# RULES, REGULATIONS AND SYLLABI FOR TWO-YEAR M.Tech. DEGREE PROGRAMME IN STRUCTURAL & CONSTRUCTION ENGINEERING

(Approved by Board of Studies, Civil Engineering, Kakatiya University)

With effect from the academic year 2002-2003.


**DEPARTMENT OF CIVIL ENGINEERING**
**KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE**
**WARANGAL – 506 015.**
(Sponsored by Ekashila Education Society)

**APPROVED BY BOARD OF STUDIES, CIVIL ENGINEERING,**

**KAKATIYA UNIVERSITY**

# KAKATIYA UNIVERSITY, WARANGAL.
## ACADEMIC REGULATIONS FOR TWO-YEAR M.E DEGREE PROGRAMMES

### 1.0 MINIMUM QUALIFICATION FOR ADMISSION

Candidates seeking admission to 1st year of Four semester M.E Degree program shall have passed B.E./B.Tech./AMIE or any other equivalent exam in Civil Engineering with at least 50% aggregate marks recognized by the Kakatiya University.

### 2.0 CONFERMENT OF THE DEGREE

The degree of Master of Engineering in a specified Branch of Engineering will be conferred on a candidate who has fulfilled the following conditions.

2.1 The candidate, after admission to the first year of the four semester M.E degree program, has to pursue a regular course of study for two academic years and

2.2 The candidate must have satisfied the academic requirements of the specified field of specialization in each semester/ year hereinafter prescribed.

### 3.0 THE PROGRAMMES OF STUDY

The programs of study prescribed for the degree of Master of Engineering shall provide for specialization in the following branch.

3.1 Structural & Construction Engineering

### 4.0 REGULAR PROGRAMME OF STUDY

A candidate will be deemed to have pursued a regular program of study as a full time student provided he/she satisfied the following condition:

4.1 The candidate must not have enrolled as a student in any other degree or diploma program recognized by the Government or Kakatiya University.

### 5.0 ATTENDANCE REQUIREMENTS

5.1 Attendance requirements of a semester shall be deemed to have been satisfied provided:

5.1.1 The candidate puts in a minimum attendance of 75 per cent in each course of instruction prescribed for the semester.

**NOTE:** The attendance in case of practicals shall be counted on the basis of the contact hours provided in the scheme of instruction and not on the sessions of engagement. The attendance at the mid-session tests and University examinations shall not be considered in the computation of the percentage of attendance.

5.2 A candidate, who failed to satisfy the above requirements of attendance shall be detained and will not be permitted to appear at the University examinations of that course. Condonation of attendance to a maximum of 10% is permitted by the Principal on prior intimation on medical grounds for all the courses of that semester.

5.3 The candidate, who has been detained for failure to satisfy the requirements of attendance, shall be required to re-register and repeat those courses of the semester when they are next offered.

## 6.0 DURATION OF A SEMESTER

6.1 Each semester of the M.E. degree Programme shall consist of 72 days of instruction, excluding the period of mid-session tests and the University examinations.

## 7.0 REGISTRATION

7.1 All the students are required to get themselves registered for the course work by paying the prescribed tuition fee before the start of course work of each semester failing which they shall not be allowed to attend the course work prescribed for that semester.

7.2 Candidates detained due to shortage of attendance are to register within 7 days of commencement of class work of the next academic session by paying the tuition fee before the commencement of semester failing which they shall not be allowed to attend the course work prescribed for that semester

7.3 Registration shall be the sole responsibility of the student.

## 8.0 EVALUATION

8.1 The performance of the student in every semester thereafter shall be evaluated course-wise as detailed in the scheme of instruction and evaluation.

8.2 The pattern of allocation of marks for University Examinations and sessional work shall be the following.

8.2.1 Theory courses:

| | |
|---|---|
| University Examinations | 100 |
| Internal Examination | |
| Mid Examinations | 25 |
| Continuous evaluation of tutorials & assignments | 25 |

8.2.2 Laboratory/Design/Seminar/Comprehensive Viva

| | **Lab** | **Design** | **Seminar** | **Comprehensive Viva** |
|---|---|---|---|---|
| University Examinations | 50 | -- | -- | 100 |
| Internal Examinations (by Continuous Evaluation) | 50 | 100 | 100 | -- |

8.3 Internal evaluation of theory courses in each of the semesters shall be based on two mid-session tests of two hours duration. Best of the two tests shall be considered for the award of Internal marks.

8.4 Internal evaluation for other than theory courses shall, in addition to day-to-day work, be based on Viva-voce/Quiz tests/Report/Continuous evaluation.

8.5 Evaluation of the Dissertation work for final submission shall be made jointly by a departmental Research Review Committee and the supervisor on the basis of a minimum of two presentations/semester and assessment of the contribution made by the individual student. Departmental Research Review Committee will be constituted by Head of the Department.

## 9.0 MINIMUM REQUIREMENTS FOR PASSING A COURSE:

9.1 A candidate is deemed to have passed in a course if he/she secures:
40 percent of the marks assigned to the University examination of the course, and

9.2 40 percent of the marks assigned to the sessionals and University Examination of the course taken together.

## 10.0 EXAMINATIONS

10.1 Examinations for each semester will be conducted once in an academic year.

10.2 A candidate who failed in a course (theory or practical) can appear at a subsequent University examination in the same course as a supplementary candidate to fulfil the minimum requirements for securing a pass in that course. However, the sessional marks secured by the candidate in that course during the semester of study shall remain unaltered.

## 11.0 ELIGIBILITY FOR AWARD OF DEGREE

11.1 A candidate shall be deemed to have satisfied the requirements for the award of the M.E degree provided he/she passes in all the courses including dissertation prescribed in the scheme of instruction within a period of four consecutive years from the year of admission to the Programme.

