – Stress (IS 1343-1987); Limit state of Collapse – Flexure and Shear (IS 1343-2012).
SDA: Calculation for the stresses and flexural moment carrying capacity of PT element as per IS 1343 using appropriate tools.

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 transfer bond length in pre-tensioned beams; 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.
SDA: Prepare calculation for the deflection (short and long term) of PT elements using appropriate tools.

Module 5: Special Topics
Detailing of Post-tensioned Beams and Slabs, Composite Construction of Pre-stressed and in-situ concrete; Pre-stressed Concrete Poles, Piles, Railway Sleepers – concepts; Construction Methodology of Bonded and Un-bonded PT Slabs.
SDA: Group activity to prepare detailing and quantities of materials for PT slab and PT beam using appropriate software tool or conventional methods.

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 Delhi, 6e, 2018.

Reference Books:

1. Raja Gopalan N, "Pre-stressed Concrete", Narosa Publishing House, New Delhi, 2e, 2010.
2. Pandit and Gupta, “Pre-stressed concrete”, CBS, 2009.
3. Sinha N.C. & Roy, “Fundamentals of Pre-stressed Concrete”, S. C & Co, 1985.
4. Precast/Pre-stressed Concrete Institute Manual, "Fundamentals of pre-stressed concrete design", ISBN-0-937040-02-9.
5. IS: 1343-1987, IS: 1343-2012.
6. Sami Khan and Marin Williams, “Design Guide Post-Tensioned Concrete Floors”, Butterworth-Heinemann Ltd., UK, ISBN: 0750616814, 1995.
7. Handbook on Precast Concrete Buildings, Indian Concrete Institute, Chennai, 2016.

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

Subject: Material Testing Laboratory - 1

Subject Code	20CIML16	CIE Marks	40
Number of Lecture Hours/week	0:4:0	SEE Marks	60
Credits	02	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

- Basic physical properties: Cement, fillers (fly-ash and GGBS) materials, Fine aggregate, and Coarse Aggregates – Natural, Recycled.
- Mix design of normal concrete as per IS 10262: 2019 and ACI 211.1
- Workability of concrete - Slump test, Compaction Factor test and Flow Table test.
- Tests for compressive strength of concrete cubes/cylinder; Split Tensile strength of concrete cylinder and Flexural Strength of concrete beam.
- Test on Soil – Gradation: Wet Sieve Analysis; Index properties, Shear Test, UCS, Compaction Test, and CBR.
- Test on Bituminous materials – Flash and fire, Ductility test, Penetration test; Softening point test, Specific gravity test and Viscosity test.
- 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*

Reference Books:
1. Khanna, S.K., Justo, C.E.G., and A.Veeraragavan, Highway Materials and Pavement Testing, Nem Chand and Bros, Roorkee, 2015.
2. B C Punmia, Ashok Kumar Jain and Anil Kumar Jain, "Soil Mechanics and Foundations", 16e, Laxmi Publications, ISBN: 978-8170087915, New Delhi, 2017.
3. M. S Shetty, A. K Jain, "Concrete Technology – Theory and Practice", 8e, S. Chand& Co. ISBN: 978-9352533800, 2018
4. Relevant IS Codes / standards

RESEARCH METHODOLOGY AND IPR

Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. ■

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. ■

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. ■

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests. ■

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor

Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition,

Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout- Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO. ■

Course outcomes:

At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR. ■

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.■

Textbooks

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.
2. Research Methodology a step-by-step guide for beginners. Ranjit Kumar, SAGE Publications, 3rd Edition, 2011. (For the topic Reviewing the literature under module 2),
3. Study Material, (For the topic Intellectual Property under module 5), Professional Programme Intellectual
4. Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

1. Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
2. Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

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

Subject: Special Concrete

Subject Code	20CIM21	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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
Salient features of concrete mix design as per Indian standard (IS: 10262:2019).
High Strength Concrete: Definition, Mix Proportioning as per IS 10262-2019, Properties and Applications.
SDA: Preparation of design spreadsheets of different Concrete Mixes.

Module 2
Light Weight Concrete: Introduction, Definition, types, Properties and Applications.
Geo-polymer Concrete: Brief history of development, Definition, material characterization, mix proportioning, properties, and applications.
SDA: Characterisation of light weight and geo-polymer concrete / blocks.

