DEPARTMENT OF CIVIL AND STRUCTURAL ENGINEERING

VISION
The Department of Civil and Structural Engineering came into existence in the year 1978 with a vision to serve the industry, the profession and the society in general. The prime focus is to bring into limelight the inborn and untapped potential of the student fraternity and prepare them to face challenges of the future with confidence, courage and faith.

MISSION
The ultimate goal of the Department of Civil and Structural Engineering is to provide quality education to prepare nationally competitive students and trend setters for the future generation in the realm of technical education. The student should be able to assimilate the available theories, explore new frontiers to propound new theories which will result in improving the quality of the life of the people. It will also to develop their personality in a healthy way and to provide opportunity to acquire knowledge in state-of-the-art research; and to provide service to the university, engineering profession, and the public through consultancy services.

M.E. (STRUCTURAL ENGINEERING)

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)
The following program educational objectives are consistent with the university, college and department missions.

1. To develop the technical and engineering skills of the students and to train them in applying fundamental principles in the field of Structural Engineering domain feeding the needs of global expectations with professional competence.
2. To provide proficiency in the basic principles and advanced courses in Structural Engineering so that students are able to deal with confidence on the formulation, analysis and solve the societal problems for sustainable development related to structural Engineering.
3. To explore the students in the latest innovations and trends in the field of Structural Engineering both in theory and practice and tuning the academic programmes
periodically to make the students fit for a professional job, a research assignment or self-employment.

4. To impart communication, analytical and soft skills for the students towards either placing them in a comfort zone in their profession or a path to pursue graduate education master and doctoral degree.

5. To produce Structural Engineers who integrate and build on the program's core curricular concepts in the pursuit of professional leadership, teamwork, life-long learning, and successful career advancement.

**PROGRAMME OUTCOMES (PO)**

After the successful completion of M.E (Structural Engineering) degree programme the students should be able to;

**PO 1:** Rudimentary principles of mathematics, basic engineering sciences and their technology applications in the field of Structural engineering problems.

**PO 2:** Inculcate the analysis and design of concrete and steel structural multi-storeyed structures, bridge structures, special structures, structural joints etc., under extreme wind and seismic conditions using relevant codal standards.

**PO 3:** Analyze and to identify the various advancements in Structural engineering materials utilized in the construction industry and its technical knowhow. Also create special concretes with the different waste materials using recycling concept and to reduce the environment pollutions, implementation of suitable and proper water supply and sanitary systems for the betterment of society and to promote Clean India Movement.

**PO 4:** Know the basics and advancement in the elastic and plastic nature of variety of materials used in the structures and its related research will be tuned as per the needs of the society.

**PO 5:** Understand the fundamental principles in testing the structural members with proper testing techniques (static and dynamic), instrumentations and equipments for their behaviour and performances in structural engineering.
PO 6: The students must be able to formulate, analyse, design and execute the construction of various types of engineering structures with appropriate consideration for public health and safety and cultural, societal and environmental conditions.

PO 7: To expertise the students in the field of solving the structural problems using various classic and approximate methods including the finite element analysis procedures.

PO 8: Demonstrate and to conduct different experiments for checking the property and quality of materials, carryout analysis and design of structures using softwares, and exposure in taking up student dissertation works.

PO 9: Gain exposure on curricular, extracurricular activities, different social activities of professionally and ethically responsibility and to apply ethical reasoning to society in case of emergency.

PO 10: Gain knowledge latest and advanced topics in structural engineering like different concreting techniques, selection of concrete, methods of concrete and repair and rehabilitation methodologies and applications for the present and future scenario in the construction of structures.

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M.E. / M. Tech (Two-Year Full Time & Three-year Part Time)

DEGREE PROGRAMME

CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS

1. Condition for Admission
Candidates for admission to the first year of the four-semester M.E / M.Tech Degree programme in Engineering shall be required to have passed B.E / B.Tech degree of Annamalai University or any other authority accepted by the syndicate of this University as equivalent thereto. They shall satisfy the condition regarding qualifying marks and physical fitness as may be prescribed by the syndicate of the Annamalai University from time to time. The admission for part time programme is restricted to those working or residing within a radius of 90 km from Annamalainagar. The application should be sent through their employers.

2. Branches of Study in M.E / M.Tech
The Branch and Eligibility criteria of programmes are given in Annexure 1

3. Courses of study
The courses of study and the respective syllabi for each of the M.E / M. Tech programmes offered by the different Departments of study are given separately.

4. Scheme of Examinations
The scheme of Examinations is given separately.

5. Choice Based Credit System (CBCS)
The curriculum includes three components namely Professional Core, Professional Electives and Open Electives in addition to Thesis. Each semester curriculum shall normally have a blend of theory and practical courses.

6. Assignment of Credits for Courses
Each course is normally assigned one credit per hour of lecture / tutorial per week and one credit for two hours or part thereof for laboratory or practical per week. The total credits for the programme will be 65.

7. Duration of the programme
A student of M.E / M.Tech programme is normally expected to complete in four semesters for full-time / six semesters for part-time but in any case not more than four years for full-time / six years for part-time from the date of admission.
8. **Registration for courses**
A newly admitted student will automatically be registered for all the courses prescribed for the first semester, without any option. Every other student shall submit a completed registration form indicating the list of courses intended to be credited during the next semester. This registration will be done a week before the last working day of the current semester. Late registration with the approval of the Dean on the recommendation of the Head of the Department along with a late fee will be done up to the last working day. Registration for the Thesis Phase - I and II shall be done at the appropriate semesters.

9. **Electives**
The student has to select two electives in first semester and another two electives in the second semester from the list of Professional Electives. The student has to select two electives in third semester from the list of Open Electives offered by the department/ allied department. A student may be allowed to take up the open elective courses of third semester (Full Time program) in the first and second semester, one course in each of the semesters to enable them to carry out thesis in an industry during the entire second year of study provided they should register those courses in the first semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

Further, the two open elective courses to be studied in III semester (Full Time programme) may also be credited through the SWAYAM portal of UGC with the approval of Head of the Department concerned. In such a case, the courses must be credited before the end of III Semester.

10. **Assessment**
The break-up of continuous assessment and examination marks for theory courses is as follows:

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<td>Third Assessment</td>
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<td>Maintenance of record book</td>
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<tr>
<td>End Semester Examination</td>
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The thesis Phase I will be assessed for 40 marks by a committee consisting of the Head of the Department, the guide and a minimum of two members nominated by the Head of the Department. The Head of the Department will be the chairman. The number of reviews must be a minimum of three per semester. 60 marks are allotted for the thesis work and viva voce examination at the end of the third semester. The same procedure will be adopted for thesis Phase II in the fourth semester.

11. Student Counsellors (Mentors)
To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester, monitor their progress in SWAYAM courses / open elective courses and obtain the final approval of the Head of the Department.

12. Class Committee
For each of the semesters of M.E / M.Tech programmes, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from first to fourth semesters for Full time and first to sixth semesters for Part-time will be as follows:

- Teachers of the individual courses.
- A Thesis coordinator (for Thesis Phase I and II) shall be appointed by the Head of the Department from among the Thesis supervisors.
- A thesis review committee chairman shall be appointed by the Head of the Department.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.
- All counselors of the class and the Head of the Department (if not already a member) or any staff member nominated by the Head of the Department may opt to be special invitees.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.
The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory / 40 marks for practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department for approval and transmission to the Controller of Examinations.