11.2 A candidate who fails to fulfil all the requirements for the award of M.E. degree in a period of four consecutive academic years from the year of his/her admission to the M.E degree Programme shall forfeit his/her enrolment to the Programme.

11.3 Submission of dissertation work is subject to completion of course work of all the semesters.

## 12.0 AWARD OF DIVISION

Division is awarded as follows:

12.1 Single attempt in every exam. &
Securing 70% or more in aggregate .. 1st class with Distinction.

12.2 Securing 60% or more in aggregate .. 1st class

12.3 Securing less than 60% and more than 40% in aggregate .. Second Class

## 13.0 GENERAL

13.1 The award of degree to a candidate shall be withheld if:-

13.1.1 He/she has not cleared dues to the institution / Hostel and/or

13.1.2 A case of disciplinary action is pending against him/her

13.2 The marks secured in sessional evaluation and University examinations shall be shown separately in the marks sheet.

13.3 Whenever ambiguities arise in interpreting the regulations, the standing Committee of Kakatiya University shall have the power to make rules or to issue clarifications for removing such ambiguities.

13.4 The Academic Regulations should be read as a whole for purposes of any interpretation.

13.4.1 These academic regulations shall come into force from the year 2002-2003 for the batches of students who will be admitted in 2002-2003 and subsequent academic years.

13.5 The Total duration for the course shall normally be 24 calendar months. No course shall commence more than once in an academic year.

13.6 A candidate shall have to appear in overall comprehensive Viva-voce Examinations as laid down in the schemes of Examination.

13.7 A candidate who has promoted to third semester examination of Master of Engineering shall be required to register dissertation seminar and defend it through oral Examination.

13.8 A candidate who fails in the oral examination for dissertation shall have to defend it again as per recommendation of the Departmental Research Review Committee.

13.9 For each theory examination there shall be one examiner, who can be from Kakatiya University or any other institution. Theory papers set in such manner shall be subjected to moderation as per the norms of the University.

13.10 An examination board will be set up for comprehensive Viva-voce for M.E. course as per scheme of Examination. The Boards shall consist of the following.

(i) Five internal faculty including the Chairman of DRRC and

(ii) One external examiner.

The Chairman, DRRC and the external examiner will award marks.

13.11 For each dissertation examination there shall be a panel of examiners consisting of one supervisor and one external examiner.

13.12 Every student has to under go Industrial Training for 8 weeks. However the students who are from industry/organization are exempted from undergoing industrial Training.

## CIVIL ENGINEERING DEPARTMENT

The Course Structure and Scheme of Evaluation (Semester wise) for the Post - Graduate Program **M.E. (Structural and Construction Engineering).**

### SEMESTER - I

| Course Number | Name of The Course | Periods per Week | | Internal Examination | | End Semester Examination | | Total |
|---|---|---|---|---|---|---|---|---|
| | | L / T | P / D | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks | |
| MECE 101 | Numerical and Statistical Methods | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 102 | Theory of Elasticity and Plasticity | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 103 | Limit Analysis of Structures | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 104 | Design of Composite Structures | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 105 | Ground Improvement Techniques | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 106 | Concrete Laboratory | 0 | 3 | CW | 50 | Viva - Vice | 50 | 100 |
| MECE 107 | Seminar – I | - | 1 | Report and Viva - Voce | 100 | - | - | 100 |
| | **TOTAL** | **15** | **4** | | **400** | | **550** | **950** |

### SEMESTER - II

| Course Number | Name of The Course | Periods per Week | | Internal Examination | | End Semester Examination | | Total |
|---|---|---|---|---|---|---|---|---|
| | | L / T | P / D | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks | |
| MECE 201 | Advanced Analysis of Structures | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 202 | Prefabricated Concrete Structures | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 203 | Construction Techniques and Equipment | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 204 | Design of Sub Structures | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 205 | Elective – I* | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 206 | CAD Laboratory | 0 | 3 | CW | 50 | Viva - Voce | 50 | 100 |
| MECE 207 | Seminar – II | - | 1 | Report and Viva - Voce | 100 | - | - | 100 |
| | Industrial Training | 8 Weeks | | - | - | - | - | - |
| | **TOTAL** | **15** | **4** | | **400** | | **550** | **950** |

*** Elective - I**

A. Design of Bridges
B. Rehabilitation of Structures
C. Total Quality Management
D. Pavement Design and Construction

## SEMESTER - III

| Course Number | Name of The Course | Periods per Week | | Internal Examination | | End Semester Examination | | Total |
|---|---|---|---|---|---|---|---|---|
| | | L / T | P / D | Time (Hrs) | Max. Marks | Time (Hrs) | Max. Marks | |
| MECE 301 | Design of Special Structures | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 302 | Seismic analysis and Design of RC Structures | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 303 | Construction Planning and Management | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 304 | Elective – II** | 3 | 0 | 2 | 50 | 3 | 100 | 150 |
| MECE 305 | Design Project | - | 3 | - | 100 | - | - | 100 |
| MECE 306 | Comprehensive Viva | - | - | Viva - Voce | 100 | - | - | 100 |
| MECE 307 | Dissertation Seminar | - | 3 | Report & Seminar | 100 | - | - | 100 |
| | **TOTAL** | **12** | **6** | | **500** | | **400** | **900** |

**** Elective - II**

A. Composite Construction Materials
B. Theory of Elastic Stability
C. Concrete Technology
D. Legal Issues in Construction

## SEMESTER - IV

| | | |
|---|---|---|
| **Dissertation** | **24 Weeks** | **Excellent / Good / Satisfactory / Not Satisfactory** |

## ME CE 101 NUMERICAL & STATISTICAL METHODS

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

### 1. Matrices and Linear System of Equations

Basic definitions and notations in Matrix Theory. Solution of Linear Systems – Direct Methods: Gauss – Jordon Elimination Method - Triangularization Method - Cholesky method - Partition Method, Iteration Methods: Jacobi iteration method - Gauss – Siedel Iteration Method - Relaxation Method - The Eigen value Problem; To determine the eigen values of a symmetric Tridiagonal matrix.

