# K.S. Rangasamy College of Technology

**(Autonomous Institution affiliated to Anna University, Chennai)**

**CURRICULUM & SYLLABI**

**FOR**

## M.E. Structural Engineering

**(For the batch admitted in 2022– 2023)**

# R 2022

**Accredited by NAAC with A++ Grade,**
**Approved by AICTE, Affiliated to Anna University, Chennai.**

**KSR Kalvi Nagar, Tiruchengode – 637 215.**
**Namakkal District, Tamil Nadu, India.**

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R7/ w.e.f. 03.01.2024
Passed in the BOS Meeting Held on 21.11.2023
Approved in Academic Council Meeting held on 23/12/2023

BOS Chairman
CHAIRMAN
Board of Studies
Faculty of Civil Engineering
K.S.Rangasamy College of Technology
TIRUCHENGODE - 637 215

## Department of Civil Engineering

**VISION OF THE DEPARTMENT**

To empower the graduates to excel as a competent Professional in the areas of Design and Development of Safe, Healthy, Sustainable and Eco friendly Infrastructure for overall development of the Society.

**MISSION OF THE DEPARTMENT**

- To provide quality education through interdisciplinary research and innovative practices for the Betterment of human society in teaching and learning.
- To develop creative solutions for a wide range of challenges in Civil Engineering by adopting modern Tools and Techniques.

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

**PEO1:** Gain knowledge and skills in structural engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations.

**PEO2:** Become consultants in Structural Engineering and solve complex real-life issues related to the analysis, design and maintenance of structures under various environmental conditions.

**PEO3:** Contribute to the enhancement of knowledge in Structural Engineering by performing quality research in institutions of international repute or Research organizations or Academia.

**PROGRAMME OUTCOMES (POs)**

**Engineering Graduates will be able to:**

**PO1:** Ability to individually carryout the STEM based (Science, Technology, Engineering, and Mathematics) research project.

**PO2:** Ability to write, present and publish technical articles in reputed international/national conferences and journals.

**PO3:** The skill developed by the student should be at a level of higher than the requirements in the appropriate bachelor program.

**PO4:** Ability to acquire in depth knowledge of engineering design concepts and application of the same to solve complex engineering problems.

**PO5:** Ability to find optimum safe and cost effective solutions in the development of mechanical systems taking into consideration sustainability, societal, environmental and public health aspects.

**PO6:** Ability to support professional ethics and social responsibilities consistent with their roles as design engineers.

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

Engineering Graduates will be able to:

**PSO1:** Acquire in-depth knowledge of the Structural Engineering discipline, with an ability to evaluate, ana synthesize existing and new knowledge in structural design.

**PSO2:** Critically analyze complex Structural Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.

**PSO3:** Conceptualize and solve Structural Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio-cultural factors.

**MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) WITH PROGRAMMEOUTCOMES (POs)**

The M.E. Strucutural Programme outcomes leading to the achievement of the objectives are summarized in the following Table.

| Programme Educational Objectives | Programme Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
| PEO 1 | 3 | 2 | 3 | 3 | 2 | 1 |
| PEO 2 | 3 | 2 | 3 | 3 | 2 | 1 |
| PEO 3 | 3 | 2 | 3 | 3 | 2 | 1 |

**Contributions: 1- low, 2- medium, 3- high**

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| Year | Sem. | Course Name | PO | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 |
| I | I | Applied Mathematics for Structural Engineering | 3 | 3 | 2 | 1 | 2 | |
| | | Theory of Elasticity and Plasticity | 3 | 3 | 3 | 2 | 3 | 3 |
| | | Structural Dynamics and Earthquake Engineering | 2 | 2 | 3 | 2 | 2 | 3 |
| | | Research Methodology and IPR | 3 | 3 | 2 | 2 | 2 | 2 |
| | | Advanced Construction Engineering and Experimental Techniques Laboratory | 3 | 3 | 3 | 3 | 3 | 3 |
| | | Technical Seminar | 3 | 3 | 3 | 2 | 2 | 2 |
| | II | Advanced Steel Structures | 3 | 3 | 3 | 3 | 3 | 3 |
| | | Advanced Concrete Structures | 3 | 3 | 3 | 3 | 2 | 2 |
| | | Finite Element Analysis in Structural Engineering | 3 | 3 | 3 | 3 | 2 | 2 |
| | | Advanced Structural Engineering Laboratory | 3 | 2 | 3 | 2 | 2 | 2 |
| | | Computer Aided analysis and Design laboratory | 3 | 3 | 2 | 2 | 2 | 2 |
| II | III | Project Work - Phase I | 3 | 3 | 3 | 2 | 3 | 2 |
| | | Inplant Training | 3 | 3 | 3 | 2 | 3 | 2 |
| | IV | Project Work - Phase II | 3 | 3 | 3 | 2 | 3 | 2 |

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# K.S. RANGASAMY COLLEGE OF TECHNOLOGY

## Credit Distribution for M.E (SE)Programme–2022 –2023 Batch

| S. No. | Category | Credits Per Semester | | | | Total Credits | Percentage % |
|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | | |
| 1 | PC | 17 | 14 | - | - | **31** | **42.46** |
| 2 | PE | 3 | 6 | 6 | - | **15** | **20.56** |
| 3 | CG | 1 | - | 10 | 16 | **27** | **36.98** |
| 4 | AC | - | - | - | - | **-** | **-** |
| **Total** | | **21** | **20** | **16** | **16** | **73** | **100** |

PC – PROFESSIONAL CORE
PE – PROFESSIONAL ELECTIVES
CG - CAREER GUIDANCE COURSES
AC- AUDIT COURSES

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K.S.RANGASAMY COLLEGE OF TECHNOLOGY,TIRUCHENGODE -637215
(An Autonomous Institution affiliated to Anna University)

**CONCEIVE DEVELOP IMPLEMENT EXECUTE(CDIE)**

**PROFESSIONAL CORE COURSES (PC)**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 PSE 101 | Applied Mathematics for Structural Engineering | PC | 3 | 3 | 2 | 0 | 4 | Engineering Mathematics, Probability and Statistics |
| 2. | 60 PSE 102 | Theory of Elasticity and Plasticity | PC | 3 | 3 | 0 | 0 | 3 | Fundamentals of Mathematics, Strength of Material |
| 3. | 60 PSE 103 | Structural Dynamics and Earthquake Engineering | PC | 3 | 3 | 0 | 0 | 3 | Fundamentals of Mathematics |
| 4. | 60 PED 001 | Research Methodology and IPR | PC | 3 | 3 | 0 | 0 | 3 | Nil |
| 5. | 60 PSE 1P1 | Advanced Construction Engineering and Experimental Techniques Laboratory | PC | 4 | 0 | 0 | 4 | 2 | Concrete Technology |
| 6. | 60 PSE 201 | Advanced Steel Structures | PC | 3 | 3 | 0 | 0 | 3 | Steel member design and foundation design |
| 7. | 60 PSE 202 | Advanced Concrete Structures | PC | 3 | 3 | 0 | 0 | 3 | Design of RC elements |
| 8. | 60 PSE 203 | Finite Element Analysis in Structural Engineering | PC | 3 | 3 | 0 | 0 | 3 | Knowledge of forces and resolution and equilibrium concepts. |
| 9. | 60 PSE 2P1 | Advanced Structural Engineering Laboratory | PC | 4 | 0 | 0 | 4 | 2 | Basic RC and steel design theory and design |
| 10. | 60 PSE 2P2 | Computer Aided analysis and Design laboratory | PC | 4 | 0 | 0 | 4 | 2 | CAD for structures |

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## PROFESSIONAL ELECTIVES (PE)

### SEMESTER I, PROFESSIONAL ELECTIVE I

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60PSE E11 | Theory of Structural Stability | PE | 3 | 3 | 0 | 0 | 3 | Foundation Engineering |
| 2. | 60PSE E12 | Theory of Plates and Shells | PE | 3 | 3 | 0 | 0 | 3 | Strength of materials and its mechanics |
| 3. | 60PSE E13 | Design of Tall Buildings | PE | 3 | 3 | 0 | 0 | 3 | Industrial Structures |
| 4. | 60PSE E14 | Design of Structures for Dynamic Loads | PE | 3 | 3 | 0 | 0 | 3 | Structural Dynamics |
| 5. | 60PSE E15 | Fracture Mechanics of Concrete Structures | PE | 3 | 3 | 0 | 0 | 3 | Basic Strength of material |
| 6. | 60PSE E16 | Advanced Groundwater Hydrology | PE | 3 | 3 | 0 | 0 | 3 | - |
| 7. | 60PSE E17 | Groundwater Modeling and Management | PE | 3 | 3 | 0 | 0 | 3 | - |

### SEMESTER II, PROFESSIONAL ELECTIVE II

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60PSE E21 | Structural Health Monitoring | PE | 3 | 3 | 0 | 0 | 3 | Nil |
| 2. | 60PSE E22 | Design of Sub Structures | PE | 3 | 3 | 0 | 0 | 3 | Foundation design |
| 3. | 60PSE E23 | Structural Optimization | PE | 3 | 3 | 0 | 0 | 3 | Nil |
| 4. | 60PSE E24 | Ground Improvement Techniques | PE | 3 | 3 | 0 | 0 | 3 | Design concepts of RCC, prestressed concrete and steel structures. |
| 5. | 60PSE E25 | Non-linear Analysis of Structures | PE | 3 | 3 | 0 | 0 | 3 | Finite element methods |
| 6. | 60PSE E26 | Environmental Monitoring Instruments | PE | 3 | 3 | 0 | 0 | 3 | - |
| 7. | 60PSE E27 | Municipal Solid Waste Management | PE | 3 | 3 | 0 | 0 | 3 | - |

### SEMESTER II, PROFESSIONAL ELECTIVE III

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60PSE E31 | Soil Structure Interaction | PE | 3 | 3 | 0 | 0 | 3 | Geotechnical Engineering |
| 2. | 60PSE E32 | Design of Shell and Spatial Structures | PE | 3 | 3 | 0 | 0 | 3 | Theory of elasticity and plasticity. |
| 3. | 60PSE E33 | Off Shore Structures | PE | 3 | 3 | 0 | 0 | 3 | Nil |
| 4. | 60PSE E34 | Experimental Techniques and Instrumentation | PE | 3 | 3 | 0 | 0 | 3 | Fundamentals of Mathematics |
| 5. | 60PSE E35 | Matrix Method of | PE | 3 | 3 | 0 | 0 | 3 | Mechanics of structures and |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Structural Analysis | | | | | | | structural analysis. |
| 6. | 60PSE E36 | Secondary Treatment of Wastewater | PE | 3 | 3 | 0 | 0 | 3 | - |
| 7. | 60PSE E37 | Industrial Wastewater Pollution - Prevention and Control | PE | 3 | 3 | 0 | 0 | 3 | - |

**SEMESTER III, PROFESSIONAL ELECTIVE IV**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60PSE E41 | CADD for Structures | PE | 3 | 3 | 0 | 0 | 3 | Nil |
| 2. | 60PSE E42 | Design of Industrial Structure | PE | 3 | 3 | 0 | 0 | 3 | Steel Structures |
| 3. | 60PSE E43 | Advances Application of Geotextiles in Civil Engineering | PE | 3 | 3 | 0 | 0 | 3 | Nil |
| 4. | 60PSE E44 | Industrial Steel Structures | PE | 3 | 3 | 0 | 0 | 3 | Steel Structures |
| 5. | 60 PSE E45 | Corrosion Engineering | PE | 3 | 3 | 0 | 0 | 3 | RCC and Steel Structures |
| 6. | 60PSE E46 | Principles and Design of Biological Treatment System | PE | 3 | 3 | 0 | 0 | 3 | - |
| 7. | 60PSE E47 | Transportation of Water and Wastewater | PE | 3 | 3 | 0 | 0 | 3 | - |

**SEMESTER III, PROFESSIONAL ELECTIVE V**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60PSE E51 | Prestressed Concrete Structures | PE | 3 | 3 | 0 | 0 | 3 | Nil |
| 2. | 60PSE E52 | Advanced Concrete Technology | PE | 3 | 3 | 0 | 0 | 3 | Concrete Technology |
| 3. | 60PSE E53 | Aseismic Design of Structures | PE | 3 | 3 | 0 | 0 | 3 | Dynamics of Structures |
| 4. | 60PSE E54 | Maintenance and Rehabilitation of Structures | PE | 3 | 3 | 0 | 0 | 3 | RCC and Steel Structures |
| 5. | 60PSE E55 | Modern Construction Materials | PE | 3 | 3 | 0 | 0 | 3 | Concrete Technology |
| 6. | 60PSE E56 | Remote Sensing and GIS for Hydrology and Water Resources | PE | 3 | 3 | 0 | 0 | 3 | - |
| 7. | 60PSE E57 | Principles and Design of Physico Chemical Treatment Systems | PE | 3 | 3 | 0 | 0 | 3 | - |

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## AUDIT COURSES (AC)

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 60 PAC 001 | English For Research Paper Writing | AC | 2 | 2 | 0 | 0 | 0 | -NIL- |
| 2. | 60 PAC 002 | Disaster Management | AC | 2 | 2 | 0 | 0 | 0 | -NIL- |
| 3. | 60 PAC 003 | Constitution Of India | AC | 2 | 2 | 0 | 0 | 0 | -NIL- |

## CAREER GUIDANCECOURSES (CG)

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C | Pre-requisite |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | 60 PSE 1P2 | Technical Seminar | CG | 2 | 0 | 0 | 2 | 1 | Nil |
| 2. | 60 PSE3P1 | Project Work - Phase I | CG | 16 | 0 | 0 | 16 | 08 | Nil |
| 3. | 60 PSE3P2 | Inplant Training | CG | 0 | 0 | 0 | 0 | 2 | Nil |
| 4. | 60 PSE4P1 | Project Work - Phase II | CG | 32 | 0 | 0 | 32 | 16 | Project Work - Phase I |

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**K.S.RANGASAMY COLLEGE OF TECHNOLOGY,TIRUCHENGODE -637215**

**(An Autonomous Institution affiliated to Anna University)**

**COURSES OF STUDY**

**(For the candidates admitted from 2022-2023 onwards)**

**SEMESTER I**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 PSE 101 | Applied Mathematics for Structural Engineering | PC | 5 | 3 | 2 | 0 | 4 |
| 2. | 60 PSE 102 | Theory of Elasticity and Plasticity | PC | 5 | 3 | 2 | 0 | 4 |
| 3. | 60 PSE 103 | Structural Dynamics and Earthquake Engineering | PC | 5 | 3 | 2 | 0 | 4 |
| 4. | 60 PED 001 | Research Methodology and IPR | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 PSE E1* | Professional Elective I | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 PAC 001 | English for Research Paper Writing | AC | 2 | 2 | 0 | 0 | 0 |
| **PRACTICALS** | | | | | | | | |
| 7. | 60 PSE 1P1 | Advanced Construction Engineering and Experimental Techniques Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | 60 PSE 1P2 | Technical Seminar | CG | 2 | 0 | 0 | 2 | 1 |
| | | | **Total** | **29** | **17** | **6** | **6** | **21** |

**SEMESTER II**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 PSE 201 | Advanced Steel Structures | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | 60 PSE 202 | Advanced Concrete Structures | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | 60 PSE 203 | Finite Element Analysis in Structural Engineering | PC | 5 | 3 | 2 | 0 | 4 |
| 4. | 60 PSE E2* | Professional Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | 60 PSE E3* | Professional Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | 60 PAC 002 | Disaster Management | AC | 2 | 2 | 0 | 0 | 0 |
| **PRACTICALS** | | | | | | | | |
| 7. | 60 PSE 2P1 | Advanced Structural Engineering Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | 60 PSE 2P2 | Computer Aided analysis and Design laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **Total** | **27** | **17** | **2** | **8** | **20** |

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**SEMESTER III**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 60 PSE E4* | Professional Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | 60 PSE E5* | Professional Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 3. | 60 PSE3P1 | Project Work - Phase I | CG | 16 | 0 | 0 | 16 | 8 |
| 4. | 60 PSE3P2 | Inplant Training | CG | 0 | 0 | 0 | 0 | 2 |
| | | | **Total** | **22** | **6** | **0** | **16** | **16** |

**SEMESTER IV**

| S.No. | Course Code | Course Title | Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| | | | | | | | | |
| **PRACTICALS** | | | | | | | | |
| 1. | 60 PSE4P1 | Project Work - Phase II | CG | 32 | 0 | 0 | 32 | 16 |
| | | | **Total** | **32** | **0** | **0** | **32** | **16** |

**TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 73**

**Note**:
PC- Professional Core Courses; PE- Professional Elective Courses; CG-Career Guidance Courses; AC- Audit Courses.

L: Lecture;
T: Tutorial;
P: Practical;
C: Credit

1 Hour Lecture = 1 credit
2 Hours tutorial = 1 credit
2 Hours practical = 1 credit

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(An Autonomous Institution affiliated to Anna University)

M.E. / M.Tech. Degree Programme

**SCHEME OF EXAMINATIONS**

(For the candidates admitted from 2022-2023 onwards)

**FIRSTSEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 60 PSE 101 | Applied Mathematics for Structural Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 2 | 60 PSE 102 | Theory of Elasticity and Plasticity | 2 | 40 | 60 | 100 | 45 | 100 |
| 3 | 60 PSE 103 | Structural Dynamics and Earthquake Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 4 | 60 PED 001 | Research Methodology and IPR | 2 | 40 | 60 | 100 | 45 | 100 |
| 5 | 60 PSE E1* | Professional Elective I | 2 | 40 | 60 | 100 | 45 | 100 |
| 6 | 60 PAC 001 | English for Research Paper Writing | 2 | 100 | - | 100 | | |
| **PRACTICAL** | | | | | | | | |
| 7 | 60 PSE 1P1 | Advanced Construction Engineering and Experimental Techniques Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 8 | 60 PSE 1P2 | Technical Seminar | 3 | 100 | - | 100 | - | 100 |

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to60marksfortheawardofterminalexamination marks.

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| 60 PSE101 | APPLIED MATHEMATICS FOR STRUCTURAL ENGINEERING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 2 | 0 | 4 |

**Objective**

- To describe the concepts of solving system of equations.
- To understand the least square method to find the curve of best fit.
- To get exposed to the functional optimization related problems.
- To acquire knowledge of solving partial differential equations using Laplace transform.
- To familiarize the basic concepts on Fourier transform.

***Prerequisite***

NIL

***Course Outcomes***

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Apply various iteration techniques to solve the algebraic, transcendental and linear equations. | Remember, Apply |
| CO2 | Use method of least square to find the best fit curves and analyze interpolation problems. | Remember, Understand, Analyze |
| CO3 | Compute the solutions for functional optimization problems. | Remember, Understand, Apply |
| CO4 | Solve partial differential equations using Laplace transform. | Remember, Apply |
| CO5 | Solve the boundary value problems using Laplace transform techniques. | Remember, Apply |

***Mapping with Programme Outcomes***

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 2 |
| CO3 | | 3 | 2 | 1 | 2 |
| CO4 | 3 | 3 | 2 | 1 | 2 |
| CO5 | 3 | 3 | 2 | 1 | 2 |
| 3- Strong; 2-Medium; 1-Low | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 10 | 10 | 10 |
| Understand (Un) | 10 | 10 | 10 |
| Apply (Ap) | 20 | 40 | 60 |
| Analyze (An) | 20 | 0 | 20 |
| Evaluate (Ev) | 0 | 0 | 0 |
| Create (Cr) | 0 | 0 | 0 |

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**K.S.Rangasamy College of Technology–Autonomous R2022**

**60 PSE101 - APPLIED MATHEMATICS FOR STRUCTURAL ENGINEERING**

**M.E. STRUCTURAL ENGINEERING**

| Semester | Hours/Week | | | Total Hrs | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 2 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Eigenvalue Problems**<br>Matrix operations – Solution of system of linear equation by Gauss Seidal iterative method– Eigen value and eigen vector by iterative methods: Power method – Jacobi method – Given's method – House holder method. | **[9]** |
| **Regression Analysis**<br>Curve fitting by the method of least squares – Fitting a curve of the form $y = ax^b$ and $y = ae^{bx}$. Interpolation: polynomial approximation –Lagrange's method – Newton's method. | **[9]** |
| **Calculus of Variations**<br>Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functionals dependent on functions of several independent variables– Variational problems with moving boundaries – Isoperimetric problems – Direct methods –Ritz method. | **[9]** |
| **Laplace Transform Techniques for Partial Differential Equations**<br>Laplace transform: Definitions – Properties– Dirac delta function – Unit step functions – Convolution theorem – Inverse Laplace transform: Complex inversion formula – Solutions to partial differential equations: Heat equation – Wave equation. | **[9]** |
| **Fourier Transform Techniques for Partial Differential Equations**<br>Fourier transform: Definitions – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equation – Wave equation – Laplace and Poisson's equations. | **[9]** |
| **Total Hours: 45 + 15(Tutorial)** | **60** |

**Textbook(s):**


1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, "Numerical Methods: For Scientific and Engineering Computation", 8th Edition, New Age International Private Limited, New Delhi, 2022.
2. K. SankaraRao, "Introduction to Partial Differential Equations", 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.


**Reference(s):**


1. B.S.Grewal, "Numerical methods in Engineering and Science, 11th Edition, Khanna Publishers, New Delhi, 2013.
2. A.S. Gupta, "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi 1999.
3. S.Rajasekaran, "Numerical Methods in Science and Engineering: A Practical Approach", S.Chand& Co., New Delhi, 1st Edition, 1999 (Reprint 2012).
4. G. James, "Advanced Modern Engineering Mathematics", 3rdEdition,Pearson Education, 2004.
5. Prof. AdrijitGoswami, "Transform Calculus and its applications in Differential Equations" – NPTEL Video Course.



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## *Course Contents and Lecture Schedule*

| S.No. | Topic | No.of Hours |
|---|---|---|
| **1** | **Eigenvalue Problems** | |
| 1.1 | Matrix operations | 1 |
| 1.2 | Solution of system of linear equation by Gauss Seidal iterative method | 1 |
| 1.3 | Eigen value and eigen vector by iterative methods: Power method | 1 |
| 1.4 | Tutorial | 2 |
| 1.5 | Jacobi method | 1 |
| 1.6 | Given's method | 2 |
| 1.7 | House holder method | 2 |
| 1.8 | Tutorial | 2 |
| **2** | **Regression Analysis** | |
| 2.1 | Curve fitting by the method of least squares | 2 |
| 2.2 | Fitting a curve of the form $y = ax^b$ and $y = ae^{bx}$ | 2 |
| 2.3 | Tutorial | 2 |
| 2.4 | Interpolation: polynomial approximation | 1 |
| 2.5 | Lagrange's method | 1 |
| 2.6 | Newton's method | 2 |
| 2.7 | Tutorial | 2 |
| 3 | **Calculus of Variations** | |
| 3.1 | Concept of variation and its properties | 1 |
| 3.2 | Euler's equation | 1 |
| 3.3 | Functional dependent on first andhigher order derivatives | 2 |
| 3.4 | Functionals dependent on functions of several independent variables | 1 |
| 3.5 | Tutorial | 2 |
| 3.6 | Variational problems with moving boundaries | 1 |
| 3.7 | Isoperimetric problems | 1 |
| 3.8 | Ritz method | 1 |
| 3.9 | Tutorial | 2 |
| **4** | **Laplace Transform Techniques for Partial Differential Equations** | |
| 4.1 | Laplace transform: Definitions – Properties | 1 |
| 4.2 | Dirac delta function – Unit step functions | 1 |
| 4.3 | Convolution theorem | 1 |
| 4.4 | Tutorial | 2 |
| 4.5 | Inverse Laplace transform: Complex inversion formula | 1 |
| 4.6 | Solutions to partial differential equations: Heat equation | 2 |

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| | | |
|---|---|---|
| 4.7 | Solutions to partial differential equations: Wave equation | 2 |
| 4.8 | Tutorial | 2 |
| **5** | **Fourier Transform Techniques for Partial Differential Equations** | |
| 5.1 | Fourier transform: Definitions – Properties | 1 |
| 5.2 | Transform of elementary functions | 1 |
| 5.3 | Convolution theorem – Parseval's identity | 1 |
| 5.4 | Tutorial | 2 |
| 5.5 | Solutions to partial differential equations: Heat equation | 1 |
| 5.6 | Solutions to partial differential equations: Wave equation | 1 |
| 5.7 | Laplace's equation | 2 |
| 5.8 | Poisson's equation | 1 |
| 5.9 | Tutorial | 2 |
| | **Total** | **60** |

## CourseDesigners

1. **Dr.D.TAMIZHARASAN** -tamizharasan@ksrct.ac.in

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| 60 PSE 102 | THEORY OF ELASTICITY AND PLASTICITY | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 2 | 0 | 4 |

**Objective**

- To understand the concepts of stresses, strains and stress-strain relationships, basic theory of elasticity and failure criteria.
- To expose the two dimensional problems in Cartesian and polar coordinates.
- To make familiar with problem formulations and solution techniques.
- To familiarize with the principle of torsion of prismatic bars of non circular sections.
- To Learn different energy methods and also basics of plasticity.

***Prerequisite***

Fundamentals of Mathematics, knowledge of basic Science

***Course Outcomes***

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Understand the equilibrium equation and stress-strain relationship with various Coordinate Systems. | Remember, Understand, Apply |
| CO2 | Analyze the problem with bi-harmonic equations. | Remember, Understand, Analyze |
| CO3 | Identify the different approaches for solving the torsional problems and thin walled open and closed sections | Remember, Understand, Apply, Analyze |
| CO4 | Analyze the elasticity problems with various energy methods. | Analyze |
| CO5 | State the assumptions of plasticity and solve plastic problems. | Understand and Apply |

***Mapping with Programme Outcomes***

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 1 |
| CO5 | 2 | 3 | 2 | 3 | 2 | 2 |
| 3- Strong; 2-Medium; 1-Low | | | | | | |

**Assessment Pattern**

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 20 | 10 | 30 |
| Analyse | 20 | 30 | 50 |
| Evaluate | - | - | - |

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| | | | |
|---|---|---|---|
| Create | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60 PSE 102 - THEORY OF ELASTICITY AND PLASTICITY** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Semester** | **` Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | 60 | **C** | **CA** | **ES** | **Total** |
| **I** | 3 | 2 | 0 | | 4 | 40 | 60 | 100 |

**Elasticity**
Analysis of stress and strain, equilibrium equations – Compatibility equations – stress strain relationship. Generalized Hooke's law. [9]

**Elasticity Solution**
Plane stress and plane strain problems -Two dimensional problems in Cartesian and Polar co-ordinates - Airy's stress function – Bi harmonic equation – Saint Venant's principle. [9]

**Torsion of Non Circular Section**
St.venant's approach – Prandtl's approach – membrane analogy – Torsion of thin walled open and closed sections. [9]

**Energy Methods**
Strain energy - Principle of Virtual Work-Energy theorem - Rayleigh Ritz method-finite difference method – application to elasticity problems. [9]

**Plasticity**
Physical assumption – Yield criteria - Yield surface, Flow rule – Plastic stress strain relationship- Elastic – Plastic problems in bending - Torsion and Thick cylinders. [9]

**Total Hours 45+15(Tutorial) = 60**

**Text book (s) :**

| | |
|---|---|
| 1 | Sadhu singh," Theory of Elasticity", Khanna Publishers, New Delhi, 2013. |
| 2 | Sadhu singh," Theory of Plasticity", Khanna Publishers, New Delhi, 2011. |

**Reference(s) :**

| | |
|---|---|
| 1 | S. Timoshenko.S and J.N Goodier.," Theory of Elasticity", Mc Graw Hill Book Co., New York, 2010 |
| 2 | H Jane Helena, "Theory of Elasticity and Plasticity", PHI Learning Pvt. Ltd., 2016. |
| 3 | L.S.Srinath, "Advanced Mechanics of Solids", Tata McGraw Hill, New Delhi, Third Edition, 2011 |
| 4 | Sadhu singh, "Applied Stress Analysis", Khanna Publishers, New Delhi, 2007. |

***Course Contents and Lecture Schedule***

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Elasticity** | |
| 1.1 | Analysis of stress and strain in 2D and 3D system - Introduction | 1 |
| 1.2 | Longitudinal Vibrations Equation of motion, SDOF analysis | 1 |
| 1.3 | Equation of Equilibrium – 2D (Cartesian & Polar coordinate system) & Problems | 1 |
| 1.4 | Equation of Equilibrium - 3D (Cartesian system) & Problems | 2 |
| 1.5 | Compatibility equation | 1 |
| 1.6 | Analysis of stress – 2D(Cartesian & Polar coordinate system) & Problems | 1 |
| 1.7 | Analysis of strain – 2D(Cartesian & Polar coordinate system) & Problems | 1 |

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| | | |
|---|---|---|
| 1.8 | Specification of stress and strain –2D & 3D & Problems | 1 |
| 1.9 | Generalized Hook's law, Stress-Strain relationship- Mohr Circle | 2 |
| **2** | **Elasticity Solution** | |
| 2.1 | Plane Stress and Plane Strain Problems. | 1 |
| 2.2 | Derivation of Airy's stress functions in cartesian coordinate system | 2 |
| 2.3 | Derivation of Airy's stress functions in polar coordinate system | 2 |
| 2.4 | Application of Airy's stress functions | 2 |
| 2.5 | Problems in airy's stress functions | 2 |
| 2.6 | Thick cylinders under uniform pressure | 1 |
| 2.7 | Bi harmonic equation | 1 |
| 2.8 | Saint Venant's principle | 1 |
| 2.9 | Shrink & Force fit & Problems | 2 |
| 2.10 | Problem | 2 |
| 3 | **Torsion of Non Circular Section** | |
| 3.1 | Torsion of non-circular by St. Venant's approach | 2 |
| 3.2 | Torsion of circular Prismatic bar by St. Venant's approach | 2 |
| 3.3 | Torsion of non-circular by Prandtl approach & Problems | 2 |
| 3.4 | Torsion of Prismatic bar by Prandtl approach & Problems | 2 |
| 3.5 | Membrane analogy of torsion of Closed section | 2 |
| 3.6 | Torsion of thin walled open and closed sections | 2 |
| **4** | **Energy Methods** | |
| 4.1 | Introduction to energy theorem | 1 |
| 4.2 | Strain Energy for 2D & 3D stress system | 1 |
| 4.3 | Complimentary energy theorem | 1 |
| 4.4 | Principle of Virtual Work | 1 |
| 4.5 | Energy theorem | 1 |
| 4.6 | Rayleigh Ritz method | 1 |
| 4.8 | Finite difference method | 1 |
| 4.9 | Engesser's theorem & Castingliano's theorem | 1 |
| 4.10 | Problems in energy method | 2 |
| 5 | **Plasticity** | |
| 5.1 | Physical assumption | 1 |
| 5.2 | Yield criteria and Yield surface | 2 |
| 5.3 | **Plastic stress strain relations,** Flow rule | 2 |
| 5.4 | Tresca criteria & Problems | 2 |
| 5.5 | **Von mises criteria & Problems** | 2 |
| 5.6 | Plastic problems in bending | 1 |
| 5.7 | Plastic problems in Torsion | 1 |
| 5.8 | Plastic problems in Thick cylinders | 1 |
| | **Total** | **60** |