Module 3
Self-compacting concrete: Introduction, Materials, Mix design of SCC as per IS 10262-2019, Fresh Properties of SCC - Filling, Passing and Segregation resistance, Hardened Properties of SCC – Compressive strength, Production and transportation, Placement and SCC application.
SDA: Group activity - Developing SCC mixes by other than IS method.

Module 4
Fiber-reinforced Concrete: Brief Introduction on FRC, Properties of fibres and matrices, Theoretical stress–strain curves in uniaxial tension, Fresh concrete and Hardened concrete, Applications.
Roller Compacted Concrete: Introduction, Materials, Mix design as per IS 10262-2019, Fresh and Hardened Properties of mass concrete.
SDA: Group activity - Application of the fibers in construction materials.

Module 5
Recycled concrete: Introduction, Properties of recycled aggregate, Methods of recycling and quality, Applications.
CLSM: Brief Introduction, Materials and Properties as per ACI 229R, Applications.
SDA: Group activity – Develop concrete for low strength applications using un-conventional and recycled materials.

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”, 5e, Pearson Education India, ISBN: 978-8131791073, 2012.
2. Mehta P. Kumar & Monteiro, Paulo J.M., "Concrete Microstructure, Properties and Materials", 4e, McGraw Hill Education, ISBN: 978-9339204761, 2017.

References:

1. John Newman and Ban Seng Choo, “Advanced Concrete Technology”, ISBN: 0750651059, Elsevier Ltd., 2003
2. Dr. Edward G Nawy, “Concrete Construction Engineering Handbook”, 2e, CRC Press, ISBN: 9780849374920, 2008.
3. Joseph A. Daczko, “Self-Compacted Concrete by-Applying what we know”, 1e, CRC Press, ISBN: 978-0415590648, 2012.
4. IS: 10262:2019 - Guidelines for Concrete Mix Design proportioning, BIS, New Delhi, 2019.
5. ACI 229R - Report on Controlled Low-Strength Materials, June 2013.
6. ASTM D 6103: Standard Test Method for Flow Consistency of Controlled Low Strength Material.
7. Current Literatures.

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

Subject: Contract Management

Subject Code	20CIM22	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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.
SDA: Group based assignment on comparing contract documents of different categories of project.

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.
SDA: Group based study on preparing a contract agreement process for a given project.

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.
SDA: Group based study on listing roles and responsibilities of principal and Contractor for a contract.

Module 4:
Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages.
SDA: Group based assignment on case study of breaches.

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.
SDA: Group based assignment on preparing a contract document for a given project inclusive of DRB and its evaluating case studies.

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
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – 2

Subject: Prefabricated Structures

Subject Code	20CIM23	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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.

SDA: Group activity - Prepare simple models on elements like slab, beam, and column to understand their behavior in prefab structures.

Module 2

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

SDA: Prepare simple building plan (prefab structure) using modular coordinate system.

Module 3

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

SDA: Prepare detailing of conventional slab, flat slab using appropriate tools.

Module 4

Precast concrete Beams: Introduction - Types of beams – non composite and composite beams - design and detailing of R C precast non composite beams.

Walls: Types of wall panels - load bearing wall- stability of wall panels – construction procedure of pre-cast walls.

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

SDA: Prepare the detailing of conventional beams and column manually through sketches/appropriate software tools.

Module 5

Components of Industrial Building (Single-Storey) - Purlins, Principle Rafter, Roof Truss, Gantry Girders, Corbel, Column, Bracings.

Precast Reinforced Concrete Truss – General, Requirement for Design of Truss, Reinforcement as per IS: 3201-1988, Construction Sequence.

Purlins – Design Procedure only.

Pre – Cast Columns – Design Procedure only.

Corbel- General Consideration as per IS-456:2000, Initial Dimensioning of Corbels as per BS 8110, Design of Corbel - Step by Step Procedure as per BS 8110.

SDA: Visit to nearby site or pre-cast plant.

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, ISBN: 978-3433029602, 2011.

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

Subject: Construction Equipment and Safety Management

Subject Code	20CIM241/20CHT241	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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 and its Management', Khanna Publications.
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.