### 2. Numerical Solution of Ordinary and Partial Differential Equations

Introduction – Initial value problems, Picards method, successive approximations, Euler Method, Runge-Kutta Methods. Predicator – corrector Methods; Adams – Moulton Method. Milne's method, Cubic spline method. Second-order linear partial differential equations: Finite – difference approximations to Derivatives. Laplace equation. Parabolic equations, Hyperbolic equation.

### 3. Classification and Presentation of Data

Basic Concepts of Probability, Probability Axioms. Analysis and Treatment of Data, Population and Samples, Measures of Central Tendency, Measures of Disperson, Measures of Symmetry, Measures of Peakedness.

### 4. Probability Distributions

Discrete and Continuous Probability Distribution Functions, Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distributions, Extreme Value Distributions, Transformations to Normal Distributions, Selection of a Probability Distribution, Parameter Estimation – Method of Moments, Method of Maximum Likelihood, Probability Weighted Moments and Least Square Method, Joint Probability Distributions.

### 5. Regression Analysis

Simple Linear Regression, Evaluation of Regression, Confidence Intervals and Tests of Hypotheses, Multiple Linear Regression, Correlation and Regressional Analysis.

### Suggested Reading


1. S.S. Sastry - *Introduction Methods of Numerical Analysis* – Prentice Hall of India (1998).
2. M.K.Jain, S.R.K. Iyengar and R.K. Jain., - *Numerical Methods for Scientific and Engineering Computations* –Wiley Eastern Limited (2001).
3. M.K. Jain - *Numerical Analysis for Scientists and Engineers* – SBW Publishers (1971).
4. Akai T.J. – *Applied Numerical Methods for Engineers* – John Wiley Inc., New York.
5. Hann C.T. – *Statistical Methods in Hydrology* – East West Press, New Delhi.
6. Charpa S.C and Canale R.P. – *Numerical Methods for Engineers with Personal Computer Applications* – Mc.Graw Hill Publishing Co.,
7. Alfredo H.S., Wilson H.Tang – *Probability Concepts in Engineering, Planning and Design,* Vol. I & II, Wiley International.

## ME CE 102 THEORY OF ELASTICITY AND PLASTICITY

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Introduction**
   State of stress at a point in three-dimensional elasticity - Principal stresses - Octahedral stresses - Strain at a point - Equilibrium and compatibility conditions - Generalized Hooke's law.

2. **Plane Cartesian Elasticity**
   Plane stress - plane strain - Equations of equilibrium in two dimensions - Compatibility of strain - Boundary conditions - Governing differential equation in Cartesian coordinates - Airy's stress function - Two-dimensional problems in rectangular co-ordinates - Method of solution by polynomials.

3. **Plane Problems in Polar Co – ordinates**
   Solution of two dimensional problem in polar coordinates - Stress distribution in radially symmetric problems - Effect of circular holes - Concentrated force acting on a beam - Stress on a circular disc.

4. **Torsion of Non - circular shafts**
   Saint Venant's method - stress Function Method of solution - Boundary conditions for torsion problems - Membrane Analogy.

5. **Theory of Plasticity**
   Yielding and various yield criteria – yield surface – Heigh Wester gard stress space subsequent yield surface – loading and unloading – Plastic stress – strain relations – Prandit's Equations – Relation based on Tresca criteria

**Suggested Reading**


1. Timoshenko & Goodier, *Theory of Elasticity,* McGraw Hill Book Co. Ltd., NewYork
2. Kamal kumar and R.C. Ghai, *Advanced Mechanics of Materials*
3. Dr. Sadhu Singh, *Theory of Plasticity,* Khanna Publishers, New Delhi.

## ME CE 103 LIMIT ANALYSIS OF STRUCTURES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Introduction**
   A brief review of limit state design philosophy – application to beams.

2. **Behaviour of columns**
   Rectangular and circular columns – Interaction diagrams – uniaxial bending – design for Bi-axial bending.

3. **Behaviour of RC structure in shear and torsion**
   Kani's theory for shear – Skew bending, Theory for torsion – different modes of failure in shear – design of beams in combined shear, bending and torsion as per IS code.

4. **Limit state of serviceability**
   Calculation of total deflection – crack width.

5. **Yield line theory of slabs**
   Analysis and design of slabs at limit state of failure.

6. **Plastic Analysis of Steel Structures.**
   Plastic Analysis of Portal frames and gable frames – Design of Steel Roof Trusses using SP:6.

**Suggested Reading**


1. Park and Paulay,. *Reinforced Concrete Design*
2. Jain A. K., *Reinforced Concrete Design.,* Nem Chand Bros. Roorkee.
3. Shah H. J., *Reinforced Concrete Design.,* Charotar Publications, Anand.
4. Handbook on Steel: SP 6.
5. Neal.B.G.: Plastic Analysis of Steel Structures.

## ME CE 104 DESIGN OF COMPOSITE STRUCTURES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Introduction**
   Structural elements in a composite beam, method of construction, advantages of composite construction

2. **Design Method**
   Effective width of concrete slab, modular ratio

3. **Shear Connection**
   Types of shear connections, shear resistance of rigid connections, anchor connections, spiral connections, recent developments in shear connectors

4. **Design Of Bond – Type Connections**
   Types of bond connectors, simplified design procedure only.

