

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.



## Semester-I

Scheme of Teaching and Examinations and Syllabus  
**M.Tech., Infrastructure Engineering and Management**  
(Effective from the Academic year 2022-23)

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Scheme of Teaching and Examinations -2022-23**  
**M.Tech ( Infrastructure Engineering and management)(CEM)**  
**Choice Based Credit System (CBCS) and Outcome-Based Education(OBE)**

**I SEMESTER**

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical/Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	BSC	22CEM11	Statistical Methods	03	--	--	03	50	50	100	3
2	IPCC	22CEM12	Modern Construction Materials and Technology	03	02	--	03	50	50	100	4
3	PCC	22CEM13	Infrastructure Planning and Management	03	--	02	03	50	50	100	4
4	PCC	22CEM14	Construction Equipments and Management	02	--	02	03	50	50	100	3
5	PCC	22CEM15	Prefabrication and Construction Technology	02	--	02	03	50	50	100	3
6	MCC	22RMI16	Research Methodology and IPR	03	--	--	03	50	50	100	3
7	PCCL	22CEML17	Construction materials Lab 1	01	02		03	50	50	100	2
8	AUD/AEC	22AUD18/ 22AEC18	BOS recommended ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
<b>TOTAL</b>				<b>17</b>	<b>04</b>	<b>06</b>	<b>21</b>	<b>350</b>	<b>350</b>	<b>700</b>	<b>22</b>

Note: BSC-Basic Science Courses, PCC: Professional core Courses. IPCC-Integrated Professional Core Courses, MCC- Mandatory Credit Course, AUD/AEC –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree)

**Integrated Professional Core Course (IPCC):** These refer to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

**Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses):** These are prerequisite courses suggested by the concerned Board of Studies. Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs.

**Ability Enhancement Courses:**

- These courses are prescribed to help students to enhance their skills in fields connected to the field of specialisation as well as allied fields that leads to employable skills. Involving in learning such courses is impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.
- The Audit/ Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

**Skill development activities:** Under Skill development activities in a concerned course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help for evolving creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldworks.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different soft-wares/tools to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Students and the course instructor/s to involve either individually or in group to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

**Semester-I**

<b>STATISTICAL METHODS</b>			
Course Code	<b>22CEM11</b>	CIE Marks	50
Teaching Hours/Week (L:P: S)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 Hours of Teaching	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course objectives:</b></p> <ul style="list-style-type: none"> <li>To study the concepts of Statistical methods and its applications in Engineering.</li> <li>To study the effect of estimation theory, testing of hypothesis, correlation and regression, randomized design, and multivariate analysis.</li> </ul>			
<p><b>Teaching-Learning Process (General Instructions)</b>            These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1.Blackboard teaching/PowerPoint presentations (if needed)</li> <li>2. Regular review of students by asking questions based on topics covered in the class.</li> <li>3. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.</li> <li>4. Encourage the students for group learning to improve their creative and analytical skills</li> </ol>			
<b>Module-1</b>			
<b>DESCRIPTIVE STATISTICS</b> - Definition of Statistics, Methods of collection of data, Presentation of data, Types of variables, Scales of measurement, Measures of Central tendency, Measures of Variation.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-2</b>			
<b>PROBABILITY AND DISTRIBUTION.</b> - Basic probability, sample space, events, axioms of probability conditional probability, independent events. Random variables, continuous/Discrete random variables, exception, Variance, covariance, conditional distributions, Baye's Theorem.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-3</b>			
<b>TESTING OF HYPOTHESIS</b> -Sampling distributions - Small and large samples -Tests based on Normal, t, Chi square, and F-distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-4</b>			
<b>DESIGN OF EXPERIMENTS</b> -Analysis of variance – One way and two way classifications – Completely randomized design Randomized block design – Latin square design - 22 Factorial design.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-5</b>			
<b>CORRELATION AND REGRESSION</b> -Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order co - efficient.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		

**Course outcome (Course Skill Set)**

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

1. Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
2. Use statistical tests in testing hypotheses on data.
3. Concept of linear regression, correlation, and its applications.
4. List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
5. Perform exploratory analysis of multivariate data, such as multivariate normal density, Calculating descriptive statistics, testing for multivariate normality. The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.