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

Subject: Bridge and Grade Separated Structures

Subject Code	20CIM242	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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", World Scientific Publishing Company, ISBN: 978-9812818614, 2009.
2. Victor. D. J, "Essentials of Bridge Engineering", 6e, Oxford IBH, ISBN: 978-8120417175, 2019

References:

1. Ponnuswamy. S, "Bridge Engineering", 2e, Tata McGraw Hill, ISBN: 978-0070656956, 2008.
2. Raina V.K., "Concrete for Construction", 2e, Tata-McGraw Hill Publishing Co. Ltd. New Delhi, ISBN: 978-8184047530, 2009.
3. Derrick Beckett, "An Introduction to Structural Design of Concrete Bridges", Surry University Press, Oxford Shire, 1973.
4. Ken Fleming, Austin Weltman, Mark Randolph and Keith Elson, "Piling Engineering", 3e, Taylor and Francis, UK, ISBN: 978-0415266468, 2009.
5. IRC: 5 - 2015 Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design (Eighth Revision).
6. IRC: 6 - 2017 Standard Specifications and Code of Practice for Road Bridges, Section-II Loads and Load Combinations (Seventh Revision).
7. IRC: 22 - 2015 Standard Specifications and Code of Practice for Road Bridges, Section VI – Composite Construction (Limit States Design) (Third Revision).

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

Subject: Ground Improvement Techniques

Subject Code	20CIM243/20CHT243	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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, ISBN: 978-0070272798, 1991.
2. Robert M. Koerner, "Construction and Geotechnical methods in Foundation Engineering", McGraw- Hill Pub. Co., New York, ISBN: 978-0070352452, 1984.

References

1. Winterkornand Fang, "Foundation Engineering Hand Book" - Van Nostrand Rein hold Co., New York, 1975
2. Aris C. Stamatopoulos & Panaghiotis C.Kotzios,"Soil Improvement by Preloading", John Wiley & Sons Inc. Canada, ISBN: 978-0471815938, 1985.
3. P. Purushothama Rao, "Ground Improvement Techniques", 2e, Laxmi Publications, ISBN: 978-8131805947, 2016.

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

Subject: Soil Mechanics for Pavement Engineers

Subject Code	20CIM244/20CHT244	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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

Special attention for subgrade condition: Problematic soils, compressible & collapsible soils, swelling, subsurface water, frost-susceptible soils.

Surface drainage: Sub-surface drainage, methods, Design of subsurface drainage system, soil stabilization, soil encapsulation. Base layer requirement-erodibility of bases, bound bases, modified or treated bases, base reinforcement.

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. Landslides – definition, classifies, factors producing.

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 and Veeraragavan, Revised 10th Edition, Nem Chand and Bros.,

Reference Books:

1. Geotechnical Aspects of Pavement Reference Manual, US department of transportation, Publication no: FHWA NHI-05-037, Federal Highway Administration, May 2006, NHI Course No: 132040.
2. "Soil Mechanics & Foundation Engineering" – K.R. Arora Standard Publishers Distributors.
3. "Soil Mechanics for road Engineers" – HMSO, London.
4. IRC – Relevant Codes.

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	20CIM251	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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, ISBN: 9788120328921, 2006.
2. S. K. Duggal, “Earthquake Resistant Design of Structures”, 2e, Oxford University Press, New Delhi, ISBN: 978-0198083528, 2013.

References:

1. Damodaraswamy S. R and Kavitha. S, “Basics of Structural Dynamics and Aseismic Design”, PHI Publication, 1e, ISBN: 978-8120338432, 2009.
2. IS 1893 (Part I): 2016, IS 13920-2016, IS 4326: 2013, IS 13828: 2013 and other relevant codes

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

Subject: Structural Masonry

Subject Code	20CIM252	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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.

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., 2e, ISBN 10: 0333733096 ISBN 13:9780333733097, 1998.
2. Jagadish K S, "Structural Masonry", I K International Publishing House Pvt. Ltd., ISBN 10 - 9384588660, ISBN 13: 978-9384588663, 2015.