5. **Designs**
   Composite slabs (ribbed, voided and hollow blocks) method of analysis, deflection, size and position of ribs, hollow blocks and formers, arrangement of reinforcement
   Design of steel sections for both propped and Un - propped conditions and their shear connections, design of composite columns according to IS 456-2000

6. **Timber Concrete Composite Structures**
   Introduction to timber concrete composite structures and their suitability

**Suggested Reading**


1. H.T.Yan, *Composite construction in steel and concrete*.
2. P. Purushothaman, *Behaviour of RC Elements, Analysis and Design,* Tata –McGraw Hill Book Co. Ltd. New Delhi

## ME CE 105 GROUND IMPROVEMENT TECHNIQUES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Dewatering**
   Definition – Methods of de-watering – Interceptor ditches – Single and multistage well points – Vacuum well points – Electro-osmosis – Foundation and blanket drains.

2. **Field compaction**
   Shallow and Deep compaction – Shallow compaction equipment – Compaction control – Techniques of Deep compaction – Vibro-flotation – Blasting – Compaction piles – Pounding.

3. **Stabilisation**
   Purpose – Methods of Stabilisation – Mechanical - Lime – Cement – Bitumen – Chemical - Stabilisation – Lime and Cement Columns.

4. **Drainage Improvement**
   Need – Vertical drains – Sand drains – Sand wicks – Strip drains

5. **Reinforced Earth**
   Concept – Materials – Geo-synthetics - Effect of reinforcement on soils – Principles of Interfacial Friction and its determination – Factors affecting Friction Coefficient – Applications of reinforced earth.

6. **Slope Stability Techniques**
   Soil Nailing – Ground Anchors- Anchored spider netting - Tie backs

**Suggested Reading**


1. Monfred. R. Hausmann – *Engineering Principles of Ground Modification* – Mc Graw Hill Publishing Co., New York.
2. Purushotham Raj – *Ground Improvement Techniques* – Tata Mc Graw Hill Publishing Co., New Delhi.
3. Peck, Hanson and Thornborn - *Foundation Engineering* – Wiley Eastern Limited.

## ME CE 106 CONCRETE LABORATORY

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 0 | 0 | 3 | 0 | CW | 50 | Viva - Voce | 50 |

1. Study of the effect of water/cement ratio on workability and strength of concrete.
2. Study of effect of aggregate/cement ratio on strength of concrete.
3. Study of effect of fine aggregate/coarse aggregate ratio on strength.
4. Mix design methods: (a) I.S. Code method (b) ACI Code method.
5. A study of stress-strain curve of concrete for different mixes and for different rates of loading.
6. A study of correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
7. A study of stress-strain curve for Fe-4l5 and High-tensile steel
8. Study of effect of cyclic loading on steel.
9. A study of behaviour of under reinforced and over reinforced beams.
10. Demonstration experiments on Non-Destructive testing of concrete.

**Suggested Reading**

1. Neiveli, *Concrete Technology,* Tata McGrawHill Book Co. Ltd, New Delhi.
2. SP 23: *Hand Book of Concrete Mix Design*
3. IS 456:2000,

## ME CE 201 ADVANCED ANALYSIS OF STRUCTURES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

**Matrix Methods of Structural Analysis**

1. **Flexibility Method**
   Basics, Introduction, Review of matrix algebra, Force method, Basic concepts, Internal forces, external loads and redundants, Relation between internal forces and deformation, determination of redundant forces, various load conditions, relation between displacements and deformation. Application of Flexibility method to pin jointed and rigid jointed plane frames, continuous beams, stresses due to lack of fit, settlement etc.

2. **Stiffness Method**
   Relation between internal forces and displacements, relation between internal forces and internal loads, various load conditions, superposition of stiffness, transformation of stiffness matrix, stresses due to lack of fit, use of sub-matrices, Generalized derivation of stiffness matrix for flexure. Analysis of pin jointed plane frame, rigid jointed plane frames and continuous beams by stiffness method.

**Finite Element Method**

3. **Fundamental Concepts & Mathematical Modelling**
   Finite Element Method – Concept, Basic theory and application, Advantages and disadvantages, requirement of a model, concept of element, various element shapes, shape functions, Displacement models - Generalized co-ordinate form, Convergence and compatibility requirements.

4. **Analysis & Application**
   Formation of element stiffness matrix in plane stress and plane strain constant strain triangle (CST) elements, Rectangular, quadrilateral and Isoparametric elements. Condensation of internal degrees of freedom. Formation of overall stiffness matrix, Boundary conditions and Solution to overall problem. Applications to structural engineering problems.

**Suggested Reading**


1. Weaver & Gere, *Matrix Analysis of Framed Structures,* CBS Publishers & Distributors, Delhi.
2. Pandit & Gupta, *Matrix Analysis of Structures*, Tata McGraw-Hill, New Delhi.
3. Rajasekharan S., *Finite Element Analysis in Engineering Design*
4. Chandrakanth S. Desai & John F. Abel, *Introduction to Finite Element Method*, Van Nostrand Reinhold Company, New York.
5. Belegundu & Chandrupatla R., *Introduction to Finite Elements in Engineering*, Prentice Hall India Private Limited, New Delhi.
6. Bhavikatti S.S., *Structural Analysis Vol. II,* Vikas Publishing Company Limited, New Delhi.
7. Zeinkiwiez, O.C., *Finite Element Method,* Mc Graw Hill Co. Ltd. New York
8. Rao S.S., *The Finite Element Method in Engineering*, Pergamon Press, Oxford.
9. Krishnamurthy, C.S., *Finite Element Analysis – Theory and Programming,* Tata Mc Graw Hill Co.,New Delhi

## ME CE 202 PREFABRICATED CONCRETE STRUCTURES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Introduction**
   Development and economy – advantages of prefabricated structures compared to steel and monolithic structures – Plant and site pre-fabrication – Suitable fields of application

2. **Basics of Pre-fabricates**
   Classification by size, weight, shape, materials etc. Effects of quality, size, and weight cross section of members on the economy – form factor – weight of structure in comparison with steel and timber.