13. Temporary Break Of Study
A student can take a one-time temporary break of study covering the current semester and / or the next semester with the approval of the Dean on the recommendation of the Head of the Department, not later than seven days after the completion of the mid-semester test. However, the student must complete the entire programme within the maximum period of four years for Full time / six years for Part time.

14. Substitute Assessments
A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the end of semester examination may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

15. Attendance Requirements
The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.
A student who withdraws from or does not meet the minimum attendance requirement in a semester must re-register and repeat the same semester in the subsequent academic years.

16. Passing and declaration of Examination Results
All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the grade point average (GPA) and cumulative grade point average (CGPA) and prepare the mark sheets.
90 to 100 marks  Grade ‘S’
80 to 89 marks  Grade ‘A’
70 to 79 marks  Grade ‘B’
60 to 69 marks  Grade ‘C’
55 to 59 marks  Grade ‘D’
50 to 54 marks  Grade ‘E’
Less than 50 marks  Grade ‘RA’
Withdrawn from the Examination  Grade ‘W’

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course and earned the credits for that course. Such a course cannot be repeated by the student.

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10;  A - 9;  B - 8;  C - 7;  D - 6;  E - 5;  RA – 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.
GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

17. Awarding Degree
After successful completion of the programme, the degree will be awarded with the following classifications based on CGPA.

For First Class with Distinction the student must earn a minimum of 65 credits within four semesters for full-time / six semesters for Part time from the time of admission, pass all the courses in the first attempt and obtain a CGPA of 8.25 or above.

For First Class, the student must earn a minimum of 65 credits within two years and six months for full-time / three years and six months for Part time from the time of admission and obtain a CGPA of 6.75 or above.

For Second class, the student must earn a minimum of 65 credits within four years for full-time / six years for Part time from the time of admission.

18. Ranking Of Candidates
The candidates who are eligible to get the M.E /M.Tech degree in First Class with Distinction will be ranked on the basis of CGPA for all the courses of study from I to IV semester for M.E / M.Tech full-time / I to VI semester for M.E / M.Tech part-time.

The candidates passing with First Class and without failing in any subject from the time of admission will be ranked next to those with distinction on the basis of CGPA for all the courses of study from I to IV semester for full-time / I to VI semester for M.E / M.Tech part-time.

19. Transitory Regulations
If a candidate studying under the old regulations M.E. / M.Tech could not attend any of the courses in his/her courses, shall be permitted to attend equal number of courses, under the new regulation and will be examined on those subjects. The choice of courses will be decided by the concerned Head of the department. However he/she will be permitted to submit the thesis as per the old regulations. The results of such candidates will be passed as per old regulations.

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.
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<tr>
<th>S.No.</th>
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| i. | Chemical Engineering | B.E. / B.Tech – Chemical Engg, Petroleum Engg, Petrochemical Technology  
| iii. | Industrial Bio Technology | B.E. / B.Tech - Chemical Engg, Food Technology, Biotechnology, Leather Technology  
| iv. | Industrial Safety Engineering | B.E. / B.Tech – Any Branch of Engineering  
| 8 | Computer Science & Engineering |  
| 9 | Information Technology |  
| 10 | Electronics & Communication Engineering |  

* AMIE in the relevant discipline is considered equivalent to B.E
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Note:  * Four weeks during the Summer vacation at the end of II\textsuperscript{nd} Semester

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## M.E. (STRUCTURAL ENGINEERING) - (PART TIME) (Three Years)

### Choice Based Credit System (CBCS)

### Courses of Study and Scheme of Examinations

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Note: * Four weeks during the Summer vacation at the end of IVth Semester

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L - Lecture;  P - Practical;  T – Thesis;  CA – Continuous Assessment;  FE – Final Examination
PROFESSIONAL ELECTIVES (PE)

1. Theoretical & Experimental Stress Analysis with Instrumentation
2. Forensic Engineering and Retrofitting of Structures
3. Tall Structures
4. Behaviour of Pre-stressed Concrete Structures
5. Theory and Design of Plates
6. Design of Shell Structures
7. Theory of Elasticity and Plasticity
8. Advanced Foundation Design
9. Structural up gradation with Fibre Reinforced Polymer (FRP) Composites
10. Strength and deformation of Concrete members
11. Composites for Constructions using FRP Pultruded Profiles

OPEN ELECTIVES (OE)

1. Research Methodology
2. Experimental Techniques and Instrumentation
3. Contract Laws and Regulations
4. Structural Optimization
5. Prefabricated Structures
6. Soil Structure Interaction
7. Composite Structures
8. Special Concretes
9. GIS in Construction Engineering and Management
10. Bridge Engineering
11. Stability of Structures
12. Construction Planning and Scheduling
13. Shoring, Scaffolding and Formwork
14. Value Engineering and Valuation
15. Construction Personnel Management
16. Construction Workplace and Employees behaviour
17. Design of Nuclear Structures
COURSE OBJECTIVES:

- The course-work consists of the students actively investigating mathematical ideas.
- This mathematics course for engineering deals with advanced analytical and numerical techniques for solving engineering problems.
- To acquaint the student with the concepts in Calculus of variations, special functions boundary value problem and conformal mapping.

Matrices and Vector Space
Inverse of a matrix by elementary transformation method, partition methods, Choleski’s method- Degeneration of a symmetric Matrix- Hermitian form –Canonical form Unitary matrix - Orthogonal Matrix - Orthogonal system of vectors-Vector space-Linear independence -bases - sub space - dimensionality - Inner Product space.

Calculus of Variations
Maxima and Minima of functions of two variables - Lagrange Multipliers - Functional - Strong and weak variation - vibrational notations - Euler Lagrange Equation - Euler Lagrangian equations for functional with higher order derivatives - simultaneous Euler Lagrange Equation for functional with several independent variables subject to constraints.

Special Functions
BETA and GAMMA functions - Bessel’s functions, Legendre Polynomials and their properties - expansion of an arbitrary function in terms of Bessel functions and Legendre Polynomials.

Storage of Large Number of Equations
Introduction - Solution of large number of equations - Sky line storage, band form - Band width reduction - Algorithm due to Grooms - Solution of large number of equations - Band solver, Frontal Solver, Cholesky LU decomposition in sky line storage - Substructure concept - Sub matrix equation solver.

Boundary Value Problems
REFERENCES:


COURSE OUTCOMES:

At the end of the course students will be able
1. to acquire basic understanding of the concepts in the topics mentioned above
2. to learn some methods of solving problems.

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COURSE OBJECTIVES:

- This course is a prelude to the finite element analysis, a very versatile tool for solving complex Structural problems.
- Basic knowledge regarding the formulation of stiffness matrices at the element level as well as at the system level is included in the course.

**Rudimentary Concepts**


**Characteristics of Structure Stiffness and Flexibility**


**Transformation Concepts**


**Flexibility Method**

Flexibility Equation –Member end actions– Flexibility coefficients – Member and system Flexibility Matrices – Transformation Matrix – Equivalent Joint Loads – Solution procedure – choice of redundant leading to ill and well–Conditioned Matrices–Internal forces due to thermal expansion, prestrains, support settlements and flexural hinges –Reducing the Size of flexibility matrix- application to Pin-Jointed Plane truss– continuous beams– plane frames–Grids.