Reference Books:

1. W. Robert G Drysdale; Ahmad A Hamid, Masonry structures: Behavior and Design. Boulder, CO: Masonry Society, 3e, ISBN: 1929081332; ISBN: 978-1929081332, 2008.
2. Sven Sahlin, "Structural Masonry"- Prentice Hall Publisher: Prentice Hall, ISBN-10: 0138539375, ISBN-13: 978-0138539375, 1971.
3. Jagadish K S, "Sustainable Building Technologies", IK International Publishing House Pvt. Ltd., ISBN: 978-93-86768-20-9, 2019.

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

Subject: Highway Construction Technology

Subject Code	20CIM253	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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

Plants and Equipment:

Components of pavement structure, functions and requirements.

Plants and equipment: Excavators, graders, compactors, crushers, bituminous hot mix plants, cement concrete mixers, pavers - uses in road construction.

Module 2

Construction of Subgrade and Subbase:

Specifications and steps for construction of subgrade, subbase, quality control tests.

Construction of granular layers: Specifications and steps of construction, WBM, WMM, CRM, quality control tests.

Construction of Bituminous Layers: Different types of bituminous layers, specifications and construction of bituminous layers, quality control tests.

Module 3

Construction of Cement Concrete Pavements:

Specifications and steps for construction of DLC, Paving Quality Concrete pavements, quality control tests.

Specifications and steps for construction of White topping, Interlocking concrete block pavements, quality control tests.

Safety during Construction: Safety aspects during construction and maintenance works, road safety furniture.

Module 4

Drainage:

Assessment of drainage requirements for the road, design of various drainage components, drainage materials, surface and sub-surface drainage system for roads, drainage of urban roads.

Module 5

Maintenance and Rehabilitation of bituminous and concrete pavements:

Routine and periodic maintenance, preventive and reactive maintenance for drainage and pavements, Preparation of existing pavement for patching, profile correction, special measures to deal with reflection cracks in pavement overlays, requirements for rehabilitation, recycling.

Recycling of pavements- cold recycling, hot recycling, Full Depth Reclamation, road construction in water logged areas, design & construction of RE walls to be added.

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.
- Analyze the defects in road construction and general pavement failures and propose suitable remedies.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Critical thinking.*
- *Ethical practices and social responsibility*
- *Use of modern tools*

Text Books:

1. "Highway Engineering", Khanna and CEG Justo, A. Veeraragavan, Revised 10th edition, published by Nem Chand & Bros, Roorkee, ISBN:978-81-85240-80-0.
2. Prithvi Singh Kandhal, "Bituminous Road Construction in India", ISBN: 978-8120352582.
3. Delatte N. J., Concrete Pavement Design, Construction, and Performance, CRC Press, Taylor & Francis Group, 2014.

Reference Books:

1. MoRTH "Specifications for Roads and Bridge Works"- 2013 Fifth revision, Indian Roads Congress.
2. MoRTH "Manual for Construction and Supervision of Bituminous Works"- 2001, Indian Roads Congress.
3. MoRTH "Manual for Maintenance of Roads"- 1989, Indian Roads Congress.
4. "Pavement Drainage- Theory and Practice", G.L. Shivakumar Babu, Prithvi S Kandhal, Nivedya Mandankara Kottayi, Rajib Mallick, A. Veeraragavan, CPC Press.
5. 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.
6. National Asphalt Pavement Association "Hot Mix Asphalt Paving Hand book"- 5100 Forbes Boulevard, Lanhm, Mary Land, USA.
7. "Hand Book on Cement Concrete Roads"- Cement Manufacturers Association, New Delhi.
8. Relevant IRC Codes.

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

Subject: Low Volume Roads Engineering

Subject Code	20CIM254/20CHT254	CIE Marks	40
Number of Lecture Hours/week	4:0:0	SEE Marks	60
Credits	04	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

Introduction to Low-Volume Roads (LVR). Significance of LVR, Definition, Design Environments.

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 fly ash 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, maximize use of Locally available materials, Use of Geo-synthetics in LVR.

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 sub-base, gravel roads.

Pavement Maintenance and Rehabilitation Management System (RMS) for LVR.