3. **Dis-uniting and Joints in Pre-fabricated structures**
   Classification of members, Rigid and flexible members – joining of column to footing and to beams, jointing of beams.

4. **Structural behavior**
   General principles of analysis and design- code specifications – elimination of handling stresses effect of creep and shrinkage – effect of sequences and methods of assembling on the strength and stability – Quality of materials used

5. **Design Principles**
   Design principles to floor and roof members. Purlins, bearings and expansion joints

6. **National Building code**
   Specification of precast R.C.Structures- Discussion

**Suggested Reading**


1. D.Orchard Vol 1 & 2, *Concrete Technology*
2. Neville, *Properties of Concrete*
3. Laxzle Mock, *Prefabricated Concrete for Industrial and Public Building*

## ME CE 203 CONSTRUCTION TECHNIQUES AND EQUIPMENT

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Pre-cast and Pre-fabricated Construction**
   Importance of and suitability pre-fabrication, Classification and scope. Advantages and disadvantages of pre-fabrication. Design principles of pre-fabrication system.

2. **Modular coordination**:
   Importance of modular coordination. IS recommendations for modular planning, standardization, mass production and methods of transportation.

3. **Construction equipment**
   Need for mechanization in construction industry. Financing aspects of construction plants and equipment. Factors effecting selection of construction equipment. Cost of owning and operating the construction equipment, Equipment Management and maintenance characteristic performance and application to building process for Excavating and demolishing equipment: Shovels, scrapers, bull dozers.

4 **Hoisting equipment-**hoist winch, chains, and hooks, slings, various types of cranes- tower crane, mobile crane and derrick crane. Safety in crane operation.

5 **Conveying equipment**- various types of belts and conveyors.
Concreting equipment: Concrete mixers, truck mixers, pneumatic Concrete placers, vibrators and Scaffolding.

**Suggested Reading**


1. Peurify, R.L. (1996). *Construction, Planning, equipment and methods* McGrawHill Book Company, Inc. NY.

2. Mahesh Varma. (1997) *Construction Equipment, and its planning & Applications*." Metropolitan Book Co. (P) Ltd., New Delhi, India.

3. U.K. Srivastava **(**1999). *Construction Planning and Management*. Galgotia Publications Pvt., Ltd., New Delhi, India.

## ME CE 204 DESIGN OF SUB STRUCTURES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Substructures**
   Definition and Purpose - Design principles – Design loads – Permissible settlements - Considerations in seismic design of sub structures.

2. **Raft Foundations**
   Types of raft - Bearing capacity and settlement of rafts – Beams on elastic foundation – Methods of design of rafts.

3. **Pile Foundations**
   Load capacity of single piles – Static and dynamic formulae – Pile load tests – Cyclic pile load tests – Laterally loaded piles.
   Pile groups – Group Efficiency – Design of pile groups – Settlement of single and pile groups in clays and sands – Negative skin friction on single and pile groups.

4. **Pier Foundations**
   Types of piers and Uses – Allowable bearing capacity – Design and construction of Piers – Settlement of Piers.

5. **Well Foundations**
   Types - Construction of Wells – Failures and Remedies – Bearing capacity Design of well foundations – Lateral stability – sinking of wells.

6. **Substructures in Expansive soils**
   Characteristics of Expansive soils – Foundation problems – Foundation alternatives – Methods of Foundations - Design and Construction of under reamed piles.

**Suggested Reading**


1. J.E.Bowles, *Foundation Analysis and Design,* Mc. Graw Hill Publishing Co., New York
2. Tomlinson, *Pile Design and Construction Practice,* A View Point Publication.
3. Swami Saran, *Design of Substructures,* Oxford & IBH publishers, New Delhi
4. W.C. Teng, *Foundation Design,* Prentice Hall of India, New Delhi

**ME CE 205 (A) DESIGN OF BRIDGES**
**(Elective –I)**

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

**1. Introduction**

Types of bridges, materials for construction, codes of practice (Railway and Highway bridges), aesthetics, loading standards (IRC, RDSO, AASHTO), recent developments, box girder bridges, historical bridges (in India and Overseas). Planning and layout of bridges, hydraulic design, geological and geo technical considerations, Design aids, computer software and expert systems.

**2. Concrete Bridges**

Bridge deck and approach slabs, design of bridge deck systems, slab – beam systems (Guyon and Massonet, Hendry and Jaeger methods), box girder systems, analysis and design.

**3. Steel and Composite Bridges**

Orthotropic decks, box girders, composite steel – concrete bridges, analysis and design, truss bridges.

**4. Design of Sub - Structure**

Piers, columns and towers, analysis and design, shallow and deep foundations, caissons, abutments and retaining wall.

Bridge Appurtenances: Expansion joints, design of joints, types and functions of bearings, design of elastomer bearings, railings, drainage system and lighting.

**5. Long span Bridges**

Design principles of continuous box girders, curved and skew bridges, cable stayed and suspension bridges, seismic resistant design, seismic isolation and damping devices, construction techniques (cast in-situ, pre-fabricated, incremental launching, free cantilever construction), inspection, maintenance and rehabilitation, current design and construction practices.

**Suggested Reading**


1. Victor D.J., *Essentials of Bridge Engineering,* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Krishnaraju N., *Design of Bridges,* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Raina V.K., *Concrete Bridge Practice,* Tata McGraw Hill Publishing Co. Ltd. New Delhi.
4. Swamisaran, *Analysis and Design of Sub Structures,* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Ponnuswamy S., *Bridge Engineering*, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
6. Wai-Fah Chen Lian Duan, *Bridge Engineering Handbook,* CRC Press, USA.