Develop computer programs for storing data; assembling stiffness and flexibility matrices; load vectors; displacement vectors. Develop computer programs for analysis of framed structure. Modelling and analysis of real-life structure using professional softwares.

**Stiffness Method**


Develop computer programs for storing data; assembling stiffness and flexibility matrices; load vectors; displacement vectors. Develop computer programs for analysis of framed structure. Modelling and analysis of real-life structure using professional softwares.

**REFERENCES:**

7. Dr. Devadas Menon., *Advanced Structural Analysis*, Narosa Publishing House, New Delhi, 2009

**COURSE OUTCOMES:**

At the end of the course students will be able to

1. To analyze the indeterminate structures like beams, frames, etc. with different end conditions through various advanced and modern methods.
2. To solve the structural problems with matrix approach.

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**COURSE OBJECTIVES:**

- As modern structures are becoming more slender and light, they are also becoming more susceptible to dynamic loadings.
- Examples of real-life dynamic problems that frequently confront civil engineers include: aerodynamic stability of long-span bridges, earthquake response of multi-storey buildings, impact of moving vehicles on highway structures, etc.,
- The traditional engineering solutions to these problems, based on “static force” and “static response”, are no longer valid in most cases.
- Many of these problems have to be tackled by applying knowledge of structural dynamics.
- Thus, a basic understanding of the dynamic behaviour of structures as well as the underlying principles is essential for structural engineers.


REFERENCES:


**COURSE OUTCOMES:**

At the end of the course students will be able
1. To understand the dynamic properties.
2. To gain knowledge about the earthquake occurrence and resistance.

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**STEC104 ADVANCED CONCRETE TECHNOLOGY**

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**COURSE OBJECTIVES:**

- This course provides the advanced knowledge of concrete technology which covers the properties of fresh and hardened concrete and the concept of durability.
- New concrete making materials and recent advancements in concrete technology such as High strength concrete, High performance concrete, Fiber reinforced concrete and self-compacting concrete.


REFERENCES:


COURSE OUTCOMES:

1. On completion of this course the students will know various tests on fresh, hardened concrete.

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COURSE OBJECTIVES:
- This course enables the students in studying and understanding the behaviour of steel reinforcement, non-prismatic sections, concrete etc.,

Utilization of mechanical and electrical resistance strain gauges-studying the behaviour of concrete elements –studying the behaviour steel beams.

1. Model analysis
   a. Concrete beam
   b. Portal frame
2. Beams of various cross sections.
3. Continuous beam.
4. Sand heap analogy
5. E for concrete
6. Euing’s Extensometer
7. Mechanical strain gauge
8. Unsymmetrical bending
9. Concrete durability test
   a. RCPT
   b. Sorptivity test
   c. Soundness of aggregate test
   d. Acid resistance test
   e. Sea water resistance
   f. Corrosion resistance

REFERENCES:

COURSE OUTCOMES:
At the end of the course students will be able
1. To gain knowledge on Steel elements for practical application.
2. To get experience in Modal analysis.
3. To understand the development of concrete durability
## Mapping with Programme Outcomes

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### STEC201 BEHAVIOUR OF REINFORCED CONCRETE STRUCTURES

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## COURSE OBJECTIVES:

- The objective of this course is to provide basic knowledge relating to the behaviour of concrete under flexure, shear and torsion in isolation and in combination.
- The serviceability issues are also included in the course.


Detailing of reinforcements – Beams – Columns – beam-column connections – corbels – deep beams. Concrete cover-Fire Rating as per IS specification.

REFERENCES:

1. Robert Park & Thomas Paulay, Reinforced Concrete Structures, John Wiley & Sons, 1975

COURSE OUTCOMES:

At the end of the course students will be able to
1. Understand the behaviour of concrete under uni-axial compression, Tension and Combined stresses
2. Understand the behaviour of concrete under bond and anchorage.

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COURSE OBJECTIVES:

- This course provides an introduction to the finite element method, from engineering rather than a purely mathematical point of view.
- However, the mathematical foundations of the methods are presented along with their physical interpretations.
- The basic theory and several applications of the finite element method, as well as the standard procedures taken in developing stand-alone finite element computer codes or
applying larger public domain or commercial finite element software packages to analyze particular problems, are presented.


Finite Element types – Displacement Function – Relationship between the nodal degrees of freedom and generalized coordinates – Convergence requirements – Natural Coordinates – Shape Functions – Element strains and stresses – Shape function for truss elements in local and global coordinates - Shape function for beam and frame elements.

Triangular elements (CST and LST elements), Rectilinear elements -Iso-parametric elements– Iso-parametric elements – Four noded Iso-parametric elements–Eight Noded Iso-parametric elements–Incompatible displacements models– Patch test–Reinforced Concrete Element– Element stiffness formulation for truss elements in local and global coordinates, beams, LST, CST elements, Solid Elements, Load vectors for gravity, surface and body forces.


Pre and Post Preprocessing – Modelling techniques – Sub-structuring techniques – Error estimation – Regular and Adoptive meshing techniques. Complete algorithms with flow chart for solving FEM problems - Solution Techniques – Linear analysis-Non-linear analysis both material and geometric non-linearity – Application of Finite element software packages such as ANSYS, SAP 2000N, STAAD Pro, ETABS, ABAQUS, MSC/NASTRAN, etc.

REFERENCES:
5. Dr. Rajasekaran,S, Finite Element Analysis in Engineering Design, S.Chand and Co., New Delhi, 2014

COURSE OUTCOMES:
At the end of the course students will be able to
1. Solve physical problems using finite element software’s.
2. Develop computer coding for any structural problem and creating software packages.

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**COURSE OBJECTIVES:**

- Wind and earthquake excitations are two major dynamic loadings to be considered for many modern civil engineering structures.
- An improved understanding of these loadings will enable design engineers to ensure the safety and serviceability of structures.

Elements of Engineering Seismology: Earthquake occurrence in the world causes of earthquake, plate tectonics, earthquake mechanism, seismic zoning map of India & its use. Earthquake Effects: Land and rock slides, liquefaction, fires, tsunamis, floods, release of poisonous gases and radiation.

Earthquake Phenomenon - focus epicenter, seismic waves, magnitude, intensity, intensity scale and its correlation with ground acceleration, characteristics of strong ground motions and attenuation, earthquake recording instruments. Do's and Don'ts for protection of life and property

Introduction to theory of vibrations: Single degree un-damped and damped systems, elastic response to simple load functions & earthquake response spectra.


Analysis of Infill shear wall. Modelling of Infill masonry and shear waif - Effect of openings - Strength of equivalent strut Local crushing failure - Shear failure. Introduction to a seismic design of Structures: Philosophy and principles of earthquake resistance design- Strength and stiffness, ductility design and detailing (15:13920), design of energy absorbing devices, concepts of seismic base isolation and seismic active control. Building forms and architectural design concepts-Horizontal and vertical eccentricities due to mass and stiffness distribution, structural redundancy and setbacks.
Performance of building and Structures: Main causes of damage-Intensity of earth quake forces, lack of strength and integrity in buildings, quasi resonance, lack of ductility, lack of detailing. Lessons learnt from the past earthquakes: - case studies of important Indian earthquakes, major world earthquakes, earthquake catalogue, assessment of damage. Use of relevant codes. Building deficiencies - Local and Global refit strategies.