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)

- *Critical thinking.*
- *Problem Analysis.*
- *Use of modern tools*
- *Project management and finance*

Text Books:

1. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10th Edition.
2. Robert A. Douglas, Low-Volume Road Engineering, Design, Construction, and Maintenance, I edition, CRC Press

Reference Books:

1. IRC: SP:72-2015, Guidelines for the design of Flexible Pavements for Low Volume Roads, First Revision
2. IRC: SP:62-2014, Guidelines for Design & Construction of CC pavements for low volume roads
3. IRC SP 20 Rural Roads Manual.
4. Ministry of Rural Road Development publications.
5. Relevant IRC 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	20CIML26	CIE Marks	40
Number of Lecture Hours/week	0:4:0	SEE Marks	60
Credits	02	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 Proportion of Concrete (using partial replacement of fly-ash or GGBS) as per IS -10262-2019.
- Self-Compacting Concrete – Fresh and hardened properties- as per IS - 10262-2019
- High Strength Concrete – Fresh and hardened properties - as per IS - 10262-2019.
- Mass Concrete – Fresh and hardened properties - as per IS - 10262-2019.
- Permeability tests on hardened concrete – Demonstration.

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

- Determine the mix proportion of normal concrete and effect of filler on fresh and Hardened Properties through experiments.
- Development of Special concrete mixes like SCC, HSC and Mass Concrete.
- Determine the Fresh and hardened properties of special concrete mixes like SCC, HSC and Mass Concrete.

Graduate Attributes (as per NBA)

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

References:

1. Relevant IS Codes / Standards
2. IS: 10262:2019 - Guidelines for Concrete Mix Design proportioning, BIS, New Delhi, 2019.
3. John Newman and Ban Seng Choo, “Advanced Concrete Technology – Process” ISBN 07506 5105 9, Elsevier Ltd, 2003.
4. Dr. Edward G Nawy, “Concrete Construction Engineering Handbook”, 2e, CRC Press, ISBN: 9780849374920, 2008.
5. Joseph A. Daczko, “Self-Compacted Concrete by-Applying what we know”, 1e, CRC Press, ISBN: 978-0415590648, 2012.

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

Subject: Infrastructure Construction Methods

Subject Code	20CIM31	CIE Marks	40
Number of Lecture Hours/week	3:0:2	SEE Marks	60
Credits	04	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 Formwork and High-Rise RC Structures Construction

General, formwork - Beams, Slabs (normal and flat slabs), Columns, Foundations (shallow), Shear Walls, Calculation of Horizontal Formwork Pressure as per ACI.

Erection techniques of High-Rise Building - Slip form - Jump form – Climb form – Table form.

SDA: Field visit to nearer high-rise building construction.

Module 2: Segmental and Cantilever Construction

General Construction of RC and PSC Bridges; Types of superstructure construction - Deck Slab, T-beam, and Box girder deck; Erection of Segments – Form travelers and Launching girders.

Construction of Segmental Bridges – Balance Cantilever Method, Span by Span method, Incremental Launching Method, Progressive placement method.

SDA: Field visit to BMRCL metro works.

Module 3: Composite Construction

Composite Construction – General, Terminology, Advantages, Applications; Construction of Composite Floor Systems; Construction of Composite Beams Systems; Construction of Composite Columns (fundamentals).

Construction of Steel Frame Structures – Construction procedure only.

SDA: Group activity - Geo-synthetics material for different structural applications.

Module 4: Tunnel Construction

Tunnel Construction and methodologies: General, Types of Tunnels, Tunnel Constructions – Open cut method, Cut and Cover method, Tunnel Boring method (TBM), New Austrian Tunnelling Method (NATM). Repair of Tunnels: Short Term Repairs, Long Term Repair, Reconstruction and New Construction.

SDA: Field visit to BMRCL metro works.

Module 5: Special Structure Construction

Top and down construction Methods: General construction sequence for Building tower constructions.

Transmission Towers: General Construction procedure of transmission towers.

Demolition and Dismantling of Buildings - Building Demolition Process.

SDA: Group activity - Understanding demolition equipment and techniques.

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.
8. Relevant IRC Codes.

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

Subject: Foundation Technology

Subject Code	20CIM321	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	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, ISBN: 0824708733, 2003
2. C. Venkatramaiah, "Geotechnical Engineering", 5e, New Age International (P) Ltd., ISBN: 978-9386070135, 2017.