**ME CE 205 (B) REHABILITATION OF STRUCTURES**
**(Elective –I)**

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

**1.** Aging of structures - performance of structures - need for rehabilitation.

**2.** Distress in Concrete / steel structures - damage - source - cause - effects - case studies.

**3.** Damage assessment and Evaluation models - Damage testing methods - NDT - Core samples.

**4.** Rehabilitation methods - grouting - detailing - imbalance of structural stability - case studies.

**5.** Methods of repairs - shotcreting - guniting - apoxy - cement mortar injection - crack ceiling.

**6.** Repair and maintenance of buildings - IS standards - Bridge repairs - Seismic strengthening.

**Suggested Reading**


**1.** RN Raikar, *Diagnosis and treatment of Structures in distress*
**2.** VK Raina, *Bridge Rehabilitation*
**3.** WH Ransom, *Building Failures - Diagnosis and Avoidance*
**4.** Kenneth and Carper, *Forensic Engineering*

**ME CE 205 (C) TOTAL QUALITY MAMAGEMENT**
**(Elective –I)**

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

**1.** Quality Management in Construction Industry, New approach to Quality Management, and Road to Quality Management.

**2.** Formal QA, Quality Assurance, ISO 9000, Clauses of ISO 9000, Third Party assessment for construction works.

**3.** Leadership and Total Quality Management, Tools for Total Quality Management, Teamwork for Total Quality Management, Stages in Team Development, and Role with in a Team.

**4.** Learning Organization, Lean Production and Management Applied to Construction Industry.

**5.** Quality Management in The Construction Industry, Research Objectives, Senior Management and Total Quality Management, Cultural Change in Construction.

**Suggested Reading**


**1.** Steven McCabe. (1998), "Quality Improvement Techniques in Construction." LONGMAN.
**2.** Kwakye, A.A. (1997), "Construction project Administration", Adisson Wesley Longman, London.

**ME CE 205 (D) PAVEMENT DESIGN AND CONSTRUCTION**
**(Elective –I)**

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Factors Affecting Pavement Design**
   Highway – Air Field Pavement characteristics – Design requirements – Parameters considered in pavement design, construction – Types of pavements – Functions – Traffic loads; EAL & ESWL, Concepts, Traffic Analysis – ADT, Truck factors Growth Factors etc.

2. **Stresses in Pavements**
   Flexible Pavements – Factors inducing stresses, Visco-Elastic Theory – Assumptions, Layered Theories – Stress equations in One Two and Three layered systems – Rigid pavements – stress inducing factors.
   Westergaards theory. Computation of stress due to wheel loads and Temperature. Stresses in dowel and tie bars.

3. **Material Characteristics**
   Dynamic Modulus of Bituminous Mixes Resilient Modulus of Pavement Materials – Fatigue Characteristics – Permanent deformation parameters and other parameters.

4. **Design of Flexible Pavements**
   Elastic and Visco-Elastic Approaches, Empirical and Semi Empirical Approaches. Examples to include full depth Asphalt pavements. AASHO and Asphalt Institute Methods IRC Specifications.

5. **Design of Rigid Pavements**
   Determination of stresses due to loads temperature, and friction. AASHO method, introduction to the design of reinforced concrete, prestresed concrete pavements and continuous concrete pavements.

6. **Construction of Basic, Sub Base, Shoulders and Drain**
   Roadway and Drain Excavation and Blasting, Embankment Construction. Construction of Gravel line cement stabilised sub bases, WBM bases wet mix construction, shoulder construction Drainage. Surface/Sub Surface drainage.

7. **Bituminous Pavement Construction**
   Preparation and laying of Tack Coat, Bituminous Macadam, Penetration Macadam, Built up Spray Grout, Open Graded Premix, Mix Seal, Semi-dense, Asphalt concrete interface treatment and over lay construction – IRC specifications.

8. **Cement Concrete-Pavement Construction**
   Construction of cement concrete roads. Manual and mechanical methods joints in reinforced cement concrete construction. Interface treatment over lay construction.

**Suggested Reading**


1. Yoder and Witzrock, *Principles of Pavement Design*, John Wiley & Sons.
2. Huang, H.Yang, *Pavement Analysis and Design*, Prentice Hall – New Jersey.
3. Sargious M.A., *Pavements and Surfacing of Highways and Airports,* Applied Science Publishers Ltd.
4. Haas and Hudson, W.R., *Pavement Management Systems*, McGraw Hill Publications, New York.

## ME CE 206 CAD LABORATORY

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 0 | 0 | 3 | 0 | CW | 50 | Viva - Voce | 50 |

1. **Introduction**
   Computer Systems, Computer specifications, peripherals, computer language and developments, concepts of programming, flow charts and algorithms.

2. **C – Language**
   C-Character set, Identifiers and Key words, Data types constants, variables, arrays, declarations, expressions, statement and symbolic constants. Data input and output, arithmetic, unary and relational operators, expressions, assignment and conditional operators, library functions and control statements.

3. **Civil Engineering Applications**
   Preparing and running complete programs in C for civil engineering problems such as analysis of beams, trusses and determinate frames, design of pipes, pavements and footings, slope stability analysis

4. **Computer Aided Design and Drafting**
   Introduction to AutoCAD. Simple exercises like line diagrams, reinforcement detailing using AutoCAD. Developments of plan using Chief Architect. Analysis and Design of concrete and Steel elements using STRAP/STAD-PRO. Exercises on construction engineering and management problems using PRIMA VERA

**Suggested Reading**


1. C.S. Krishnamoorthy & S.Rajeev, *Computer Aided Design*, Narosa Publications.
2. Boyd C. Panbou, *Computer applications in Construction*, Tata Mc Graw-Hill Book Co. Ltd.