**Suggested Learning Resources:****Text Books**

1. Gupta.S.C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 11th Edition, 2002.10
2. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2014.

**Reference Books**

1. Johnson, R.A. and Wichern, D. W. "Applied Multivariate Statistical Analysis", Pearson Education, Asia, 6th Edition, 2007.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Rice, J.A. "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.

**Web links and Video Lectures (e-Resources):**

- <https://www.digimat.in/nptel/courses/video/111105077/L21.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignment
- Seminars

**Semester - I**

<b>MODERN CONSTRUCTION MATERIALS AND TECHNOLOGY</b>			
Course Code	<b>22CEM12</b>	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:02:00	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
<b>Course objectives:</b>			
<ul style="list-style-type: none"> <li>• Know the different types of special concrete and also its properties and applications</li> <li>• Understand the applications of different types of metals and coatings</li> <li>• Explain the different composite and advanced materials used in construction</li> <li>• Select suitable techniques for constructions of substructures</li> <li>• Select appropriate techniques for construction of superstructure</li> </ul>			
<b>MODULE-1</b>			
<b>SPECIAL CONCRETES</b>			
Concretes, Behaviour of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self Compacting Concrete, Alternate Materials to concrete on high performance & high Strength concrete			
<b>Teaching-Learning Process</b>	Chalk and talk, Power point Presentation, videos		
<b>MODULE-2</b>			
<b>METALS</b> Types of Steels – Manufacturing process of steel – Advantages of new alloy steels – Properties and advantages of aluminium and its products – Types of Coatings & Coatings to reinforcement – Applications of Coatings			
<b>Teaching-Learning Process</b>	Chalk and talk, Power point Presentation, videos		
<b>MODULE-3</b>			
<b>COMPOSITES AND OTHER MATERIALS</b>			
Types of Plastics – Properties & Manufacturing process – Advantages of Reinforced polymers–Types of FRP–FRP on different structural elements – Applications of FRP -Types and properties of Water Proofing Compounds – Types of Non- weathering Materials and its uses – Types of Flooring and Facade Materials and its application Types & Differences between Smart and Intelligent Materials - Special features – Case studies showing the applications of smart & Intelligent Materials.			
<b>Teaching-Learning Process</b>	Chalk and talk, Power point Presentation, videos		
<b>MODULE-4</b>			
<b>SUB STRUCTURE CONSTRUCTION</b>			
Box jacking- pipe jacking- under water construction of diaphragm walls and basement- tunnelling Techniques - cable anchoring and grouting-driving diaphragm walls, sheet piles, laying operations for built up offshore system- shoring for deep cutting- large reservoir construction –trenchless technology			
<b>Teaching-Learning Process</b>	Chalk and talk, Power point Presentation, videos		
<b>MODULE 5</b>			
<b>SUPERSTRUCTURE CONSTRUCTION FOR BUILDINGS</b>			
Vacuum dewatering of concrete flooring - concrete paving Technology, Techniques of construction for continuous concreting , Operation in tall buildings of various shapes and varying sections – launching techniques- suspended form work -erection techniques of tall structures, Large span structures- launching techniques for heavy decks, In situ pre-stressing in high rise structures, aerial transporting, handling, erecting lightweight components on tall structures			



<b>Teaching-Learning Process</b>	Chalk and talk, Power point Presentation, videos
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**PRACTICAL COMPONENT OF IPCC** (*May cover all / major modules*)

<b>Sl.NO</b>	<b>Experiments</b>
1	To determine the physical properties of Cement as per BIS Codes.
2	To determine flakiness and elongation index of coarse aggregates
3	To determine silt in fine aggregate.
4	Determination of specific gravity, moisture and water absorption of aggregates
5	Determination of bulk density and voids of aggregates.
6	Determination of particle size distribution of fine, coarse aggregate by sieve analysis (grading of aggregate)
7	To determine necessary adjustment for bulking of fine aggregate.
8	Tension test on mild steel and HYSD bars.
9	Compression test on mild steel, cast iron and wood
10	Tests on Bricks, Tiles and Concrete Blocks.
11	<b>Can be Demo experiments for CIE</b>
12	<b>Can be Demo experiments for CIE</b>

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**CIE for the theory component of IPCC**