## Course Designers

Dr.J.Abdul Bari - abdulbari@ksrct.ac.in

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| 60 PSE 103 | STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 2 | 0 | 4 |

## Objective

- To know the fundamentals of vibrations of SDOF system
- To gain knowledge on free and forced vibration of MDOF system
- To understand the basic principles of dynamics, different methods of multi degree of freedom system and their dynamic response, modeling
- To evaluate the free and forced vibration analysis of continuous system
- To know the practical applications of structural dynamics

## Prerequisite

**Fundamentals of Mathematics, knowledge of basic Science**

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Analyse the single degree of freedom with free vibration. | Analyze |
| CO2 | Analyse the single degree of freedom forced vibration with harmonic excitation. | Analyze |
| CO3 | Analyse the two degree of freedom with free vibration. | Analyze |
| CO4 | Analyse the Multi degree of freedom with free and forced vibration. | Analyze |
| CO5 | Apply the principle of vibration to the sub structure design.. | Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 2 | 3 |
| CO2 | | | 3 | | 2 | 3 |
| CO3 | 2 | 2 | 3 | 2 | 2 | 3 |
| CO4 | | | 3 | | 2 | 3 |
| CO5 | 1 | 1 | 3 | 2 | 3 | 3 |
| 3- Strong; 2-Medium; 1-Low | | | | | | |

## AssessmentPattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 30 |
| Analyse | 30 | 30 | 50 |
| Evaluate | - | - | - |
| Create | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| 60 PSE 103- STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 2 | 0 | 60 | 4 | 40 | 60 | 100 |

| | |
|---|---|
| **Principles of Vibration Analysis**<br>Equations of Motion by equilibrium and energy methods, Free & Forced vibration of single degree of freedom systems, Effect of damping – transmissibility | **[12]** |
| **Multi Degree of Freedom System**<br>Formulation of Structure, property matrices - Eigen value problems – problems on two degree of freedom system – Mode shapes - Orthonormality of modes | **[12]** |
| **Dynamic Analysis of Multi Degree of Freedom**<br>Multi degree of freedom systems, Orthogonality of normal modes, approximate methods- Dunkerly's method Holzer method- Stodola method-Rayleigh's method- Rayleigh Ritz method- Mode superposition technique Numerical integration techniques | **[12]** |
| **Dynamic Analysis of Continuous Systems**<br>Free and forced vibration of continuous system –Rayleigh Ritz method – formulation using conservation of energy- formulation using virtual work. | **[12]** |
| **Practical Applications**<br>Idealization of multi-storeyed frames – Impact loading - blast loading - aerodynamics, gust phenomenon principles of analysis.. | **[12]** |
| **TotalHours** | **60** |

**Textbook(s):**

| | |
|---|---|
| 1. | Madhujith Mukhopadhyay "Structural Dynamics (Vibration & systems)" ,Ane books Pvt.Ltd, 2015. |
| 2. | M Paz, " Structural Dynamics-Theory and Computation", Springer, 2007. |

**Reference(s):**

| | |
|---|---|
| 1. | Anil K Chopra, "Dynamics of Structures – Theory and Applications to Earthquake Engineering", Prentice Hall,New Delhi, 2007. |
| 2. | Roy R Craig and Andrew J.Kurdila," Fundamentals of Structural dynamics", John Wiley and Sons, 2011. |
| 3. | R W Clough and J Penzien, "Dynamics of Structures", McGraw Hill Book Co. Ltd, 2003. |
| 4. | J L Humar, "Dynamics of Structures", Prentice Hall on India Pvt. Ltd, 2000. |

## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Principles of Vibration Analysis** | |
| 1.1 | Free vibration of single degree of freedom systems, Simple Harmonic motion | 1 |
| 1.2 | Longitudinal Vibrations Equation of motion, SDOF analysis | 1 |
| 1.3 | Undamped SDOFs- dynamic equation of motion with electrical equivalent | 1 |
| 1.4 | Tutorial | 2 |
| 1.5 | Newtons law of motion, D'Alemberts principle- equivalent stiffness | 1 |
| 1.6 | Springs are connected in series and parallel, frequency and period, problems | 1 |
| 1.7 | Amplitude of motion, Energy method for the equation of motion | 1 |

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| | | |
|---|---|---|
| 1.8 | Damped SDOFs- underdamped, overdamped and critically damped | 1 |
| 1.9 | Logarithmic decrement ,method of determining damping | 1 |
| 1.10 | Tutorial | 2 |
| **2** | **Multi Degree of Freedom System** | |
| 2.1 | Forced vibration of single degree of freedom system | 1 |
| 2.2 | Undamped harmonic excitation | 2 |
| 2.3 | Damped harmonic excitation with electrical equivalent | 1 |
| 2.4 | Tutorial | 1 |
| 2.5 | Response to support motion Torsional vibration and Dynamic Magnification Factor | 2 |
| 2.6 | Impulsive loading problems using Fourier series | 1 |
| 2.7 | Forced vibration problems using Laplace transform method | 1 |
| 2.8 | Numerical evaluation of Duhamel's integral for damped system | 2 |
| 2.9 | Tutorial | 2 |
| 3 | **Dynamic Analysis of Multi Degree of Freedom** | |
| 3.1 | Two degrees of freedom | 2 |
| 3.2 | Principle modes of vibration and equation of motion for two degree of freedom | 2 |
| 3.3 | Two degrees of freedom for torsional system, Vibrations of undamped Two degrees of freedom | 2 |
| 3.4 | Tutorial | 2 |
| 3.5 | Forced Vibrations and Undamped forced vibration for two degrees of freedom | 2 |
| **4** | **Multi Degree of Freedom** | |
| 4.1 | Stiffness, mass, damping matrices and Influence Coefficient | 2 |
| 4.2 | Modal analysis – damped undamped free vibration | 2 |
| 4.3 | Matrix Method and Matrix Iteration Method | 2 |
| 4.4 | Tutorial | 2 |
| 4.5 | Dunkerleys ,Stodola's , Rayleigh's and Holzer Method | 2 |
| 4.6 | Dynamic analysis method to evaluate lateral forces, Static and dynamic condensation | 2 |
| 4.8 | Tutorial | 2 |
| 5 | **Vibration Analyse in Sub Structure** | |
| 5.1 | Base Isolation and design of bearings | 2 |
| 5.2 | Machine foundation- types , basic and design criteria | 2 |
| 5.3 | MSD Method of analysis | 2 |
| 5.4 | Tutorial | 2 |
| 5.5 | EHS Method of Analysis | 1 |
| 5.6 | Tschebotarioff's reduced frequency method- design problems | 2 |
| | **Total** | **60** |

## CourseDesigners

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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| 60 PED 001 | RESEARCH METHODOLOGY AND IPR | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

**Objective(s)**

- To understand the principles of research process.
- To develop knowledge in analytical skills for collection of research data.
- To understand the procedure in the preparation of reports.
- To accomplish basic idea about the process involved in intellectual property rights.
- To enlighten the process of patent filing.

**Pre-requisite**

Nil

**Course Outcomes**

On the successful completion of the course, students will be able

| | | |
|---|---|---|
| **CO1** | To understand the research process and design. | Remember, Understand, Apply |
| **CO2** | To gain the knowledge about sources and collection of research data | Remember, Understand, Aanalyze |
| **CO3** | To understand the procedure of data analysis, preparation of reports and checking plagiarism | Remember, Understand, Analyze |
| **CO4** | To gain the knowledge on Trade mark and functions of UNESCO in IPR | Remember, Understand, Apply |
| **CO5** | To enlighten the benefits, E-filing and Examinations related to patents | Remember, Understand, Apply |

**Mapping with Programme Outcomes**

| COURSE NAME | CO | PO | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| Research Methodology and IPR | CO1 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 3 |
| | CO2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 3 |
| | CO3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 3 |
| | CO4 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 3 |
| | CO5 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 3 |

**Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution**



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**AssessmentPattern**

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | Model Exam (Marks) | End Semester Examination (Marks) |
|---|---|---|---|---|
| | 1 | 2 | | |
| **Remember** | 10 | 10 | 20 | 30 |
| **Understand** | 20 | 20 | 40 | 30 |
| **Apply** | 30 | 30 | 40 | 30 |
| Analyse | 0 | 0 | 0 | 10 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**Syllabus**

**K.S.Rangasamy College of Technology – Autonomous R2022**

**60 PED 001 - Research Methodology and IPR**

**Common to all Branches**

| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Research Design**<br>Overview of research process and design- Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys, Selection of the Right Medium and Journal for publication, Translation of Research | [9] |
| **Data Collection and Sources**<br>Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying. | [9] |
| **Data Analysis and Reporting**<br>Overview of Multivariate Analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation. Checks for Plagiarism, Falsification, Fabrication, and Misrepresentation | [9] |
| **Intellectual Property Rights**<br>Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance. | [9] |
| **Patents**<br>Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents. | [9] |
| **Total Hours** | 45 |

**Text Book(s):**

| | |
|---|---|
| 1. | David I. Bainbridge, "Intellectual Property", Longman, 9th Edition, 2012. |
| 2 | Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012) |

**Reference(s):**

| | |
|---|---|
| 1. | Chawla H S., "Introduction to Intellectual Property Rights", CBS PUB & DIST PVT Limited, INDIA, 2019. |

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| | |
|---|---|
| 2. | Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007 |
| 3. | David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007 |
| 4. | Arun K. Narasani, Kankanala K.C., Radhakrishnan V., “Indian Patent Law and Practice”, Oxford University Press, 2010. |
| 5. | Richard Stim, “Patent, Copyright & Trademark - An Intellectual Property Desk Reference”, NOLO Publishers, 2020. |
| 6. | The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013. |


**Course Content and Lecture Schedule**

| S.No. | Topics | No.of hours |
|---|---|---|
| 1.0 | **Research Design** | |
| 1.1 | Overview of research process and design | 1 |
| 1.2 | Use of Secondary and exploratory data to answer the research question | 2 |
| 1.3 | Qualitative research | 1 |
| 1.4 | Observation studies | 1 |
| 1.5 | Experiments and Surveys | 1 |
| 1.6 | Selection of the Right Medium and Journal for publication | 2 |
| 1.7 | Translation of Research | 1 |
| 2.0 | **Data Collection and Sources** | |
| 2.1 | Measurements, Measurement Scales | 2 |
| 2.2 | Questionnaires and Instruments | 2 |
| 2.3 | Sampling and methods | 2 |
| 2.4 | Data - Preparing, Exploring, examining and displaying | 3 |
| 3.0 | **Data Analysis and Reporting** | |
| 3.1 | Overview of Multivariate analysis | 1 |
| 3.2 | Hypotheses testing and Measures of Association | 2 |
| 3.3 | Presenting Insights | 1 |
| 3.4 | Findings using written reports and oral presentation | 2 |
| 3.5 | Checks for Plagiarism | 1 |
| 3.6 | Falsification | 1 |
| 3.7 | Fabrication, and Misrepresentation | 1 |
| 4.0 | **Intellectual Property Rights** | |


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| | | |
|---|---|---|
| 4.1 | Intellectual Property – The concept of IPR | 1 |
| 4.2 | Evolution and development of concept of IPR, IPR development process | 2 |
| 4.3 | Trade secrets, utility Models, IPR & Bio diversity | 2 |
| 4.4 | Role of WIPO and WTO in IPR establishments | 1 |
| 4.5 | Right of Property, Common rules of IPR practices | 1 |
| 4.6 | Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance | 2 |
| 5.0 | **Patents** | |
| 5.1 | Patents – objectives and benefits of patent, Concept, features of patent | 2 |
| 5.2 | Inventive step, Specification, Types of patent application | 2 |
| 5.3 | Process E-filling, Examination of patent | 1 |
| 5.4 | Grant of patent, Revocation | 1 |
| 5.5 | Equitable Assignments, Licences, Licensing of related patents | 2 |
| 5.6 | Patent agents, Registration of patent agents | 1 |
| | **Total Hrs** | **45** |

**CourseDesigner**

Dr.A.Murugesan – murugesana@ksrct.ac.in

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| 60 PSE 1P1 | ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTAL TECHNIQUES LABORATORY |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 0 | 0 | 4 | 2 |

## Objectives

- To impart knowledge on various test of concrete making materials
- To perform mix design using IS and ACI method
- To learn the various test for self-compacting & hardened concrete
- To acquire skills on non- destructive test of concrete
- To conduct various durability test available for concrete

## Pre-requisite

Courses – Construction Materials & Concrete Technology

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Identify the suitable test available for concrete making materials | Apply |
| CO2 | Execute mix design for manufacturing the concrete | Apply |
| CO3 | Perform various test for self - compacting & hardened concrete | Apply |
| CO4 | Examine the strength of existing structure by non - destructive testing methods | Apply |
| CO5 | Analyze the durability performance of concrete | Analyse |

## Mapping with Programme outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3- Strong; 2-Medium; 1-Low | | | | | | |

## List of Experiments

1. Tests on concrete making materials
   a) Test on cement - Specific gravity, Setting time, Soundness, Fineness & Compressive strength
   b) Test on aggregate - Flakiness & Elongation, Density and Fineness modulus
2. Concrete Mix Design as per IS 10262 - 2019 method & ACI Method
3. Tests on self-compacting concrete
4. Tests on hardened concrete
   a) Mechanical properties of concrete & their relationship
   b) Stress strain behavior of concrete
5. Non-Destructive testing Methods

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a) Ultra sonic Pulse Velocity Meter

b) Rebound hammer

6. Durability test on hardened concrete

a) Water absorption test

b) Sulphate attack

c) Chloride attack

d) RCPT Test

| **Text book(s):** | |
|---|---|
| 1. | A R Santhakumar, “Concrete Technology, Oxford Higher Education, New Delhi, 2018 |
| 2. | P. Kumar Mehta, Paulo J. M. Monteiro, Concrete: Microstructure, Properties, and Materials, McGraw Hill Education, 2014 |
| **Reference(s)** | |
| 1. | IS 383 – 2016, Coarse and Fine Aggregate for Concrete - Specification (Third Revision) |
| 2. | IS: 10262 – 2019, Concrete Mix Proportioning - Guidelines (Second Revision) |
| 3. | IS 456 – 2000, Code of Practice - Plain and reinforced concrete (Fourth Revision) |
| 4. | IS: 516 – 1959, (Reaffirmed 2018) - Methods of Tests for Strength of Concrete |

**Course Designer**

1. Mr.K. Angu Senthil – angusenthil@ksrct.ac.in

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| 60 PSE 1P2 | TECHNICAL SEMINAR | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | CG | 0 | 0 | 2 | 1 |

## Objective

- To encourage the students to study advanced engineering developments.
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.
- To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced.
- To encouraged the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

## Prerequisite

Basic knowledge about Civil Engineering Topics.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Establish motivation for any topic of interest and develop a thought process for technical presentation. | Apply |
| CO2 | Organize a detailed literature survey and build a document with respect to technical presentations. | Apply |
| CO3 | Analysis and comprehension of proof-of-concept and related data. | Analyze |
| CO4 | Effective presentation and improve soft skills. | Apply |
| CO5 | Make use of new and recent technology (e.g. graphical abstract) for creating technical reports. | Analyze |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

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|---|---|---|---|---|---|---|---|---|
| **60 PSE 1P2- TECHNICAL SEMINAR** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 0 | 0 | 2 | 45 | 1 | 100 | - | 100 |

The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to Structural Engineering and to engage in dialogue with the audience.

A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic.

They will also answer the queries on the topic. The students as the audience also should interact.

Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

| **Total Hours** | **45** |
|---|---|

## Course Designers

1. Dr.S.GUNASEKAR -gunasekar@ksrct.ac.in

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**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**
(An Autonomous Institution affiliated to Anna University)

M.E. / M.Tech. Degree Programme
**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2022-2023 onwards)
**SECOND SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 60 PSE 201 | Advanced Steel Structures | 2 | 40 | 60 | 100 | 45 | 100 |
| 2 | 60 PSE 202 | Advanced Concrete Structures | 2 | 40 | 60 | 100 | 45 | 100 |
| 3 | 60 PSE 203 | Finite Element Analysis in Structural Engineering | 2 | 40 | 60 | 100 | 45 | 100 |
| 4 | 60 PSE E2* | Professional Elective II | 2 | 40 | 60 | 100 | 45 | 100 |
| 5 | 60 PSE E3* | Professional Elective III | 2 | 40 | 60 | 100 | 45 | 100 |
| 6 | 60 PAC 002 | Disaster Management | 2 | 100 | - | 100 | - | 100 |
| **PRACTICAL** | | | | | | | | |
| 7 | 60 PSE 2P1 | Advanced Structural Engineering Laboratory | 3 | 60 | 40 | 100 | 45 | 100 |
| 8 | 60 PSE 2P2 | Computer Aided analysis and Design laboratory | 3 | 60 | 40 | 100 | 45 | 100 |

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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| 60 PSE 201 | ADVANCED STEEL STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objective

- To know about the analysis and design of steel structures.
- To understand about the different types of steel connections
- To know about the analysis and design of cold formed steel structures
- To understand the analysis and design of special steel structures
- To demonstrate advanced design philosophies and concepts.

## Prerequisite

Courses –Strength of Materials, Design of Steel Structures

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Assess the general behaviour of beam –column employ them to design beam-column – crane column. | Remember/ Understand/ Analyse/Apply |
| CO2 | Classify the different types of connection and identity suitable connections to apply for required situation. | Remember/ Understand/ Analyse/Apply |
| CO3 | Analyse the cold formed steel sections and design them. | Remember/ Understand/ Analyse/Apply |
| CO4 | Evaluate the various forces acting on self-supporting chimney guyed steel chimney and design them. | Remember/ Understand/ Analyse/Apply |
| CO5 | Calculate the base shear and employ them to design a structure. | Remember/ Understand/ Analyse/Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember(Re) | 05 | 05 | 10 |
| Understand(Un) | 05 | 05 | 20 |
| Apply (Ap) | 15 | 20 | 30 |
| Analyse (An) | 35 | 30 | 40 |
| Create (Cr) | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| 60 PSE 201- ADVANCED STEEL STRUCTURES | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Analysis and Design of Beam Column**<br>Introduction-General Behaviour of beam column-Beam column under bi-axial loading- Design of beam-columns-Beams column subjected to tension and bending-crane column. | **[9]** |
| **Behaviour and Design of Joints**<br><br>Connection Behaviour – Design Requirements of Bolted and welded Connection – Un stiffened and stiffened Seat connection – Framed connection – Moment resistant connection – Tee Stub and End plate connections –Column Stiffeners and other reinforcements – design of moment resistant base plate - -concept of semi rigid connections. | **[9]** |
| **Analysis and Design of Cold Formed Steel Structures**<br><br>Types of cross sections – Concept of local buckling and effective width –Design of compression and tension members – Concept of lateral buckling- Design of beams-Combined stresses and connections – Empirical design of Z –Purlins with lips and wall studs. | **[9]** |
| **Analysis and Design of Special Structures**<br><br>Design of self-supporting chimney and guyed steel stacks-Design of bunkers and silos. | **[9]** |
| **Seismic Design of Steel Structures**<br><br>Base shear calculations –IS 1893-2002,codal provisions – Design and detailing-IS 800-2007(Theory only) | **[9]** |
| **Total Hours** | **45** |

| **Textbook(s):** | |
|---|---|
| 1. | Subramaniam.N.,“Design of Steel Structures “,(As per IS 800-2007),Oxford University Press,2014. |
| 2. | Bhavikatti SS, “Design of Steel Structures”, I.K.International Publishing House Pvt. Ltd 2012 |
| **Reference(s):** | |
| 1. | Duggal S K., ’’Limit State Design of Steel Structures,Tata McGraw Hill, New Delhi, 2014. |
| 2. | S.Ramachandra “Design of Steel Structures” Standard Publications, New Delhi,2011 |
| 3. | Teaching Resources for Structural Steel Design, INSDAG, Kolkatta. |
| 4. | Design of Steel Structure, Punmia B.C, Jain Ashok K.R, Jain Arun K.R, Lakshmi Publishers, 2011. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Analysis and Design of Beam Column** | |
| 1.1 | Introduction-General Behaviour of beam column | 1 |

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| | | |
|---|---|---|
| 1.2 | Beam column under bi-axial loading | 2 |
| 1.3 | Design of beam | 2 |
| 1.4 | Columns-Beams column subjected to tension | 1 |
| 1.5 | Bending-crane column | 2 |
| **2** | **Behaviour and Design of Joints** | |
| 2.1 | Connection Behaviour | 1 |
| 2.2 | Design Requirements of Bolted and welded Connection | 1 |
| 2.3 | Un stiffened and stiffened Seat connection – Framed connection | 1 |
| 2.4 | Moment resistant connection – Tee Stub and End plate connections | 1 |
| 2.5 | Column Stiffeners and other reinforcements | 1 |
| 2.6 | Design of moment resistant base plate | 2 |
| 2.7 | Concept of semi rigid connections. | 1 |
| **3** | **Analysis and Design of Cold Formed Steel Structures** | |
| 3.1 | Types of cross sections | 1 |
| 3.2 | Concept of local buckling and effective width | 1 |
| 3.3 | Design of compression and tension members | 1 |
| 3.4 | Tutorial | 2 |
| 3.5 | Concept of lateral buckling | 1 |
| 3.6 | Design of beams-Combined stresses and connections | 1 |
| 3.7 | Empirical design of Z. | 1 |
| 3.8 | Purlins with lips and wall studs. | 2 |
| **4** | **Analysis and Design of Special Structures** | |
| 4.1 | Design of self-supporting chimney. | 3 |
| 4.2 | Guyed steel stacks. | 3 |
| 4.3 | Design of bunkers. | 3 |
| 4.4 | Design of silos. | 3 |
| **5** | **Seismic Design of Steel Structures** | |
| 5.1 | Base shear calculations | 3 |
| 5.2 | IS 1893-2002,codal provisions | 3 |
| 5.3 | Design and detailing-IS 800-2007(Theory only) | 2 |
| | **Total** | **45** |

## CourseDesigner

1. Dr.M.VELUMANI - velumani@ksrct.ac.in

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| 60 PSE 202 | ADVANCED CONCRETE STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Objective

- To apply various limit states and design beams & columns
- To learn the design of special RC elements
- To perform the design of flat slab and grid floors
- To study the inelastic behavior of RC beams
- To gain knowledge in detailing codes

## Prerequisite

Courses –Structural Analysis &RCC Design

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Design the elements under flexure, shear, torsion and compression | Remember/ Understand/ Analyse/Apply |
| CO2 | Perform the design of special RC elements | Remember/ Understand/ Analyse/Apply |
| CO3 | Learn the design of flat slabs and grid floors | Remember/ Understand/ Analyse/Apply |
| CO4 | Analyze the inelastic behavior of RC beams | Remember/ Understand/ Analyse/Apply |
| CO5 | Draw the reinforcement detailing of structural elements | Remember/ Understand/ Analyse/Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember(Re) | 05 | 10 | 10 |
| Understand(Un) | 05 | 10 | 20 |
| Apply (Ap) | 30 | 20 | 40 |
| Analyse (An) | 20 | 20 | 30 |
| Create (Cr) | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60 PSE 202 - ADVANCED CONCRETE STRUCTURES** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Design of Beams and Columns**<br><br>Design for Limit state of collapse- Design for limit state of serviceability- Calculation of deflection and crack width. -Design of beams for combined effect of shear, bending moment and torsion. Design of beams curved in plan and spandrel beams - Design of slender columns | **[9]** |
| **Design of Special RC Elements**<br><br>Design of RC walls- Shear walls-Classification and Design principles.-Design of rectangular and flanged Shear walls- Design of Corbels- Design of Deep beams | **[9]** |
| **Design of Flat Slab and Grid Floors**<br><br>Yield line theory of slabs – Hillerberg's method of design of slab – Design of flat Slab –shear in flat slab - Approximate analysis and Design of grid floors | **[9]** |
| **Inelastic Behaviour of RC Beams**<br><br>Inelastic behaviour of concrete beams – Moment Rotation curves – Moment redistribution – Baker's method of analysis and design – Design of cast in situ joints in frame | **[9]** |
| **Detailing Requirements**<br><br>Design and detailing of structural members - Reinforcement detailing as per SP: 34 & IS:5525 - Earthquake Resistant Design – Detailing requirements for Ductility as per IS:13920 | **[9]** |
| **Total Hours** | **45** |

| **Textbook(s):** | |
|---|---|
| 1. | Varghese, P.C. "Advanced Reinforced Concrete Design", PHI Learning Pvt. Ltd.,2015. |
| 2. | Krishna Raju N and Pranesh RN., "Design of Reinforced Concrete Structures", New Age International Publishers, New Delhi,2018. |
| **Reference(s):** | |
| 1. | Unnikrishna Pillai S, Devdas Menon, "Reinforced Concrete Design", McGraw-Hill Education, India, New Delhi, 2021 |
| 2. | Ramamrutham S, Design of Reinforced Concrete Structures, Dhanpat Rai Publications, New Delhi, 2016 |
| 3. | SP 34 – Handbook on Concrete reinforcement and detailing – Fifth reprint, 1999 |
| 4. | IS 13920 :2016 – Ductile detailing of Reinforced Concrete structures subjected to seismic forces – Code of Practice |

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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Design of Beams and Columns** | |
| 1.1 | Design for Limit state of collapse& serviceability | 1 |
| 1.2 | Calculation of deflection and crack width | 1 |
| 1.3 | Design of beams for combined effect of shear, bending moment and torsion. | 1 |
| 1.4 | Design of beams curved in plan | 2 |
| 1.5 | Design of Spandrel beams | 2 |
| 1.6 | Design of slender columns | 1 |
| **2** | **Design of Special RC Elements** | |
| 2.1 | Design of RC walls | 1 |
| 2.2 | Shear walls Classification and Design principles | 1 |
| 2.3 | Design of rectangular and flanged Shear walls | 2 |
| 2.4 | Design of Corbels | 2 |
| 2.5 | Design of Deep beams | 2 |
| **3** | **Design of Flat Slab and Grid Floors** | |
| 3.1 | Yield line theory of slabs | 1 |
| 3.2 | Hillerberg's method of design of slab | 2 |
| 3.3 | Design of flat Slab | 2 |
| 3.4 | Shear in flat slab Approximate analysis | 1 |
| 3.5 | Design of grid floors | 2 |
| **4** | **Inelastic Behaviour of RC Beams** | |
| 4.1 | Inelastic behaviour of concrete beams | 1 |
| 4.2 | Moment Rotation curves | 2 |
| 4.3 | Moment redistribution | 2 |
| 4.4 | Baker's method of analysis and design | 3 |
| 4.5 | Design of cast in situ joints in frame | 2 |
| **5** | **Detailing Requirements** | |
| 5.1 | Design and detailing of structural members | 2 |
| 5.2 | Reinforcement detailing as per SP : 34 | 2 |
| 5.3 | Reinforcement detailing as per IS:5525 | 2 |
| 5.4 | Earthquake Resistant Design | 2 |
| 5.5 | Detailing requirements for Ductility as per IS:13920 | 2 |
| | **Total** | **45** |

## Course Designer

1. Mr.K.ANGU SENTHIL - angusenthil@ksrct.ac.in

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| 60 PSE 203 | FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 2 | 0 | 4 |

**Objective**

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To know the procedure and to solve two dimensional problems
- To appreciate the use of FEM to a range of Engineering Problems.
- To learn the concept of material and geometric Non-linearity
- To know the realistic engineering problem through computational simulations.

**Prerequisite**

Fundamentals of Mathematics, knowledge of forces and resolution and equilibrium concepts.