REFERENCES:


LIST OF IS CODES:


COURSE OUTCOMES:

At the end of the course students will be able
1. To understand the dynamic properties.
2. To gain knowledge about the earthquake occurrence and resistance.
COURSE OBJECTIVES:

- This course will focus on the issues relating to the analysis and design of industrial building bents, towers and pre-engineered building systems.

**Behaviour of Industrial Bends**
Design of members subjected to lateral loads and axial loads - Analysis and Design of industrial building bents - cranes Gantry Girders and Crane columns - Bracing of Industrial Buildings and Bents. **Behaviour of Tall Steel Frames**- Analysis & Design of Steel Towers, Trestles & Masts Subjected to wind and earthquake forces.

**Plastic Analysis**
Introduction - Shape factors - moment redistribution - static - Kinematic and uniqueness theorems- combined mechanisms - Analysis of single bay and two bay portal frames -Methods of plastic moment distribution - Effect of Axial force and Shear force on plastic moment - connections -moment resisting connection.

**Cold Formed Sections**
Types of cross sections - Design of cold formed thin walled members - local Buckling and post buckling strength - Beams - Columns - beam columns - connections.

**Pre Engineered Building**
Introduction-Rigid frame End -Post and beam End -Design of Purlins and girders subjected to different load conditions - Limitations of pre-engineered buildings-Ad vantages Comparison with Conventional Steel Buildings.

**Structural Detailing**
Base plate with anchor bolt details - columns with battened plate and lacing - Column splice plate -Column with cap plate details - Gantry supporting columns -Stepped columns - Beam and
column connections - Beam to beam connections - Roof truss details - Vertical and Horizontal bracings with gusset plates.

REFERENCES:


COURSE OUTCOMES:

At the end of this course students
1. Will be in a position to design bolted and welded connections in industrial structures.
2. Will know the plastic analysis and design of light gauge steel structures.

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STEP207 | COMPUTING TECHNIQUES LABORATORY | L | T | P |
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COURSE OBJECTIVES:

- This course gives an exposure to the students in utilizing sophisticated computer aided tools for analysis and design.

Introduction to STADD PRO and Etabs Softwares

Plate 1. Analysis of Symmetrical Building Frames (Gravity Load Only) using STADD PRO Software.
Plate 2. Analysis of Symmetrical Building Frames (Wind Load Only) using STADD PRO Software.
Plate 3. Analysis of Symmetrical Building Frames (Earthquake Load Only) using STADD PRO Software.
Plate 4. Analysis of Un-Symmetrical Building Frames (Gravity Load Only) using STADD PRO Software.
Plate 5. Analysis of Un-Symmetrical Building Frames (Wind Load Only) using STADD PRO Software.
Plate 6. Analysis of Un-Symmetrical Building Frames (Earthquake Load Only) using STADD PRO Software.
Plate 7. Analysis of Symmetrical Building Frames (Gravity Load Only) using Etabs Software.
Plate 8. Analysis of Symmetrical Building Frames (Wind Load Only) using Etabs Software.
Plate 9. Analysis of Symmetrical Building Frames (Earthquake Load Only) using Etabs Software.
Plate 10. Analysis of Un-Symmetrical Building Frames (Gravity Load Only) using Etabs Software.
Plate 11. Analysis of Un-Symmetrical Building Frames (Wind Load Only) using Etabs Software.
Plate 12. Analysis of Un-Symmetrical Building Frames (Earthquake Load Only) using Etabs Software.

REFERENCES:

1) STADD PRO and Etabs Software Working Manuals.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Know how to model the symmetrical and unsymmetrical frames.
2. Do finite element analysis of structural problems with ease

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COURSE OBJECTIVES:

- To work on a technical topic related to Structural Engineering and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals

The students will work for two periods per week guided by student counsellor. They will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student’s choice related to Structural Engineering to engage in discussion with audience. They will defend their presentation. A brief copy of their presentation also should be submitted. Evaluation will be done by the student counsellor based on the technical presentation and the report and also on the interaction shown during the seminar.

COURSE OUTCOMES:

1. The students will be getting the training to face the audience and to interact with the audience with confidence.
2. To tackle any problem during group discussion in the corporate interviews.

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COURSE OBJECTIVES:

- This course gives an all-round exposure to the students on the courses studied in the previous Semesters.
A thesis work on a specialized topic in Structural Engineering should be taken at the beginning of the Third Semester in consultation with the Head of the Department. A report must be submitted at the end of the Third semester and there will be a Viva Voce examination on the thesis.

**COURSE OUTCOMES:**

At the end of the course students will be able to
1. do the project related to structural engineering.
2. Do the analysis on materials and check the quality and its application.

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**COURSE OBJECTIVES:**

- To train the students in the field work related the Structural Engineering and to have a practical knowledge in carrying out Structural Engineering field related works.
- To train and develop skills in solving problems during execution of certain works related to Structural Engineering.

The students individually undergo a training program in reputed concerns in the field of Structural during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he had, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time. The students will be evaluated by a team of staff members nominated by head of the department through a viva-voce examination.
COURSE OUTCOMES:

1. The students can face the challenges in the practice with confidence.
2. The student will be benefited by the training with managing the situation arises during the execution of works related to Structural Engineering.

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STET401 THESIS PHASE – II

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COURSE OBJECTIVES:

- This course gives an all-round exposure to the students on the courses studied in the previous semesters.

The thesis work on a specialized topic in Structural Engineering already selected in the Third Semester will be continued in the fourth semester. A report must be submitted at the end of the Fourth semester and there will be a Viva Voce examination on the thesis.

COURSE OUTCOMES:

At the end of the course students will be able to
1. do the thesis related to structural engineering.
2. Frames and materials testing and design
3. Software applications to structural related research problems

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PROFESSIONAL ELECTIVES

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COURSE OBJECTIVES:

- The objective of the course is to provide in-depth knowledge on advanced theoretical and experimental techniques of displacement and load measurements.
- The course deals specifically with all building materials and its behaviour. Emphasis is placed on design and fabrication of devices with attention to specifications, environment and length of application.
- In-depth consideration is given to the device as well as associated data acquisition.

Part-A Theoretical Stress Analysis

Basic concepts of deformation of deformable Bodies, Notations for stress and strain in two and three dimensions. Stress transformation laws - Differential equations of equilibrium in two and three dimensions in Cartesian coordinates, Generalised Hooke's law -Lame's constants.

Plane stress and plane strain problems - examples- Airy's stress function - polynomials – direct method of determining Airy's stress function. Two dimensional problems in rectangular coordinates -(a) bending of a cantilever loaded at free end (b) bending of a beam by uniform load. Equation of Equilibrium in polar coordinates - Two dimensional problems in polar coordinates for curved beam, thick cylinders and plate with holes.


Part-B Experimental Stress Analysis with Instrumentation

Basic concepts in stress and strain analysis - Two dimensional, three dimensional and plane stress problems - stress analysis using equilibrium equations and load relaxation techniques – Strain measurements using mechanical, optical and electrical gauges for static and dynamic stress analyses - Whole field methods, Photo-elasticity - stress optic law – plane and circular polarscope - Isoclinics -Isochromatics - compensation methods of separation of stresses - Three dimensional photo-elasticity, stress freezing and slicing techniques - Photostress techniques.