1. Two Tests each of **20 Marks**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

**CIE for the practical component of IPCC**

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

#### **SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).**

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE))

#### **Suggested Learning Resources:**

##### **Books**

1. ACI Report 440.2R-02, "Guide for the design and construction of externally bonded RP systems for strengthening concrete structures", American Concrete Institute, 2002.
2. Aitkens, High Performance Concrete, McGraw Hill, 1999
3. Ashby, M.F. and Jones. D.R.H.H. "Engineering Materials 1: An introduction to Properties, applications and designs", Elsevier Publications, 2005.
4. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998.
5. Ganapathy, C. "Modern Construction Materials", Eswar Press, 2015.
6. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
7. Santhakumar. A.R. "Concrete Technology", Oxford University press, New Delhi.
8. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
9. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2005.
10. Jerry Irvine, "Advanced Construction Techniques", C.A. Rocketr, 1984
10. Sankar S.K. and Saraswathi. S, "Construction Technology", Oxford University Press, New Delhi, 2008.

##### **Web links and Video Lectures (e-Resources):**

<https://www.digimat.in/nptel/courses/video/105106053/L01.html>

<https://www.digimat.in/nptel/courses/video/105102088/L01.html>

<https://nptel.ac.in/courses/124105013>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Presentations

Seminar report preparations

Site visit and collect the different types of samples

**Semester-I**

<b>INFRASTRUCTURE PLANNING AND MANAGEMENT</b>			
Course Code	<b>22CEM13</b>	CIE Marks	50
Teaching Hours/Week (L:P: S)	03:00:02	SEE Marks	50
Total Hours of Pedagogy	40 Hours of teaching and 10-12 sessions of SDA	Total Marks	100
Credits	04	Exam Hours	03

<b>Course objectives:</b>	
<ul style="list-style-type: none"> <li>To study challenges and various strategies involved in infrastructure planning.</li> <li>To study infrastructure management systems in present and future directions.</li> </ul>	
<b>Teaching-Learning Process (General Instructions)</b>	
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.	
<ol style="list-style-type: none"> <li>Chalk and talk</li> <li>Power point Presentation, video</li> <li>Group discussion</li> </ol>	
<b>Module-1</b>	
<b>AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE:</b> Introduction to Infrastructure, an overview of the Power Sector in India., an Overview of the Water Supply and Sanitation Sector in India., an overview of the Road, Rail, Air and Port Transportation Sectors in India. , an overview of the Telecommunications Sector in India. ,an overview of the Urban Infrastructure in India, an overview of the Rural Infrastructure in India, an Introduction to Special Economic Zones, Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle., an overview of Infrastructure Project Finance.	
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation /Group Discussion
<b>Module-2</b>	
<b>PRIVATE INVOLVEMENT IN INFRASTRUCTURE:</b> A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization of Water Supply: A Case Study, Challenges in Privatization of Power: Case Study, Privatization of Infrastructure in India: Case Study, Privatization of Road Transportation Infrastructure in India.	
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation /Group Discussion
<b>Module-3</b>	
<b>CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION:</b> Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks: The Case study for Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.	
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation /Group Discussion
<b>Module-4</b>	
<b>STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION</b> Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.	
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation /Group Discussion
<b>Module-5</b>	
<b>SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE</b> Information Technology and Systems for Successful Infrastructure Management, - Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modelling and Life Cycle Analysis Techniques, Capacity Building and Improving the Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.	
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation /Group Discussion

**Course outcome (Course Skill Set)**

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

- Explain the basic concepts related to Infrastructure Projects
- Explain the role of private sector in infrastructure growth.
- Describe the strategies for successful Infrastructure Project implementation.
- Develop Infrastructure modelling and Life Cycle Analysis Techniques.
- Explain Sustainable development of Infrastructure

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbook/ Textbooks**

- 1 A. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
- 2 J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
- 3 P. Chandra, Projects: Planning, analysis, selection, financing, implementation, and review, Tata McGraw-Hill, New Delhi, 2009.