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Construct and solve the element equation for one dimensional structural element. | Remember, Understand, Apply |
| CO2 | Describe the concept of two dimensional elements. | Remember, Understand, Analyze |
| CO3 | Analyze the 2D problems using isoparametric quadrilateral elements and Implement the Gaussian Quadrature expression for numerical integration. | Remember, Understand, Apply, Analyze |
| CO4 | Identify the concepts of Non-linear Analysis of the structures. | Understand and Analyze |
| CO5 | Apply the knowledge on application of Finite Element method | Remember, Understand |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | | 2 | |
| CO2 | 3 | 2 | 3 | 3 | 2 | 3 |
| CO3 | 2 | 3 | 3 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 3 | |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**AssessmentPattern**

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 5 | 5 | 10 |
| Understand | 5 | 5 | 10 |
| Apply | 35 | 35 | 30 |
| Analyse | 15 | 15 | 50 |
| Evaluate | - | - | - |
| Create | - | - | - |

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| K.S.Rangasamy College of Technology - Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **60 PSE 203- FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| II | 3 | 2 | 0 | 60 | 4 | 40 | 60 | 100 |

**Introduction to Finite Element Analysis**

Introduction-basic concepts of finite element analysis-steps in finite element analysis-Weighted Residual methods – Variational formulation of boundary value problem Finite element modeling - Element equation-Linear and quadratic shape functions- Bar, Beam and Truss Elements. [9]

**Finite Element Analysis of 2D Problems**

Basic boundary value problem in 2 Dimensions – Triangular, quadrilateral, higher order elements-Poisson and Laplace equation-weak formulation-Linear strain triangular elements. [9]

**Isoparametric Formulation**

Natural co-ordinate systems-Lagrangian interpolation polynomials-Isoperimetric element formulation-axisymmetry element-Numerical integration- one and two point problems. [9]

**Non-Linear Analysis**

Definition – geometric and material nonlinearity – strain displacement – stress- strain– finite element format – software usage for large deflection – software for inelastic behaviour. [9]

**Practical Application of Finite Element Analysis**

Modeling and analysis using software packages-types of analysis-meshing-material properties and boundary conditions-Error evaluation. [9]

**Total Hours 45+15 (Tutorial) = 60**

**Text book (s) :**


| | |
|---|---|
| 1 | Chandrupatla and Belegundu “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd. New Delhi, 4th Edition, 2015. |
| 2 | P.Seshu, “Finite Element Analysis”, Prentice Hall of India Pvt. Ltd., New Delhi, 2009. |


**Reference(s) :**


| | |
|---|---|
| 1 | Madhujit Mukhopadhyay,Abdul Hamid Sheikh., Matrix and Finite element Analyses of Structures. Ane Books India.2008. |
| 2 | Reddy J N, “Finite Element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3rdEdition, 2006. |
| 3 | Bathe K.J., Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHILearning, Eastern Economy Editions, 2009.. |
| 4 | Logan Deryl L., “A First Course in Finite Element Method”, Thomson Brook/Cole, 5th Ed.2012. |


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction to Finite Element Analysis** | |
| 1.1 | Basic Concepts of Finite element analysis | 1 |
| 1.2 | Steps in finite element analysis | 1 |
| 1.3 | Weighted Residual methods and Weak formulation | 1 |
| 1.4 | Variational formulation of boundary value problem | 1 |
| 1.5 | Finite element modeling | 1 |
| 1.6 | Tutorial- Rayleigh Ritz method | 2 |
| 1.7 | Element equation-Linear and quadratic | 2 |
| 1.8 | Shape functions- Bar and Beam Elements | 2 |
| 1.9 | Shape functions- Truss Elements | 2 |

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| | | |
|---|---|---|
| **2** | **Finite Element Analysis of 2D Problems** | |
| 2.1 | Basic boundary value problem in 2 Dimensions | 1 |
| 2.2 | Element stiffness matrix for Triangular element. quadrilateral, higher order elements | 2 |
| 2.3 | Constant strain triangle – Isoparametric representation | 2 |
| 2.4 | Potential energy approach – Element stiffness matrix, force terms and stress calculations | 2 |
| 2.5 | Element stiffness matrix for quadrilateral and higher order elements | 2 |
| 2.6 | Poisson equation | 1 |
| 2.7 | Laplace equation | 1 |
| 2.8 | Tutorial-Problems in two dimensional stress field | 2 |
| 2.9 | Linear strain triangular elements | 1 |
| 3 | **Isoparametric Formulation** | |
| 3.1 | Natural co-ordinate systems | 2 |
| 3.2 | Four node quadrilateral elements | 2 |
| 3.3 | Lagrangian interpolation functions | 2 |
| 3.4 | Isoperimetric element formulation | 2 |
| 3.5 | Axisymmetry element | 2 |
| 3.6 | Numerical Integration - One point formula and two point formula | 2 |
| 3.7 | Tutorial-Problems in numerical integration using Gauss quadrature formula | 2 |
| **4** | **Non-Linear Analysis** | |
| 4.1 | Basic Concepts of Non-Linear Analysis | 1 |
| 4.2 | Geometric and Material nonlinearity | 1 |
| 4.3 | Strain displacement | 1 |
| 4.4 | Stress- Strain behavior of Non-linear analysis | 1 |
| 4.5 | Finite element format for non-linear analysis | 1 |
| 4.6 | Software usage for large deflection | 1 |
| 4.8 | Software for inelastic behaviour | 1 |
| 4.9 | Iteration methods and iterative methods, Newtons Raphson Method | 1 |
| 4.10 | Tutorials on Non-linear analysis problems | 2 |
| 5 | **Practical Application of Finite Element Analysis** | |
| 5.1 | Convergence and requirements | 1 |
| 5.2 | Modeling and analysis using software packages | 2 |
| 5.3 | Types of analysis | 1 |
| 5.4 | Types of meshing- Ill conditioned elements | 1 |
| 5.5 | Properties and boundary conditions | 1 |
| 5.6 | Discretisation errors | 1 |
| 5.7 | Error evaluation | 1 |
| 5.8 | Auto and Adaptive Mesh Generation Techniques | 1 |
| | **Total** | **60** |

**Course Designers**

Dr.J.Abdul Bari - abdulbari@ksrct.ac.in

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| 60 PSE 2P1 | ADVANCED STRUCTURAL ENGINEERING LABORATORY | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 4 | 2 |

**Objective**

- To explain about the behavior of beams and slabs in flexure and shear
- To understand the concepts of Strain recording instruments
- To know about the measurement of vibration.
- To illustrate about the Dynamic testing of cantilever beams
- To identify the Static cyclic testing of single bay two storied frames

**Prerequisite**

Strength of Materials, Structural Analysis, Design of Reinforced Concrete design, Design of Steel Structures, Experimental Methods and Model Analysis.

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Construct the concrete beam and absorb the behavior of flexural member for different loading conditions. | Apply |
| CO2 | Demonstrate the testing for strength and deflection behavior of steel sections. | Analyze |
| CO3 | Illustrates the behavior of column under axial load and compute the direct and bending stresses. | Apply |
| CO4 | Familiarize the behavior of cantilever beam under dynamic loading and evaluate the mode shapes. | Apply |
| CO5 | Employ the static cyclic testing on frames and predict the stiffness and energy dissipation of the frame. | Evaluate |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | 1 | 1 | 2 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 2 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO5 | 3 | 2 | 3 | 2 | 2 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

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|---|---|---|---|---|---|---|---|---|
| 60 PSE 2P1 -ADVANCED STRUCTURAL ENGINEERING LABORATORY | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | MaximumMarks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 0 | 0 | 4 | 45 | 2 | 60 | 40 | 100 |

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behavior.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever beams.
   a. To determine the damping coefficients from free vibrations.
   b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied frames and evaluate
   a. Drift of the frame
   b. Stiffness of the frame.

Energy dissipation capacity of the frame

| | |
|---|---|
| **TotalHours** | **45** |

**Textbook(s):**

1. Sadhu Singh, " Experimental Stress Analysis", Khanna Publications, New Delhi, 2000.

**Reference(s):**

1. Dalleey J W, and Riley W F, "Experimental Stress Analysis", McGraw-Hill, Inc. New York, 1991.
2. Srinath L.S, Raghavan M.R, Lingaish K, Gargesha G, Paint B, and Ramachandra K, "Experimental Stress Analysis", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1984.

## Course Designer

1. Dr.R.JAGADEESAN - jagadeesan@ksrct.ac.in

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| 60 PSE 2P2 | COMPUTER AIDED ANALYSIS AND DESIGN LABORATORY |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 0 | 0 | 4 | 2 |

## Objective

- To learn the principles of computer graphics and application packages, optimization and artificial intelligence.
- To expose students to computer aided drafting.
- To familiarize students with 2D objects in drawing and enable them to prepare plan, elevation and sectional drawings.
- To expose students to 3D modelling.

## Prerequisite

Basic knowledge in computer operation and Civil Engineering design software's.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | To work on spreadsheets and worksheets. | Understand |
| CO2 | To understand regression and matrix inversion concepts. | Understand |
| CO3 | To arrive at C programs to solve problems using numerical techniques. | Apply |
| CO4 | To use computer methods of structural analysis to solve structural problems. | Apply |
| CO5 | To work on finite element programming to solve real time problems. | Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Understand (U) | - | - | 20 |
| Apply (Ap) | - | - | 50 |
| Analyse (An) | - | - | 30 |
| Create (Cr) | - | - | 0 |

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|---|---|---|---|---|---|---|---|---|
| 60 PSE 2P2 -COMPUTER AIDED ANALYSIS AND DESIGN LABORATORY | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 0 | 0 | 4 | 45 | 2 | 60 | 40 | 100 |

**LIST OF EXPERIMENTS**

Module 1: Analysis, design and drafting with commercial software: (3 D modelling – RCC & STEEL).

(a) Modelling and analysis - applying known concepts of structural components, codal provisions for loads and dimensioning, analysis procedures etc.

(b) Design using software or manual designusing spreadsheets software or Macros.

(c) Drafting / detailing using commercial CAD software. (Different groups may be assigned different buildings/structures).

Module 2: Programming for structural engineering using MATLAB or any programming language choice of student. Exercises include, but not limited to: Solution using Newton Raphson method, Gauss elimination, Gauss-Jordan method, Linear Regression, Curve fitting by Polynomial Regression, Eigen value extraction by power method etc.

Module 3: Finite Element software fundamentals - modelling, analysis and postprocessing of simple planar, wire and shell models – introduction to different types of meshes, elements, analysis steps etc.

**Textbook(s):**

| | |
|---|---|
| 1. | Rajaraman, V., Computer Oriented Numerical Methods, Prentice – Hall of India, 2004. |

**Reference(s):**

| | |
|---|---|
| 1. | Krishnamoorthy C. S and Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 1991. |
| 2. | Hinton E. and Owen D. R. J., Finite Element Programming, Academic Press, 1977. |

## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Model - I** | |
| 1.1 | Drafting – 2D & 3D | 4 |
| 1.2 | Design of Buildings | 6 |
| 1.3 | Analysis of loads on Buildings | 6 |
| **2** | **Model - II** | |
| 2.1 | Programming – Basic | 4 |
| 2.2 | Programming with MATLAB | 6 |
| 2.3 | Programming with MATLAB | 6 |
| 3 | **Model - III** | |
| 3.1 | Finite Element Analysis - Introduction | 4 |
| 3.2 | Finite Element Analysis – Software Application | 4 |
| 3.3 | Finite Element Analysis – Software Application | 5 |

## Course Designers

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**K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215**
(An Autonomous Institution affiliated to Anna University)

M.E. / M.Tech. Degree Programme
**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2022-2023 onwards)
**THIRD SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 60 PSE E4* | Professional Elective IV | 2 | 40 | 60 | 100 | 45 | 100 |
| 2 | 60 PSE E5* | Professional Elective V | 2 | 40 | 60 | 100 | 45 | 100 |
| **PRACTICAL** | | | | | | | | |
| 7 | 60 PSE3P1 | Project Work - Phase I | 3 | 100 | - | 100 | - | 100 |
| 8 | 60 PSE3P2 | Inplant Training | 3 | 100 | - | 100 | - | 100 |

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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|---|---|---|---|---|---|---|---|---|
| **60 PSE 3P1 PROJECT WORK PHASE I** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total hrs** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **III** | 0 | 0 | 16 | 60 | 08 | 100 | 0 | 100 |
| **Objective(s)** | • To import the practical knowledge to the students<br>• To make them to carry out the technical procedures in their project work.<br>• To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work.<br>• To learn about new product development<br>• To learn how to apply theoretical knowledge in the field. | | | | | | | |
| **Course Outcomes** | **At the end of the course, the students will be able to**<br>1. Survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.<br>2. Use different experimental techniques/different software/ computational/analytical tools.<br>3. Design and develop an experimental set up/ equipment/test rig.<br>4. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.<br>5. Work in a research environment or in an industrial environment. | | | | | | | |

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M.E/M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

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|---|---|---|---|---|---|---|---|---|
| **60 PSE 3P2 IN-PLANT TRAINING** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total hrs** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **III** | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 100 |

| | |
|---|---|
| **Objective(s)** | • Make exposer for the students to actual working environment and enhance their knowledge<br>• Provide students the opportunity to test their interest in a particular career before permanent commitments are made<br>• To develop skills in the application of theory to practical work situations<br>• Enhance the ability to improve student's creativity skills and sharing ideas<br>• To cultivate student's leadership ability and responsibility to perform or execute the given task |
| **Course Outcomes** | **At the end of the course, the students will be able to**<br>1. Understand the psychology of the workers, their habits, attitudes and approach to problems along with the practices followed either at factory or at site<br>2. Familiarized with various Design, Manufacturing, Analysis, Automation and their appli cations along with relevant aspects of industry management<br>3. Understand the scope, functions and job responsibilities in various departments of an organization<br>4. Interpreting the theoretical knowledge with real time site conditions while executing projects<br>5. Develop detailed report of the complete project during the training. |

- Students undergo in-plant training during second semester summer vacation (Minimum of Two weeks)
- Reports containing the observation of the students after the training with their personal comments/suggestion are to be prepared and submitted in the beginning of third semester
- A technical presentation to be done by the students immediately after submission of the report at the beginning of third semester

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M.E. / M.Tech. Degree Programme
**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2022-2023 onwards)
**FOURTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Internal Exam | Weightage of Marks | | | Minimum Marks for Pass in End Semester Exam | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | End Semester Exam ** | Max. Marks | End Semester Exam | Total |
| **PRACTICAL** | | | | | | | | |
| 1 | 60 PSE4P1 | Project Work - Phase II | 3 | 60 | 40 | 100 | 45 | 100 |

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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|---|---|---|---|---|---|---|---|---|
| **60 PSE 4P1 PROJECT WORK – PHASE II** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total hrs** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **IV** | 0 | 0 | 32 | 60 | 16 | 60 | 40 | 100 |
| **Objective(s)** | • To implement their innovative ideas in practical<br>• To retrieve the hazards by adopting suitable assessment methodologies and staring it to global.<br>• To strengthens the students to carry out the problems on their own<br>• To improve the leadership skills and work in a group<br>• To solve complex problems and obtaining solution for them | | | | | | | |
| **Course Outcomes** | **At the end of the course, the students will be able to**<br>1. Develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field will.<br>2. Write technical reports and research papers to publish at national and international level.<br>3. Develop strong communication skills to defend their work in front of technically qualified audience.<br>4. Learn about Patent filing and IPR<br>5. Gain knowledge about new business ideas and product development | | | | | | | |

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.



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| 60PSE E11 | THEORY OF STRUCTURAL STABILITY | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To Learn behaviour of structural elements under compressive loads,
- To understand the stability of columns, beams and plates under various load conditions.
- To analyse beam column behaviour along with frames.
- To know the basic theory for buckling of beams for various applications.
- To Introduce numerical techniques

## Prerequisite

knowledge of Structural Analysis, Strength of Materials & Mathematical Logic.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Obtain the concept of structural stability of structures | Apply |
| CO2 | Compare the method and analysis of structures | Apply |
| CO3 | Design a beam column behaviour with the portal frame | Analyze |
| CO4 | Explain the torsional buckling in beam | Apply |
| CO5 | Interpret the use of energy methods with numerical techniques | Analyze |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | | 3 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO3 | 2 | | 2 | 3 | 2 | 1 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO5 | 3 | 3 | | 2 | 3 | |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 10 | 10 | 10 |
| Apply (Ap) | 40 | 40 | 60 |
| Analyse (An) | 10 | 10 | 30 |
| Create (Cr) | 0 | 0 | 0 |

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TIRUCHENGODE - 637 215

| K.S.Rangasamy College of Technology - Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 60PSE E11- THEORY OF STRUCTURAL STABILITY | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Stability of Columns**

Concepts of Elastic Structural stability- Analytical approaches to stability - characteristics of stability analysis- Elastic Buckling of columns- Equilibrium - Energy and Imperfection approaches – Non-prismatic columns- Built up columns- orthogonality of buckling modes- Effect of shear on buckling load - Large deflection theory. [9]

**Methods of Analysis and in Elastic Buckling**

Approximate methods – Rayleigh and Galerkin methods – numerical methods – Finite difference and finite Element - analysis of columns – Experimental study of column behaviour – South well plot - Column curves - Derivation of Column design formula - Effective length of Columns - Inelastic behaviour- Tangent modulus and Double modulus Theory. [9]

**Beam Columns and Frames**

Beam column behaviour- standard cases- Continuous columns and beam columns – Column on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Approximate evaluation of critical loads in multistoried frames – Use of Wood's charts. [9]

**Buckling of Beams**

Lateral buckling of beams – Energy method- Application to Symmetric and unsymmetric I beams – simply supported and Cantilever beams - Narrow rectangular cross sections- – Numerical solutions – Torsional buckling – Uniform and non uniform Torsion on open cross section - Flexural torsional buckling – Equilibrium and energy approach. [9]

**Buckling of Thin Plates**

Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges – Use of Energy methods – Plates with stiffeners – Numerical Techniques. [9]

**Total Hours: 45**

**Text book (s) :**


| | |
|---|---|
| 1 | Chajes, A. "Principles of Structures Stability Theory", Prentice Hall of India, 2010. |
| 2 | Ashwin Kumar, "Stability of Structures", Allied Publishers Ltd, New Delhi, 2008. |


**Reference(s) :**


| | |
|---|---|
| 1 | Iyengar, N.G.R, "Structural Stability of Columns and Plates" East West Press Pvt Ltd, New Delhi, 2016 |
| 2 | Timoshenko, S.P, and Gere, J.M. "Theory of Elastic stability", McGraw-Hill Company, 2010 |
| 3 | Gambhir, "Stability Analysis and Design of Structures", Springer, New York, 2004. |
| 4 | Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006. |


## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Stability of Columns** | |
| 1.1 | Concepts of Elastic Structural stability | 1 |
| 1.2 | Analytical approaches to stability | 1 |
| 1.3 | characteristics of stability analysis | 1 |
| 1.4 | Elastic Buckling of columns- Equilibrium | 1 |
| 1.5 | Energy and Imperfection approaches | 1 |
| 1.6 | Non-prismatic columns | 1 |

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| | | |
|---|---|---|
| 1.7 | Built up columns - orthogonality of buckling modes | 1 |
| 1.8 | Effect of shear on buckling load | 1 |
| 1.9 | Large deflection theory | 1 |
| **2** | **Methods of Analysis and in Elastic Buckling** | |
| 2.1 | Approximate methods | 1 |
| 2.2 | Rayleigh and Galerkin methods – numerical methods | 2 |
| 2.3 | Finite difference and finite Element - analysis of columns | 1 |
| 2.4 | Experimental study of column behaviour | 1 |
| 2.5 | South well plot - Column curves | 2 |
| 2.6 | Derivation of Column design formula | 1 |
| 2.7 | Effective length of Columns | 1 |
| 2.8 | Inelastic behaviour | 1 |
| 2.9 | Tangent modulus and Double modulus Theory. | 1 |
| 3 | **Beam Columns and Frames** | |
| 3.1 | Beam column behaviour | 1 |
| 3.2 | standard cases- Continuous columns and beam columns | 1 |
| 3.3 | Column on elastic foundation | 1 |
| 3.4 | Buckling of frames | 1 |
| 3.5 | Single storey portal frames with and without side sway | 1 |
| 3.6 | Classical and stiffness methods | 1 |
| 3.7 | Approximate evaluation of critical loads in multistoried frames | 1 |
| 3.8 | Use of Wood's charts | 2 |
| **4** | **Buckling of Beams** | |
| 4.1 | Lateral buckling of beams | 1 |
| 4.2 | Energy method- Application to Symmetric and unsymmetric I beams | 1 |
| 4.3 | simply supported and Cantilever beams | 1 |
| 4.4 | Narrow rectangular cross sections – Numerical solutions | 2 |
| 4.5 | Torsional buckling | 1 |
| 4.6 | Uniform and non uniform Torsion on open cross section | 1 |
| 4.7 | Flexural torsional buckling | 1 |
| 4.8 | Equilibrium and energy approach | 1 |
| 5 | **Buckling of Thin Plates** | |
| 5.1 | Isotropic rectangular plates | 1 |
| 5.2 | Governing Differential equations | 2 |
| 5.3 | Simply Supported on all edges | 1 |
| 5.4 | Use of Energy methods | 2 |
| 5.5 | Plates with stiffeners | 2 |
| 5.6 | Numerical Techniques | 1 |
| | | |
| | **Total** | **45** |

## Course Designers

1. Dr.D.SIVAKUMAR - sivakumard@ksrct.ac.in

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| 60PSE E12 | THEORY OF PLATES AND SHELLS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To study the behavior of the plates and shells with different geometry under various types of loads
- To illustrate design of several of plates.
- To enable the student analyze and design thin shell structures including domes, hyperbolic, parabolic, elliptic and cylindrical shells.
- To knowledge about thin and thick shells.
- To understand design of cylindrical shells.

## Prerequisite

Fundamentals of Mathematics, knowledge of strength of materials and its mechanics and theory of elasticity and plasticity.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Analyse bending of long rectangular plates using thin plate theory | Evaluate |
| CO2 | Analyse circular plates with various loading conditions | Evaluate |
| CO3 | Analyse rectangular plates using classical approach and methods | Evaluate |
| CO4 | Analyse bending of Anisotropic plates | Evaluate |
| CO5 | Design of R. C. Cylindrical shells and long shells. | Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 2 | 1 |
| CO2 | | | 3 | | 2 | 1 |
| CO3 | 2 | 2 | 3 | 2 | 2 | 1 |
| CO4 | | | 3 | | 2 | 1 |
| CO5 | 1 | 1 | 3 | 2 | 3 | 1 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom'sCategory | Continuous AssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E12 -THEORY OF PLATES AND SHELLS | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Laterally Loaded Plates**<br>Thin Plates with small defection, Laterally loaded thin plates, governing differential equation, various boundary conditions. | **[09]** |
| **Rectangular Plates**<br>Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's methods, Rectangular plates with various edge conditions - Energy methods, Finite difference and Finite element methods | **[09]** |
| **Circular Plates**<br>Symmetrical bending of circular plates, plates on elastic foundation. | **[09]** |
| **Theory of Shells**<br>Structural behavior of thin shells – classification of shells – Translational and rotational ruled surface, Design of the following shells: spherical, conical, paraboloid and ellipsoid. | **[09]** |
| **Design of Cylindrical Shells**<br>Design of R.C cylindrical shell with edge beams using theory for long shells – Design for long shells – Design of shells with ASCE manual coefficients | **[09]** |
| **Total Hours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | Reddy J N, “Theory and Analysis of Elastic Plates and Shells”, Second edition, CRC press,2006. |
| 2. | Timoshenko,S and Woinowsky – Kreiger,”Theory of plates and shells”.Mc Graw- Hill book Company, Newyork.1990. |

**Reference(s):**

| | |
|---|---|
| 1. | Iyengar, N.G.R, “Structural Stability of Columns and Plates” East West Press Pvt Ltd, New Delhi, 2016 |
| 2. | Timoshenko, S.P, and Gere, J.M. “Theory of Elastic stability”, McGraw-Hill Company, 2010 |
| 3. | Gambhir, “Stability Analysis and Design of Structures”, Springer, New York, 2004. |
| 4. | Simitser.G.J and Hodges D.H, “Fundamentals of Structural Stability”, Elsevier Ltd., 2006. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Laterally Loaded Plates** | |
| 1.1 | Cylindrical bending of long rectangular plates - Differential equation | 1 |
| 1.2 | Plates with simply supported edges | 1 |
| 1.3 | Plates with built-in edges | 1 |
| 1.4 | Slope and curvature of slightly bent plates | 2 |
| 1.5 | Relation between bending moment and curvature | 2 |
| 1.6 | Various boundary conditions. | 2 |
| **2** | **Rectangular Plates** | |
| 2.1 | Small deflections of laterally loaded plates – Differential equation | 1 |

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| | | |
|---|---|---|
| 2.2 | Simply supported rectangular plates under sinusoidal loading | 1 |
| 2.3 | Introduction to Navier's solution | 1 |
| 2.4 | Simply supported rectangular plates under uniform loading | 1 |
| 2.5 | Simply supported rectangular plates under hydrostatic pressure | 1 |
| 2.6 | Simply supported rectangular plates under concentrated load | 1 |
| 2.7 | Simply supported rectangular plates under uniform loading over an area of a rectangle | 1 |
| 2.8 | Introduction to Levy's method | 1 |
| 2.9 | Simply supported rectangular plates under uniform loading | 1 |
| **3** | **Circular Plates** | |
| 3.1 | Symmetrical bending of laterally loaded circular plates – Differential equation | 2 |
| 3.2 | Circular plates with uniform loading | 2 |
| 3.3 | Circular plate with triangular loading | 1 |
| 3.4 | Circular plate with circular hole subjected to moment at the inner edge | 1 |
| 3.5 | Circular plate with concentrated load | 1 |
| 3.6 | Circular plate loaded at the centre | 1 |
| 3.7 | Circular plates with moments at the edges | 1 |
| **4** | **Theory of Shells** | |
| 4.1 | Simply supported rectangular plates under hydrostatic pressure | 2 |
| 4.2 | Bending of laterally loaded thin plates – Differential equation | 1 |
| 4.3 | Simply supported and fixed square and rectangular plates under uniform loading | 1 |
| 4.4 | Simply supported and fixed square and rectangular plates under partial loading | 1 |
| 4.5 | Simply supported and fixed square and rectangular plates under triangular loading | 1 |
| 4.6 | Simply supported and fixed square and rectangular plates under trapezoidal loading | 1 |
| 4.8 | Energy methods - Principle of virtual work- Principle of minimum potential energy | 1 |
| **5** | **Design of Cylindrical Shells** | |
| 5.1 | Bending of Anisotropic plates – Differential equation | 2 |
| 5.2 | Bending of rectangular plates | 1 |
| 5.3 | Bending of circular and elliptic plates | 1 |
| 5.4 | Classification of shells | 1 |
| 5.5 | Case Study – Shell Structures | 1 |
| 5.6 | Design of R.C cylindrical shell with edge beams using theory for long shells | 1 |
| 5.7 | Design for long shells | 1 |
| 5.8 | Design of shells with ASCE manual coefficients | 1 |
| | **Total** | **45** |

## Course Designers

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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| 60PSE E13 | DESIGN OF TALL BUILDINGS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- The design criteria of the tall buildings, materials used, modern concepts
- The different types of loads to be considered in designing, behaviour of structural systems, analysis.
- The design of tall structures using different methods.
- The stability analysis of the tall buildings.
- Design against wind loads as per BIS code of practice and special consideration in the design of tall structures.

## Prerequisite

Fundamentals of Mathematics, knowledge of basic Science

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Implement design philosophies for the development of high rise structures. | Create |
| CO2 | Find out the design loads for high rise buildings. | Evaluate |
| CO3 | Analyse the behaviour of tall building subjected to lateral loading. | Analyze |
| CO4 | Perform computerized general three dimensional analysis for high rise building. | Analyze |
| CO5 | Perform stability analysis using various methods for tall buildings. | Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO2 | | | 3 | | 2 | |
| CO3 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO4 | | | 3 | | 2 | |
| CO5 | 1 | 1 | 3 | 2 | 3 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E13 -DESIGN OF TALL BUILDINGS** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Totalhrs | Credit | MaximumMarks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Design Criteria**<br>Design Philosophy, Materials – Modern concepts – High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self Compacting Concrete. | **[09]** |
| **Loading**<br>Gravity Loading – Dead load, Live load, Impact load, Construction load, Sequential loading. Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. Earthquake Loading – Equivalent lateral Load analysis, Response Spectrum Method, Combination of Loads | **[09]** |
| **Behaviour of Structural Systems**<br>Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, In filled frames, Shear walls, Coupled Shear walls, Wall – Frames, Tubular, Outrigger braced, Hybrid systems. | **[09]** |
| **Analysis and Design**<br>Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of structures as an integral unit, Analysis for member forces, drift and twist. Computerized 3D analysis. Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance. | **[09]** |
| **Stability Analysis**<br>Overall buckling analysis of frames, wall – frames, Approximate methods, Second order effect of gravity loading, P – Delta Effects, Simultaneous first order and P-Delta analysis, Translational instability, Torsional Instability, Out of plumb effects, Effect of stiffness of members and foundation rotation in stability of structures. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


| | |
|---|---|
| 1. | Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc. Wiley India Pvt.Ltd. New Delhi., 2011. |
| 2. | Taranath B.S, “Structural Analysis and Design of Tall Buildings”, McGraw-Hill, 1988. |


**Reference(s):**


| | |
|---|---|
| 1. | Harry G Poulos, “Tall Building Foundation Design”, Taylor & Francis., 2017. |
| 2. | Mark P Sarkisian, “Designing Tall Buildings Structure As Architecture”, Taylor & Francis., 2015. |
| 3. | Coull, A. and Smith, Stafford, B. “Tall Buildings”, Pergamon Press, London, 2003. |
| 4. | Lynn S.Beedle, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1996. |


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Design Criteria** | |
| 1.1 | Design Philosophy, Materials | 1 |
| 1.2 | Modern concepts | 1 |
| 1.3 | High Performance Concrete | 1 |
| 1.4 | Fibre Reinforced Concrete | 2 |



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| | | |
|---|---|---|
| 1.5 | Light weight concrete | 2 |
| 1.6 | Self Compacting Concrete. | 2 |
| **2** | **Loading** | |
| 2.1 | Gravity Loading | 1 |
| 2.2 | Dead load, Live load, Impact load | 1 |
| 2.3 | Construction load, Sequential loading | 1 |
| 2.4 | Wind Loading | 1 |
| 2.5 | Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. | 1 |
| 2.6 | Earthquake Loading | 1 |
| 2.7 | Equivalent lateral Load analysis | 1 |
| 2.8 | Response Spectrum Method | 1 |
| 2.9 | Combination of Loads | 1 |
| 3 | **Behaviour of Structural Systems** | |
| 3.1 | Factors affecting the growth, height and structural form | 2 |
| 3.2 | Behaviour of Braced frames | 2 |
| 3.3 | Behaviour of Rigid Frames | 1 |
| 3.4 | Behaviour of In filled frames | 1 |
| 3.5 | Shear walls, Coupled Shear walls, Wall | 1 |
| 3.6 | Tubular Systems | 1 |
| 3.7 | Outrigger braced, Hybrid systems | 1 |
| **4** | **Analysis and Design** | |
| 4.1 | Modeling for approximate analysis | 2 |
| 4.2 | Accurate analysis and reduction techniques | 1 |
| 4.3 | Analysis of structures as an integral unit | 1 |
| 4.4 | Analysis for member forces, drift and twist | 1 |
| 4.5 | Computerized 3D analysis | 1 |
| 4.6 | Design for differential movement | 1 |
| 4.8 | Creep and Shrinkage effects, Temperature Effects and Fire Resistance. | 1 |
| 5 | **Stability Analysis** | |
| 5.1 | Overall buckling analysis of frames | 2 |
| 5.2 | Overall buckling analysis of wall frames | 1 |
| 5.3 | Second order effect of gravity loading – Approximate method | 1 |
| 5.4 | P – Delta Effects, Simultaneous first order and P-Delta analysis | 1 |
| 5.5 | Translational instability | 1 |
| 5.6 | Torsional Instability | 1 |
| 5.7 | Out of plumb effects | 1 |
| 5.8 | Effect of stiffness of members and foundation rotation in stability of structures | 1 |
| | **Total** | **45** |

## Course Designers

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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| 60PSE E14 | DESIGN OF STRUCTURES FOR DYNAMIC LOADS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To Design factors, behaviour of structures in cyclic loads,
- To recap of structural dynamics with reference of different systems,
- To understand ductility, earth quake design of structures,
- To design of structures against blast and impact
- To Design against wind loads as per BIS code of practice and special consideration in the design of structures.