Applied measurements; Displacement measurements - measurement of force and torque- load cells- cantilever beams and torque tubes -stress-strain measurements and strain bridges –
measurements of temperature and pressure - Electronic measuring instruments - Recorders, oscillographs and oscilloscopes - sonic and ultrasonic testers - data loggers. Microprocessors - selection and use.

REFERENCES:


COURSE OUTCOMES:

At the end of the course students will be able to
1. understand about plane stress problems
2. understand about polariscope and to use it.

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COURSE OBJECTIVES:

- To provide students with a basic knowledge regarding the causes of failure of concrete structures, methods of condition assessment in field and techniques of repair and retrofitting of civil engineering systems.
Durability and Deterioration of Concrete


Investigation and Diagnosis


Repair Materials


Refurbishment and Protection Techniques


REFERENCES:

7. R.N. Raikar, Diagnosis and Treatment of Structures in Distress, Structwel D & C Pvt. Ltd.
COURSE OUTCOMES:

At the end of the course students will be able to

1. Upon completion of this course, the students can able to understand about the damages, damage assessments, repair materials and rehabilitation of concrete structures.
2. Perfectly analyze the damage by testing methods, suggestion and recommendations for different rehabilitation techniques.

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COURSE OBJECTIVES:

- This course covers different structural systems used for tall structures. Also an understanding of the types and principles of analysis and design is essential to be a successful structural engineer.

Design Criteria


Structural Action

Structural systems – Structural and non-structural systems – Structural system idealizations - Floor slab systems (wall supported slab system, Beam supported slab system, Ribbed slab system, Flat slab system). Vertical framing system (Columns, concrete walls, transfer girders, Suspenders) – Composite floor systems.

Modelling for gravity and lateral loads – Assumptions – Modelling for approximate analyses – Modelling for accurate analysis. Lateral load resisting systems – Behaviour of Rigid frames, Behaviour of Braced Rigid frames, Behaviour of shear wall with Rigid frames, Behaviour of framed-tubes, Behaviour of tube in tube, Behaviour of bundled tubes – Behaviour of In-filled frame structures
Analysis Concepts
Analysis and design concepts of Rigid frames, Rigid frames with bracings, Rigid frames with shear walls, framed-tubes, tube in tube and bundled tubes.

Stability

REFERENCES:

COURSE OUTCOMES:
At the end of this course the students are expected
1. to gain the behaviour of tall buildings subjected to lateral loads and their stability.
2. to know the design of tall buildings as per the existing codes.

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COURSE OBJECTIVES:
- To inculcate the basics of pre-stressing techniques to understand the design concepts used for design of bridge structures.

Behaviour of Reinforced Cement Concrete (RCC) and Pre-stressed Concrete (PSC) sections. Acceptability criterion for Pre-stressed Concrete sections – Pre and Post tensioning methods –

Flexural strength – Simplified procedures as per codes – Strain compatibility method – Basic concepts in selection of cross section for bending - Design of sections as per code for pre-tensioned and post-tensioned rectangular beams – Check for strength limit based on IS:1343-2012 – Design for shear based on IS1343-2012


Behaviour of Redundant Beams-Method of achieving continuity– Analysis-Concordant cable and linear transformation – Behaviour of T Beam and I Beam girder bridges, Behaviour of Segmental girder bridges – Behaviour of Box girder bridges.

Behaviour of concrete pipes – Circular tanks – poles – Rail way sleepers – Stress distribution in end block, Behaviour of end blocks and their reinforcement pattern as per code – Partial pre-stressing – Applications.

REFERENCES:

7. IS-3370-1(2009), *Concrete structures for storage of Liquids* - Code of practice.

COURSE OUTCOMES:

At the end of the course students will be able
1. To gain knowledge on methods of pre-stressing
2. To design various Pre-stressed concrete structural elements.
COURSE OBJECTIVES:

- Plate members are indispensable for structural systems. The main objective of this course is to provide students with a rational basis of the analysis and design of reinforced concrete plate members through advanced understanding of material and structural behavior. The subject will be approached by looking into the behavior of reinforced concrete plate elements at material level, element level and structural level and systems level.

Thin Plates with Small Deflections
Laterally loaded thin plates - governing differential equations various boundary conditions

Rectangular Plates and Circular Plates
Simply supported rectangular plates - Navier’s solution and Levy's method Rectangular plates with various edge conditions. Symmetrical bending of circular plates - plates on Elastic foundation

Special and Approximate Methods
Energy methods - Finite difference and Finite Element Methods

Anisotropic Plates
Orthotropic plates & grids. Large Deflection Theory

Folded Plates
Folded plate structures - structural behaviour - various types -Design by ACI, ASCE - Task committee method-Winter Pie method

REFERENCES:

2. Rudolph Szilard, Theory and Analysis of Plates; Classical and Numerical Methods, Prentice – Hall (1973)

**COURSE OUTCOMES:**

1. Students can able to understand the concept of plates
2. Able to analyse the plate structures and design to the need

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**COURSE OBJECTIVES:**

- Shells have become indispensable for long span roofing systems at public buildings like auditoria. The main objective of this course is to provide students with a rational basis of the analysis and design of reinforced concrete shell members and structures through advanced understanding of material and structural behavior.

Classification of shells - types of shells - Structural action - shells of revolution & shells of translation - examples - membrane theory - limitation of membrane theory

Flexure theory - Design of cylindrical shell by D.K.J. Method - other theories of analysis - use of ASCE manual for the design of cylindrical shells - prestressing of shells
Beam method of analysis of cylindrical shell by Lundgren - limitations - Detailed design of cylindrical shells -

Hyper shells & Conoidal shells. Element of Buckling of shells & shell structures

Software for the analysis of various types of shells.

REFERENCES:


COURSE OUTCOMES:

1. Students can able to understand the concept of curved structures
2. Able to analyse the shell structures and design to the need

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COURSE OBJECTIVES:

- Theory of Elasticity and Plasticity forms the basis for the analysis of the macroscopic behavior of solids, liquids and gases under the influence of external effects due to surface loads, body forces, and heating. As such it is central to the scientific disciplines of
mechanical engineering and applied mechanics and forms a common basis for further study and analysis of structural systems.

Part - A Elasticity

Basic concepts of deformation of deformable Bodies, Notations for stress and strain in two and three dimensions. Stress transformation laws - Differential equations of equilibrium in two and three dimensions in Cartesian coordinates, Generalised Hooke's law -Lame's constants.

Plane stress and plane strain problems - examples- Airy's stress function - polynomials - direct method of determining Airy's stress function. Two dimensional problems in rectangular coordinates -(a) bending of a cantilever loaded at free end (b) bending of a beam by uniform load.

Equation of Equilibrium in polar coordinates - Two dimensional problems in polar coordinates for curved beam, thick cylinders and plate with holes.

Energy principle - theorem of minimum potential energy Hamilton's principle - Castigliano's least work theorem - Castigliano's theorem on deflection - Maxwell's reciprocal law.

Torsion of various shaped bars - Prandle's membrane analogy - sand heap analogy - Torsion of thin walled sections and hollow shafts.

Part - B Plasticity

Introduction - physical assumptions, yield criteria of metals, graphical representation of yield criteria, Flow rule (plastic stress - strain relation) - Prandle Reuss equation - Levy Mises equation – Lower bound, upper bound and uniqueness Theorems.