**Reference Books**

1. Grigg, Neil, Infrastructure engineering and management, Wiley, (1988).
2. Haas, Hudson, Zaniewski, Modern Pavement Management, Krieger, Malabar, (1994).
3. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).
4. Munnell, Alicia, Editor, Is There a Shortfall in Public Capital Investment? Proceedings of a Conference Held in June (1990).
5. World Development Report 1994: Infrastructure for Development (1994).
6. Zimmerman, K. and F. Botelho, "Pavement Management Trends in the United States," 1st European Pavement Management Systems Conference, Budapest, September (2000).

**Web links and Video Lectures (e-Resources):**

- <https://www.digimat.in/nptel/courses/video/105106188/L01.html>.
- <https://www.digimat.in/nptel/courses/video/105106188/L44.html>
- <https://www.digimat.in/nptel/courses/video/105106188/L10.html>
- <https://www.digimat.in/nptel/courses/video/105106188/L24.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignment
- Seminars
- Group Discussion

**Semester-I**

<b>CONSTRUCTION EQUIPMENTS AND MANAGEMENT</b>			
Course Code	<b>22CEM14</b>	CIE Marks	50
Teaching Hours/Week (L:P: S)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 Hours of Teaching+ 10-12 sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03
<b>Course objectives:</b>			
<ul style="list-style-type: none"> <li>Understand the importance of safety in construction industry.</li> <li>Understand different types of equipment used in construction and its economic consideration.</li> </ul>			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>Chalk and talk</li> <li>Power point Presentation, video</li> <li>Group discussion</li> </ol>			
<b>Module-1</b>			
<b>Plants and Equipment for production of materials-</b> Crushers, mixers, bituminous mixing plants, concrete mixing plants, transit mixers, advantages, choice, production rate calculation.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-2</b>			
<b>Construction Equipment</b> – Operations, applications and performance of dozers, excavators, graders, compactors, pavers, haulers, crawler, wheel tractors, power shovels, pile driving equipments, hauling equipment's, and drilling, blasting and tunnelling equipment.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-3</b>			
<b>Miscellaneous Equipment's</b> - Equipment for: Dredging, tunnelling, dewatering. Equipment for flooring dewatering and floors finishing. Sprayers, kerb casting equipment, screening equipment.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-4</b>			
<b>Selection of Construction Equipment-</b> Task considerations, cost considerations, engineering considerations, equipment acquisition options			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-5</b>			
<b>Management Of Construction Equipment:</b> Need for mechanization of construction – planning and financing construction plant and equipment – Owning and operating equipment versus hiring – planning for infrastructure mechanization equipment management – equipment maintenance and repair, log maintenance, safety during operation, economical life of equipment.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		

**Course outcome (Course Skill Set)**

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

- Achieve Knowledge of Planning and management of construction Equipment's.
- Understand the selection of equipment's used for construction.
- Develop equipment management skills.
- Summarize the solution of Equipment inventory. Understand the concepts of usage standards and equipment management

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text book and Reference**

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.
3. Smith, R.C, Andres, C.K., Principles and Practive of Heavy Construction, Prentice Hall
4. SC Sharma 'Construction equipment'
5. Chitkara, K. K. Construction Project Management: Panning, Scheduling and Control, Tata McGraw Hill Publishing Company, New Delhi,1998.

**Web links and Video Lectures (e-Resources):**

- [https://onlinecourses.nptel.ac.in/noc21\\_ce21/preview](https://onlinecourses.nptel.ac.in/noc21_ce21/preview)
- <https://nptel.ac.in/courses/105103206>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignment
- Seminars