References:

1. Tomlinson M J, "Foundation Design and Construction", 7e, Pearson Education, ISBN: 978-0130311801, 2001.
2. Bowles Joseph E, "Foundation Analysis and Design", 5e, McGraw Hill, ISBN: 978-0071188449, 2001.
3. Braja M. Das, "Principles of Foundation Engineering", 7e, Cengage Learning (SI Unit Edition), ISBN: 978-0495668121, 2007.
4. B C Punmia, "Soil Mechanics and Foundations", 16e, Laxmi Publications (P) Ltd., ISBN: 978-8170087915, 2017.
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", 5e, Taylor & Francis, ISBN: 978-0415385824, 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	20CIM322	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	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

Durability And Deterioration

Introduction, Durability of concrete, Causes of distress in concrete structures, Chemical attack on the concrete – Sulphate attack, Chloride attack, Carbonation attack, Alkali Aggregate Reaction.

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

Module 2

Damage Assessment

Introduction, Purpose of assessment, Investigation of damage, Observation, Damage assessment procedure.

Destructive Testing system- Testing system of hardened concrete, Direct Load tests.

Non-Destructive Testing – Rebound Hammer, Ultrasonic Pulse Velocity.

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

Selection of Repair Materials, Classification of repair materials, Grouts, Resin based materials, Sealing materials, Sealant types and properties, Water proofing materials, Bonding materials, Polymer resin-based materials, Cement based coatings, Bituminous materials, SIFCON and SIMCON materials.

Module 4

Repair of Cracks

Introduction, Factors effect cracking, Measure of cracking, Stages of concrete repair, Types and classification of repair, Methods of Repair- Resin injection, Routing and sealing, Stitching, Dry packing, External stressing, Bonding, Polymer impregnation, Vacuum impregnation.

Rehabilitation Techniques

Introduction, Replacement mortar, Resin Injection, Dry packing, Sprayed Concrete, Grouting, Slab Jacketing, Tremie concrete. Epoxy bonded dry pack.

Module 5

Strengthening Techniques

Introduction, Need for Strengthening, Structural concrete repair, Structural repair technique for R C structure, Jacketing technique, External Post-tensioning, Externally bonding technique, Externally bonded mild steel plates, Strengthening by SIMCON, Section enlargement.

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. B. Vidivelli, "Rehabilitation of Concrete Structures", 1e, Standard Publishers, ISBN: 978-8180141102, 2009.

References:

1. Ted Kay, "Assessment and Renovation of Concrete Structures", 1e, Longman Scientific & Technical, ISBN: 978-0582057791, 1992.
2. R. T. L. AIlen and S. C. Edwards, "Repair of Concrete Structures", 1e, Blackie & Son, ISBN: 978-0751400861, 1993.
3. Sidney M. Johnson, "Deterioration, Maintenance and Repair of Concrete Structures", McGraw- Hill Book
4. P. H. Perkins, "Repair, Protection and Water proofing of Concrete Structures", 3e, CRC Press, ISBN: 978-0419202806, 1997.
5. R. N. Raikar, "Diagnosis and Treatment of Structures in Distress", Structwel D & C Pvt. Ltd, 1994
6. Ransem W. H, "Building Failures", E & F.N, SPON Ltd, 1981.
7. Ralph Haas, Ronald Hudson and Zaneiswki, "Modern Pavement Management", Kreiger Publications, ISBN: 978-0894645884, 1994.
8. Peter H. Emmons, "Concrete Repair and Maintenance", John Wiley & Sons, ISBN: 978-0876292860, 2002.
9. S. Champion, "Failure and Repair of Concrete Structures", John Wiley & Sons, 1961.
10. Handbook on Concrete Durability, Indian Concrete Institute, Chennai, 2019.
11. Peter H. Emmons, Brandon W. Emmons (Illustrator), Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques, ISBN: 978-0876292860, 1992.
12. Concrete Repair manual (2nd Edition). International Concrete Repair Institute, 2007.

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

Subject: Special Problems in Road Construction

Subject Code	20CIM323/20CHT323	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	Exam Hour	03

Course objectives:

This course will enable students to

- Understand the difficulties of road construction in weak and marshy soils and necessary to be taken during design and construction.
- Understand the methods of strengthening soil fills and embankments to improve their performance as pavement component layer.
- Understand the difficulties associated with construction of high embankments and maintaining stability of hill slopes with precautions to be taken.
- Understand the use of recycled materials in road construction including milled bituminous waste with necessary design methodology
- Understand the design and construction of roads in coastal and desert environments with exclusive exposure conditions.