Application to simple problems in tension - compression, Torsion solution of Elastic Plastic problems.

REFERENCES:

COURSE OUTCOMES:

1. Students can understand the concepts of elastic behaviour of materials.
2. Students can understand and analyse he materials with its plasticity

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COURSES OBJECTIVES:

- The analysis and design of various types of foundations are dealt with in this course so that the structural engineers design foundation systems based both on the soil and structural aspects of the performance of foundations.

Classification of foundation - soil design parameters -Terzaghi's bearing capacity theory - settlement - loads for design - depth of foundation - depth of soil exploration - related IS codes - proportioning of footing dimensions.

Shallow foundations in clay - footings in clay - rafts in clay - shallow foundations in sand - soil design of footing in sand – soil design of rafts in sand - soil design of continuous footings-soil design in c-φ soils - survey of relevant IS codes.

Flexible analysis of shallow foundations by the theory of sub grade reaction - individual footings - soil pressure for structural design - structural design of square footings - plain concrete footings - circular footings - rectangular footings - continuous footings - pile caps - footings subjected to moments - footings subjected to tension. Structural design of cantilever footings, rafts, grid foundation-circular and annular rafts.


Foundation design for machines - problems of vibrating foundations - theory of vibrations - design of vibrating foundations - wave propagation behaviour of non-soil materials - static and dynamic modulii for soils-vibration isolation.

REFERENCES:


COURSE OUTCOMES:

1. Students can understand and propose the suitable foundation for a particular depth
2. Students can design the foundation.

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COURSE OBJECTIVES:

- To develop an understanding of the behavior and design study of Steel concrete composite elements and structures.


**Flexural Strengthening of Beams:** Failure modes - Flexure strength of an FRP plated section - Interfacial stresses - Bond Behaviour - Strength models for debonding failures - Design Procedure. **Shear Strengthening of Beams:** Shear strengthening schemes - Shear failure modes - Shear strength of FRP strengthened RC beams - Design Procedure.

**Strengthening of Reinforced Concrete (RC) Columns:** Behaviour of FRP confined concrete - Design oriented stress - strain models for FRP confined concrete - Analysis oriented stress strain models for FRP confined concrete - Section analysis - Design of FRP confined reinforced concrete columns.

**Design guidelines for FRP Strengthening:**

**Strengthening of Reinforced Concrete (RC) Structures:** Material Properties - Characteristics and design values - Flexural strengthening - Shear strengthening - Strengthening of column with FRP wraps. **Strengthening of Metallic Structures:** Critical issue in the design of FRP strengthening for metallic structures - Selection of strengthening materials - Design of flexural strengthening. **Strengthening of Masonry Structures:** General aspects of FRP strengthening of masonry structures - Bond of FRP system to masonry - Strengthening of masonry panels under in-plane loads - Strengthening of lintels and floor belts - Strengthening of arches and vaults - Confinement of concrete columns.

**REFERENCES:**


**COURSE OUTCOMES:**

1. Students explores with the FRP applications
2. Students can design the members with FRP profiles

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COURSE OBJECTIVES:

- This course provides the advanced knowledge of concrete technology which covers the properties of fresh and hardened concrete and the concept of durability.
- New concrete making materials and recent advancements in concrete technology such as High strength concrete, high performance concrete, Fiber reinforced concrete and self-compacting concrete.


Strength and Deformation of Members with Flexure - Moment - Curvature Relationships - Ductility of Unconfined Beam Sections - Ductility of Unconfined Column Sections - Flexural Deformation of Members - Deformation of Members with Cyclic Loading.

Strength and Deformation of Members with Shear - Mechanism of Shear Resistance in RC Beams without and with Shear Reinforcement - Interaction of Shear and Flexure - Interaction of Shear, Flexure and Axial Forces - Shear Deformations - Effects of Repeated and Cyclic Loadings on shear Strength.

Strength and Deformation of Members with Torsion - Beams subjected to Torsion and Flexure without Web Reinforcement - Beams subjected to Torsion and Shear without and with Web Reinforcement.

Bond and Anchorage - Mechanisms - Bond Failure Modes - Factors influencing Bond Strength - Flexural Bond - Anchorage Bond.

Service Load Performance - Deflection - Need for Deflection Control - Methods of Deflection Control - Calculation of Deflections - Cracking - Need for Crack Control - Calculation of crack width - Control of Flexural Cracks in Design.

REFERENCES:


COURSE OUTCOMES:
1. On completion of this course the students will know various tests on fresh, hardened concrete, special concrete and the methods of manufacturing of concrete.

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<th>STEEXXX</th>
<th>COMPOSITES FOR CONSTRUCTION USING FRP PULTRUDED PROFILES</th>
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**COURSE OBJECTIVES:**

- To develop an understanding of the behavior and design study of FRP pultruded sections.


Deformation of concentrically loaded compression members – axial shortening – global Torsional buckling – local buckling due to axial loads – design procedure for concentrically loaded compression and tension members.


**REFERENCES:**

3. Ayman S. Mosallam, “Design guide for FRP composite connections”, American Society of Civil Engineers, (ASCE Manuals and reports on Engineering Practice No.102)

**COURSE OUTCOMES:**

At the end of the course students will be able to
1. Know about the FRP pultruded sections.
2. Design and construct the composite structures

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COURSE OBJECTIVES:

- To study and understand the research methodology in future research

**Introduction to Research**
Meaning of research - types of research- process of research- Sources of research problem- Criteria / Characteristics of a good research problem- Scope and objectives of research problem- Significance of Research- Research Methods versus Methodology- Research and Scientific Method -Errors in selecting a research problem- Criteria of Good Research - Problems Encountered- formulation of research hypotheses- Search for causation.

**Developing a Research Proposal**
Format of research proposal- Individual research proposal- Institutional research proposal- Significance- objectives- methodology- Funding for the proposal- Different funding agencies- Framework for the planning.

**Design, Sampling Design, Measurement and Scaling Techniques**

**Data Collection and Analysis**
Collection of Primary Data - Observation Method- Interview Method- Collection of Data through Questionnaires- Collection of Data through Schedules - Difference between Questionnaires and Schedules- Some Other Methods of Data Collection- Collection of Secondary Data- Selection of Appropriate Method for Data Collection- Elements/Types of Analysis - Measures of Dispersion- Approaches to qualitative and quantitative data analysis- Case study.

**Report Writing, Presentation of Research**
REFERENCES:
3. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction’

COURSE OUTCOMES:
1. On completion of this course the students will know methodology of research in thesis work.

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<tr>
<th>STEEXXX</th>
<th>EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION</th>
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COURSE OBJECTIVES:

- The objective of the course is to provide in-depth knowledge on advanced theoretical and experimental techniques of displacement and load measurements.
- The course deals specifically with all building materials and its behaviour. Emphasis is placed on design and fabrication of devices with attention to specifications, environment and length of application.
- In-depth consideration is given to the device as well as associated data acquisition.

Principles of measurements, Accuracy, Sensitivity and range of measurements. Mechanical, Electrical extensometers and their uses, Advantages and disadvantages.

Principle of operation and requirements, Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

Two dimensional photo elasticity, Concept of light – photo elastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic materials.

Fundamentals of NDT, Radiography, ultrasonic, magnetic particle inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique.