**Semester-I**

<b>PREFABRICATION AND CONSTRUCTION TECHNOLOGY</b>			
Course Code	<b>22CEM15</b>	CIE Marks	50
Teaching Hours/Week (L:P: S)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 Hours of Teaching+ 10-12 sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03
<b>Course objectives:</b>			
<ul style="list-style-type: none"> <li>• understand the importance of Prefabrication</li> <li>• To know the process of prefabrication of various structural elements</li> <li>• To understand the assembling and dismantling of prefabricated components</li> <li>• To study the design considerations in the process of prefabrication</li> <li>• To understand the joining techniques in prefabrication</li> </ul>			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<b>Module-1</b>			
<b>Types of RC Prefabricated Structures:</b> Long wall and cross wall large panel buildings- One way and two way prefabricated slabs - Framed buildings with partial and curtain walls, single storey industrial buildings with trusses and shells - Crane – Gantry systems.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-2</b>			
<b>Functional Design Principles:</b> Modular coordination – Standardization - Disuniting, Diversity of prefabricates – Production – Transportation – Erection - Stages of loading and codal provisions Safety factors - Material properties - Deflection control - Lateral load resistance - Location and types of shear walls.			
<b>Teaching-Learning Process</b>	.Chalk and talk method/Power Point Presentation		
<b>Module-3</b>			
<b>Floors, Stairs and Roofs:</b> Types of floor slabs – Methods of Analysis and design example of cored and panel types and two-way systems - Staircase slab design - Types of roof slabs and insulation requirements - Description of joints, behaviour and requirements - Deflection control for short term and long term loads - Ultimate strength calculations in shear and flexure.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-4</b>			
<b>Walls:</b> Types of wall panels - Blocks of large panels – Curtain partition and load bearing walls Load transfer from floor to wall panels – Vertical loads Eccentricity and stability of wall panels –Use of Design curves - Types of wall joints, their behaviour and design – Leak prevention, Joint sealants, sandwich wall panels.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-5</b>			
<b>Industrial Buildings:</b> Components of single storey industrial sheds with crane gantry systems - Design aspects of R.C. Roof Trusses - Roof panels R.C. Crane - Gantry Girders - Corbels and columns and Wind bracing.			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Course outcome (Course Skill Set)</b>			
At the end of the course the student will be able to:			
<ul style="list-style-type: none"> <li>• Understand general principles of pre-fabrication.</li> <li>• Plan simple buildings using various types of prefabricated elements.</li> <li>• Design simple prefabricated elements</li> <li>• Outline the various phases involved in precast/pre-fabricated technology</li> <li>• Distinguish pre-engineered buildings from conventional units</li> </ul>			

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks** or **One Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Book & References:**

1. L. Mokka, "Prefabricated Concrete for Industrial and Public Structures", Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. T. Koncz, "Manual of Precast Concrete Construction, Vol. I, II, III & IV", Berlin, 1971.
3. B. Lewicki, "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam, London, New York, 1998.
4. "Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete", Netherland Betor Verlag, 2009.
5. Hass, A.M. "Precast concrete design and Applications", Applied Science Publishers, 1983.
6. "Handbook on Precast concrete for buildings", ICI Bulletin 02, Indian Concrete Institute, 2016
7. "National Building Code of India", BIS, New Delhi, 2005
8. Marashev, V.I.Sigalov, E.Y.Baikov, U.N., "Design of RC Structures", Mir Publishers, Moscow.
9. "SERC, Design & Construction of Prefabricated Residential & Industrial Buildings", Organized by SERC, Chennai.
10. B.Leweicki, "Building with Large Prefabrication", Elsevier Publishing Co.

**Web links and Video Lectures (e-Resources):**

- <https://www.youtube.com/watch?v=FdbHC4sfqBo>
- <https://www.youtube.com/watch?v=SlIPqJEJVVo>
- <https://www.youtube.com/watch?v=SlIPqJEJVVo>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignment
- Seminars

**Semester-I**

<b>RESEARCH METHODOLOGY AND IPR</b>			
Course Code	<b>22RMI16</b>	CIE Marks	50
Teaching Hours/Week (L:P: S)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hours of teaching	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course objectives:</b></p> <ul style="list-style-type: none"> <li>To understand the knowledge on basics of research and its types.</li> <li>To learn the concept of Literature Review, Technical Reading, Attributions and Citations.</li> <li>To learn Ethics in Engineering Research.</li> <li>To Discuss the concepts of Intellectual Property Rights in engineering</li> </ul>			
<p><b>Teaching-Learning Process (General Instructions)</b></p> <p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video to explain various concepts on IPR.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to analyze the research problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps Improve the students' understanding</li> </ol>			
<b>Module-1</b>			
<p><b>Research Methodology:</b> 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.</p>			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-2</b>			
<p><b>Reviewing the literature:</b> 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.</p>			
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation		
<b>Module-3</b>			
<p><b>Design of Sampling:</b> 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.</p>			