## Prerequisite

Basic knowledge of Earthquake, RCC Structures & Soil Mechanics.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Explain the behavior of structures under dynamic loads | Apply |
| CO2 | Design structures for earthquake, blast and impact loads | Analyze |
| CO3 | Perform ductile detailing | Understand |
| CO4 | Design against wind load as per BIS Code | Apply |
| CO5 | Ductility Detailing should be considering for vibrations structures | Analyze |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 3 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 1 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 10 | 10 | 10 |
| Apply (Ap) | 40 | 40 | 60 |
| Analyse (An) | 10 | 10 | 30 |
| Create (Cr) | 0 | 0 | 0 |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E14 - DESIGN OF STRUCTURES FOR DYNAMIC LOADS** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Semester** | **Hours / Week`** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Introduction**

Factors affecting design against dynamic loads - Behaviour of concrete, steel, masonry and soil under impact and cyclic loads - Recap of Structural dynamics with reference to SDOF, MDOF and continuum systems – Ductility and its importance [9]

**Design Against Earthquakes**

Earthquake characterization - Response spectra - seismic co-efficient and response spectra methods of estimating loads - Response of framed, braced frames and shear wall buildings - Design as per BIS codes of practice - Ductility based design [9]

**Design Against Blast And Impact**

Displacement method for three dimensional Structure - Coordinate transformations - Analysis of space trusses and space frames [9]

**Design Against Wind**

Characteristics of wind - Basic and Design wind speeds - Pressure coefficient - Aero elastic and Aerodynamic effects - Design as per BIS code of practice including Gust Factor approach - tall buildings, stacks and chimneys. [9]

**Special Considerations**

Energy absorption capacity - Ductility of the material and the structure - Detailing for ductility - Passive and active control of vibrations - New and favorable materials [9]

**Total Hours: 45**

**Text book (s) :**

| | |
|---|---|
| 1 | Paulay, .T. and Priestly, .M.N.J., “A seismic Design of Reinforced Concrete and Masonry building ", John Wiley and Sons, 2011. |
| 2 | Damodarasamy S.R,”Basics of Structural Dynamics and Aseismic Design”, PHI Learning Pvt Ltd, New Delhi, 2009. |

**Reference(s) :**

| | |
|---|---|
| 1 | Bela Goschy, “Design of Building to withstand abnormal loads ", Butterworths, 2010. |
| 2 | Dowling, .C.H., “Blast vibration - Monitoring and control ", Prentice Hall Inc., Englewood Cliffs, 2015. |
| 3 | Kolousek, .V., “Wind effects on Civil Engineering Structures ", Elsevier, 2014. |
| 4 | R.R. Craig - Structural Dynamics, John Wile 2003 |

## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Factors affecting design against dynamic loads | 1 |
| 1.2 | Behaviour of concrete, steel, masonry | 2 |
| 1.3 | Behaviour of soil under impact and cyclic loads | 2 |
| 1.4 | Recap of Structural dynamics with reference to SDOF | 1 |

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| | | |
|---|---|---|
| 1.5 | Recap of Structural dynamics with reference to MDOF | 1 |
| 1.6 | Recap of Structural dynamics with reference to continuum systems | 1 |
| 1.7 | Ductility and its importance | 1 |
| **2** | **Design Against Earthquakes** | |
| 2.1 | Earthquake characterization | 1 |
| 2.2 | Response spectra | 1 |
| 2.3 | seismic co-efficient | 1 |
| 2.4 | response spectra methods of estimating | 1 |
| 2.5 | loads | 1 |
| 2.6 | Response of framed, braced frames and | 1 |
| 2.7 | shear wall buildings | 1 |
| 2.8 | Design as per BIS codes of practice | 1 |
| 2.9 | Ductility based design | 1 |
| 3 | **Design Against Blast And Impact** | |
| 3.1 | Displacement method for Structure | 1 |
| 3.2 | Displacement method for three dimensional Structure | 2 |
| 3.3 | Coordinate transformations | 2 |
| 3.4 | Analysis of space trusses | 2 |
| 3.5 | Analysis of space frames | 2 |
| **4** | **Design Against Wind** | |
| 4.1 | Characteristics of wind | 1 |
| 4.2 | Basic and Design wind speeds | 1 |
| 4.3 | Pressure coefficient | 1 |
| 4.4 | Aero elastic and Aerodynamic effects | 2 |
| 4.5 | Design as per BIS code of practice including Gust Factor approach | 1 |
| 4.6 | tall buildings, | 1 |
| 4.7 | stacks | 1 |
| 4.8 | chimneys | 1 |
| | | |
| 5 | **Special Considerations** | |
| 5.1 | Energy absorption capacity | 2 |
| 5.2 | Ductility of the material and the structure | 2 |
| 5.3 | Detailing for ductility | 1 |
| 5.4 | Passive and active control of vibrations - | 2 |
| 5.5 | New and favorable materials | 2 |
| | | |
| | **Total** | **45** |

## Course Designers

1. Dr.D.SIVAKUMAR - sivakumard@ksrct.ac.in

**R1/ w.e.f. 12.07.2023**
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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TIRUCHENGODE - 637 215

| 60PSE E15 | FRACTURE MECHANICS OF CONCRETE STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To give an outline of the total field of fracture mechanics
- To familiarize students with problems that can be solved with fracture mechanics concepts.
- To impart knowledge on the mechanisms of failure and non linear fracture mechanics.
- To study crack criteria by using Griffith's Criteria, Stress Intensity Factors, R curves.
- To apply crack concepts & numerical modelling to high strength concrete & fibre reinforced concrete.

**Prerequisite**

Fundamentals of Mathematics, knowledge of basic strength of material.

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Evaluate the fracture failure parameters | Evaluate |
| CO2 | Evaluate the linear elastic fracture mechanics problems | Evaluate |
| CO3 | Explain the concept of elastic plastic fracture mechanics | Understand |
| CO4 | Estimate the residual life of fatigue Crack Growth in structure. | Analyze |
| CO5 | Evaluate the fracture parameters using direct and indirect methods | Evaluate |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | | 2 | |
| CO2 | 2 | 2 | 3 | | 2 | |
| CO3 | 1 | 2 | | 3 | 2 | 3 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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| K.S.Rangasamy College of Technology–Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **60PSE E15- FRACTURE MECHANICS OF CONCRETE STRUCTURES** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **INTRODUCTION:**<br>Courses of failures of structures – case studies Fracture Mechanics Approach to Design: Energy Criterion – Stress intensity approach – Time dependent crack growth – Effect of Material Properties on Fracture.. | **[09]** |
| **LINEAR ELASTIC FRACTURE MECHANICS**:<br>An atomic view of fracture – Stress concentration Effect of Flows – The Griffith Energy Balance – Comparison with the Critical Stress Criterion – Modified Griffith equation – The Energy Release rate – Instability and the R Curve – Stress analysis of cracks – Crack tip plasticity – Plane strain fracture –Mixed mode fracture. | **[09]** |
| **ELASTIC – PLASTIC FRACTURE MECHANICS:**<br>Crack –tip- opening displacement – J contour integral – Crack growth resistance curves – J controlled fracture – Crack tip constraint under large –scale yielding – Sealing model for clearage fracture.. | **[09]** |
| **DYNAMIC AND TIME – DEPENDENT FRACTURE:**<br>Dynamic fracture and crack arrest – Creep crack growth – Viscoelastic fracture mechanics. Material Behaviour: Fracture mechanisms in metals, plastics, ceramics, ceramic composites and concrete | **[09]** |
| **APPLICATION TO STRUCTURES :**<br>Linear Elastic Fracture Mechanics – Elastic plastic J – integral analysis – Failure Assessment Diagrams- Application to welded structures – Primary VS secondary stresses in the FAD Method – Ductile –Tearing analysis with FAD – Probabilistic Fracture Mechanics – Fatigue crack propagation – Environmentally assisted cracking in metals. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | Anderson,T.L. “Fracture Mechanics Fundamentals and Applications”, Taylor & Francis Group, 2015. |
| 2. | David Broek “Elementary engineering fracture mechanics” Kluwer Academic Publisher, 2012 |

**Reference(s):**

| | |
|---|---|
| 1. | David Broek , Sijthoff&Noordhoff .,“Elementary engineering fracture mechanics” , Alphen aan den Rijn.<br>Netherlands, 2012 |
| 2. | Fracture mechanics of concrete structures – Theory and applications – Rilem Report – Edited by L–Chapman and Hall – 1989. |
| 3. | Fracture mechanics – applications to concrete – Edited by Victor, C. Li, & Z.P. Bazant – ACI SP 118. |
| 4. | Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **INTRODUCTION** | |
| 1.1 | Review of Engineering Failure Analysis | 1 |
| 1.2 | Brittle fracture-Ductile fracture | 1 |
| 1.3 | Modes of fracture failure | 1 |
| 1.4 | The Griffith energy Balance Approach | 2 |

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| | | |
|---|---|---|
| 1.5 | Crack tip Plasticity | 2 |
| 1.6 | Fracture toughness | 2 |
| **2** | **LINEAR ELASTIC FRACTURE MECHANICS** | |
| 2.1 | Elastic crack tip stress field | 1 |
| 2.2 | Stress and displacement fields in isotropic elastic materials | 1 |
| 2.3 | Westergaard's approach (opening mode) | 1 |
| 2.4 | Plane Strain Fracture toughness (KIC) testing | 1 |
| 2.5 | Feddersen approach | 1 |
| 2.6 | Determination of R curve. | 1 |
| 2.7 | Energy released rate for DCB specimen | 1 |
| 2.8 | Anelastic deformation at crack tip | 1 |
| 2.9 | Test techniques, Various test specimens | 1 |
| 3 | **ELASTIC – PLASTIC FRACTURE MECHANICS:** | |
| 3.1 | Critical energy release rate | 2 |
| 3.2 | limitation of K approach | 2 |
| 3.3 | Approximate shape and size of the plastic zone | 1 |
| 3.4 | Effective crack length | 1 |
| 3.5 | Effect of plate thickness | 1 |
| 3.6 | Elastic plastic fracture concept | 1 |
| 3.7 | Crack tip opening displacement | 1 |
| **4** | **DYNAMIC AND TIME – DEPENDENT FRACTURE:** | |
| 4.1 | Fatigue crack growth to sharpen the tip | 2 |
| 4.2 | Load displacement test | 2 |
| 4.3 | Test methods to determine J1c | 1 |
| 4.4 | Mechanism of Fatigue ,Fatigue crack propagation | 1 |
| 4.5 | Paris law | 1 |
| 4.6 | Crack closure mechanism | 1 |
| 4.7 | Residual stresses at crack tip | 1 |
| **5** | **APPLICATION TO STRUCTURES :** | |
| 5.1 | Principles of crack arrest, crack arrest in practice | 2 |
| 5.2 | K-R Curves, Crack resistance curve | 1 |
| 5.3 | Numerical Methods and Approaches in Fracture Mechanics | 1 |
| 5.4 | Direct methods to determine fracture parameters | 1 |
| 5.5 | Indirect methods to determine fracture parameters | 1 |
| 5.6 | variable amplitude service loading, Interaction effects. | 1 |
| 5.7 | Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor | 1 |
| 5.8 | Retardation effect | 1 |
| | **Total** | **45** |

## CourseDesigners

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **60PSE E16** | **ADVANCED GROUNDWATER HYDROLOGY** | PE | 3 | 0 | 0 | 3 |

**Objective**

- The basic knowledge of groundwater hydrogeology, hydrometeorology, aquifers and it parameter.
- Understand various theories and equations related to groundwater hydraulics.
- Locating the hydro geological boundaries through conducting pumping tests and analysis.
- Understanding the concepts well design criteria.
- Acquire knowledge about problem identification and also providing suitable remedy in terms of maintaining the local groundwater table.

**Pre requisite**

Basic knowledge of Environmental Engineering courses

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Study the ground water hydrologic cycle and types of acquifiers. | Remember/ Analyse/ Apply |
| CO2 | Understand the ground water movement and principles of ground water flow and equation. | Remember / Analyse/ Apply |
| CO3 | Analyze the aquifer parameters and well characteristics. | Remember / Analyse/ Apply |
| CO4 | Discuss the construction of wells and design of wells. | Remember / Analyse/ Apply |
| CO5 | Explain the methods of ground water recharge and assessment | Remember / Analyse/ Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | | | 3 | 2 |
| CO4 | 3 | 2 | | 2 | 3 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 2 |

**AssessmentPattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E16- ADVANCED GROUNDWATER HYDROLOGY** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Totalhrs | Credit | MaximumMarks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction to Groundwater**<br>Groundwater in Hydrologic Cycle – Occurrence of groundwater– Hydrogeology – Hydrometeorology – soil sample analysis - Water bearing materials - Types of aquifers – parameters of Aquifers – Determination of specific yield and permeability. | **[09]** |
| **Groundwater Hydraulics**<br>Groundwater Movement - Darcy's law and its limitations - Stream lines and flow net analysis – Potential flow theory – Discharge and draw down for various condition of groundwater flow - Principles of groundwater flow and its equation – Dupuit – Forchheimer assumptions – Influent and Effluent streams - Evaluation of well loss parameters – Partial penetration of wells – Interference of wells – Collector wells and Infiltration galleries | **[09]** |
| **Pumping Test Analysis**<br>Determining aquifer parameters for unconfined, leaky and non-leaky aquifers – steady and transient conditions - Slug test – Locating hydro geological boundaries – Image well theory – Determination of well characteristics and specific capacity of wells – Well characteristics of large diameter wells. | **[09]** |
| **Well Design and Construction**<br>Well design criteria – Construction of wells – Well drilling methods – Filter design – Artificial and natural packing – Well castings and screens – Production test – Maintenance of production wells | **[09]** |
| **Special Topics**<br>Methods of artificial groundwater recharge – Groundwater assessment and balancing – Seawater intrusion in coastal aquifers – Land Subsidence - Wells in hard rock areas. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. D K Todd, "Groundwater Hydrology", John Wiley & Sons, Inc, New York, 2005.
2. H M Raghunath, "Groundwater" New Age International,1987.


**Reference(s):**


1. Bear J, "Hydraulics of Groundwater", McGraw-Hill, New York,1979.
2. Bouwer H, "Groundwater Hydrology", McGraw-Hill, NewYork,1978.
3. Driscoll, "Groundwater and Wells", Johnson Filtration Systems, Inc., 1986.
4. M S Hantush, "Hydraulics of wells in Advances in Hydro science", Academic Press, 1964.


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction to Groundwater** | |
| 1.1 | Groundwater in Hydrologic Cycle | 1 |
| 1.2 | Occurrence of groundwater | 1 |
| 1.3 | Hydrogeology and Hydrometeorology | 2 |

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| | | |
|---|---|---|
| 1.4 | Soil sample analysis and Water bearing materials | 2 |
| 1.5 | Types of aquifers and parameters of Aquifers | 2 |
| 1.6 | Determination of specific yield and permeability | 1 |
| **2** | **Groundwater Hydraulics** | |
| 2.1 | Groundwater Movement and Darcy's law and its limitations | 1 |
| 2.2 | Stream lines and flow net analysis | 1 |
| 2.3 | Discharge and draw down for various condition of groundwater flow | 2 |
| 2.4 | Principles of groundwater flow and its equation | 2 |
| 2.5 | Evaluation of well loss parameters and Partial penetration of wells, Interference of wells | 1 |
| 2.6 | Collector wells and Infiltration galleries | 2 |
| **3** | **Pumping Test Analysis** | |
| 3.1 | Determining aquifer parameters for unconfined, leaky and non-leaky aquifers | 3 |
| 3.2 | Steady and Transient conditions and Slug test | 2 |
| 3.3 | Locating hydro geological boundaries | 2 |
| 3.4 | Determination of well characteristics and specific capacity of wells | 1 |
| 3.5 | Well characteristics of large diameter wells. | 1 |
| **4** | **Well Design and Construction** | |
| 4.1 | Well design criteria | 1 |
| 4.2 | Construction of wells and Well drilling methods | 2 |
| 4.3 | Filter design – Artificial and natural packing | 2 |
| 4.4 | Well castings and screens | 1 |
| 4.5 | Production test | 1 |
| 4.6 | Maintenance of production wells. | 2 |
| 5 | **Special Topics** | |
| 5.1 | Methods of artificial groundwater recharge | 2 |
| 5.2 | Groundwater assessment and balancing | 2 |
| 5.3 | Seawater intrusion in coastal aquifers | 1 |
| 5.4 | Land Subsidence | 2 |
| 5.5 | Wells in hard rock areas | 2 |
| | **Total** | **45** |

## Course Designers

1. Dr. S.Ramesh - rameshs@ksrct.ac.in

**R1/ w.e.f. 12.07.2023**
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| 60PSE E17 | GROUNDWATER MODELING AND MANAGEMENT | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- Understand the groundwater exploration techniques both surface and subsurface by remote sensing and geophysical methods.
- Acquire preliminary idea about different methods of groundwater modeling techniques.
- Understand the different equations and model formulation methods.
- Acquire knowledge about data required for design and run the model.
- Understand about the influence of modeling for attaining the effective groundwater management.

## Pre requisite

Basic knowledge of Environmental Engineering courses

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Acquired knowledge on ground water exploration through various geophysical methods by surface and substance investigation. | Remember/ Analyse/ Apply |
| CO2 | Understand about the term model and it's types. | Remember / Apply |
| CO3 | Gain knowledge about different equations related to ground water modeling. | Remember / Analyse/ Apply |
| CO4 | Acquired knowledge on groundwater model design and development | Remember / Analyse/ Apply |
| CO5 | Familiar to create the need based model and its development. | Remember / Analyse/ Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | | | 3 | 2 |
| CO4 | 3 | 2 | | 2 | 3 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 2 |

## Assessment Pattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E17- GROUNDWATER MODELING AND MANAGEMENT** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Totalhrs | Credit | MaximumMarks | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Groundwater Prospecting**<br>Investigation and evaluation – Geophysical methods- Electrical Resistivity methods – Interpretation of data – Seismic method – Subsurface investigation – Test drilling – Resistivity logging – Application of remote sensing techniques . | **[09]** |
| **Groundwater Flow Model**<br>Physical models – Analog models – Mathematical modeling – Unsaturated flow models Numerical modeling of groundwater flow – Finite Differential equations - Finite difference solution – Successive over Relaxation, Alternating direction implicit procedure – Crank Nicolson equation – Iterative methods -Direct methods - Inverse problem – Finite element method | **[09]** |
| **Contaminant Transport Model**<br>Contaminant transport theory – Advection, dispersion equation – Longitudinal and transverse dispersivity – Hydrodynamic dispersion – Analytical models – Numerical simulation of solute transport – Solution methods - Sorption model – Subsurface mass transport through the vadose zone - Density driven flow - Heat transport. | **[09]** |
| **Model Development**<br>Data requirements – Conceptual model design : Conceptualization of aquifer system – Parameters, Input-output stresses, Initial and Boundary conditions - Model design and execution : Grid design, Setting boundaries, Time discretization and Transient simulation – Model calibration : steady state and unsteady state – sensitivity analysis – Model validation and prediction – Uncertainty in the model prediction | **[09]** |
| **Groundwater Management Model**<br>Optimal groundwater development – Indian GEC norms – Conjunctive use models Modeling multilayer groundwater flow system -Modeling contaminant migration – Modeling fracture flow system – Artificial recharge feasibility through modeling – Simulation of movements of solutes in unsaturated zone – Stochastic modeling of groundwater flow - Groundwater contamination, restoration and management | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. L Elango and R Jayakumar, "Modelling in Hydrology", Allied Publishers Ltd., 2001.
2. Randall, J Charbeneau, " Groundwater Hydraulics and Pollutant Transport",, Printice Hall, 2000.


**Reference(s):**


1. K R Rushton, "Groundwater Hydrology : Conceptual and Computational Models", Wiley, 1st Edition,2003.
2. C W Fetter, "Contaminant Hydrogeology", Prentice Hall,1999.
3. I Remson, G M Hornberger and F J, Moltz, "Numerical Methods in Subsurface Hydrology", Wiley, New York, 1971.
4. Robert Willis and William W G Yenth, "Groundwater System Planning and Management", Prentice Hall, Englewood Cliffs,New Jersey, 1987.



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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Groundwater Prospecting** | |
| 1.1 | Investigation and evaluation | 1 |
| 1.2 | Geophysical methods | 1 |
| 1.3 | Electrical Resistivity methods | 2 |
| 1.4 | Interpretation of data | 2 |
| 1.5 | Seismic method and Subsurface investigation | 2 |
| 1.6 | Application of remote sensing techniques | 1 |
| **2** | **Groundwater Flow Model** | |
| 2.1 | Physical models, Analog models and Mathematical modeling | 1 |
| 2.2 | Unsaturated flow models and Numerical modeling of groundwater flow | 1 |
| 2.3 | Finite Differential equations and Finite difference solution | 2 |
| 2.4 | Alternating direction implicit procedure | 2 |
| 2.5 | Crank Nicolson equation, Iterative methods and Direct methods | 1 |
| 2.6 | Finite element method | 2 |
| **3** | **Contaminant Transport Model** | |
| 3.1 | Contaminant transport theory, Advection, dispersion equation | 3 |
| 3.2 | Longitudinal and transverse dispersivity | 2 |
| 3.3 | Hydrodynamic dispersion and Analytical models | 2 |
| 3.4 | Solution methods - Sorption model, Subsurface mass transport through the vadose zone | 1 |
| 3.5 | Density driven flow - Heat transport. | 1 |
| **4** | **Model Development** | |
| 4.1 | Conceptual model design | 1 |
| 4.2 | Conceptualization of aquifer system its Parameters, Input-output stresses, Initial and Boundary conditions | 2 |
| 4.3 | Model design and execution | 2 |
| 4.4 | Time discretization and Transient simulation | 1 |
| 4.5 | Sensitivity analysis | 1 |
| 4.6 | Model validation and prediction | 2 |
| 5 | **Groundwater Management Model** | |
| 5.1 | Optimal groundwater development | 2 |
| 5.2 | Modeling multilayer groundwater flow system | 2 |
| 5.3 | Artificial recharge feasibility through modeling | 1 |
| 5.4 | Simulation of movements of solutes in unsaturated zone | 2 |
| 5.5 | Stochastic modeling of groundwater flow | 2 |
| | **Total** | **45** |

## Course Designers

1. Dr. S.Ramesh - rameshs@ksrct.ac.in

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| 60PSE E21 | STRUCTURAL HEALTH MONITORING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To learn the concept of structural health monitoring
- To acquire knowledge on structural audit
- To understand the static field testing procedures
- To learn the dynamic field testing procedures
- To apply various repair techniques in structures

**Prerequisite**

Courses –Construction Materials & Practices, Concrete Technology and Basic Sciences

**Course Outcomes**

On the successful completion of the course,students will be able to

| | | |
|---|---|---|
| CO1 | Understand the concept and measures of structural health monitoring | Remember/ Understand/ Analyse/Apply |
| CO2 | Investigate the health of structure using SHM procedures | Remember/ Understand/ Analyse/Apply |
| CO3 | Examine the health of structure using static field test | Remember/ Understand/ Analyse/Apply |
| CO4 | Assess the health of structure using dynamic field test | Remember/ Understand/ Analyse/Apply |
| CO5 | Apply suitable repair and rehabilitation techniques | Remember/ Understand/ Analyse/Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember(Re) | 05 | 05 | 10 |
| Understand(Un) | 05 | 05 | 20 |
| Apply (Ap) | 25 | 30 | 50 |
| Analyse (An) | 25 | 20 | 20 |
| Create (Cr) | - | - | - |

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| K.S.Rangasamy College of Technology–Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 60PSE E21 - STRUCTURAL HEALTH MONITORING | | | | | | | | |
| M.E -STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Structural Health**<br>Factors affecting Health of Structures, Causes of Distress, Regular Maintenance and monitoring structural monitoring - Concepts, Various Measures, Structural Safety in Alteration. | **[09]** |
| **Structural Audit**<br>Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures | **[09]** |
| **Static Field Testing**<br>Types of Static Tests - Behavior test, Diagnostic test, Proof load test, Simulation and Loading Methods, Sensor systems and hardware requirements, Static Response Measurement. | **[09]** |
| **Dynamic Field Testing**<br>Types of Dynamic Field Test - Stress History Test, Dynamic Response Methods, Ambient Vibration test, Pull-back test, Hardware for Remote Data Acquisition Systems,Remote Structural Health Monitoring. | **[09]** |
| **Repairs and Rehabilitations of Structures**<br>Case Studies (Site Visits), Piezo - electric materials and other smart materials, Electro–mechanical impedance (EMI) technique,Adaptations of EMI technique. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. Daniel Balageas, Claus_PeterFritzen, Alfredo Güemes, Structural Health Monitoring, JohnWiley and Sons, 2006
2. Douglas E Adams, “Health Monitoring of Structural Materials and Components - Methods with Applications”, John Wiley and Sons, 2007


**Reference(s):**


1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, Wiley , ISTE, 2006
2. Victor Giurgiutiu, “Structural Health Monitoring” Academic Press, 2014
3. Handbook on Repair & Rehabilitation of R.C.C. Buildings, CPWD, Govt of India, 2011
4. Structural Health Monitoring and Intelligent Infrastructure, Two Volume SetProceedings of the 2nd International Conference on Structural Health Monitoring of Intelligent Infrastructure, Nov. 16-18, 2005, Shenzhen, China


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Structural Health** | |
| 1.1 | Introduction to Structural health monitoring | 1 |
| 1.2 | Factors affecting Health of Structures | 1 |
| 1.3 | Causes of Distress | 1 |
| 1.4 | Regular Maintenance and monitoring | 2 |

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| | | |
|---|---|---|
| 1.5 | Concepts in Structural monitoring | 1 |
| 1.6 | Various measures in structural monitoring | 2 |
| 1.7 | Structural Safety in Alteration. | 1 |
| **2** | **Structural Audit** | |
| 2.1 | Structural Audit – Introduction & Importance | 1 |
| 2.2 | Need for Assessment of Structure and Damage identification | 1 |
| 2.3 | Assessment of Health of Structure | 1 |
| 2.4 | Collapse and Investigation | 2 |
| 2.5 | Investigation Management | 1 |
| 2.6 | SHM Procedures | 2 |
| 2.7 | Role of sensors in SHM | 1 |
| **3** | **Static Field Testing** | |
| 3.1 | Static field testing - Concept and types | 1 |
| 3.2 | Behavior test - Procedure& Applications | 1 |
| 3.3 | Diagnostic test - Procedure& Applications | 1 |
| 3.4 | Proof load test - Procedure& Applications | 1 |
| 3.5 | Simulation and loading methods for SHM | 2 |
| 3.6 | Sensor Systems & Hardware requirements | 2 |
| 3.7 | Static response measurement | 1 |
| **4** | **Dynamic Field Testing** | |
| 4.1 | Dynamic field testing - Concept and types | 1 |
| 4.2 | Stress history test | 1 |
| 4.3 | Dynamic Load Allowance test | 2 |
| 4.4 | Ambient Vibration test | 1 |
| 4.5 | Pull-back test | 1 |
| 4.6 | Hardware for Remote Data Acquisition Systems | 1 |
| 4.7 | Remote Structural Health Monitoring. | 2 |
| **5** | **Repairs and Rehabilitations of Structures** | |
| 5.1 | Introduction to Repairs and Rehabilitations of Structures | 1 |
| 5.2 | Case Studies | 2 |
| 5.3 | Piezo - electric materials | 2 |
| 5.4 | Smart materials | 2 |
| 5.5 | Electro–mechanical impedance (EMI) technique, | 1 |
| 5.6 | Adaptations of EMI technique | 1 |
| | **Total** | **45** |

## Course Designer

Mr.K.ANGU SENTHIL - angusenthil@ksrct.ac.in

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| 60PSE E22 | DESIGN OF SUB STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To impart knowledge in the selection of sites for investigate and procedure of sub surface exploration
- To determine the soil condition and provide the suitable foundation.
- To design the pile foundation based on capacity of super structure.
- To understand different types of foundations and their designing methods.
- Laying foundation for other miscellaneous structures like towers and different types of machine foundations and their design.