## ME CE 301 DESIGN OF SPECIAL STRUCTURES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Shells**
   Classification of shell structures – Lames Parameters – Gauss – Godazzi relations – Loves first approximation – Design of singly curved shells – Domes.

2. **Folded Plates**
   Structural behaviour of folded plates – equation of three shears – application of Simpson's and Whitney's methods – comparison of cylindrical shells with folded plates.

3. **Grid Slabs**
   I.S. code provisions – analysis and design of grid slabs.

4. **Industrial structures**
   Analysis and design portal – Gable frames – Design of Gantry Girder.

5. Design of Self Supported Steel Chimney.

6. **Design of Flat slabs**
   Introduction – components – IS code recommendations – design methods – design for flexure and shear – moments in columns.

**Suggested Reading**


1. Ramaswamy G. S., Design *and Construction of concrete shell roofs*.
2. Hendry & Jaeger., *The analysis of Grid Frames and related structures*.
3. Krishna Raju N., *Design of Reinforced concrete Structures*
4. Arya & Azmani., *Design of Steel Structures*
5. Reynolds Handbook.
6. Flugay Handbook.

## ME CE 302 SEISMIC ANALYSIS AND DESIGN OF RCC STRUCTURES

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Structural Dynamics**
   Introduction; Single and Multi degrees of freedom, Damped and Undamped Systems, Free and Forced Vibrations, Natural Time Period and Frequency, Dynamic Load Factor, Response to a pulsating force, Characteristic shapes, Modal Analysis of Multidegree systems.

2. **Structures with Distributed Mass and Load**
   Introduction; Single span beams – Normal modes of Vibration, Forced Vibrations of beams, Beams with variable cross section and Mass.

3. **Earthquake Engineering**
   Earthquake – Causes, Types, Intensity and Magnitude, Seismic waves – Measuring Instruments, Ground motions. Indian Seismicity and Past Earthquakes, Seismic zones of India.

4. **Earthquake Resistant Design**
   Introduction; IS Code Specifications - Permissible increase in stresses, Load Factors, Design seismic coefficients, Horizontal Seismic Coefficient – Seismic Coefficient Method, Seismic Zone Factors.

5. **Earthquake Resistant Design of Common Structures**
   Multistoreyed building frames, water tanks – IS code method.

**Suggested Reading**


1. Mario Paz, *Introduction to Structural Dynamics: Theory and Computations*, 3rd edition, Van Nostrand Reinhold.
2. Krishna, Chandrashekaran and Chandra, *Elements of Earthquake Engineering, 1994,* 2nd edition, South Asian Publishers, New Delhi.
3. Wakabayashi, M. (1986), *Design of Earthquake Resistant Buildings,* McGraw Hill Book Company Limited, New York
4. Clough and Penzien, *Dynamics of Structures,* 2nd edition, McGraw Hill Book Company Limited, New York
5. Agarwal, *Engineering Seismology,* Oxford & IBH Publishing Company Pvt. Ltd, 1991.
6. IS: 1893 - 1984: *Indian Standard Criteria for Earthquake Resistant Design of Structures*, Bureau of Indian Standards, New Delhi.
7. IS: 4326 - 1993: *Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings*, Bureau of Indian Standards, New Delhi.
8. IS: 13920 - 1993: *Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces*, Bureau of Indian Standards, New Delhi.
9. IS: 3370: *Code for water tanks (Parts I, II, III & IV),* Bureau of Indian Standards, New Delhi.
10. IS: 875: Code of Practice for Design loads (Parts I, II, III, IV & V), Bureau of Indian Standards, New Delhi.

**ME CE 303 CONSTRUCTION PLANNING AND MANAGEMANT**

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Introduction**
   Historical background. Planning for construction projects, steps involved in planning objectives and principles of planning. Advantages, limitations and stages of planning. Bar charts and its limitations. Milestone charts. Work break down. Events and activities.

2. **Networks**
   Rules for networks . Numbering the events. PERT and CPM. Project duration. Calculation of floats. Time estimates. Calculation of slacks and probable completion time.

3. **Applications in Construction Engineering**
   Cost Analysis and control: Direct cost, Indirect cost. Optimization of cost. Exercises in civil engineering projects. Cost control in construction project. Resource analysis- smoothening and leveling in various construction projects.

4. **Construction management**
   Introduction. Significance of construction management. Objectives and functions of construction management. Resources for construction industry. Construction team Major problems in construction industry. Functions and responsibilities of construction manager. Case studies. Future of construction management.

5. **Decision making in construction industry**
   Benefit cost analysis, replacement analysis, Break even analysis, Risk management in construction industry.

6. **Management information and control systems**
   Management Information and Control Systems, Communication, System Concepts, Need for Management Information, Design of Management Information Systems, Computer Processing, Value of Information, Management Information Systems in Construction Industry.

**Suggested Reading**


1. Moder, J.J., Phillips, C.R., and Davis, E.W., *Project Management with CPM and PERT and precedence diagramming,* C.B.S. Publishers & Distributors, New Delhi, 1986.
2. Pilcher, R., *Project Cost Control in Construction* Collins, London, 1992.
3. Brien. J.J., *CPM in Construction Management*, McGraw Hill Book Company Inc., NY, 1971.
4. S.Seetharaman, *Construction Engineering and Management,* Umesh Publications, New Delhi, 1997.

## ME CE 304(A) COMPOSITE CONSTRUCTION MATERIALS
## (Elective–II)

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Introduction**
   Classification and characteristics of composite materials – basic terminology – advantages.

2. **Stress-strain relations**
   Orthotropic and anisotropic materials – engineering constants for orthotropic materials – restrictions on elastic constants – plane stress problem – biaxial strength – theories for an orthotropic lamina.