<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation
<b>Module-4</b>	
<b>Testing of Hypotheses:</b> 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.	
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation
<b>Module-5</b>	
<b>Interpretation and Report Writing:</b> 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) Act 1999, 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, 18 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.	
<b>Teaching-Learning Process</b>	Chalk and talk method/Power Point Presentation
<b>Course outcome (Course Skill Set)</b>	
At the end of the course the student will be able to:	
<ul style="list-style-type: none"> <li>• Discuss research methodology and the technique of defining a research problem</li> <li>• Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.</li> <li>• Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.</li> <li>• Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports.</li> <li>• Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.</li> </ul>	

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

- Three Unit Tests each of **20 Marks**
- Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:**

- (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. (For the topic Reviewing the literature under module
- (3), Ranjit Kumar, SAGE Publications, 3rd Edition, 2011.
- (4) Study Material (For the topic Intellectual Property under module
- 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.
- (6) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
- (7) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009

**Web links and Video Lectures (e-Resources):**

- <https://www.youtube.com/watch?v=E2gGF1rburw>
- <https://www.digimat.in/nptel/courses/video/109105115/L01.html>
- <https://www.digimat.in/nptel/courses/video/121106007/L01.html>
- <https://www.digimat.in/nptel/courses/video/110105091/L01.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignment
- Seminars

**Semester-I**

<b>CONSTRUCTION MATERIALS LABORATORY -I</b>			
Course Code	<b>22CEML17</b>	CIE Marks	50
Teaching Hours/Week (L:P: S)	01:02:00	SEE Marks	50
Credits	02	Exam Hours	03
<b>Course objectives:</b> This course introduces students to the properties, testing methods and interpretation of common construction materials with emphasis on concrete, steel, wood and Bitumen			
<b>Sl.NO</b>			
1	Mix design, casting and testing High Performance/Strength concrete cylinders and obtaining the stress-strain behavior (Modulus of Elasticity) under compressive loading , Flexure and Split Tensile		<b>6hrs</b>
2	Effect of Chemical admixtures on fresh & harden properties of concrete		<b>6hrs</b>
3	Effect of mineral admixtures on fresh & harden properties of concrete		<b>6 hrs</b>
4	Tests Related to Self-Compacting Concrete		<b>3hrs</b>
5	In situ testing of concrete structures, test methods available, planning of in situ tests, Surface hardness methods- Rebound Hammer equipment, its operation and procedure for testing, factors influencing rebound no., calibration and interpretation of results, applications and limitations, Ultrasonic methods- UPV testing equipment, its use, different transducer arrangements, tests calibration and interpretation of results, Exposure to IS and other relevant codes		<b>6 hrs</b>
6	Bonding Patterns in Brick work (joints, alignments, level and Plumb maintenance)		<b>6hrs</b>
7	<b>Demonstration Experiments ( For CIE )</b>		
8	<b>Demonstration Experiments ( For CIE )</b>		
<b>Course outcomes (Course Skill Set):</b> At the end of the course the student will be able to:			
<ul style="list-style-type: none"> <li>• Achieve Knowledge of Design and development of experimental skills.</li> <li>• Understand the principles of design of experiments.</li> <li>• Design and Develop analytical skills.</li> <li>• Summarize the testing methods of equipment's.</li> </ul>			

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.
- The duration of SEE is 03 hours

**Suggested Learning Resources:**

Text Book & References:

NOTE: All tests to be carried out as per relevant latest Codes

1. Raju N Krishna, (2004) "Design of concrete mixes", CBS Publishers, New Delhi.
2. Gahlot P S, "Concrete mix design", Indian society for technical education, Mysore.
3. Krishnamurthy S ,Bhattacharjee B, "Concrete mix design and recent technology of placing concrete", Indian society for technical education, Mysore.
4. Kishore Kaushal, (1992) "Method of concrete mix design with chemical admixtures and for pumped concrete", Standard Publishers, Delhi.
5. RathoreShailendra Singh, (2003) "Computer aided concrete mix design", Allied Publishers Delhi. 6. "Fibre reinforced concrete", SERC, 1987.
7. Raj Baldev, (1997) "Practical non destructive testing", Narosa Publishing House Delhi.
8. Maldague Xavier P V, Moore Patrick O, (2001) "Non destructive testing Handbook", American Society for Non-destructive Testing, USA