**Prerequisite**

Basic knowledge of Soil Mechanics, Geology & Mathematical

**CourseOutcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | State the knowledge on soil exploration | Apply |
| CO2 | Analysis the concepts of safe bearing capacity of shallow foundation | Apply, Analyze |
| CO3 | Explain pile foundation and their types | Understand |
| CO4 | Estimation the well foundations and sheet pile wall | Apply |
| CO5 | Identify the general analysis of machine foundation and soil dynamics | Analyze |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Knowledge (Kn) | 10 | 10 | 10 |
| Apply (Ap) | 40 | 40 | 60 |
| Analyse (An) | 10 | 10 | 30 |
| Create (Cr) | 0 | 0 | 0 |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E22 -DESIGN OF SUB STRUCTURES** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Sub Surface Exploration**
Purpose - Programme and Procedures – Sampling- Exploration- soil data and Bore-hole log reports. [9]

**Shallow Foundations**
Types of foundations and their specific applications – depth of foundation – bearing capacity and settlement estimates (Plate load) – structural design of isolated footings, strip, rectangular and trapezoidal combined footings – strap– raft foundation – Approximate flexible method of raft design. [9]

**Deep Foundations**
Types of Piles and their applications - Pile capacity – Settlement of piles – Pile group – Structural design of piles and pile caps. [9]

**Foundations for Other Miscellaneous Structures**
Design of Caissons and Well foundations - Foundations for towers –Sheet Pile wall-Coffer dams. [9]

**Machine Foundations**
Types - General requirements and design criteria - General analysis of machine foundations-Soil Dynamics – Vibration isolation - Guide lines for design of reciprocating engines, impact type machines, rotary type machines, framed foundations. [9]

**Total Hours 45**

**Text book (s) :**


| | |
|---|---|
| 1 | Swamy Saran , “Analysis and Design of Substructures”, Oxford and IBH Publishing Co., Pvt.Ltd., New Delhi,2018. |
| 2 | Venkatramaiah.C, “Geotechnical Engineering”, New Age International Ltd., New Delhi, 2016. |


**Reference(s) :**


| | |
|---|---|
| 1 | Thomlinson, M.J. and Boorman. R. “Foundation Design and Construction”,ELBS Longman VI, 2005 |
| 2 | Nayak, N.V., “Foundation Design manual for Practicing Engineers”, Dhanpat Rai and Sons, 2009. |
| 3 | Winterkorn H.F., and Fang H.Y., “Foundation Engineering Hand Book - VanNostrard - Reinhold - 2006. |
| 4 | Brain J Bell and Smith M.J.“Reinforced Concrete Foundations” George Godwin Ltd., 2011. |


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Sub Surface Exploration** | |
| 1.1 | Purpose | 1 |
| 1.2 | Programme and Procedures | 2 |
| 1.3 | Sampling | 1 |
| 1.4 | Exploration | 2 |
| 1.5 | soil data | 1 |
| 1.6 | Bore-hole log reports | 2 |
| | | |

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| | | |
|---|---|---|
| **2** | **Shallow Foundations** | |
| 2.1 | Types of foundations and their specific applications | 1 |
| 2.2 | depth of foundation | 1 |
| 2.3 | bearing capacity and settlement estimates (Plate load) | 1 |
| 2.4 | structural design of isolated footings, | 1 |
| 2.5 | structural design of strip, rectangular and trapezoidal combined footings | 2 |
| 2.6 | structural design of strap – raft foundation | 2 |
| 2.7 | Approximate flexible method of raft design. | 1 |
| | | |
| 3 | **Deep Foundations** | |
| 3.1 | Types of Piles | 1 |
| 3.2 | Pile applications | 1 |
| 3.3 | Pile capacity | 1 |
| 3.4 | Settlement of piles | 2 |
| 3.5 | Pile group | 2 |
| 3.6 | Structural design of piles | 1 |
| 3.7 | pile caps | 1 |
| | | |
| **4** | **Foundations for Other Miscellaneous Structures** | |
| 4.1 | Design of Caissons | 2 |
| 4.2 | Design of Well foundations | 2 |
| 4.3 | Foundations for towers | 2 |
| 4.4 | Sheet Pile wall | 2 |
| 4.5 | Coffer dams | 1 |
| | | |
| 5 | **Machine Foundations** | |
| 5.1 | Types | 1 |
| 5.2 | General requirements and design criteria - | 1 |
| 5.3 | General analysis of machine foundations-. | 1 |
| 5.4 | Soil Dynamics | 2 |
| 5.5 | Vibration isolation | 1 |
| 5.6 | Guide lines for design of reciprocating engines, | 1 |
| 5.7 | impact type machines, | 1 |
| 5.8 | rotary type machines, | 1 |
| 5.9 | framed foundations | 1 |
| | | 2 |
| | **Total** | **45** |

## Course Designers

1. Dr.D.SIVAKUMAR - sivakumard@ksrct.ac.in

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| 60PSE E23 | STRUCTRUAL OPTIMIZATION | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To explain basics concepts of optimizing in structural design.
- To develop optimization techniques, and application of algorithms.
- To understand linear Programming methods for plastic design of frames.
- To apply Optimization theorems and using several methods.
- To evaluate different types of non – traditional optimization techniques.

## Prerequisite

Basic knowledge of Soil Mechanics, Geology & Mathematical

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Apply the knowledge on the recent advances in optimization. | Remember, Understand, Apply |
| CO2 | Write algorithm for Geometric and Dynamic programming. | Remember, Understand, Analyze |
| CO3 | To know the basis of univariate and multivariate minimization. | Remember, Understand, Apply, Analyze |
| CO4 | Understand the concepts of optimization structural theorems. | Analyze |
| CO5 | Understand the concepts of optimization problems in the Structural Engineering | Understand and Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 20 | 10 | 30 |
| Analyse | 20 | 30 | 50 |
| Evaluate | - | - | - |
| Create | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E23 -STRUCTRUAL OPTIMIZATION | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Elective II | | | | | | | | |
| Semester | Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Introduction**

Basic concepts of minimum weight, minimum cost design, objective function, constraints, classical methods [9]

**Optimization Techniques And Algorithms**

Linear programming, Integer Programming, Quadratic Programming. Dynamic Programming and geometric Programming methods for optimal design of structural elements. [9]

**Computer Search Methods**

Linear Programming methods for plastic design of frames. Computer search for univariate and multivariate Minimization [9]

**Optimization Theorems**

Optimization by structural theorems, Maxwell, Mitchell and Heyman's Theorems for trusses and frames, fully stressed design with deflection constraints, optimality criterion methods. [9]

**Non-Traditional Optimization Techniques**

Methods land on national evolution – Genetic Algorithm – simulated annealing – Truss problem – Hand simulation for simple problems. [9]

**Total Hours: 45**

**Text book (s) :**


| | |
|---|---|
| 1 | Spillers, William R., MacBain, Keith M, "Structural Optimization", 2006. |
| 2 | Rao., S.S., " Optimization theory and Applications", Wiley Eastern Limited, New Delhi, 1995. |


**Reference(s) :**


| | |
|---|---|
| 1 | Christensen, Peter, Klarbring, Anders, "An Introduction to Structural Optimization", 2009, Springer. |
| 2 | Rao, S.S., Optimization Theory and Applications" Wiley Eastern Ltd., New Delhi, 1978. |
| 3 | Majid, K.I., "Optimum Design of Structures" Newnes-Butter Worths, London, 1974. |
| 4 | Gallegher, R.H. and Zienkiewiez, O.C., John Wiley and Sons, "Optimum Structural Design, Theory and Applications", New York, 1973. |


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Basic concepts of minimum weight | 1 |
| 1.2 | Basic concepts of minimum cost design | 2 |
| 1.3 | Objective of Cost design | 1 |
| 1.4 | Functions | 2 |
| 1.5 | constraints | 1 |
| 1.6 | Classical methods | 2 |
| **2** | **Optimization Techniques And Algorithms** | |
| 2.1 | Basics of Optimization Techniques | 1 |
| 2.2 | Linear programming methods for optimal design of structural | 1 |

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| | | |
|---|---|---|
| | elements | |
| 2.3 | Integer Programming methods for optimal design of structural elements | 1 |
| 2.4 | Quadratic Programming methods for optimal design of structural elements | 2 |
| 2.5 | Dynamic Programming, methods for optimal design of structural elements | 2 |
| 2.6 | Geometric Programming methods for optimal design of structural elements | 2 |
| 3 | **Computer Search Methods** | |
| 3.1 | Linear Programming methods for plastic design of frames | 1 |
| 3.2 | Concepts of Plastic design of frames | 1 |
| 3.3 | Computer search for univariate Minimization | 1 |
| 3.4 | Computer search for multivariate Minimization | 2 |
| 3.5 | Problems in Univariate Minimization | 2 |
| 3.6 | Problems in mutltivariate minimization | 2 |
| **4** | **Optimization Theorems** | |
| 4.1 | Optimization by structural theorems | 2 |
| 4.2 | Maxwell Theorems for trusses and frames | 1 |
| 4.3 | Mitchell Theorems for trusses and frames | 1 |
| 4.4 | Heyman's Theorems for trusses and frames | 1 |
| 4.5 | Fully stressed design with deflection constraints | 2 |
| 4.6 | optimality criterion methods | 2 |
| 5 | **Non-Traditional Optimization Techniques** | |
| 5.1 | Methods on national evolution | 1 |
| 5.2 | Genetic Algorithm | 1 |
| 5.3 | Simulated annealing | 1 |
| 5.4 | Truss problem | 2 |
| 5.5 | Hand simulation for simple problems | 2 |
| 5.6 | Simple problems in Non-traditional optimization techniques | 2 |
| | **Total** | **45** |

## Course Designers

1. Dr. J.Abdul Bari- abdulbari@ksrct.ac.in

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| 60 PSE E24 | Ground Improvement Techniques | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To learn the basics of various factors influencing compaction
- To know Treatment of various soil conditions.
- To evaluate the behavior of stabilization of soil
- To understand the concepts of basic mechanism of reinforced earth.
- To enhance the ability to design and Stabilization of expansive clays

## Pre-requisites

- Foundation Engineering
- Soil Mechanics

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Understand various types of ground improvement. | Remember |
| CO2 | Solve the dewatering techniques. | Understand |
| CO3 | Compute the Dynamic compaction Virilization. | Remember |
| CO4 | Describe the various methods of grouting for treated. | Apply |
| CO5 | Analyse the Soil improvement by adding materials. | Analyse |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | - | - | - | - | - | - | 2 | 2 | - | - | 2 | - |
| CO2 | 3 | 3 | - | 2 | - | - | - | - | - | - | - | - | 2 | - |
| CO3 | 3 | 3 | - | 2 | - | - | - | - | 2 | 2 | - | - | 2 | - |
| CO4 | 3 | - | - | 2 | - | - | - | - | | | - | - | 2 | - |
| CO5 | 3 | - | - | - | - | - | - | - | 2 | 2 | | 2 | 2 | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | 10 | 20 | 10 | - | 34 | - |
| Understand | 10 | 10 | 10 | 10 | - | 66 | - |
| Apply | 10 | 30 | 10 | 30 | 50 | - | 50 |
| Analyse | 20 | 50 | 20 | 50 | 50 | - | 50 |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

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**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E. Civil Engineering | | | | | | | | |
| 60 PSE E24 - Ground Improvement Techniques | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| I | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Dewatering *** <br> Introduction – Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage: Ground Water lowering by well points, deep wells, vacuum and electro osmotic methods; Stabilization by thermal and freezing techniques - Applications. | [9] |
| **Compaction and Sand Drains** <br> In-situ compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods. | [9] |
| **Stone Column, Lime Piles and Soil Nailing Systems*** <br> Stone column, lime piles – Functions – Methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications - Soil liquefaction mitigation methods - case studies. | [9] |
| **Geosynthetics and Geotextiles** <br> Types of geosynthetics: geotextiles, geogrids, geonets, geomembranes, geocomposites - Geotextile fibres - Natural fibres, synthetic fibres - Classification based on manufacturing – applications in building construction and maintenance. | [9] |
| **Grouting**** <br> Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays – case studies. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | Day, R.W., **Foundation Engineering Handbook**, McGraw – Hill Companies, Inc, 2018. |
| 2. | Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 2019. |
| **Reference(s):** | |
| 1. | Jewell, R.A., Soil Reinforcement with Geotextiles, CIRIA, London, 2019. |
| 2. | Das B.M., Principles of Soil Dynamics, McGraw Hill, 2019 |
| 3. | Swami Saran, Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd. New Delhi 2020. |
| 4. | Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 2019 |

*SDG 9 – Industry Innovation and Infrastructure
**SDG 3 – Good Health and Well Being

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## Course Contents and Lecture Schedule

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1.0** | **Dewatering** | |
| 1.1 | Introduction – about dewatering | 1 |
| 1.2 | Basic definitions, Scope and necessity of ground improvement in Geotechnical engineering basic concepts | 1 |
| 1.3 | Drainage for dewatering, Ground Water lowering by well points and deep wells | 1 |
| 1.4 | Ground Water lowering by vacuum and electro osmotic methods | 1 |
| 1.5 | Viscous damping | 1 |
| 1.6 | Stabilization by thermal and freezing techniques and applications | 1 |
| **2.0** | **Compaction and Sand Drains** | |
| 2.1 | In-situ compaction of granular and cohesive soils | 1 |
| 2.2 | Shallow, Deep compaction methods and Sand piles | 1 |
| 2.3 | Concept, design, factors influencing compaction | 1 |
| 2.4 | Blasting and dynamic consolidation | 1 |
| 2.5 | Preloading with sand drains, fabric drains, wick drains etc | 1 |
| 2.6 | Theories of sand drain, Design and relative merits of various methods | 1 |
| **3.0** | **Stone Column, Lime Piles and Soil Nailing.** | |
| 3.1 | Introduction to Stone column and lime piles | 1 |
| 3.2 | Functions and Methods of installation | 1 |
| 3.3 | Design, estimation of load carrying capacity and settlement. | 1 |
| 3.4 | Root piles and soil nailing | 1 |
| 3.5 | methods of installation, Design and Applications | 1 |
| 3.6 | Soil liquefaction mitigation methods, case studies | 1 |
| **4.0** | **Geosynthetics and Geotextiles** | |
| 4.1 | Types of geosynthetics | 1 |
| 4.2 | Principles involved in geotextiles, geogrids, geonets | 2 |
| 4.3 | Geotextile fibres | 1 |
| 4.4 | Natural fibres and synthetic fibres | 2 |
| 4.5 | Classification based on manufacturing. | 2 |
| 4.6 | Application of Geotextiles in building construction and maintenance | 1 |
| **5.0** | **Grouting** | |
| 5.1 | Grouting and Types of grout | 1 |
| 5.2 | Suspension and solution grouts | 1 |
| 5.3 | Basic requirements of grout. Grouting equipment | 1 |
| 5.4 | Methods of injection and Use of jet grouting and grout monitoring | 1 |
| 5.5 | Electro – Chemical stabilization and Stabilization with cement | 1 |
| 5.6 | Lime - Stabilization of expansive clays and case studies. | 1 |

## Course Designer(s)

**1.** Dr.D.Siva Kumar - sivakumard@ksrct.ac.in

**R1/ w.e.f. 12.07.2023**
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| 60PSE E25 | NON LINEAR ANALYSIS OF STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- Analyze the bar system considering the material and geometric nonlinearity.
- Perform inelastic analysis of flexural members.
- Perform vibration analysis of flexural members.
- Perform elastic and inelastic analysis of Plates.
- Perform nonlinear and instability analysis of elastically supported beams.

**Prerequisite**

Basic knowledge of Soil Mechanics, Geology & Mathematical

**CourseOutcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Describe the concept of Non-Linear Analysis of the structures | Remember, Understand, Apply |
| CO2 | Analyse the members subjected to deformations and analysis of bars with and without restraints | Remember, Understand, Analyze |
| CO3 | Apply the knowledge of vibration theory on flexural members and identify its behaviour under cyclic loading | Remember, Understand, Apply, Analyze |
| CO4 | Identify the Non-linear behaviour of plates. | Analyze |
| CO5 | Solve the elemental equation of beams Non linear vibrations | Understand and Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 20 | 10 | 30 |
| Analyse | 20 | 30 | 50 |
| Evaluate | - | - | - |
| Create | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E25 -NON LINEAR ANALYSIS OF STRUCTURES** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Elective II** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**INTRODUCTION TO NONLINEAR ANALYSIS :** Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness. [9]

**INELASTIC ANALYSIS OF FLEXURAL MEMBERS** : Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of bars of uniform and variable stiffness members with and without axial restraints [9]

**VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS** : Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading [9]

**ELASTIC AND INELASTIC ANALYSIS OF PLATES** : Elastic and inelastic analysis of uniform and variable thickness plates [9]

**NONLINEAR VIBRATION AND INSTABILITY**: Nonlinear vibration and Instabilities of elastically supported beams. [9]

**Total Hours: 45**

**Text book (s) :**

| | |
|---|---|
| 1 | Gang Li, Kevin Wong ,"Theory of Nonlinear Structural Analysis: The Force Analogy Method for Earthquake Engineering", Wiley,1st edition (23 June 2014). |
| 2 | Fertis, D.G, Non-linear Mechanics, CRC Press, 1999. |

**Reference(s) :**

| | |
|---|---|
| 1 | Sathyamoorthy.M, Nonlinear Analysis of Structures, CRC Press, 2010. |
| 2 | Reddy.J.N, Non-linear Finite Element Analysis, Oxford University Press, 2008. |
| 3 | F.C. Filippou and G.L. Fenves, "Methods of Analysis for Earthquake-Resistant Structures" from "Earthquake Engineering, From Engineering Seismology to Performance-Based Engineering", CRC Press, 2004. |
| 4 | McGuire, William; Gallagher, Richard H.; and Ziemian, Ronald D., "Matrix Structural Analysis, 2nd Edition" 2000. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **INTRODUCTION TO NONLINEAR ANALYSIS** | |
| 1.1 | Material nonlinearity | 1 |
| 1.2 | Geometric nonlnearity | 1 |
| 1.3 | Statically determinate bar systems of uniform thickness | 1 |
| 1.4 | Statically indeterminate bar systems of uniform thickness | 2 |
| 1.5 | Statically determinate bar systems of variable thickness | 2 |
| 1.6 | Statically indeterminate bar systems of variable thickness | 2 |
| | | |

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| | | |
|---|---|---|
| **2** | **INELASTIC ANALYSIS OF FLEXURAL MEMBERS** | |
| 2.1 | Inelastic analysis of uniform thickness members subjected to small deformations | 1 |
| 2.2 | Inelastic analysis of variable thickness members subjected to small deformations | 1 |
| 2.3 | inelastic analysis of bars of uniform stiffness members with axial restraints | 1 |
| 2.4 | inelastic analysis of bars of variable stiffness members with axial restraints | 2 |
| 2.5 | inelastic analysis of bars of uniform stiffness members without axial restraints | 2 |
| 2.6 | inelastic analysis of bars of variable stiffness members without axial restraints | 2 |
| | | |
| 3 | **VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS** | |
| 3.1 | Vibration theory – Basic introductions | 1 |
| 3.2 | Analysis of Flexural Members | 1 |
| 3.3 | Hysteretic Models | 1 |
| 3.4 | Analysis of uniform stiffness members under cyclic loading | 2 |
| 3.5 | Analysis of variable stiffness members under cyclic loading | 2 |
| 3.6 | Problems related to cyclic loading | 2 |
| | | |
| **4** | **ELASTIC AND INELASTIC ANALYSIS OF PLATES** | |
| 4.1 | Elastic analysis of uniform plates | 2 |
| 4.2 | In Elastic analysis of uniform plates | 2 |
| 4.3 | Elastic analysis of variable thickness plates | 2 |
| 4.4 | In Elastic analysis of variable thickness plates | 2 |
| 4.5 | Simple Problems | 1 |
| 5 | **NONLINEAR VIBRATION AND INSTABILITY** | |
| 5.1 | Nonlinear vibration | 3 |
| 5.2 | Instabilities of elastically supported beams | 3 |
| 5.3 | Problems related to nonlinear vibrations | 3 |
| | **Total** | **45** |

## Course Designers

1. Dr. J.Abdul Bari- abdulbari@ksrct.ac.in

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| 60PSE E26 | ENVIRONMENTAL MONITORING INSTRUMENTS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To understand the chemical analysis of water
- To know the analysis of pollutants.
- To find the methods for toxic organics estimation.
- To learn the non-destructive methods of analysis.
- To provide knowledge about monitoring analyzers.

## Pre requisite

Basic knowledge of Environmental Engineering courses

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Able to select appropriate instrumental method for chemical analysis. | Knowledge/ Analyse/ Apply |
| CO2 | Explore spectroscopic methods of analysis of pollutants | Knowledge/ Analyse/ Apply |
| CO3 | Select the correct method for toxic organics estimation using chromatography methods | Knowledge/ Analyse/ Apply |
| CO4 | Understand electro and nondestructive methods of analysis | Knowledge/ Analyse/ Apply |
| CO5 | Identify the continuous monitoring instruments | Knowledge/ Analyse/ Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | | | 3 | 2 |
| CO4 | 3 | 2 | | 2 | 3 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 2 |

## Assessment Pattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Knowledge (Kn) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E26 – ENVIRONMENTAL MONITORING INSTRUMENTS** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Fundamentals**<br>Wet chemistry methods and their limitations-instrumental methods, selection of method- precision and accuracy, error in measuring signals- quality control & assurance- sample preservation, sample preparation and analyte isolation. | **[09]** |
| **Spectroscopic Methods**<br>Principles, techniques and applications of spectrophotometry, fluorimetry, nephelometry and turbidimetry, Atomic Absorption Spectrometry (Flame, graphite furnace, cold vapour and hydride generation), Atomic Emission Spectrometry (AES), flame photometry and Inducted Coupled Plasma (ICP) – TOC Analyzer | **[12]** |
| **Chromatrographic Methods**<br>Principles, techniques and applications of GC, GC-MS, high performance liquid chromatography (HPLC) and Ion Chromatography (IC)-hyphenated techniques for environmental contaminant (trace organics) analysis, ICP-MS | **[08]** |
| **Electro and Radio Analytical Methods**<br>Principles, techniques and applications of conductometry, potentiometry, coulometry, AOX Analyzer. amperometry, polarography, electro-capillary analysis, Neutron Activation Analysis (NAA), X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) methods. | **[08]** |
| **Continuous Monitoring Instruments**<br>Principles, techniques and applications of NDIR analyzer for CO, chemiluminescent analyzer for NOx, fluorescent analyzer for SO2- particulates analysis- auto analyzer for water quality using flow injection analysis. LIMS. | **[08]** |
| **Total Hours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | Bruce Wiersma G, “Environmental Monitoring” CRC Press, 2004 |
| 2. | Paul R. Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, and Applications, Marcel Dekker; 2nd Edition , 2005, |

**Reference(s):**

| | |
|---|---|
| 1. | Willard H. Merritt, L. Dean, D.A. and Settle, F.A. ‘Instrumental methods of analysis Edn. Words Worth, New York, 2004. |
| 2. | Ewing Instrumental Methods of Chemical Analysis, 5th Edition, McGraw Hill, New York.1985 |
| 3. | Reeve, R.N., “Introduction to Environmental Analysis”, Analytical Techniques in the Sciences, John Wiley & Sons, Chichester, UK, 2002. |
| 4. | Barcelo, D.(editor), “Environmental analysis. Techniques, Applications and Quality Assurance”, Elsevier, The Netherlands, 1996 |

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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Fundamentals** | |
| 1.1 | Wet chemistry methods | 1 |
| 1.2 | instrumental methods | 2 |
| 1.3 | error in measuring signals | 2 |
| 1.4 | quality control & assurance | 2 |
| 1.5 | sample preparation and analyte isolation | 2 |
| **2** | **Spectroscopic Methods** | |
| 2.1 | techniques and applications of spectrophotometry | 2 |
| 2.2 | fluorimetry, nephelometry and turbidimetry | 2 |
| 2.3 | Atomic Absorption Spectrometry | 2 |
| 2.4 | Atomic Emission Spectrometry | 2 |
| 2.5 | flame photometry and Inducted Coupled Plasma (ICP) | 2 |
| 2.6 | TOC Analyzer | 2 |
| **3** | **Chromatrographic Methods** | |
| 3.1 | Principles, techniques and applications of GC, | 2 |
| 3.2 | high performance liquid chromatography | 2 |
| 3.3 | Ion Chromatography | 2 |
| 3.4 | hyphenated techniques for environmental contaminant analysis | 2 |
| **4** | **Electro and Radio Analytical Methods** | |
| 4.1 | Introduction to Electro and Radio Analytical Methods | 1 |
| 4.2 | Principles, techniques and applications of conductometry, potentiometry, coulometry, | 2 |
| 4.3 | AOX Analyzer. amperometry, polarography | 2 |
| 4.4 | electro-capillary analysis | 1 |
| 4.5 | Neutron Activation Analysis | 1 |
| 4.6 | X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) methods. | 1 |
| **5** | **Continuous Monitoring Instruments** | |
| 5.1 | Principles, techniques and applications of NDIR analyzer for CO | 2 |
| 5.2 | chemiluminescent analyzer for NOx | 2 |
| 5.3 | fluorescent analyzer for SO2 | 1 |
| 5.4 | particulates analysis | 1 |
| 5.5 | auto analyzer for water quality using flow injection analysis | 2 |
| | **Total** | **45** |

## Course Designers

1. Dr. S.Ramesh - rameshs@ksrct.ac.in

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| 60PSE E27 | MUNICIPAL SOLID WASTE MANAGEMENT | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To know the types, sources, generation of municipal solid waste
- To understand the Storage, collection, transport, of municipal solid waste.
- To learn the design and operation aspects of sanitary landfills.
- To acquire knowledge on waste processing
- To study the source reduction and onsite storage methods.

**Pre requisite**

Basic knowledge of properties learnt in waste management courses

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | . Identify the sources, types and characteristics of solid wastes. . | Knowledge/ Analyse/ Apply |
| CO2 | Describe the health, environmental effects and solid waste management strategies | Knowledge/ Analyse/ Apply |
| CO3 | Choose the on-site storage methods and segregation of municipal solid wastes | Knowledge/ Analyse/ Apply |
| CO4 | Summaries the methods of collection and operating, maintenance of transfer station | Knowledge/ Analyse/ Apply |
| CO5 | Explain the off-site processing techniques and equipments. | Knowledge/ Analyse/ Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | | | 2 | 1 |
| CO4 | 2 | 2 | | 3 | 3 | 1 |
| CO5 | 3 | 2 | 2 | 3 | 3 | 1 |

**Assessment Pattern**

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Knowledge (Kn) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E27 – MUNICIPAL SOLID WASTE MANAGEMENT** | | | | | | | | |
| **M.E – Structural Engineering** | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | MaximumMarks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Sources and Types**<br>Sources and types of municipal solid wastes-Waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management – Municipal solid waste (M&H) rules- Integrated management.- Social and Financial aspects; Public awareness; Role of NGO's | **[09]** |
| **Source Reduction and On-Site Storage**<br>Source reduction of waste- Reduction, Reuse and Recycling - On-site storage methods- Effect of storage, materials used for containers- segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage – case studies under Indian conditions. | **[09]** |
| **Collection and Transfer**<br>Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems – solving. | |
| **Processing of Wastes**<br>Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options- case Studies under Indian conditions. | **[09]** |
| **Disposal**<br>Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills –Landfill liners - Management of leach ate and landfill gas – Land fill Bioreactor.-Dumpsite Rehabilitation | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | T.V Ramachandra, "Management of Municipal solid waste" TERI Press, 2010 |
| 2. | George Tchobanoglous and Frank Kreith, "Handbook of Solid waste Management", Mc Graw Hill, Newyork, 2002. |

**Reference(s):**

| | |
|---|---|
| 1. | Handbook of Solid Waste Management (McGraw-Hill Handbooks), 2002 |
| 2. | Paul T Williams, "Waste Treatment and Disposal", John Wiley and Sons, 2000. |
| 3. | Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000. |
| 4. | Manser A.G.R and Keeling A.A, "Practical Handbook of Processing and Recycling of Municipal solid Wastes", Lewis Publishers, CRC Press, 1996. |

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**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Sources and Types** | |
| 1.1 | Sources and types of municipal solid wastes | 1 |
| 1.2 | Waste generation rates | 1 |
| 1.3 | factors affecting generation | 1 |
| 1.4 | methods of sampling | 1 |
| 1.5 | Effects of improper disposal of solid wastes | 1 |
| 1.6 | Public health and environmental effects | 1 |
| 1.7 | Elements of solid waste management | 1 |
| 1.8 | Municipal solid waste (M&H) rules | 1 |
| 1.9 | Public awareness; Role of NGO's | 1 |
| **2** | **Source Reduction and On-Site Storage** | |
| 2.1 | Source reduction of waste | 1 |
| 2.2 | Reuse and Recycling | 1 |
| 2.3 | On-site storage methods- | 2 |
| 2.4 | Effect of storage on material | 1 |
| 2.5 | materials used for containers | 1 |
| 2.6 | segregation of solid wastes | 1 |
| 2.7 | Public health and economic aspects of open storage | 1 |
| 2.8 | waste segregation and storage | 1 |
| **3** | **Collection and Transfer**<br>vehicles – Manpower –Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems – solving. Me | |
| 3.1 | Methods of Residential and commercial waste collection | 1 |
| 3.2 | Collection vehicles | 2 |
| 3.3 | Collection routes | 1 |
| 3.4 | Analysis of collection systems | 2 |
| 3.5 | Transfer stations | 1 |
| 3.6 | Selection of location for transfer stations | 1 |
| 3.7 | operation & maintenance transfer stations | 1 |
| **4** | **Processing of Wastes** | |
| 4.1 | Objectives of waste processing | 1 |
| 4.2 | Physical Processing techniques and Equipments | 2 |
| 4.3 | Resource recovery from solid waste | 2 |
| 4.4 | composting and biomethanation | 1 |

| | | |
|---|---|---|
| 4.5 | biomethanation | 1 |
| 4.6 | Thermal processing options | 1 |
| 4.7 | case Studies | 1 |
| 5 | **Disposal** | |
| 5.1 | Land disposal of solid waste | 1 |
| 5.2 | Sanitary landfills site selection | 1 |
| 5.3 | design and operation of sanitary landfills | 2 |
| 5.4 | Landfill liners | 1 |
| 5.5 | Management of leach ate and landfill gas | 2 |
| 5.6 | Land fill Bioreactor | 1 |
| 5.7 | Dumpsite Rehabilitation | 1 |
| | **Total** | **45** |

## CourseDesigners

1. Dr.S.RAMESH - rameshs@ksrct.ac.in

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| 60PSE E31 | SOIL STRUCTURE INTERACTION | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To know Soil foundation interaction problems, behaviors and models.
- To understand the elastic foundation soil models and plate on elastic medium
- To design plate types, numerical analysis of finite plates,
- To develop elastic analysis of single pile and group of piles based on settlement.
- Interaction analysis of piles and about the analysis of laterally loaded piles.

## Prerequisite

Basic knowledge of Soil Mechanics, Foundation Design & Geology.

## CourseOutcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Generate concepts of soil structure Interaction | Apply |
| CO2 | Assess the soil models as isotropic elastic half-space | Apply |
| CO3 | Formulate winkler foundation model for elastic continum | Understand |
| CO4 | Calculate elastic medium for rectangular and circular plates | Apply |
| CO5 | Estimate the load distribution in pile. | Analyze |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Knowledge (Kn) | 10 | 10 | 10 |
| Apply (Ap) | 40 | 40 | 60 |
| Analyse (An) | 10 | 10 | 30 |
| Create (Cr) | 0 | 0 | 0 |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E31 -SOIL STRUCTURE INTERACTION** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Elective III** | | | | | | | | |
| **Semester** | **Hours / Week`** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Soil-Foundation Interaction**
Introduction to soil-foundation interaction problems – Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Elastic continuum, two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour. [9]

**Beam on Elastic Foundation- Soil Models**
Infinite beam, two parameters, Isotropic elastic half-space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. [9]

**Plate on Elastic Medium**
Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, Simple solutions. [9]

**Elastic Analysis of Pile**
Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in pile. [9]

**Laterally Loaded Pile**
Load deflection prediction for laterally loaded piles, Sub grade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions through influence charts. [9]

**Total Hours: 45**

**Text book (s) :**


| | |
|---|---|
| 1 | Selvadurai, A.P.S., “Elastic Analysis of Soil Foundation Interaction”, Elsevier, 2009 |
| 2 | Poulos, H.G., and Davis, E.H., “Pile Foundation Analysis and Design”, John Wiley, 2001 |


**Reference(s) :**


| | |
|---|---|
| 1 | Scott, R.F., “Foundation Analysis”, Prentice Hall, 2011 |
| 2 | Structure-Soil Interaction – State of Art Report”, Institution of Structural Engineers, 2018 |
| 3 | ACI 336, “Suggested Analysis and Design Procedures for combined footings and Mats”, American Concrete Institute, Delhi, 2011 |
| 4 | Prakash, S., and Sharma, H. D., “Pile Foundations in Engineering Practice.”John Wiley & Sons, New York, 1990. |


## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Soil-Foundation Interaction** | |
| 1.1 | Introduction to soil | 1 |
| 1.2 | foundation interaction problems | 1 |
| 1.3 | Soil behaviour, Foundation behaviour | 1 |
| 1.4 | Interface behaviour | 2 |
| 1.5 | Scope of soil foundation interaction analysis | 1 |
| 1.6 | Soil response models | 1 |

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| | | |
|---|---|---|
| 1.7 | Elastic continuum, two parameter elastic models | 1 |
| 1.8 | Elastic plastic behaviour | 1 |
| 1.9 | Time dependent behaviour | 1 |
| **2** | **Beam on Elastic Foundation- Soil Models** | |
| 2.1 | Infinite beam, | 1 |
| 2.2 | two parameters, | 2 |
| 2.3 | Isotropic elastic half-space, | 2 |
| 2.4 | Analysis of beams of finite length, | 1 |
| 2.5 | Classification of finite beams | 2 |
| 2.6 | Classification of finite beams in relation to their stiffness | 1 |
| 3 | **Plate on Elastic Medium** | |
| 3.1 | Infinite plate, Winkler | 1 |
| 3.2 | Two parameters | 1 |
| 3.3 | Isotropic elastic medium, | 1 |
| 3.4 | Thin and thick plates, | 1 |
| 3.5 | Analysis of finite plates, | 1 |
| 3.6 | rectangular and circular plates, | 1 |
| 3.7 | Numerical analysis of finite plates, Simple solutions | 1 |
| 3.8 | Simple solutions | 2 |
| **4** | **Elastic Analysis of Pile** | |
| 4.1 | Elastic analysis of single pile, | 2 |
| 4.2 | Theoretical solutions for settlement | 2 |
| 4.3 | Theoretical solutions for settlement and load distributions, | 2 |
| 4.4 | Analysis of pile group | 1 |
| 4.5 | Interaction analysis, | 1 |
| 4.6 | Load distribution in pile. | 1 |
| 5 | **Laterally Loaded Pile** | |
| 5.1 | Load deflection prediction for laterally loaded piles, | 2 |
| 5.2 | Sub grade reaction and | 2 |
| 5.3 | elastic analysis, | 1 |
| 5.4 | Interaction analysis, | 2 |
| 5.5 | Pile raft system, , | 1 |
| 5.6 | Solutions through influence charts | 1 |
| | | |
| | **Total** | **45** |

**Course Designers**

1. Dr.D.SIVAKUMAR - sivakumard@ksrct.ac.in

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **60PSE E32** | **DESIGN OF SHELL STRUCTURES** | **PE** | **3** | **0** | **0** | **3** |

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## Objective

- Classification of shells, membrane theory of shells, and design of folded plate structures
- Design philosophy of space frame, optimization techniques and structural theorems
- Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.
- To expose the students the principles of design of folded plates.
- Students will be introduced to general principles of design Philosophy and behaviour.

## Prerequisite

Fundamentals of Mathematics, knowledge of strength of materials and its mechanics and theory of elasticity and plasticity.

## Course Outcomes

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Analyze various types of shells and using membrane theory. | Evaluate |
| CO2 | Analyze various shapes of plates using various methods. | Evaluate |
| CO3 | Principles and design philosophy of space frames. | Evaluate |
| CO4 | Analyze and design space frames. | Evaluate |
| CO5 | Analyze various optimization structural members. | Apply |

## MappingwithProgrammeOutcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 3 | 1 | 1 |
| CO2 | 3 | 3 | 1 | 3 | 1 | 1 |
| CO3 | 3 | 3 | 1 | 3 | 1 | 1 |
| CO4 | 3 | 3 | 1 | 3 | 1 | 1 |
| CO5 | 3 | 3 | 1 | 3 | 1 | 1 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## AssessmentPattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E32 - DESIGN OF SHELL STRUCTURES | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Membrane Theory of Shells**<br>Classification of shells – Types of shells – Structural action – Membrane theory – Shells of revolution and shells of translation – Examples – Limitations of membrane theory. | **[09]** |
| **Design of Folded Plates**<br>Folded Plate structures – structural behaviour – Types – Design by ACI – ASCE Task Committee method. | **[09]** |
| **Space Frame - Design Philosophy**<br>Space frames – configuration – types of nodes – general principles of design Philosophy – Behaviour | **[09]** |
| **Analysis of Space Frames**<br>Analysis of space frames – Formex Algebra, Formian – Detailed design of Space frames | **[09]** |
| **Optimization**<br>Optimization by structural theorems – Maxwell, Mirchell and Heyman's Theorems for trusses and frames – Fully stressed design with deflection constraints – Genetic Algorithm. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | Timoshenko, S. and Krieger S.W. "Theory of Plates and Shells", McGraw Hill book company, New York,2003 |
| 2. | Reddy J.N " Theory and analysis of elastic plates and shells", McGraw Hill Book company, New York, 2006. |

**Reference(s):**

| | |
|---|---|
| 1. | Ramasamy, G.S., "Design and Construction of Concrete Shell Roofs", CBS Publishers, New Delhi, 1999. |
| 2. | Belegundu, A.D., "Optimization Concepts and Applications in Engineering ", Pearson Education, 2002. |
| 3. | Bangash M.Y.H, Bangash., T "Elements of Spatial Structures: Analysis and Design", Thomas Telford, 2003. |
| 4. | KokKeong Choong., "Recent Advances in Analysis, Design and Construction of Shell & Spatial Structures in the Asia-Pacific Region Kindle Edition", CRC Press; 1st edition 2019. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Membrane Theory of Shells** | |
| 1.1 | Shell surfaces | 1 |
| 1.2 | Classification of shell surfaces | 1 |
| 1.3 | Surfaces of revolution | 1 |
| 1.4 | ∆-forms of surfaces | 2 |
| 1.5 | Folded plates | 2 |
| 1.6 | Characteristics of shell surfaces. | 2 |
| **2** | **Design of Folded Plates** | |

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| | | |
|---|---|---|
| 2.1 | Surfaces and its related aspects | 1 |
| 2.2 | Curvatures of a surface | 1 |
| 2.3 | Curves and related aspects | 1 |
| 2.4 | Structural behaviour of shell | 1 |
| 2.5 | Stress-strain relationships | 1 |
| 2.6 | Equilibrium equations | 1 |
| 2.7 | Equilibrium equations for thin shell elements in membrane state | 1 |
| 2.8 | Curvilinear coordinate system | 1 |
| 2.9 | Shells of revolution | 1 |
| **3** | **Space Frame - Design Philosophy** | |
| 3.1 | Analysis of shells | 2 |
| 3.2 | Membrane analysis | 2 |
| 3.3 | Axisymmetric loading | 1 |
| 3.4 | Concentrated load – Self weight | 1 |
| 3.5 | Uniform loading – Pressure loading | 1 |
| 3.6 | Hydrostatic loading | 1 |
| 3.7 | Non-axisymmetric loading – Wind load | 1 |
| **4** | **Analysis of Space Frames** | |
| 4.1 | Spherical domes under concentrated load and under self-weight | 2 |
| 4.2 | Bending analysis | 1 |
| 4.3 | Axisymmetric case – Equilibrium equations for thin shells of revolution in bending | 1 |
| 4.4 | Equilibrium equations in orthogonal curvilinear coordinate system | 1 |
| 4.5 | Bending equation of spherical lattice domes | 1 |
| 4.6 | Cylindrical shells – Equilibrium equations – DKJ theory | 1 |
| 4.8 | Cylindrical shells – Equilibrium equations – Jenkin's theory | 1 |
| **5** | **Optimization** | |
| 5.1 | Beam method of analysis | 2 |
| 5.2 | Merits and demerits – Case studies for simply supported cylindrical shells – without and with edge beams | 1 |
| 5.3 | Design of shells based on membrane theory - Shells having semicircular directrix | 1 |
| 5.4 | Design of shells based on membrane theory - Shells with circular directrix | 1 |
| 5.5 | Design of shells based on beam theory | 1 |
| 5.6 | Design aspects of paraboloid, hyperboloid and hyperbolic paraboloid shells | 1 |
| 5.7 | Analysis and structural behaviour of folded plates and its various types | 1 |
| 5.8 | Design of folded plates by ACI-ASCE Task Committee method | 1 |
| | **Total** | **45** |

## Course Designers

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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| 60PSE E33 | OFF SHORE STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To understand the demand for coastal and offshore structures, overview of different types of ocean structures.
- To get exposed to structural geometry, analysis methods, design techniques, construction practice, different types of material, guidelines associated with selection of materials for marine environment.
- To learn various types of structural systems/forms, brief overview of various environmental loads.
- To be familiar with the problems associated with the material behavior in marine environment and various protection methods.
- To understand the inspection and testing methods, repair and rehabilitation processes.

**Prerequisite**

Fundamentals of Mathematics, knowledge of Mechanics of Materials, Statics, Concrete Technology and Concrete Design

**CourseOutcomes**

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Understand the functions and behaviour of offshore structures | Understand |
| CO2 | Identify the different types of loads acting on the structures | Understand |
| CO3 | Understand the behaviour of waves and its effects on structures | Understand |
| CO4 | Evaluate the behaviour of structures for its dynamic loads | Evaluate |
| CO5 | Design of offshore structures with failure probability | Create |

**MappingwithProgrammeOutcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | | 2 | 2 |
| CO2 | 2 | 2 | 3 | | 2 | 2 |
| CO3 | 1 | 2 | 1 | 3 | 2 | |
| CO4 | 2 | 2 | 3 | 3 | 2 | 2 |
| CO5 | 2 | 2 | 3 | 2 | 3 | |
| 3- Strong;2-Medium;1-Some | | | | | | |
| | | | | | | |

**AssessmentPattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E33 -OFF SHORE STRUCTURES | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **WAVE THEORIES**<br>Wave generation process, small, finite amplitude and nonlinear wave theories. | **[09]** |
| **FORCES OF OFFSHORE STRUCTURES**<br>Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation. | **[09]** |
| **OFFSHORE SOIL AND STRUCTURE MODELLING**<br>Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling. | **[09]** |
| **ANALYSIS OF OFFSHORE STRUCTURES**<br>Static method of analysis, foundation analysis and dynamics of offshore structures. | **[09]** |
| **DESIGN OF OFFSHORE STRUCTURES**<br>Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. Reddy. D. V and Swamidas A. S. J., Essential of Offshore Structures, CRC Press, 2013**.**
2. Chakrabarti. S.K, "Hydrodynamics of Offshore Structures", Computational mechanics Publications, 1987.


**Reference(s):**


1. API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design – API Publishing Services, 2005
2. James F. Wilson, Dynamics of Offshore Structures, John Wiley and Sons, Inc, 2003.
3. Reddy, D. V. and Arockiasamy, M., Offshore Structures, Vol. 1 and Vol. 2, Krieger Publishing Company,1991..
4. Turgut Sarpkaya, Wave Forces on Offshore Structures, Cambridge University Press, 2010.


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **WAVE THEORIES** | |
| 1.1 | Types of offshore structures and conceptual development | 1 |
| 1.2 | Analytical models for jacket structures | 1 |
| 1.3 | Materials and their behaviour under static and dynamic loads | 1 |
| 1.4 | Statutory regulations | 2 |
| 1.5 | Allowable stresses | 2 |
| 1.6 | Various design methods and Code Provisions | 2 |
| **2** | **FORCES OF OFFSHORE STRUCTURES** | |
| 2.1 | Design specification of API, DNV, Lloyd's and other classification societies | 1 |

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| | | |
|---|---|---|
| 2.2 | Construction of jacket and gravity platforms 28101 Module II Loads on offshore structures | 1 |
| 2.3 | Environmental loads due to wind, wave, current and buoyancy | 1 |
| 2.4 | Morison's Equation | 1 |
| 2.5 | Maximum wave force on offshore structure | 1 |
| 2.6 | Concept of Return waves | 1 |
| 2.7 | Principles of Static and dynamic analyses of fixed platforms | 1 |
| 2.8 | Use of approximate methods | 1 |
| 2.9 | Design of structural elements | 1 |
| 3 | **OFFSHORE SOIL AND STRUCTURE MODELLING** | |
| 3.1 | Introduction to tubular joints | 2 |
| 3.2 | Possible modes of failure | 2 |
| 3.3 | Eccentric connections and offset connections | 1 |
| 3.4 | Cylindrical and rectangular structural members | 1 |
| 3.5 | In plane and multi plane connections | 1 |
| 3.6 | Parameters of in-plane tubular joints | 1 |
| 3.7 | Kuang's formulae | 1 |
| **4** | **ANALYSIS OF OFFSHORE STRUCTURES** | |
| 4.1 | Elastic stress distribution | 2 |
| 4.2 | Punching shear Stress | 2 |
| 4.3 | Overlapping braces | 1 |
| 4.4 | Stress concentration | 1 |
| 4.5 | Chord collapse and ring stiffener spacing | 1 |
| 4.6 | Stiffened tubes | 1 |
| 4.7 | External hydrostatic pressure | 1 |
| **5** | **DESIGN OF OFFSHORE STRUCTURES** | |
| 5.1 | Fatigue of tubular joints | 2 |
| 5.2 | Fatigue behaviour | 1 |
| 5.3 | Palmgren-Miner cumulative damage rule | 1 |
| 5.4 | Blast walls; Platform survival capacity and Plastic design methods. | 1 |
| 5.5 | Blast Mitigation | 1 |
| 5.6 | Design of structures for high temperature | 1 |
| 5.7 | Fire Rating for Hydrocarbon fire | 1 |
| 5.8 | Behavior of steel at elevated temperature | 1 |
| | **Total** | **45** |

## Course Designers

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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| 60PSE E34 | EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To learn the basics in measurements, strain gauge types, and applications
- To understand various devices for vibration measurement
- To acquire knowledge in data acquisition systems
- To learn photo elasticity and its applications
- To performnondestructive testing methods in structures

**Prerequisite**

Courses - Engineering Mathematics and Basic Science

**CourseOutcomes**

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Demonstrate the strain measuring equipment | Remember/ Understand/ Analyse/Apply |
| CO2 | Understand various vibration measuring equipment | Remember/ Understand/ Analyse/Apply |
| CO3 | Choose various data indicating and recording instrument. | Remember/ Understand/ Analyse/Apply |
| CO4 | Outline the concept of photoelasticity | Remember/ Understand/ Analyse/Apply |
| CO5 | Apply suitable non-destructive testing methods. | Remember/ Understand/ Analyse/Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 2 | 2 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember(Re) | 10 | 05 | 15 |
| Understand(Un) | 10 | 15 | 15 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E34 -EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION | | | | | | | | |
| M.E - STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Force and Strain Measurements**<br>Basic Concept – Measurements of displacement, strain pressure, force, torque etc, Strain gauges (Mechanical, Electrical, Acoustical etc) – Strain gauge circuits – potentiometer and wheat stone bridge – Rosette analysis. Hydraulic Jack, Load cell and Proving Ring. | **[11]** |
| **Vibration Measurements**<br>Linear Variable Differential Transducers (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs. | **[07]** |
| **Data Acquisition Systems**<br>Indicating and recording devices – Static and dynamic data recording –Data acquisition and processing systems – Cathode Ray Oscilloscope – XY Plotter – Chart plotters – Digital data acquisition systems. | **[09]** |
| **Photoelasticity**<br>Photoelasticity – Optics of photoelasticity – Polariscope – Isoclinics and Isochromatics– Methods of stress separation | **[07]** |
| **Non Destructive Testing Methods**<br>Ultrasonic testing principles and application – Rebound Hammer – Holography – Use of laser for structural testing – Advanced NDT methods – Ultrasonic pulse echo, impact echo, impulse radar techniques, GECOR, Ground penetrating radar (GPR). | **[11]** |
| **TotalHours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi,1996 |
| 2. | Dally J W and Riley W.F, “Experimental stress Analysis”, McGraw-Hill, Inc. NewYork, 1991 |

**Reference(s):**

| | |
|---|---|
| 1. | Rangan C S., ”Instrumentation – Devices and Systems”, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1997 |
| 2. | Sirohi. R.S.,Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997 |
| 3. | Charles J Hellier, Handbook of Nondestructive Evaluation, Second Edition, Mc graw Hill Education,2012 |
| 4. | Ravisankar.K. and Chellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures” SERC, Chennai, 2007. |

**CourseContentsandLectureSchedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Force and Strain Measurements** | |
| 1.1 | Introduction to force and strain measurements | 1 |
| 1.2 | Explanation of displacement , strain pressure, force & torque | 1 |
| 1.3 | Various strain gauges – Mechanical Strain gauges - Principle & Working | 1 |
| 1.4 | Electrical Strain gauges - Principle & Working | 1 |
| 1.5 | Acoustical Strain gauges - Principle & Working | 1 |
| 1.6 | Working of potentiometer | 1 |
| 1.7 | Working of Wheat stone bridge | 1 |

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| | | |
|---|---|---|
| 1.8 | Rosette analysis concepts and formulas | 1 |
| 1.9 | Rosette analysis problems | 2 |
| 1.10 | Use of Hydraulic jack, load cell and proving ring | 1 |
| **2** | **Vibration Measurements** | |
| 2.1 | Introduction to transducers | 1 |
| 2.2 | Linear Variable Differential Transducers – Operation and use | 1 |
| 2.3 | Transducers for velocity measurements | 1 |
| 2.4 | Transducers for acceleration measurements | 1 |
| 2.5 | Vibration meter – Principle and working | 1 |
| 2.6 | Working principle of Seismographs | 1 |
| 2.7 | Seismogram and its inference | 1 |
| **3** | **Data Acquisition Systems** | |
| 3.1 | Introduction to data acquisition systems | 1 |
| 3.2 | Static data recording devices | 2 |
| 3.3 | Dynamic data recording devices | 1 |
| 3.4 | Data acquisition and processing systems | 1 |
| 3.5 | Cathode Ray Oscilloscope – Operation and use | 1 |
| 3.6 | XY Plotter – Principle & Construction | 1 |
| 3.7 | Chart plotter | 1 |
| 3.8 | Digital data acquisition systems | 1 |
| **4** | **Photoelasticity** | |
| 4.1 | Introduction to photoelasticity& Principles | 1 |
| 4.2 | Optics of photoelasticity | 1 |
| 4.3 | Plane Polariscope – Working principle | 1 |
| 4.4 | Circular Polariscope – Working principle | 1 |
| 4.5 | Isoclinics and isochromatics – Properties & importance | 1 |
| 4.6 | Methods of stress seperation | 2 |
| **5** | **Non Destructive Testing Methods** | |
| 5.1 | Introduction to NDT and its scope | 1 |
| 5.2 | Ultrasonic testing principles and application | 1 |
| 5.3 | Rebound hammer – Working Principle | 1 |
| 5.4 | Holography& its uses | 1 |
| 5.5 | Use of laser for structural testing | 1 |
| 5.6 | Advanced NDT methods- Ultrasonic pulse echo method | 2 |
| 5.7 | Impact echo method | 1 |
| 5.8 | Impulse radar techniques | 1 |
| 5.9 | GECOR | 1 |
| 5.10 | Ground penetrating radar (GPR). | 1 |
| | **Total** | **45** |

## Course Designer

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**R1/ w.e.f. 12.07.2023**
Passed in BoS Meeting held on 19.05.2023
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| 60PSE E35 | MATRIX METHOD OF STRUCTURAL ANALYSIS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To learn the basic concepts of structural analysis.
- To know about the matrix analysis of structures by using flexibility method.
- To understand about the matrix analysis of structures by using stiffness method.
- To learn about matrix analysis of axial elements.
- To learn about matrix analysis of beams and frames

**Prerequisite**

**Fundamentals of Mathematics, knowledge of basic Science**

**CourseOutcomes**

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Understand the concepts of energy theorems | Remember, Understand, Apply |
| CO2 | Formulation of stiffness and flexibility matrix for various co-ordinates | Remember, Understand, Analyze |
| CO3 | To solve the beam using stiffness and flexibility methods | Remember, Understand, Apply, Analyze |
| CO4 | To solve the frame using stiffness and flexibility methods | Analyze |
| CO5 | To understand the concepts of solving the truss using stiffness and flexibility methods | Understand and Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 1 |
| CO5 | 2 | 3 | 2 | 3 | 2 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**AssessmentPattern**

| Bloom'sCategory | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 20 | 10 | 30 |
| Analyse | 20 | 30 | 50 |
| Evaluate | - | - | - |
| Create | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E35 -MATRIX METHOD OF STRUCTURAL ANALYSIS | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| II | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Concepts In Structural Analysis**

Structure-Loads-Response-Equilibrium of Force-Compatibility of Displacements-Force- Displacement relation-Levels of structural analysis-Energy methods-Energy concepts based on displacement and force field. [9]

**Matrix Concepts and Matrix Analysis of Structures**

Matrix-matrix operations-linear simultaneous equations-Eigen values and Eigen vectors-coordinate systems-transformation matrix-stiffness and flexibility matrix-Equivalent joint loads-stiffness and flexibility methods. [9]

**Matrix Analysis of Structures With Axial Elements**

Introduction-axial stiffness and flexibility matrix-analysis by conventional stiffness method for axial element (2 DOF)-analysis by flexibility method. Analysis by conventional stiffness method for plane truss element (4 DOF) - analysis by flexibility method. [9]

**Matrix Analysis of Beams**

Conventional stiffness method for beams-beams element stiffness (4 DOF)-generation of stiffness matrix for continuous beams-Flexibility method for continuous beams-force transformation matrix-element flexibility matrix-analysis procedure. [9]

**Matrix Analysis of Plane Frames**

Conventional stiffness method for plane frame-element stiffness matrix(6DOF)-generation of structural stiffness matrix and analysis procedure-flexibility method for plane frames-force transformation matrix-element flexibility matrix and analysis procedure. [9]

**Total Hours: 45**

**Text book (s) :**


| | |
|---|---|
| 1 | Devados Menon, “Advanced Structural Analysis”, Narosa Publishing House,New Delhi,2010. |
| 2 | Vaidyanadhan.R and Perumal.P, “Comprehensive structural Analysis – Vol.1 & Vol2”, Laxmi Publications, New Delhi, 2016. |


**Reference(s) :**


| | |
|---|---|
| 1 | Madhujit Mukhopadhyay,Abdul Hamid Sheikh,”Matrix and Finite Element Analyses of Structures”, .Ane books India,2009. |
| 2 | Rajesekaran S. and Sankara Subramanian G. “Computational Structural Mechanics”, Prentice Hall of India Pvt Ltd, New Delhi, 2011. |
| 3 | Manickaselvam M.K.,” Elements of Matrix And Stability Analysis of Structures”, Khanna Publishers, New Delhi,2004. |
| 4 | T.S.Thandavamoorthy “Structural Analysis” Oxford University Press, New Delhi, 2011. |


**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Concepts In Structural Analysis** | |
| 1.1 | Introduction – Forces and Displacement Measurements | 1 |
| 1.2 | Equilibrium of Force | 1 |
| 1.3 | Compatibility of Displacements | 1 |
| 1.4 | Types of Structures, load and response | 1 |
| 1.5 | Force- Displacement relation | 1 |
| 1.6 | Levels of structural analysis | 1 |

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| | | |
|---|---|---|
| 1.7 | Energy methods | 1 |
| 1.8 | Energy concepts based on displacement field | 1 |
| 1.9 | Energy concepts based on force field | 1 |
| **2** | **Matrix Concepts and Matrix Analysis of Structures** | |
| 2.1 | Matrix Operations | 1 |
| 2.2 | Linear Simultaneous Equations | 1 |
| 2.3 | Eigen values | 1 |
| 2.4 | Eigen vectors | 1 |
| 2.5 | Coordinate Systems | 1 |
| 2.6 | Transformation Matrix | 1 |
| 2.7 | Stiffness And Flexibility Matrix | 1 |
| 2.8 | Equivalent joint loads | 1 |
| 2.9 | Stiffness And Flexibility Methods simple problems | 1 |
| 3 | **Matrix Analysis of Structures With Axial Elements** | |
| 3.1 | Introduction on axial elements | 1 |
| 3.2 | Axial Stiffness and Flexibility Matrix | 1 |
| 3.3 | Analysis By Conventional Stiffness Method For Axial Element (2 DOF) | 2 |
| 3.4 | Analysis By Flexibility Method | 2 |
| 3.5 | Analysis by conventional stiffness method for plane truss element (4 DOF) | 2 |
| 3.6 | Analysis By Flexibility Method | 1 |
| **4** | **Matrix Analysis of Beams** | |
| 4.1 | Conventional stiffness method for beams | 1 |
| 4.2 | Beams element stiffness (4 DOF) | 1 |
| 4.3 | Generation of stiffness matrix for continuous beams | 1 |
| 4.4 | Flexibility method for continuous beams | 1 |
| 4.5 | Force Transformation Matrix | 1 |
| 4.6 | Element Flexibility Matrix | 1 |
| 4.8 | Analysis for the flexibility matrix | 1 |
| 4.9 | Problems in Flexibility matrix | 1 |
| 5 | **Matrix Analysis of Plane Frames** | |
| 5.1 | Conventional stiffness method for plane frame | 1 |
| 5.2 | Element stiffness matrix(6DOF) | 1 |
| 5.3 | Generation of structural stiffness matrix | 1 |
| 5.4 | Analysis Procedure for structural stiffness matrix | 2 |
| 5.5 | Flexibility method for plane frames | 2 |
| 5.6 | Force transformation matrix | 1 |
| 5.7 | Element flexibility matrix and analysis procedure | 1 |
| | **Total** | **45** |

## Course Designers

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| 60PSE E36 | SECONDARY TREATMENT OF WASTEWATER | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- Process analysis and kinetics of secondary treatment
- To understand the process kinetics
- Suspended and attached growth treatment of wastewater
- To study the digestion process
- To find the attached growth treatment process.

**Prerequisite**

**Fundamentals of Mathematics, knowledge of properties of construction materials and its mechanics and concrete technology.**

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Identify the biological treatment process and analysis | Create |
| CO2 | Evaluate the bio kinetic coefficients | Apply |
| CO3 | Recognize the common physical, chemical and biological unit operations encountered in treatment process | Understand |
| CO4 | Characterize the treatment process | Understand |
| CO5 | Formulate the application of the attached growth treatment process. | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 3 | | 1 | 3 |
| CO2 | 1 | 1 | 3 | | 1 | 3 |
| CO3 | 1 | 2 | 3 | 2 | 1 | 3 |
| CO4 | 1 | 2 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 3 | 1 | 2 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**AssessmentPattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End Sem. Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E36- SECONDARY TREATMENT OF WASTEWATER** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Elective III** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **II** | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Objective(s)** | • Process analysis and kinetics of secondary treatment<br>• To understand the process kinetics<br>• Suspended and attached growth treatment of wastewater<br>• To study the digestion process<br>• To find the attached growth treatment process. |
| **Course Outcomes** | **At the end of the course, the students will be able to**<br>1. Identify the biological treatment process and analysis<br>2. Evaluate the biokinetic coefficients<br>3. Recognize the common physical, chemical and biological unit operations encountered in treatment process<br>4. Characterize the treatment process<br>5. Formulate the application of the attached growth treatment process |

**Note:** The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

**Introduction, Process Analysis and Selection**

Biological treatment processes – objectives - Choice of treatment method – Environmental impact and other considerations in planning the treatment – Cost of Wastewater treatment – Reactors used for the treatment – mass balance analysis – Reactions, Reaction rates – Enzyme reaction. Modeling of ideal flow and non ideal flow reactors – Reactors in parallel – Reactors in series – Tracer tests – Estimation of dispersion coefficient. [9]

**Fundamentals of Process Kinetics**

Role of microorganisms – Microbial growth kinetics - Biological oxidation process - loading – MCRT - F/ M ratio - Determination of biokinetic coefficients – Modelling of suspended growth treatment process – Description, Design and operating parameters – Modelling of plug flow reactors. [9]

**Suspended Growth Treatment Process - Activated Sludge Process and Ponds**

Treatment Process Loading – Biological & solids retention time – F/M ratio – Determination of Bio-kinetic constants – application of kinetics to Biological Treatment - Suspended Growth Treatment Process – Modelling of Suspended Growth Treatment Process – CFSTR – PFR - Design of Activated Sludge Process – Modifications (only theory) – Oxidation pond – Aerated lagoons – Oxygen requirements – arrangement for transfer of oxygen – Secondary clarifier - design features.