Instrumentation Techniques for structural components: slabs, beams, columns and beam column connections – Instrumentation for collecting and storing data.
REFERENCES:


COURSE OUTCOMES:

At the end of the course students will be able to
1. understand about plane stress problems
2. understand about polariscope.

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<th>STEEXXX</th>
<th>CONTRACT LAWS AND REGULATIONS</th>
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COURSE OBJECTIVES:

- This course provides a thorough knowledge in various types of construction contracts and their legal aspects and provisions, tenders, arbitration, legal requirement, and labor regulations in national and international construction Projects.

**Construction Contracts**


**Tenders**

Arbitration

Legal Requirements

Labour Regulations

REFERENCES:
1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India,

COURSE OUTCOMES:
1. Students can able to know about the contracts and their legal aspects and provisions, tenders, arbitration, legal requirement, and labour regulations in national and international construction Projects.

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<tr>
<th>STEEXXX</th>
<th>STRUCTURAL OPTIMIZATION</th>
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COURSE OBJECTIVES:
- The course provides basic knowledge with regard to linear and non linear optimization methods.
Introduction
Introduction to optimization techniques, Problem formation and merit function. Linear optimization Geometry of linear programming-Simple algorithm-Duality in Linear Programming.

Non-Linear Optimization-I
One dimensional minimization methods - Exhaustive search, Dichotomous search and direct root methods

Non-Linear Optimization-II
Direct Search method - random search methods-Descent methods -Steepest Descent method-Fletcher-Reeves method, Davidon-Fletcher- Powell method.

Linear Constrained Optimization
Cutting plane method and penalty function methods. Geometric plane programming-Dynamic Programming and integer programming.


REFERENCES:

COURSE OUTCOMES:
At the end of the course students will be able to
1. know about optimization techniques for simple structures
2. know about one dimensional minimization methods.

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<tr>
<th>STEEXXX</th>
<th>PREFABRICATED STRUCTURES</th>
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COURSE OBJECTIVES:

- Prefabricated construction has developed rapidly and continues to grow in importance.
- It is used in all major types of structures.
- The course aims to address issues related to types of prefabrication, loads for their design, design principles and detailing of joints in prefabrication construction

**RC Prefabricated Structures**
Long wall & 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

**Functional Design principles**
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

**Floors, Stairs and Roofs**
Types and floor slabs - 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, their behaviours and requirements, Deflection control for short term and long term loads – ultimate strength calculations in shear and flexure.

**Walls**
Types of wall panels - Blocks an large panels - curtain – partition and load bearing walls – load transfer from floor to wall panels vertical loads - eccentricity and stability of wall panels – Design curves, Types of wall joints , their behaviour and design , Leak prevention, Joint sealants, Sandwich wall panels - Approximate design of shear walls.

**Industrial buildings**
Components of single storey industrial sheds with crane gantry systems - Design of R.C. Roof Trusses Roof panels Design of R.C Crane -Gantry Girders - corbels and columns - Wind bracing design

**Design of shell roofs for Industrial sheds**
Cylindrical, Folded plate and hyper prefabricated shell, Erection and joining , joint design – hand book based design

**REFERENCES:**
COURSE OUTCOMES:

At the end of the course students will be able to
1. design some of the prefabricated elements and also have the knowledge of the construction methods in using these elements.

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<th>STEEXXX</th>
<th>SOIL STRUCTURE INTERACTION</th>
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COURSE OBJECTIVES:

- No structural design will be complete without consideration of the response of the supporting soil.
- As the soil and the structure mutually influence one another, interactive analysis and design is paramount to the safety and performance of both the super structure and the foundation.

Introduction
Soil behaviour - Elasticity, Plasticity, viscoelasticity - Non-linear behaviour - Strain hardening- Dilatancy-Classification of Interaction problems.

Modulus of Subgrade Reaction
Vertical and horizontal modulus of subgrade reaction - Determination of modulii - Factors affecting them.

Beams and slabs

Piles
Elastic analysis of axial, torsional and laterally loaded piles-Yielding of piles under axial and lateral loads-p-y-curves.

Pile Groups
Displacement of pile groups under axial and lateral loads. Pile - raft systems.

REFERENCES:

COURSE OUTCOMES:

At the end of the course students will be able to
1. to know about Soil behaviour
2. to know about Vertical and horizontal modulus of subgrade reaction.

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<tr>
<th>STEEXXX</th>
<th>COMPOSITE STRUCTURES</th>
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COURSE OBJECTIVES:

- To develop an understanding of the behavior and design study of Steel concrete composite elements and structures.

Introduction to composite construction – Basic concepts – Types of composite materials - Application of composite construction in Civil Infrastructure – Durability – Physical and Mechanical properties of composite structures – Influence of moisture at consistent level in composite structure – Construction of composite structures.


Introduction – Combustion of Polymer Composites – Fire reaction properties of Polymer Composites – Fire resistant Polymer Composites – Structural properties of Polymer Composites in Fire – Fire protection coatings – Predictive Modelling of Fatigue – Descriptive Modelling of Fatigue.


REFERENCES:

4) Carlo Pelleqrino Josesena, Cruz, *Design Procedure For The Use Of Composites In Strengthening Of Reinforced Concrete Structures*, Springer; 2016.

COURSE OUTCOMES:

At the end of the course students will be able
1. To gain knowledge on the composites and its applications.

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<th>STEEXXX</th>
<th>SPECIAL CONCRETES</th>
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COURSE OBJECTIVES:

- To provide students with a basic knowledge regarding the Micro structures, types of concretes.

Introduction


Steel Slag Concrete


Polymer and Geopolymer Concrete


Nano Concrete

Other Concretes

REFERENCES:
2. Shetty M.S., Concrete Technology, Chand & Co. Ltd, New Delhi.
3. Mehta P. Kumar and Monteiro, Paulo J.M., Concrete Micro structure, Indian Concrete Institute, Chennai

COURSE OUTCOMES:
1. On completion of this course the students will know various tests on fresh, hardened concrete,
COURSE OBJECTIVES:

- This course provides the details of data collection and field modeling.
- This also provides the management of Natural Resources and their application.

Introduction to GIS

Types of Data
Data Types – Spatial and Non-Spatial – Spatial Data – Points, Lines and areas– Non-spatial data


Data Structure
Raster and Vector Data Structure – Raster data storage – Methods of data compression-Run length, Chain and Block Coding – Vector Data Storage – Topology – Topological Models – Arc Node Structure – Surface Data – DEM – Grid DEM and TIN structure Applications of DEM-Database Management system

Data Quality and Output

REFERENCES:
COURSE OUTCOMES:

1) On completion of this course the students will know the development of construction planning, scheduling procedure and controls.

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<th>STEEXXX</th>
<th>BRIDGE ENGINEERING</th>
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COURSE OBJECTIVES:

1. Bridge engineering is a specialized area in structural engineering practice.
2. In this course, the students are taught the IRC loading standards and analysis and design of different types of bridges.


Pipe culverts - General features - Classification - Analysis and design of Pipe Culvert. Box culverts – General features - Analysis and design of Box culverts as per IRC: 6-2014 and IRC 21: 2000.