Modules

Module 1

Problems of construction of roads in marshy areas and weak / expansive soils and water- logged - areas. Various effective measures for solving the problems, machinery required and method of construction. Control of water table, capillary rise and seepage flow in road construction. Design and construction of filter drains and capillary cut-off. Construction of subgrade in marshy areas and weak / expansive soils and water-logged areas.

Module 2

Methods of strengthening weak foundation soil, acceleration of consolidation and settlement of compressible embankment foundation, Vertical Sand drains – application, design and construction method.

Module 3

Problems in construction of high embankments, stability of foundation and embankment slopes. Stability of hill slopes, control of erosion.

Module 4

Use of special materials such as geo-synthetics for drainage and in pavement layers. Use of reinforced earth retaining walls, Nailing Technique, Techniques of pavement construction using recycled materials – cold and hot mix recycling of bituminous materials.

Module 5

Special construction techniques - construction techniques of cell filled concrete pavements – design, economics and construction method, and its application. Road construction on desert region and coastal areas, alternative methods, Special problems in construction & maintenance of hill roads, land slide, causes, investigation, and preventive and remedial measures, protection of embankment and cut slopes.

Course outcomes:

After studying this course, students will be able to:

- Get the knowledge about the difficulties of road construction in weak and marshy soils and the precautions to be taken.
- Suggest improvement methods of strengthening soil fills and embankments to be a pavement layer.
- Know the difficulties associated with construction of high embankments and maintaining hill slopes stability
- Use recycled materials in road construction with appropriate design methods.
- Provide design and construction methods for roads in coastal and desert environments.

Graduate Attributes (as per NBA)

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

Text Books:

1. R.M. Koerner "Designing with Geosynthetics"- 4th Edition Prentice Hall, New Jerssey, 1997
2. Geotechnical Aspects of Pavements-Reference Manual / Participant Workbook, U.S. Department of Transportation, FHWA NHI-05-037 Federal Highway Administration, May 2006.
3. Pavement Drainage - Theory and Practice", G.L. Shivakumar Babu, Prithvi S Kandhal, Nivedya Mandankara Kottayi, Rajib Mallick, A. Veeraragavan, CRC Press.

References:

1. IRC-75 "Guidelines for the design of High embankments"- IRC, 2015.
2. Leonards G.A. "Foundation engineering"- McGraw Hill Book Company, New York, 1962.
3. Cedgreen H.R. "Drainage of highway and airfield pavement"- John Willey and Sons.Inc., New York, 1974.
4. G. Kassiff, M. Livnet, G. Wisemen "Pavements on Expansive clays"– Jerusalem Academy Press, Jerusalem. Israel, 1969.
5. R.D. Krebs & R.D. Walker "Highway Materials"- McGraw Hill Book House, New York, 1971.

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

Subject: Sustainable Constructions

Subject Code	20CIM324/20CHT324	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	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*

Text Books:

1. K S Jagadish, B V Venkataramana Reddy, K S Nanjunda Rao, “Alternative Buildings Materials and Technologies”, 2e, New Age International Publishers, New Delhi, ISBN: 978-9385923876, 2017
2. K S Jagadish, “Sustainable Building Technologies”, IK International Publishers Pvt. Ltd, New Delhi, ISBN: 978-9386768209, 2019.

References

1. Moore F: Environmental Control System McGraw Hill, Inc., 1994.
2. JMPQ Delgado, “Sustainable Materials in Building Construction”, Volume 11, Building Pathology and Rehabilitation, Springer, ISBN 978-3-030-46799-9 ISBN 978-3-030-46800-2 (eBook), 2020
3. Brown, G Z, Sun, Wind and Light: Architectural design strategies, John Wiley, 1985

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

Subject: Construction Quality and Material Management

Subject Code	20CIM331	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	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	20CIM332	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	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

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

Subject: Transportation Planning

Subject Code	20CIM333/20CHT333	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	Exam Hour	03

Course objectives:

This course will enable students to

- Understand the different modes of transportation and factors affecting planning process for an effective transportation system.
- Understand the characteristics of mass transit system and methods of collecting traffic data to propose an effective transport facility.
- Understand and sources of zonal trip generation or attraction and then inter-zonal trip distribution methods.
- Analyse the mode of transport and its impact on transport system and also the methods of assigning travel trips to various routes for effective management.
- Understand the mass transportation options and evaluation of the systems for economic sustainability.