3. **Cement composites**
   Types of cement composites – terminology – constituent materials and their properties – construction techniques for fibre reinforced concrete, Ferrocement, SIFCON, Polymer concretes – preparation of reinforcement – casting and curing.

4. **Mechanical properties of cement composites**
   Behaviour of ferrocement, fiber reinforced concrete in tension, compression, flexure, shear, fatigue and impact, durability and corrosion.

5. **Application of cement composites**
   FRC and Ferrocement – housing – Water storage – Boats and miscellaneous structures.

**Suggested Reading**


1. Robert Jones, *Mechanics of composite,*
2. R.P., Pama, *Ferrocement – Theory and Applications,* International Ferrocement Information Centre, Bangkok.
3. Balaguruswamy, *Fibre Reinforced Concrete*
4. R.N. Swamy, *New Engineering Materials*

**ME CE 304(B) THEORY OF ELASTIC STABILITY**
**(Elective–II)**

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Concepts Of Stability**
   Equilibrium path, geometric non linearity, stability criteria

2. **Buckling Of Columns**
   Methods of finding critical loads, critical loads for straight columns with different end conditions and loading. Inelastic buckling of axial loaded columns, energy methods, prismatic and non prismatic columns under discrete and distributed loading

3. **Buckling Of Thin Walled Members Of Open cross-section**
   Torsion of thin walled bars, warping non-uniform torsion, torsional buckling under axial loading

4. **Lateral Buckling Of Beams**
   Beams under pure bending, cantilever and simply supported beams of rectangular and I-sections – energy methods – solutions of simple problems

5. **Buckling Of Rectangular Plates**
   Plates simply supported on all edges and subjected to constant compression in or two directions.

6. **Buckling Of Shells**
   Introduction to buckling of axially compressed cylindrical shells.

**Suggested Reading**


1. Timoshenko & Gere T*heory of Elastic Stability* , McGraw Hill Book Co. Ltd. New York
2. Bleich. F, *buckling of metal structures* McGraw Hill Book Co. Ltd. New York.
3. Alexander Chajes *Principles of Structural Stability Theory,* Prentice Hall India Ltd.
4. Iyengar, N.G.R. *Structural Stability of Columns and Plates* –Affiliated East – West pvt ltd.
5. Chilver, A.H. T*hin walled structures* –Chatte and Windus Ltd.
6. Coxhl, H.L *The buckling of plates and Shells*, Pergaman press.

**ME CE 304(C) CONCRETE TECHNOLOGY**
**(Elective–II)**

| Lectures | Tutorials | Practicals | Dra3wings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Constituents of Concrete**
   Types of Cement and their composition. Tests on various properties of aggregates.

2. **Properties of fresh Concrete**
   Mixing and batching. Workability, factors effecting workability, Measurements of workability, Various tests and procedures. Segregation and bleeding,. Vibration of concrete. Types of vibrators and their influence on composition. Analysis of fresh concrete.

3. **Properties of Hardened Concrete**
   Strength of concrete. Water Cement ratio. Gel space ratio. Effective water in the max. short term and long term properties of concrete. Tests and procedure. Influence of various parameters on strength of concrete. Relationship between various mechanical strengths of concrete. Curing of concrete. Methods of curing. Maturity concept. Influence of temperature on strength of concrete. Stress-Strain curves for concrete. Durability of concrete.

4. **Admixtures used in concrete**
   Classification of admixtures. Chemical and mineral admixtures. Influence of various admixtures on properties of concrete. Application, concept of ready mixed concrete. Fly ash concrete . Properties and proportion of Fly ash, Applications.

5. **Special Concretes**
   High strength concrete, Ferro Cement, Light weigh concrete, High density concrete. Recycled aggregate concrete. Their specialties and applications, need for the Reinforced Concrete (FRC) Mechanism of FRC. Types of fibres, fibre shotcrete.

**Suggested Reading**


1. Neville A.M., *Properties of Concrete,* English Language Book Society /Longman Pub., 1988.
2. Mehta P.K. and Paulo J.M.M. *Concrete – Micro Structure - properties and Material*.

**ME CE 304(D) LEGAL ISSUES IN CONSTRUCTION MA NAGEMENT**
**(Elective–II)**

| Lectures | Tutorials | Practicals | Drawings | Mid Semester | | End semester | |
|---|---|---|---|---|---|---|---|
| | | | | Time (Hrs.) | Max. Marks | Time (Hrs.) | Max. Marks |
| 3 | 0 | 0 | 0 | 2 | 50 | 3 | 100 |

1. **Legal Issues to Project Design and Construction**
   Rights and Duties of Construction Manager as Planner, Decision Maker and Leader, Legal Liability.

2. **Contract Administration**
   Legal Issues Relating to Risk Management in Construction Management, Clauses Of Insurance Relevant To Construction Industry, Code Of Conduct.

3. **Professional Liability Considerations**
   Contract Relationship and Liability, Sources of Potential Liability in Construction Industry.

4. **Construction Productivity**
   Productivity Factors, Productivity Measurement in the Construction Industry, Job Productivity Adjustment Factors, Potential Benefits To Project Owner, Delays in Production and Legal Liability.

5. **Preparing Bidding Documents**
   Bidding and Award, Construction Management Process During The Bidding And Award Phase, Basic Concepts and Definitions Of Management Methods, Typical Management Methods, Recommended Guidelines For Developing A Workable Management Method.

**Suggested Reading**


1. Tenah, K.A., *The Construction Management Process,* Reston Publishing Company, Inc. Virginia
2. Adrian, J.J., *Construction Productivity Improvement,* Elsevier, New York.
3. Rajan, G.A.N., *Law of Engineering Contracts (Construction Disputes and Remedies),* Jain Book Agencies, New Delhi.
4. Roy, P.K*., Hand book of Construction Management*, McMillan Publishers, New Delhi.