REFERENCES:


**STANDARDS:**

2) IS 13920: 1993, *Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces* - Code of Practice
3) SP 34: 1987, *Handbook on Concrete Reinforcement And Detailing*.
4) IRC: 6-2014, *Standard Specifications and Code of Practice for Road Bridges Section: II (Loads And Stresses)*.
5) IRC 21: 2000, *Standard Specifications and Code of Practice for Road Bridges Section: III (Cement Concrete (Plain And Reinforced))*.

**COURSE OUTCOMES:**

At the end of the course students will be able
1. To understand the behaviour of bridge structures.
2. To gain knowledge about the rudimentary principles of designing the bridges as per the existing codes.

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<th>STEEXXX</th>
<th>STABILITY OF STRUCTURES</th>
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**COURSE OBJECTIVES:**

- A treatment of stability as it relates to actual behavior and design. Columns, frames, beams, and beam-columns are considered.
- Elastic and Inelastic theories are compared with actual behavior and design specifications.

**Buckling of Columns**

**Buckling of Beam-Columns and Frames**
Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples. Analysis of rigid jointed frames with and without sway–Use of stability function to determine the critical load.

**Torsional and Lateral Buckling**
Torsional buckling – Combined Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions, Lateral buckling of Beams, Pure Bending of Simply supported and Cantilever Beams

**Buckling of Plates and Inelastic Buckling**
Governing differential equation – Buckling of thin plates, various edge conditions-Analysis by equilibrium and energy approach – Finite difference method.
Double modulus theory-Tangent modulus theory- Shanley’s model-Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates.

**Beam on Elastic Foundations**
Beams on elastic foundation - foundation models - infinite and semi-infinite beams - Application -buckling of beams on elastic foundation

**REFERENCES:**

**COURSE OUTCOMES:**
On completion of this course student will know
1. the phenomenon of buckling and they are in a position to calculate the buckling load on column, beam–column, frames and plates using classical and approximate methods.
COURSE OBJECTIVES:

- To study and understand the concept of planning, scheduling, cost in construction, organization and use of project information necessary for construction project.

Construction Planning

Scheduling Procedures

Scheduling Techniques

Cost Control, Monitoring and Accounting

Organization and Use of Project Information

REFERENCES:
COURSE OUTCOMES:

1. On completion of this course the students will know the development of construction planning, scheduling procedure and controls

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<th>STEEXXX</th>
<th>SHORING, SCAFFOLDING AND FORM WORK</th>
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COURSE OBJECTIVES:

• To study and understand the overall and detailed planning of formwork, plant and site equipment.
• To understand the Design and erection of forms for various elements such as slabs, beams, columns, walls, shells and tunnels.
• To know the latest methods of form construction.

Planning, Site Equipment & Plant for Form Work
Introduction - Forms for foundations, columns, beams walls etc., General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples. Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork - Formwork accessories.

Materials Accessories Proprietary Products & Pressures

Design of Forms and Shores
Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs length behaviour of wood shores - Form lining Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.
Building and Erecting the Form Work
Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

Forms for Domes and Tunnels, Slip Forms and Scaffolds
Hemispherical, Parabolic, Translational shells - Typical barrel vaults Folded plate roof details - Forms for Thin Shell roof slabs design considerations - Building the forms - Placing concrete - Form removed -Strength requirements -Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - Form construction - Shafts. Slip Forms - Principles -Types - advantages - Functions of various components - Planning -Desirable characteristics of concrete - Common problems faced - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold -Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

REFERENCES:
2. Hurd, M.K., *Formwork for Concrete*, Special Publication No.4, American Concrete Institute, Detroit, 1996

COURSE OUTCOMES:
1. On completion of this course the students will know the design and erection of form work in construction projects.

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<th>STEEXXX</th>
<th>VALUE ENGINEERING AND VALUATION</th>
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COURSE OBJECTIVES:

• To study the various aspects of value engineering and valuation in construction

Value Analysis
Value - Meaning of value - basic and secondary functions - factor contributing to value such as aesthetic – ergonomic – technical - economic - identifying reasons or unnecessary costs - Value Analysis - 10 Commandments of value analysis - value analysis team - principles of value analysis - elements of a job plan viz. orientation, Information, presentation. Implementation,
follow up action - benefits of value analysis, various applications - assessing effectiveness of value analysis.

**Life Cycle Costing**
Life cycle costing – Forecasting of Capital as well as operating & maintenance costs, time value - present worth analysis - DCF methods - ROR analysis - sensitivity analysis.

**Methods**
Different methods of performing value engineering.

**Valuation**
Types of value - purposes of valuation factors affecting value - Different methods of valuation for different types of assets such as land and building – horticulture - historical places.

**Valuation Report**

**REFERENCES:**
1. Del Younke *Value Engineering: Analysis And Methodology*

**COURSE OUTCOMES:**
1. On completion of this course the students will know the application of value Engineering and valuation in construction projects.

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<tr>
<th>STEEXXX</th>
<th>CONSTRUCTION PERSONNEL MANAGEMENT</th>
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**COURSE OBJECTIVES:**
- To study the various aspects of manpower management such as manpower planning, organization, human relations, and welfare and development methods in construction.
Leadership, Interpersonal and Communication

Stress, Conflict, Performance

Time and Motivation
Time as a Resource, Identify Important Time Management Wasters, Individual Time Management Styles, Techniques for better Time Management.- Introduction to Motivation, Relevance and types of Motivation, Motivating the subordinates, Analysis of Motivation.

Manpower Management

Relations and Compensation Management & Training and Development
REFERENCES:


COURSE OUTCOMES:

1. On completion of this course the students will know the personnel manpower management such as man power planning, organization, human relations, and welfare and development methods in construction.

<table>
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<tr>
<th>STEEEXX</th>
<th>CONSTRUCTION WORKPLACE AND EMPLOYEES BEHAVIOUR</th>
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COURSE OBJECTIVES:

• To Study work place and employer behavior of construction projects.

**Industrial Health, Safety**

**Stress in the Workplace**

**Common Stress Factors Time & Career Plateauning**
Individual Behaviour

Group Behaviour
Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Teambuilding - Interpersonal relations – Communication – Control.

REFERENCES:
1. Arun Monappa, Ranjeet Nambudiri, Patturaja Selvaraj. *Industrial relations & Labour Laws*. Tata

COURSE OUTCOMES:

1. On completion of this course the students will know workers difficulties in working place and behavior at construction work.

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<tr>
<th>STEEXXX</th>
<th>DESIGN OF NUCLEAR STRUCTURES</th>
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COURSE OBJECTIVES:

- In this course, the effect of neutron damage in solids will be discussed extensively and the behavior of nuclear materials will be described. Students who take the course will be able to work in a specialized industry requiring qualified nuclear engineers.
Physics of Nuclear reaction and fundamentals of reactors - Nuclear fission chemical reaction - reactor materials - fuel - Moderator - reflect coolant - reaction classification - reactor problems - Location and problems on radiation hazards - shielding techniques


REFERENCES:

1. A.R Folts, R.L.Wright, Allyn and Bacon, Basic Nuclear Engineering.
2. Atomic Energy Regulatory Board - AERB Safety Manual for Civil Engineering and Building Works of Nuclear Power Plants,. Govt. of India
5. John A. Camara ,101 Solved nuclear Engineering Problem

COURSE OUTCOMES:

1. Students can understand the effect of nuclear and the critical analysis on nuclear structure.
2. Able to design the nuclear structure.