Modules

Module 1

Urbanization Process: Urban growth mechanism – Urban morphology - Urbanisation & travel demand - Urban development planning policy – NUTP - Urban transport projects - Urban transport problems in India.

Urban Transport Planning Process: Urban travel patterns - Study area delineation- Zoning - Planning surveys - Urban activity system- Sustainable urban transport - Systems approach.

Module 2

Travel Demand Estimate: Trip based and activity-based approach - Four stage travel demand modeling - Data needs and outputs - Quick response techniques - Survey designs.

Trip Generation: Productions & Attractions - Influential factors –Trip rate analysis- Category analysis- Simple & Multiple linear regression models – FHWA method.

Module 3

Trip Distribution: Interchange matrix – Growth factor methods – Synthetic methods calibration of Gravity model.

Modal Split: Influential factors – FHWA Procedure – Diversion curves & surfaces- Discrete choice models, Concept, Types, BL, MNL & HL models.

Module 4

Trip Assignment: Trip Assignment procedure – Diversion curves- BPR model - All or Nothing assignment - Multipath assignment - Capacity restraint assignment – User equilibrium and system equilibrium approach - Stochastic assignment approach.

Module 5

Land Use Transport System: Urban system components - Urban spatial structure Accessibility - Location theory - Land use models - Land use transport models, Lowry & Garin – Lowry models.

Urban public transportation: Urban growth and public transport needs - Transit mode classifications – Transit characteristics - Fleet size and capacity estimation. Use of softwares: TransCAD, CUBE.

Course outcomes:

After studying this course, students will be able to:

- Get the knowledge of different modes of transportation and factors affecting the planning process for the different modes.
- Propose effective transport facility for the mass transportation after collecting the data required.
- Compute the inter-zonal trip generations or attractions and also the trip distributions.
- Analyse the impact of transport mode on the transport system to understand effective management along the routes.
- Evaluate the economic sustainability of the mass transportation systems.

Graduate Attributes (as per NBA)

- *Scholarship of Knowledge.*
- *Problem solving.*
- *Usage of modern tools*
- *Interpretation of data.*

Text Books:

1. Hutchinson, B.G., "Principles of Urban Transport System Planning"– McGraw Hill Book Co.
2. L.R. Kadiyali, "Traffic Engineering and Transportation Planning"– Khanna Publication.
3. Khisty C J., Lall B.Kent, Transportation Engineering – An Introduction, Prentice-Hall, NJ, 2005
4. Ortuzar, J. D., Willumsen, L.G., Modeling Transport, John Wiley & Sons, 1994
5. Papacostas C.S. and Prevedouros, P.D., Transportation Engineering & Planning, PHI, New Delhi,2002
6. Chakroborty P., Das N., Principles of Transportation Engineering, PHI,New Delhi,2003
7. Dickey J.W., Metropolitan Transportation Planning, Tata Mc-Graw Hill 1980

Reference Books:

1. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning
2. Institute of Traffic Engineers – "An Introduction to highway Transportation Engineering", ITE, USA
3. Bowmen, J. and M. ben-Akiva, Activity based travel Forecasting; in Activity based travel forecasting. Washington, DC: U.S. Department of Transportation, Report DOT-97-17.
4. Bruton M.J., Introduction to Transportation Planning, Hutchinson of London, 1988

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	20CIM334/20CHT334	CIE Marks	40
Number of Lecture Hours/week	3:0:0	SEE Marks	60
Credits	03	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)", 1e, McGraw Hill Professional, ISBN: 978-0071713382, 2010.

References:

1. V M Tam, Chi Ming Tam, "Reuse of Construction and Demolition Waste in Housing Development", Nova Science Publishers, ISBN: 9781604563627, 2008.
2. JMPQ Delgado, "Sustainable Materials in Building Construction", Volume 11, Building Pathology and Rehabilitation, Springer, ISBN 978-3-030-46799-9 ISBN 978-3-030-46800-2 (eBook), 2020
3. Current Literature.