Stabilization ponds – Classification – Application – Process design, flow pattern and analysis of Aerobic ponds – Facultative ponds – Anaerobic ponds – maturation ponds – Construction and performance. [9]

**Suspended Growth Treatment Process - Digestion Process**

Sludge Digestion – Sources of sludge – Characteristics – Quantities – Anaerobic digestion – Process – Kinetic relationship – gas production – design considerations. Anaerobic treatment of liquid wastes – Anaerobic sludge blanket process – design considerations. Aerobic Digestion – Kinetics – Oxygen requirements – Design considerations [9]

**Attached Growth Treatment Process**

Attached Growth Treatment Process – Substrate Removal in Attached Growth Treatment Process - Trickling Filter – Process – Classification - design based on popular design equations – NRC, Rankine's and Eckenfelder equation - Rotating Biological contactors – Anaerobic attached growth treatment processes – up flow packed bed – up flow expanded bed – Fluidized bed – Down flow bed. (Only theory) [9]

**Total Hours: 45**

**Text book :**


| | |
|---|---|
| **1** | Garg, S.K., "Environmental Engineering" Vol. II, Khanna Publishers, New Delhi, 2003. |


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| | |
|---|---|
| **2** | Karia G L & Christian R A, “Wastewater Treatment”, Prentice Hall of India, New Delhi, 2013. |
| **Reference(s) :** | |
| 1 | Metcalf and Eddy, “Waste Water Engineering – Treatment and reuse”, Tata McGraw-Hill, New Delhi, 2003. |
| 2 | Arceivala S. J., “Waste Water Treatment and disposal, Marceldekker publishers, 1981. |
| 3 | Larry D. Benefield and Clifford W. Randall, “Biological process design for Wastewater Treatment”, 1980. |
| 4 | Howard S. Peavy, Donald R. Rowe and George Techobanoglous, “Environmental Engineering”, McGraw – Hill co., 1987. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction, Process Analysis and Selection** | |
| 1.1 | Biological treatment processes | 1 |
| 1.2 | Choice of treatment method | 1 |
| 1.3 | Environmental impact and other considerations in planning the treatment | 1 |
| 1.4 | Cost of Wastewater treatment | 2 |
| 1.5 | Reactors used for the treatment | 2 |
| 1.6 | Estimation of dispersion coefficient. | 2 |
| **2** | **Fundamentals of Process Kinetics** | |
| 2.1 | Role of microorganisms | 1 |
| 2.2 | Microbial growth kinetics | 1 |
| 2.3 | Biological oxidation process | 2 |
| 2.4 | Determination of biokinetic coefficients | 1 |
| 2.5 | Modelling of suspended growth treatment process | 1 |
| 2.6 | Design and operating parameters | 1 |
| 2.7 | Modelling of plug flow reactors. | 1 |
| 2.8 | Biological & solids retention time | 1 |
| 2.9 | Determination of Bio-kinetic constants | 1 |
| 2.10 | Determination of Bio-kinetic constants | 1 |
| **3** | **Suspended Growth Treatment Process - Activated Sludge Process and Ponds** | |
| 3.1 | Suspended Growth Treatment Process | 2 |
| 3.2 | Modelling of Suspended Growth Treatment Process | 2 |
| 3.3 | Design of Activated Sludge Process | 1 |
| 3.4 | Oxidation pond | 1 |
| 3.5 | Oxygen requirements | 1 |
| 3.6 | Arrangement For Transfer Of Oxygen | 1 |
| 3.7 | Secondary clarifier | 1 |
| **4** | **Suspended Growth Treatment Process - Digestion Process** | |
| 4.1 | Sludge Digestion | 2 |
| 4.2 | Sources of sludge | 1 |

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| | | |
|---|---|---|
| 4.3 | Anaerobic digestion | 1 |
| 4.4 | Kinetic relationship | 1 |
| 4.5 | Anaerobic treatment of liquid wastes | 1 |
| 4.6 | Anaerobic sludge blanket process | 1 |
| 4.8 | Design considerations. Aerobic Digestion | 1 |
| **5** | **Attached Growth Treatment Process** | |
| 5.1 | Attached Growth Treatment Process | 2 |
| 5.2 | Substrate Removal in Attached Growth Treatment Process | 1 |
| 5.3 | Trickling Filter | 1 |
| 5.4 | Design based on popular design equations | 1 |
| 5.5 | NRC, Rankine's and Eckenfelder equation | 1 |
| 5.6 | Rotating Biological contactors | 1 |
| 5.7 | Anaerobic attached growth treatment processes | 1 |
| 5.8 | Up flow packed bed | 1 |
| | **Total** | **45** |

## CourseDesigners

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| 60PSE E37 | INDUSTRIAL WASTEWATER POLLUTION - PREVENTION AND CONTROL | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To know the industrial wastewater and laws
- To identify techniques and approaches for minimizing the generation.
- To find the treatment of physio chemical and biological treatment methods.
- To identify an Application of physio chemical and biological treatment methods for recovery, reuse and disposal.
- To know the supported with case studies under Indian situations.

## Prerequisite

Fundamentals of Mathematics, knowledge of properties of construction materials and its mechanics and concrete technology.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss about the source and environmental impact of industrial waste water | Create |
| CO2 | Able to develop the methods for prevention and control of industrial pollution | Apply |
| CO3 | Formulate the various methods for industrial waste water treatment | Understand |
| CO4 | Know about the design of effluent treatment plant | Understand |
| CO5 | Identify the various case studies associated in industrial wastewater treatment | Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 1 | | 2 | 3 |
| CO2 | 1 | 1 | 2 | | 2 | 3 |
| CO3 | 2 | 2 | 2 | 2 | 1 | 3 |
| CO4 | 2 | 2 | 1 | 2 | 3 | 3 |
| CO5 | 1 | 2 | 1 | 1 | 3 | 3 |

## Assessment Pattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End Sem. Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E37- INDUSTRIAL WASTEWATER POLLUTION - PREVENTION AND CONTROL** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Elective III** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **II** | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Objective(s)** | • To know the industrial wastewater and laws<br>• To identify techniques and approaches for minimizing the generation .<br>• To find the treatment of physio chemical and biological treatment methods.<br>• To identify an Application of physio chemical and biological treatment methods for recovery, reuse and disposal.<br>• To know the supported with case studies under Indian situations. |
| **Course Outcomes** | **At the end of the course, the students will be able to**<br>1. Discuss about the source and environmental impact of industrial waste water<br>2. Able to develop the methods for prevention and control of industrial pollution<br>3. Formulate the various methods for industrial waste water treatment<br>4. Know about the design of effluent treatment plant<br>5. Identify the various case studies associated in industrial wastewater treatment |

**Note:** The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

**Introduction**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management [9]

**Industrial Pollution Prevention**

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Pollution Prevention of Assessment - Material balance - Evaluation of Pollution prevention options –Cost benefit analysis – payback period - Waste minimization Circles [9]

**Industrial Wastewater Treatment**

Equalisation - Neutralisation – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – carbon adsorption - Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.- Treatability studies. [9]

**Wastewater Reuse And Residual Management**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects. [9]

**Case Studies**

Attached Growth Treatment Process – Substrate Removal in Attached Growth Treatment Process - Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries [9]

**Total Hours: 45**

**Text book :**


| | |
|---|---|
| 1 | Bishop.P, "Pollution Prevention: Fundamentals and Practice", McGraw Hill International Edn. McGraw Hill Book Co., Singapore, 2000. |
| 2 | James. G. Mann and Liu.Y.A, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 1999 |


**Reference(s) :**


| | |
|---|---|
| 1 | Eckenfelder, W.W., 'Industrial Water Pollution Control', Mc-Graw Hill, 2000. |
| 2 | Nelson Leonard Nemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007 |
| 3 | Frank Woodard, "Industrial waste treatment Handbook", Butterworth Heinemann, New Delhi, 2001. |
| 4 | Paul L. Bishop, "Pollution Prevention: - Fundamentals and Practice', Mc-Graw Hill International, Boston, 2000. |



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**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Industrial scenario in India | 1 |
| 1.2 | Industrial activity and Environment | 1 |
| 1.3 | Uses of Water by industry | 1 |
| 1.4 | Sources and types of industrial wastewater | 2 |
| 1.5 | Nature and Origin of Pollutants | 2 |
| 1.6 | Toxicity of industrial effluents and Bioassay tests | 2 |
| **2** | **Industrial Pollution Prevention** | |
| 2.1 | Prevention and Control of Industrial Pollution | 1 |
| 2.2 | Benefits and Barriers | 1 |
| 2.3 | Waste management Hierarchy | 2 |
| 2.4 | Source reduction techniques | 1 |
| 2.5 | Pollution Prevention of Assessment | 1 |
| 2.6 | Material balance | 1 |
| 2.7 | Evaluation of Pollution prevention options | 1 |
| 2.8 | Cost benefit analysis | 1 |
| 2.9 | Payback period | 1 |
| 2.10 | Waste minimization Circles | 1 |
| **3** | **Industrial Wastewater Treatment** | |
| 3.1 | Aerobic and anaerobic biological treatment | 2 |
| 3.2 | carbon adsorption | 2 |
| 3.3 | Wet Air Oxidation | 1 |
| 3.4 | Ion Exchange | 1 |
| 3.5 | Oxygen requirements | 1 |
| 3.6 | Membrane Technologies | 1 |
| 3.7 | Treatability studies. | 1 |
| **4** | **Wastewater Reuse And Residual Management** | |
| 4.1 | Joint treatment of industrial and domestic wastewater | 2 |
| 4.2 | Industrial reuse , Present status and issues | 1 |
| 4.3 | Disposal on water and land | 1 |
| 4.4 | Residuals of industrial wastewater treatment | 1 |
| 4.5 | Quantification and characteristics of Sludge | 1 |
| 4.6 | Thickening, digestion, conditioning, dewatering and disposal of sludge | 1 |
| 4.8 | Management of RO rejects. | 1 |
| **5** | **Case Studies** | |
| 5.1 | Attached Growth Treatment Process | 2 |
| 5.2 | Substrate Removal in Attached Growth Treatment Process | 1 |

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| | | |
|---|---|---|
| 5.3 | Industrial manufacturing process description | 1 |
| 5.4 | wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles | 1 |
| 5.5 | Tanneries | 1 |
| 5.6 | Pulp and paper | 1 |
| 5.7 | Metal finishing | 1 |
| 5.8 | Sugar and Distilleries | 1 |
| | **Total** | **45** |

## CourseDesigners

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **60PSE E41** | **CADD for Structures** | **PE** | **3** | **0** | **0** | **3** |

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**Objective**

- To gain knowledge on Computer graphics and drafting software packages
- To analyze the structure using computer methods
- To acquire knowledge on computer aided designing and detailing
- To know Project scheduling using CPM and PERT
- To learn theartificial intelligence systems

**Prerequisite**

Courses –Structural Analysis, RCC and Steel Design

**CourseOutcomes**

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Choose software packages for 2D drafting | Remember/ Understand/ Analyse/Apply |
| CO2 | Perform structural analysis using software | Remember/ Understand/ Analyse/Apply |
| CO3 | Design the structures with computer methodologies | Remember/ Understand/ Analyse/Apply |
| CO4 | Optimize the structural design with the help of software | Remember/ Understand/ Analyse/Apply |
| CO5 | Apply artificial intelligence in construction industry | Remember/ Understand/ Analyse/Apply |

**MappingwithProgrammeOutcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**AssessmentPattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember(Re) | 05 | 10 | 10 |
| Understand(Un) | 05 | 10 | 20 |
| Apply (Ap) | 30 | 20 | 40 |
| Analyse (An) | 20 | 20 | 30 |
| Create (Cr) | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E41 - CADD FOR STRUCTURES | | | | | | | | |
| M.E STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Computer Graphics**<br>Graphic primitives - Transformations - Basics of 2D drafting - Modeling of curves and surfaces – Solid modeling - Graphic standards - Drafting software packages and usage | **[09]** |
| **Structural Analysis**<br>Computer methods of structural analysis - Finite Element programming – Analysis through application packages | **[09]** |
| **Structural Design**<br>Computer aided design of steel and RC Structural elements - Detailed drawing – Bill of materials | **[09]** |
| **Optimization**<br>Linear programming - Simplex algorithm - Post-optimality analysis – Project scheduling - CPM and PERT applications Genetic algorithm and applications | **[09]** |
| **Artificial Intelligence**<br>Introduction - Heuristic search - knowledge based expert systems - Architecture and applications of KBES - Expert system shells - Principles of neural network. | **[09]** |
| **TotalHours** | **45** |

| **Textbook(s):** | |
|---|---|
| 1. | Unnikrishna Pillai S, Devdas Menon, “Reinforced Concrete Design”, McGraw-Hill Education, India, New Delhi, 2021 |
| 2. | Punmia B C and Jain,A.K, “Comprehensive Design of Steel Structures”, Laxmi Publications, 2017 |
| **Reference(s):** | |
| 1. | Devdas Menon, Advanced Structural Analysis, Narosa publications, New Delhi, 2019 |
| 2. | Peter W, Christensen, Anders Klarbring “An Introduction to Structural Optimisation”, Springer 2009. |
| 3. | Meghre A S and Kadam K M, Finite Element Method in Structural Analysis, Khanna Publishers, New Delhi, 2014 |
| 4. | KavehA, “Applications of Metaheuristic Optimization Algorithms in Civil Engineering”, Springer, 2017 |

**CourseContentsandLectureSchedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Computer Graphics** | |
| 1.1 | Introduction to computer graphics | 1 |
| 1.2 | Graphic primitives | 1 |
| 1.3 | Transformations | 1 |
| 1.4 | Basics of 2D drafting | 1 |
| 1.5 | Modeling of curves and surfaces | 1 |
| 1.6 | Solid modeling | 1 |
| 1.7 | Graphic standards | 1 |
| 1.8 | Drafting software packages and usage | 2 |

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| | | |
|---|---|---|
| **2** | **Structural Analysis** | |
| 2.1 | Fundamentals of Structural Analysis | 1 |
| 2.2 | Computer methods of structural analysis | 1 |
| 2.3 | Various software used for Analysis | 2 |
| 2.4 | FEM technique | 1 |
| 2.5 | Finite Element programming | 2 |
| 2.6 | Analysis through application packages | 2 |
| **3** | **Structural Design** | |
| 3.1 | Fundamentals of RCC and Steel design | 1 |
| 3.2 | Codal Provisions | 1 |
| 3.3 | Computer aided design of steel structures | 2 |
| 3.4 | Computer aided design of RCC structures | 2 |
| 3.5 | Reinforcement detailing | 1 |
| 3.6 | Structural Steel detailing | 1 |
| 3.7 | Bill of materials | 1 |
| **4** | **Optimization** | |
| 4.1 | Linear programming | 2 |
| 4.2 | Simplex algorithm | 1 |
| 4.3 | Post optimality analysis | 1 |
| 4.4 | Project scheduling | 1 |
| 4.5 | CPM technique | 1 |
| 4.6 | PERT technique | 1 |
| 4.7 | Genetic algorithm and applications | 2 |
| **5** | **Artificial Intelligence** | |
| 5.1 | Introduction to Artificial intelligence | 1 |
| 5.2 | Heuristic search | 1 |
| 5.3 | Knowledge based expert systems | 2 |
| 5.4 | Architecture and applications of KBES | 2 |
| 5.5 | Expert system shells | 1 |
| 5.6 | Principles of neural network | 2 |
| | **Total** | **45** |

## CourseDesigner

1. Mr.K.ANGU SENTHIL - angusenthil@ksrct.ac.in

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| 60PSE E42 | DESIGN OF INDUSTRIAL STRUCTURE | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- Design of Steel Gantry Girders.
- Design of Steel Portal, Gable Frames.
- Design of Steel Bunkers and Silos.
- Design of Chimneys and Water Tanks.
- Design of Tubular Structures.

**Prerequisite**

Knowledge of portal frame analysis, structural steel design, foundation design

**Course Outcomes**

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Explain the planning and functional requirements of Industrial Structures | Apply |
| CO2 | Design the Pre – Engineered structures and foundations | Create |
| CO3 | Demonstrate the structural aspects of machine foundation and containment structures. | Apply |
| CO4 | Design the Turbo generator foundations & conveyor systems. | Create |
| CO5 | Design of offshore structures with failure probability | Create |

**MappingwithProgrammeOutcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 3 | 2 | 3 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO3 | 1 | 2 | 3 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**AssessmentPattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E42 - DESIGN OF INDUSTRIAL STRUCTURE | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 60 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Steel Gantry Girders**<br>Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction | **[09]** |
| **Portal Frames**<br>Design of portal frame with hinge base, design of portal frame with fixed base – Gable Structures – Lightweight Structures | **[09]** |
| **Steel Bunkers and Silos**<br>Design of square bunker – Jansen's andAiry's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.. | **[09]** |
| **Chimneys**<br>Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation. | **[09]** |
| **Water Tanks**<br>Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | Ram Chandra., "Design of Steel Structures", 13th Ed., Standard Publishers, 2011. |
| 2. | Koncz, J, "Manual of Precast Construction Vol I & II" Bauverlay GMBH, 1971. |

**Reference(s):**

| | |
|---|---|
| 1. | Punmia B. C., Jain Ashok Kr., Jain Arun Kr., "Design of Steel Structure", Lakshmi Publishers, 2011. |
| 2. | Subramaniyam, N. "Design of Steel Structures", (As per IS 800-2007), Oxford University press, 2014.. |
| 3. | Handbook on Functional Requirements of Industrial buildings, SP32 – 1986, Bureau of Indian Standards, New Delhi 1990 |
| 4. | Henn W., "Buildings for Industry, vols.I and II", London Hill Books, 1995. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Steel Gantry Girders** | |
| 1.1 | Introduction | 1 |
| 1.2 | Loads acting on gantry girder | 1 |
| 1.3 | Permissible stress | 1 |
| 1.4 | Types of gantry girders and crane rails | 2 |
| 1.5 | Crane data, maximum moments | 2 |

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| | | |
|---|---|---|
| 1.6 | Shears, construction | 2 |
| **2** | **Portal Frames** | |
| 2.1 | Design of portal frame with hinge base | 1 |
| 2.2 | Design of portal frame with fixed base | 1 |
| 2.3 | Gable Structures | 1 |
| 2.4 | Lightweight Structures | 1 |
| 2.5 | Suspended roof structures analysis | 1 |
| 2.6 | Suspended roof structure design | 1 |
| 2.7 | Design of Foundations for industrial structures | 1 |
| 2.8 | Types of power plants | 1 |
| 2.9 | Design philosophy of Turbo generator foundation | 1 |
| 3 | **Steel Bunkers and Silos** | |
| 3.1 | Design of square bunker | 2 |
| 3.2 | Jansen's and Airy's theories | 2 |
| 3.3 | IS Code provisions | 1 |
| 3.4 | Design of side plates | 1 |
| 3.5 | Stiffeners | 1 |
| 3.6 | Hooper | 1 |
| 3.7 | Longitudinal beams Design of cylindrical silo | 1 |
| **4** | **Chimneys** | |
| 4.1 | Introduction | 2 |
| 4.2 | Dimensions of steel stacks | 2 |
| 4.3 | Chimney lining, breech openings and access ladder | 1 |
| 4.4 | Loading and load combinations | 1 |
| 4.5 | Design considerations & stability consideration | 1 |
| 4.6 | Design of base plate | 1 |
| 4.7 | Design of foundation bolts, design of foundation. | 1 |
| **5** | **Water Tanks** | |
| 5.1 | Design of rectangular riveted steel water tank | 2 |
| 5.2 | Tee covers | 1 |
| 5.3 | Plates – Stays | 1 |
| 5.4 | Longitudinal and transverse beams | 1 |
| 5.5 | Design of staging | 1 |
| 5.6 | Base plates | 1 |
| 5.7 | Foundation and anchor bolts | 1 |
| 5.8 | Case Study | 1 |
| | **Total** | **45** |

## Course Designers

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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| 60 PSE E43 | Advances Application of Geotextiles in Civil Engineering | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objectives

- To learn the Understand the fundamental definitions, types, and functions of geotextiles.
- To apply design principles to effectively use geotextiles for soil stabilization.
- To evaluate the role of geotextiles in hydraulic structures such as dams and levees
- To assess the properties and applications of geosynthetic clay liners.
- To explore emerging trends in geotextile technology

## Pre-requisites

- Foundation Engineering
- Soil Mechanics

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Able to classify and select appropriate geotextiles based on their mechanical properties. | Remember |
| CO2 | Develop proficiency in designing geotextile solutions for soil stabilization and reinforcement | Understand |
| CO3 | Analyze and propose effective strategies for using geotextiles in hydraulic structures. | Remember |
| CO4 | Expertise in the design and application of geotextiles for waste containment systems | Apply |
| CO5 | Explore and evaluate emerging technologies in geotextiles, such as smart textiles and nanotechnology. | Analyse |

## Mapping with Programme Outcomes

| COs | POs | | | | | | | | | | | | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | 3 | - | - | - | - | - | - | 2 | 2 | - | - | 2 | - |
| CO2 | 3 | 3 | - | 2 | - | - | - | - | - | - | - | - | 2 | - |
| CO3 | 3 | 3 | - | 2 | - | - | - | - | 2 | 2 | - | - | 2 | - |
| CO4 | 3 | - | - | 2 | - | - | - | - | | | - | - | 2 | - |
| CO5 | 3 | - | - | - | - | - | - | - | 2 | 2 | | 2 | 2 | - |
| 3 - Strong; 2 - Medium; 1 – Some | | | | | | | | | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | | | Model Examination (Marks) | End Sem Examination (Marks) | |
|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | | | |
| | Theory | Lab | Theory | Lab | Lab | Theory | Lab |
| Remember | 20 | 10 | 20 | 10 | - | 34 | - |
| Understand | 10 | 10 | 10 | 10 | - | 66 | - |
| Apply | 10 | 30 | 10 | 30 | 50 | - | 50 |
| Analyse | 20 | 50 | 20 | 50 | 50 | - | 50 |
| Evaluate | - | - | - | - | - | - | - |
| Create | - | - | - | - | - | - | - |
| Total | 60 | 100 | 60 | 100 | 100 | 100 | 100 |

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**Syllabus**

| K.S.Rangasamy College of Technology – Autonomous R2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B.E. Civil Engineering | | | | | | | | |
| 60 PSE E43 – Advances Application of Geotextiles in Civil Engineering | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction to Geotextiles and their Properties**<br>Overview of geotextiles: Definition, types, and functions -Mechanical properties of geotextiles: Tensile strength, permeability, durability -Interaction between geotextiles and soil: Filtration, drainage, and reinforcement mechanisms -Standards and specifications: ASTM, ISO, and other relevant standards for geotextiles. | [9] |
| **Geotextiles in Soil Stabilization and Reinforcement**<br>Design principles for soil stabilization using geotextiles- Applications in road construction: Subgrade improvement, pavement design -Slope stabilization techniques: Reinforced soil slopes, erosion control - Case studies and practical examples of successful applications**.** | [9] |
| **Geotextiles in Hydraulic Engineering**<br>Role of geotextiles in hydraulic structures: Dams, levees, and coastal protection - Applications in erosion control: Riprap alternatives, shoreline protection- Filtration and drainage systems in geotechnical and hydraulic engineering -Environmental considerations and sustainability in hydraulic applications**.** | [9] |
| **Geotextiles in Waste Containment**<br>Geosynthetic clay liners (GCLs) and geomembranes: Properties and applications - Landfill design and construction using geotextiles- Applications in mining: Tailings management and acid mine drainage control- Environmental regulations and case studies in waste containment. | [9] |
| **Innovative Applications and Future Trends**<br>Emerging trends in geotextile technology: Smart geotextiles, nanotechnology Geotextiles in unconventional applications: Agriculture, architecture- Case studies of innovative projects integrating geotextiles- Future challenges and opportunities in the field of geotextiles. | [9] |
| **Total Hours:** | **45** |

| **Text Book(s):** | |
|---|---|
| 1. | R. W. Sarsby , “Geosynthetics in Civil Engineering", Woodhead Publishing 2018. |
| 2. | Wim Elsacker and Eddie Koenders., Geotextiles: From Design to Applications, CRC Press, 2019. |
| **Reference(s):** | |
| 1. | Sanjay Kumar Shukla., Geosynthetics and their Applications, CRC Press, 2019. |
| 2. | A. M. Abdelrahman., Geotextiles: Properties, Performance and Applications, Nova Science Publishers, 2019 |
| 3. | Vladan Koncar, Smart Textiles and Their Applications, Woodhead Publishing Pvt. Ltd. 2020. |
| 4. | Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 2019 |

*SDG 9 – Industry Innovation and Infrastructure
**SDG 3 – Good Health and Well Being

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## Course Contents and Lecture Schedule

| S. No. | Topics | No. of Hours |
|---|---|---|
| **1.0** | **Introduction to Geotextiles and their Properties** | |
| 1.1 | Overview of geotextiles | 1 |
| 1.2 | Basic definitions, types, and functions | 2 |
| 1.3 | Mechanical properties of geotextiles | 1 |
| 1.4 | Interaction between geotextiles and soil | 2 |
| 1.5 | Standards and specifications: ASTM, ISO | 2 |
| 1.6 | Other relevant standards for geotextiles | 1 |
| **2.0** | **Geotextiles in Soil Stabilization and Reinforcement** | |
| 2.1 | Design principles for soil stabilization using geotextiles | 1 |
| 2.2 | Applications in road construction | 2 |
| 2.3 | Slope stabilization techniques | 2 |
| 2.4 | Erosion control | 2 |
| 2.5 | Case studies and practical examples of successful applications | 2 |
| **3.0** | **Geotextiles in Hydraulic Engineering.** | |
| 3.1 | Role of geotextiles in hydraulic structures | 1 |
| 3.2 | Applications in erosion control | 2 |
| 3.3 | Filtration and drainage systems in geotechnical engineering. | 2 |
| 3.4 | Filtration and drainage systems in hydraulic engineering. | 2 |
| 3.5 | Environmental considerations in hydraulic applications**.** | 1 |
| 3.6 | Sustainability in hydraulic applications | 1 |
| **4.0** | **Geotextiles in Waste Containment** | |
| 4.1 | Geosynthetic clay liners (GCLs) and geomembranes | 1 |
| 4.2 | Properties and applications | 2 |
| 4.3 | Applications in mining | 1 |
| 4.4 | Tailings management and acid mine drainage control | 2 |
| 4.5 | Environmental regulations. | 2 |
| 4.6 | Case studies in waste containment. | 2 |
| **5.0** | **Innovative Applications and Future Trends** | |
| 5.1 | Emerging trends in geotextile technology | 1 |
| 5.2 | Nanotechnology Geotextiles in unconventional applications | 2 |
| 5.3 | Case studies of innovative projects integrating geotextiles | 2 |
| 5.4 | Future challenges in the field of geotextiles | 2 |
| 5.5 | Opportunities in the field of geotextiles | 2 |

## Course Designer(s)

**1.** Dr.D.Siva Kumar - sivakumard@ksrct.ac.in

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| 60PSE E44 | INDUSTRIAL STEEL STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To learn guidelines for industrial structures
- To acquire knowledge in design of roof and gantry girders
- To learn the design of special structures in industries
- To perform the design of tower structures
- To learn the behavior and design of pre engineering buildings

**Prerequisite**

Courses –Strength of Materials, Design of Steel Structures

**Course Outcomes**

On the successful completion of the course,students will be able to

| | | |
|---|---|---|
| CO1 | Classify the different types of industrial structures based on planning an functional requirements. | Remember/ Understand/ Analyse/Apply |
| CO2 | Assess the general behavior of steel shell roofs and design of gantry girders an gantry columns. | Remember/ Understand/ Analyse/Apply |
| CO3 | Evaluate the various forces acting on Bunkers, silos, chimney's, cooling tower steel storage tanks and design them. | Remember/ Understand/ Analyse/Apply |
| CO4 | Calculate the different types of forces acting on towers and design the towe foundations. | Remember/ Understand/ Analyse/Apply |
| CO5 | Analysis and design of pre-engineered structures | Remember/ Understand/ Analyse/Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember(Re) | 10 | 10 | 20 |
| Understand(Un) | 10 | 15 | 20 |
| Apply (Ap) | 35 | 30 | 50 |
| Analyse (An) | 05 | 05 | 10 |
| Create (Cr) | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| 60PSE E44- INDUSTRIAL STEEL STRUCTURES | | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Planning and Functional Requirements**<br>Classification of Industries and Industrial structures –planning for lay out Requirements regarding Lighting, Ventilation and Fire safety- Protection against noise and vibration- guide lines from factories Act. | **[09]** |
| **Industrial Building**<br>Roofs for Industrial Buildings- Steel shell roofs- Gantry Girders- Design of gantry columns | **[09]** |
| **Industrial Appurtenances**<br>Bunkers and Silos - Chimney and cooling Towers – Design of steel storage tanks | **[09]** |
| **Design of Lattice Towers**<br>Micro wave towers - Transmission Line Towers – pipe track structures- Tower Foundations – Testing towers. | **[09]** |
| **Design of Pre Engineered Structures**<br>Introduction-section specification-Types of assemblies –analysis and design of pre engineered structure- connection details | **[09]** |
| **TotalHours** | **45** |

| **Textbook(s):** | |
|---|---|
| 1. | Santhakumar A.R., and Murthy S.S.,"Transmission Line structures", Tata Mc Graw- Hill, 1992. |
| 2. | Subramaniam.N., "Design of Steel Structures ",(As per IS 800-2007)", Oxford university press, 2014. |
| **Reference(s):** | |
| 1. | Shiyekar M.R., "Limit State Design in Structural Steel", PHI Learning Private Limited, New Delhi, 2013.. |
| 2. | Rajagopalan K., "Storage Structures", Oxford IBH Publishing Company Ltd, 1989. |
| 3. | IS 800 – 2007, "Code of Practice for General Construction in steel", BIS, New Delhi. |
| 4. | Teaching Resources for Structural Steel Design, INSDAG, Kolkata, 2010. |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Planning and Functional Requirements** | |
| 1.1 | Classification of Industries | 1 |
| 1.2 | Classification of Industrial structures | 1 |
| 1.3 | Planning for lay out Requirements regarding Lighting | 2 |
| 1.4 | Ventilation | 1 |
| 1.5 | Fire safety | 1 |
| 1.6 | Protection against noise and vibration | 1 |
| 1.7 | Guide lines from factories Act. | 2 |
| **2** | **Industrial Building** | |

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| | | |
|---|---|---|
| 2.1 | Roofs for Industrial Buildings | 2 |
| 2.2 | Steel shell roofs | 2 |
| 2.3 | Gantry Girders | 2 |
| 2.4 | Design of gantry columns | 3 |
| **3** | **Industrial Appurtenances** | |
| 3.1 | Bunkers | 1 |
| 3.2 | Silos | 1 |
| 3.3 | Chimney | 2 |
| 3.4 | Cooling Towers | 2 |
| 3.5 | Design of steel storage tanks | 3 |
| **4** | **Design of Lattice Towers** | |
| 4.1 | Micro wave towers | 1 |
| 4.2 | Transmission Line Towers | 1 |
| 4.3 | Pipe track structures | 2 |
| 4.4 | Tower Foundations | 2 |
| 4.5 | Testing towers | 3 |
| **5** | **Design of Pre Engineered Structures** | |
| 5.1 | Introduction-section specification | 1 |
| 5.2 | Types of assemblies | 1 |
| 5.3 | Analysis of pre-engineered structure | 2 |
| 5.4 | Design of pre-engineered structure | 3 |
| 5.5 | Connection details | 2 |
| | **Total** | **45** |

## Course Designer

1. Dr.M.VELUMANI - velumani@ksrct.ac.in

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| 60 PSE E45 | CORROSION ENGINEERING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To rationalize the periodic properties such as corrosive environments
- To recall the basics of Electrochemical and Polarization
- To endow with an overview of Corrosive concentration
- To enable the students with various concepts like corrosion testing
- To implement the principles of corrosion prevention

**Prerequisite**

Courses –Strength of Materials, Design of Steel Structures, Concrete Technology

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Define the basic concepts on corrosion. | Remember/ Understand/ Analyse/Apply |
| CO2 | Discuss the testing and evaluation of forms of corrosion | Remember/ Understand/ Analyse/Apply |
| CO3 | Describes the different types of corrosive environments. | Remember/ Understand/ Analyse/Apply |
| CO4 | Illustrate the concepts of corrosion testing. | Remember/ Understand/ Analyse/Apply |
| CO5 | Apply the corrosion prevention. | Remember/ Understand/ Analyse/Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember(Re) | 10 | 10 | 20 |
| Understand(Un) | 10 | 15 | 20 |
| Apply (Ap) | 35 | 30 | 50 |
| Analyse (An) | 05 | 05 | 10 |
| Create (Cr) | - | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60 PSE E45 - CORROSION ENGINEERING** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Totalhrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **INTRODUCTION**<br>Cost of Corrosion – Corrosion Engineering – Definition of Corrosion – Environments – Corrosion Damage – Classification of Corrosion. Corrosion Principles : Introduction – Corrosion Rate Expressions. Electrochemical Aspects : Electrochemical Reactions – Polarisation – passivity, Environmental Effects: Effect of oxygen and oxidizers – Effect of Velocity – Effect of temperature – Effects of Corrosive concentration – Effect of Galvanic Coupling – Metallurgical Aspects. | **[09]** |
| **FORMS OF CORROSION**<br>Galvanic Corrosion : EMF and Galvanic Series – Environmental Effects – Distance Effect – Area Effect – Prevention. Crevice Corrosion: Environmental Factors – Mechanism – Combating Crevice Corrosion – Filiform Corrosion. Pitting – Solution composition – Velocity – Metallurgical Variables – Evaluation & Prevention of pitting damage. Intergranularcorrosion .Austentic Stainless Steels – Weld Decay – Knife Line Attack.<br>Selective Leaching: Dezincification Characteristics, Mechanism, prevention – Graphitization – Other Alloy systems. Erosion Corrosion: Surface Films – Velocity – Turbulence – Impingement - Galvanic Effect – Combating Erosion corrosion. Stress corrosion: crack morphology – Stress effects – time to cracking – Environmental & Metallurgical factors – Mechanism – methods of prevention – corrosion Factors – Hydrogen Blistering – Hydrogen Embrittlement – Prevention. | **[09]** |
| **CORROSIVE ENVIRONMENTS**<br>Mineral Acids: Sulfuric Acid – Nitric Acid – Hydrochloric Acid – Hydrofluoric Acid – Phosphoric Acid. Organic Acids – Alkalies – Atmosphere Corrosion – Sea water – Fresh water – High purity water – soils – Aerospace – Biological corrosion – Human body – Corrosion of metals by halogens – Liquid metals and fused salts – sewage and plant – waste treatment – Dew point corrosion – liquid metal embrittlement of cracking – Hydrogen peroxide – Rebar corrosion. | **[09]** |
| **CORROSION TESTING**<br>Introduction – Classification – Purpose – Materials and specimens – surface preparation – Measuring & Weighing – Exposure Techniques – Duration – Planned Interval Tests Aeration – Cleaning specimens after exposure – temperature – Standard expressions for corrosion rate – Galvanic corrosion high temperature and pressure – Erosion – Intergranular corrosion – pitting & stress corrosion – NACE Test methods – Linear polarization – paint Tests – Sea water tests – Miscellaneous tests of metals. | **[09]** |
| **CORROSION PREVENTION**<br>Materials Selection: Metals & Alloys – Metal purification. Alteration of Environment: changing mediums – Inhibitors. Design: Wall Thickness – Design Rules. Cathodic& Anodic protection – comparison. Coatings: Metallic & other Inorganic coatings – Organic coatings – corrosion control standards – Failure Analysis. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. Mars G. Fontana, Corrosion Engineering Third Edition Mc. Graw – Hill Book Company, New York 1988.
2. Raoul Francois, “Corrosion and its Consequences for Reinforced Concrete Structures”, ISTE Press – Elsevier, 2018


**Reference(s):**


1. J. H. Brophy, R. M.Rose, “The structure and Properties of Materials,” Wiley Inter-science Inc., New York, 1994
2. Amir Poursaee, “Corrosion of Steel in Concrete Structures”, Woodhead Publishing, 2016
3. Pierre R. Roberge, “Handbook of Corrosion Engineering”, McGraw-Hill Education, 2012.
4. M. D. Allen,“Corrosion in Civil Engineering, The Institution of Civil Engineers, 2015.


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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Planning and Functional Requirements** | |
| 1.1 | Cost of Corrosion | 1 |
| 1.2 | Corrosion Engineering | 1 |
| 1.3 | Definition of Corrosion – Environments | 1 |
| 1.4 | Corrosion Damage – Classification of Corrosion. | 1 |
| 1.5 | Corrosion Principles. | 1 |
| 1.6 | Introduction – Corrosion Rate Expressions. | 1 |
| 1.7 | Electrochemical Aspects: Electrochemical Reactions – Polarisation – passivity. | 1 |
| 1.8 | Environmental Effects: Effect of oxygen and oxidizers – Effect of Velocity – Effect of temperature | 1 |
| 1.9 | Effects of Corrosive concentration – Effect of Galvanic Coupling – Metallurgical Aspects | 1 |
| **2** | **FORMS OF CORROSION** | |
| 2.1 | Galvanic Corrosion : EMF and Galvanic Series – Environmental Effects – Distance Effect – Area Effect | 1 |
| 2.2 | Prevention. Crevice Corrosion: Environmental Factors – Mechanism – Combating Crevice Corrosion | 1 |
| 2.3 | Filiform Corrosion. Pitting – Solution composition – Velocity – Metallurgical Variables | 1 |
| 2.4 | Evaluation & Prevention of pitting damage. Intergranularcorrosion .Austentic Stainless Steels – Weld Decay – Knife Line Attack. | 1 |
| 2.5 | Selective Leaching: Dezincification Characteristics, Mechanism, prevention – Graphitization – Other Alloy systems. | 1 |
| 2.6 | Erosion Corrosion: Surface Films – Velocity – Turbulence – Impingement - Galvanic Effect | 1 |
| 2.7 | Combating Erosion corrosion. Stress corrosion: crack morphology | 1 |
| 2.8 | Stress effects – time to cracking – Environmental & Metallurgical factors | 1 |
| 2.9 | Mechanism – methods of prevention – corrosion Factors – Hydrogen Blistering – Hydrogen Embrittlement – Prevention. | 1 |
| **3** | **CORROSIVE ENVIRONMENTS** | |
| 3.1 | Mineral Acids: Sulfuric Acid – Nitric Acid | 1 |
| 3.2 | Hydrochloric Acid – Hydrofluoric Acid | 1 |
| 3.3 | Phosphoric Acid. Organic Acids – Alkalies | 1 |
| 3.4 | Atmosphere Corrosion – Sea water – Fresh water | 1 |
| 3.5 | High purity water – soils – Aerospace | 1 |
| 3.6 | Biological corrosion – Human body – Corrosion of metals by halogens | 1 |
| 3.7 | Liquid metals and fused salts – sewage and plant – waste treatment | 1 |
| 3.8 | Dew point corrosion – liquid metal embrittlement of cracking | 1 |
| 3.9 | Hydrogen peroxide – Rebar corrosion | 1 |
| **4** | **CORROSION TESTING** | |
| 4.1 | Introduction – Classification – Purpose – Materials and specimens | 1 |
| 4.2 | surface preparation – Measuring & Weighing – Exposure Techniques | 1 |

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| | | |
|---|---|---|
| 4.3 | Duration – Planned Interval Tests Aeration | 1 |
| 4.4 | Cleaning specimens after exposure | 1 |
| 4.5 | temperature – Standard expressions for corrosion rate | 1 |
| 4.6 | Galvanic corrosion high temperature and pressure – Erosion | 1 |
| 4.7 | Intergranular corrosion pitting & stress corrosion | 1 |
| 4.8 | NACE Test methods – Linear polarization | 1 |
| 4.9 | Paint Tests – Sea water tests – Miscellaneous tests of metals. | 1 |
| **5** | **CORROSION PREVENTION** | |
| 5.1 | Materials Selection: Metals & Alloys | 1 |
| 5.2 | Metal purification. | 1 |
| 5.3 | Alteration of Environment: changing mediums – Inhibitors | 1 |
| 5.4 | Design: Wall Thickness | 1 |
| 5.5 | Design Rules | 1 |
| 5.6 | Cathodic& Anodic protection – comparison | 1 |
| 5.7 | Coatings: Metallic & other Inorganic coatings | 1 |
| 5.8 | corrosion control standards | 1 |
| 5.9 | Failure Analysis. | 1 |
| | **Total** | **45** |

## Course Designer

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| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| 60PSE E46 | PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEM | PE | 3 | 0 | 0 | 3 |

**Objective**

- To know the Principles of Aerobic and anaerobic treatment of waste water.
- To design the Aerobic treatment of waste water.
- To identify the anaerobic treatment of waste water.
- To find out the solution of sludge treatment.
- To Know the Construction, operation and maintenance of waste water treatment units

**Pre requisite**

Basic knowledge of properties learnt in basics of Biological treatment system

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Able to develop conceptual schematics required for biological treatment of wastewater | Knowledge/ Analyse/ Apply |
| CO2 | Ability to translate pertinent criteria into system requirements | Knowledge/ Analyse/ Apply |
| CO3 | Analyze the and best solution for anaerobic treatment of wastewater | Knowledge/ Analyse/ Apply |
| CO4 | Design the sludge digestion process. | Knowledge/ Analyse/ Apply |
| CO5 | Identify the construction operation and maintenance aspects | Knowledge/ Analyse/ Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 2 | 3 | | | 2 | 2 |
| CO4 | 3 | 2 | | 2 | 3 | 3 |
| CO5 | 3 | 2 | 2 | 2 | 3 | 1 |

**Assessment Pattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Knowledge (Kn) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |



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|---|---|---|---|---|---|---|---|---|
| **60PSE E46- PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEM** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | MaximumMarks | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Principles**<br>Objectives of biological treatment – significance – aerobic and anaerobic treatment kinetics of biological growth – Factors affecting growth – attached and suspended growth Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process-reactors-batch-continuous type-kinetics | **[09]** |
| **Design of Aerobic Treatment Systems**<br>Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfectant – disposal options – reclamation and reuse – Flow charts, layout, hydraulic profile, recent trends | **[09]** |
| **Anaerobic Treatment of Wastewater**<br>Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds septic tank and disposal – Nutrient removal systems – Flow chart Layout and Hydraulic profile – Recent trends. | |
| **Sludge Treatment and Disposal**<br>Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout PID hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances. | **[09]** |
| **Construction Operations and Maintenance Aspects**<br>Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and Controlling of plant operations – capacity building, Case studies – sewage treatment plants – sludge management facilities | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. Arceivala, S.J., “Wastewater Treatment for Pollution Control”, TMH, New Delhi, Second Edition, 2000.
2. Garg, S.K., “Environmental Engineering” Vol. II, Khanna Publishers, New Delhi, 2003.


**Reference(s):**


1. Manual on “Sewerage and Sewage Treatment” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. Metcalf & Eddy, INC, ‘Wastewater Engineering – Treatment and Reuse”, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
3. Qasim, S.R. “Wastewater Treatment Plant, Planning, Design & Operation”, Technomic Publications, Newyork, 1994.
4. Karia G L & Christian R A, “Wastewater Treatment”, Prentice Hall of India, New Delhi, 2013.




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**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Principles** | |
| 1.1 | Objectives of biological treatment | 1 |
| 1.2 | aerobic and anaerobic treatment kinetics of biological growth | 2 |
| 1.3 | Factors affecting growth | 1 |
| 1.4 | attached and suspended growth | 1 |
| 1.5 | Determination of Kinetic coefficients for organics removal | 1 |
| 1.6 | Biodegradability assessment | 1 |
| 1.7 | Classification of reactors | 1 |
| 1.8 | batch-continuous type | 1 |
| **2** | **Design of Aerobic Treatment Systems** | |
| 2.1 | Design of sewage treatment plant units | 1 |
| 2.2 | Activated Sludge process | 1 |
| 2.3 | Sequencing Batch reactors | 1 |
| 2.4 | Membrane Biological Reactors | 1 |
| 2.5 | Trickling Filters | 1 |
| 2.6 | Moving Bed Reactors and fluidized bed reactors | 1 |
| 2.7 | aerated lagoons and waste stabilization ponds | 1 |
| 2.8 | constructed wet land | 1 |
| 2.9 | reclamation and reuse | |
| **3** | **Anaerobic Treatment of Wastewater** | |
| 3.1 | Attached and suspended growth | 2 |
| 3.2 | Design of units - UASB | 2 |
| 3.3 | Nutrient removal systems | 1 |
| 3.4 | septic tank and disposal | 1 |
| 3.5 | septic tank and disposal | 1 |
| 3.6 | Flow chart Layout and Hydraulic profile | 2 |
| **4** | **Sludge Treatment and Disposal** | |
| 4.1 | Design of sludge management facilities, | 1 |
| 4.2 | sludge thickening, sludge digestion | 2 |
| 4.3 | biogas generation | 2 |
| 4.4 | sludge dewatering | 1 |
| 4.5 | Layout PID hydraulics profile | 1 |
| 4.6 | upgrading existing plants | 1 |
| 4.7 | ultimate residue disposal | 1 |
| 5 | **Construction Operations and Maintenance Aspects** | |
| 5.1 | Construction and Operational Maintenance problems | 2 |
| 5.2 | Trouble shooting | 1 |
| 5.3 | Planning, Organizing and Controlling of plant operations | 1 |

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| | | |
|---|---|---|
| 5.4 | capacity building | 1 |
| 5.5 | sewage treatment plants | 2 |
| 5.6 | sludge management facilities | 1 |
| 5.7 | Case studies | 1 |
| | **Total** | **45** |

## CourseDesigners

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| 60PSE E47 | TRANSPORT OF WATER AND WASTE WATER | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To understand the fluid characteristics
- To know concepts related to water transmission mains
- To find the water distribution system, sewer networks and
- To design the storm water drain, with emphasis on computer application.
- To know the Case studies on transportation of water and waste water

**Pre requisite**

Basic knowledge of Environmental Engineering courses

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Understand the general hydraulics and principles of flow measurements. | Knowledge/ Analyse/ Apply |
| CO2 | Describe the components of water transmission system. | Knowledge/ Analyse/ Apply |
| CO3 | Analyze the water distribution networks plan the wastewater collection from various sources | Knowledge/ Analyse/ Apply |
| CO4 | Evaluate the conveyance of wastewater and various appurtenances | Knowledge/ Analyse/ Apply |
| CO5 | Estimate the storm water drainage quantity by various methods. | Knowledge/ Analyse/ Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | | | 3 | 2 |
| CO4 | 3 | 2 | | 2 | 3 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 2 |

**Assessment Pattern**

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | End SemExamination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Knowledge (Kn) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E47 - TRANSPORT OF WATER AND WASTE WATER** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **General Hydraulics and Flow Measurement**<br>Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement. | **[09]** |
| **Water Transmission and Distribution**<br>Need for Transport of water and waste water-Planning of water system-Selection of pipe materials-Water transmission main design-gravity and pumping main, selection of pumps-characteristics-economics; specials, jointing and maintenance, water hammer analysis, water distribution pipe network design, analysis and optimization-appurtenances-corrosion prevention-minimization of water losses-leak detection, storage reservoir. | **[09]** |
| **Wastewater Collection and Conveyance**<br>Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters. | **[09]** |
| **Storm Water Drainage**<br>Necessity- combined and separate system; Estimation of storm water run off Formulation of rainfall intensity duration and frequency relationships- Rational methods. | **[09]** |
| **Case Studies and Software Applications**<br>Use of computer software in water transmission, water distribution and sewer design – LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based soft ware's. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**

| | |
|---|---|
| 1. | Bajwa, G.S. "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003 |
| 2. | M.J.Hammer, "Water and Wastewater Technology", Regents / Prentice Hall, New Jercy, 2001. |

**Reference(s):**

| | |
|---|---|
| 1. | "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999. |
| 2. | "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993. |
| 3. | Ronald L Droste, "Theory and Practice of water and Wastewater Treatment", Wiley Publications. |
| 4. | Syed R Qasim, "Wastewater Treatment Plants – Planning, Design and Operations, CRC Press Additional Learning Source |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **General Hydraulics and Flow Measurement** | |
| 1.1 | Fluid properties | 1 |
| 1.2 | fluid flow – continuity principle, energy principle and momentum principle | 2 |
| 1.3 | frictional head loss in free and pressure flow | 2 |
| 1.4 | minor heads losses | 2 |
| 1.5 | Flow measurement | 2 |
| **2** | **Water Transmission and Distribution** . | |

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| | | |
|---|---|---|
| 2.1 | Need for Transport of water and waste water | 1 |
| 2.2 | Planning of water system | 1 |
| 2.3 | Selection of pipe materials | 1 |
| 2.4 | Water transmission | 1 |
| 2.5 | selection of pumps | 1 |
| 2.6 | jointing and maintenance | 1 |
| 2.7 | water distribution pipe network design | 1 |
| 2.8 | appurtenances | 1 |
| 2.9 | minimization of water losses | 1 |
| **3** | **Wastewater Collection and Conveyance** | |
| 3.1 | Design of sanitary sewer | 1 |
| 3.2 | partial flow in sewers | 2 |
| 3.3 | Wastewater pumps and pumping stations | 1 |
| 3.4 | sewer appurtenances | 1 |
| 3.5 | inspection and maintenance of sewers | 1 |
| 3.6 | Design of sewer outfalls | 2 |
| 3.7 | Conveyance of corrosive wastewaters. | 1 |
| **4** | **Storm Water Drainage** | |
| 4.1 | Necessity of storm water drainage | 1 |
| 4.2 | combined and separate system | 2 |
| 4.3 | Estimation of storm water run off | 2 |
| 4.4 | Formulation of rainfall intensity duration | 2 |
| 4.5 | Frequency Analysis | 1 |
| 4.6 | Rational methods. | 1 |
| 5 | **Case Studies and Software Applications** | |
| 5.1 | Use of computer software in water transmission | 2 |
| 5.2 | water distribution and sewer design | 2 |
| 5.3 | LOOP version 4.0 | 1 |
| 5.4 | SEWER -BRANCH | 1 |
| 5.5 | Canal ++ | 1 |
| 5.6 | GIS based soft wares | 2 |
| | **Total** | **45** |

## Course Designers

1. Dr.P.MAGESHKUMAR - mageshkumarp@ksrct.ac.in

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| 60 PSE E51 | PRESTRESSED CONCRETE STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- Understand the principles and general mechanical behavior of prestressed concrete
- To analyze the transfer of prestress and time dependent factors like losses of prestress
- Design of prestressed concrete flexural members
- Design of tension and compression members in prestressed concrete.
- Analyze and design of composite members and special structural elements like water tank, poles, pipes.

**Prerequisite**

Fundamentals of Mathematics, knowledge in mechanics.

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Evaluate the internal forces and deflection in prestressed concrete. | Remember/Apply |
| CO2 | Design the pre-stressing layout and understand the behavior of pre-stressed concrete elements under practical loading conditions | Evaluate/Apply |
| CO3 | Practice the Analysis and design of continuous beams and extend the knowledge on concept of linear transformation. | Analysis/Apply |
| CO4 | Outline the design of tension and compression members in prestressing. | Remember/ Analysis |
| CO5 | Illustrates the design of composite members and partial prestressing. | Understand |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 3 | 2 | 3 |
| CO2 | 2 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 1 | 3 |
| CO4 | 2 | 2 | 1 | 2 | 3 | 3 |
| CO5 | 1 | 2 | 1 | 1 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem. Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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|---|---|---|---|---|---|---|---|---|
| **60 PSE E51 - PRESTRESSED CONCRETE STRUCTURES** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| **Elective V** | | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **III** | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Principles of Prestressing**

Principles of Prestressing - types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cable layouts. [9]

**Design of Flexural Members**

Behaviour of flexural members, determination of ultimate flexural strength – Codal provisions -Design of flexural members, Design for shear, bond and torsion. Design of end blocks. [9]

**Design of Continuous Beams**

Analysis and design of continuous beams - Methods of achieving continuity – concept of linear transformations, concordant cable profile and gap cables [9]

**Design of Tension and Compression Members**

Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - its application in the design piles, flagmasts and similar structures. [9]

**Design of Composite Members**

Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing - its advantages and applications. [9]

**Total Hours:45**

**Text book (s) :**

| | |
|---|---|
| 1 | N.Krishna Raju, “Prestressed Concrete”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018. |
| 2 | Lin, T.Y & Burns, “Design of Prestressed Concrete Structures” John Wiley & Sons, 1982. |

**Reference(s) :**

| | |
|---|---|
| 1 | Devadas Menon & A.K Sengupta, “Prestressed Concrete Structure (Web Course)”, NPTEL Course Notes, 2008. |
| 2 | Krishna Raju.N, “Problems & Solutions – Prestressed Concrete”, CBS Publishers & Distributors., New Delhi, 2015. |
| 3 | Rajagopalan.N “Prestressed Concrete”, Narosa Publishing House, 2005. |
| 4 | IS: IS 1343: 2012, “Prestressed Concrete - Code of Practice” Second Revision |

**Course Contents and Lecture Schedule**

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Principles of Prestressing** | |
| 1.1 | Principles of Prestressing | 2 |
| 1.2 | Types and systems of prestressing | 2 |
| 1.3 | Analysis methods losses | 2 |
| 1.4 | Deflection (short-long term) | 2 |
| 1.5 | Cable layouts | 1 |
| **2** | **Design of Flexural Members** | |
| 2.1 | Behaviour of flexural members | 1 |
| 2.2 | Determination Of Ultimate Flexural Strength | 1 |

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| | | |
|---|---|---|
| 2.3 | Codal provisions | 1 |
| 2.4 | Design of flexural members | 2 |
| 2.5 | Design for shear, | 1 |
| 2.6 | Design for bond | 1 |
| 2.7 | Design for torsion | 1 |
| 2.8 | Design of end blocks | 1 |
| **3** | **Design of Continuous Beams** | |
| 3.1 | Analysis of continuous beams | 2 |
| 3.2 | Design of continuous beams | 2 |
| 3.3 | Methods of achieving continuity | 2 |
| 3.4 | Concept of linear transformations | 1 |
| 3.5 | Concordant cable profile and gap cables | 2 |
| **4** | **Design of Tension and Compression Members** | |
| 4.1 | Design of tension members | 1 |
| 4.2 | Application in the design of prestressed pipes | 1 |
| 4.3 | Prestressed concrete cylindrical water tanks | 1 |
| 4.4 | Design of compression members with flexure | 2 |
| 4.5 | Design of compression members without flexure | 2 |
| 4.6 | Application in the design piles, flagmasts and similar structures | 2 |
| **5** | **Design of Composite Members** | |
| 5.1 | Composite beams- Introduction | 1 |
| 5.2 | Analysis and design of Composite beams | 2 |
| 5.3 | Ultimate strength of Composite beams | 2 |
| 5.4 | Partial prestressing | 2 |
| 5.5 | Advantages and Applications of Partial prestressing | 2 |
| | **Total** | **45** |

## CourseDesigners

1. Dr.R.Jagadeesan – jagadeesan@ksrct.ac.in



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| 60PSE E52 | ADVANCED CONCRETE TECHNOLOGY | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To understand the knowledge of properties of durability of concrete.
- To conduct various tests on properties of special concretes.
- To gain knowledge about formwork and quality control.
- To gain knowledge about the properties of concreting under special circumstances.
- To understand the Mix design using IS method.

**Pre requisite**

Basic knowledge of properties of concrete making materials.

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Discuss about the methods of concrete mix design | Analyse/ Apply |
| CO2 | Describe the special concretes | Remember |
| CO3 | Outline the durability of concrete. | Remember/ Analyse/ |
| CO4 | Identify the concepts form work and quality control | Remember |
| CO5 | Illustrate the behavior of concreting under special circumstances. | Remember |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | | | 2 | 1 |
| CO4 | 2 | 2 | | 3 | 3 | 1 |
| CO5 | 3 | 2 | 2 | 3 | 3 | 1 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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|---|---|---|---|---|---|---|---|
| 60 PSE E52 - ADVANCED CONCRETE TECHNOLOGY | | | | | | | |
| M.E. STRUCTURAL ENGINEERING | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **III** | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction**<br>Concrete: Past, Present and Future- Constituent Materials --Strength of Concrete- Dimensional Stability of Concrete - Chemical and Mineral Admixtures-Properties of Fresh and hardened Concrete - Principles of Concrete Mix Design-Methods of Concrete mix design. | [9] |
| **Special Concretes**<br>Lightweight and Heavy Weight Concrete-High Strength Concrete-High Performance Concrete-Polymers in Concrete-Steel fiber Reinforced Concrete-Ferrocement Concrete-Vaccum Concrete-Ready Mixed Concrete-SIFCON – SIMCON. | [9] |
| **Durability of Concrete**<br>Permeability-chemical attack-sulphate attack-Quality of water - marine conditions- Thermal properties of concrete-fire resistance-methods of making durable concrete - Mass Concrete-Formwork-Structural Concrete Block Masonry -Quality Control of Concrete Construction. | [9] |
| **Formwork and Quality Control**<br>Formwork Materials and Systems-Specifications-Design-Recommendations of IS 456- 2000 on Quality - Errors in Concrete Constructions-Quality Management. | [9] |
| **Concreting Under Special Circumstances**<br>Underground Construction-Concreting in Marine Environment-Under water Construction-Hot weather and Cold weather concreting. Tests on Concrete: Evaluation of Strength of existing structures-investigation Techniques-Tests on Hardened Concrete-Non Destructive Testing-Semi destructive testing techniques-Tests on fresh Concrete. | [9] |
| | **Total Hours:45** |

| **Text book (s) :** | |
|---|---|
| 1 | Shetty M.S., Concrete Technology, S.Chand and Company Ltd, New Delhi, 2011. |
| 2 | Santha Kumar A.R., Concrete Technology, Oxford Higher Education, New Delhi, 2018. |
| **Reference(s) :** | |
| 1 | Neville, A.M., Properties of Concrete, Pitman Publishing Limited, London, 2010 |
| 2 | Gambir,M.L. “Concrete Technology”, Tata McGraw Hill, Publishing Co,Ltd,NewDelhi,2011. |
| 3 | Krishnaraju.N, “Design of Concrete mixes”, Sehgal Educational Consultants Pvt.Ltd., Faridabad, 2010. |
| 4 | Kumar. Neeraj Jha, “Formwork for Concrete Structures”, McGraw Hill Education, 2017. |

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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Introduction about concrete and concrete making materials | 1 |
| 1.2 | Concrete - Past, Present and Future | 1 |
| 1.3 | Constituent Materials - Concrete | 1 |
| 1.4 | Strength of Concrete | 1 |
| 1.5 | Dimensional Stability of Concrete | 1 |
| 1.6 | Chemical and Mineral Admixtures | 1 |
| 1.7 | Properties of Fresh and hardened Concrete | 1 |
| 1.8 | Principles of Concrete Mix Design | 1 |
| 1.9 | Methods of Concrete mix design. | 1 |
| **2** | **Special Concretes** | |
| 2.1 | Lightweight and Heavy Weight Concrete | 1 |
| 2.2 | High Strength Concrete | 1 |
| 2.3 | High Performance Concrete | 1 |
| 2.4 | Polymers in Concrete | 1 |
| 2.5 | Steel fiber Reinforced Concrete | 1 |
| 2.6 | Ferro cement Concrete | 1 |
| 2.7 | Vacuum Concrete | 1 |
| 2.8 | Ready Mixed Concrete | 1 |
| 2.9 | SIFCON – SIMCON | 1 |
| **3** | **Durability of Concrete** | |
| 3.1 | Permeability & chemical attack | 1 |
| 3.2 | sulphate attack & Quality of water | 2 |
| 3.3 | marine conditions | 1 |
| 3.4 | Thermal properties of concrete - fire resistance | 2 |
| 3.5 | methods of making durable concrete | 1 |
| 3.6 | Mass Concrete | 1 |
| 3.7 | Formwork for concrete | 1 |
| 3.8 | Structural Concrete & Block Masonry | |
| 3.9 | Quality Control of Concrete Construction. | |
| **4** | **Formwork and Quality Control** | |
| 4.1 | Formwork Materials and Systems | 1 |
| 4.2 | Specifications | 2 |
| 4.3 | Design | 2 |
| 4.4 | Recommendations of IS 456- 2000 on Quality | 1 |
| 4.5 | Recommendations of IS 456- 2000 on Quality | 1 |
| 4.6 | Errors in Concrete Constructions | 1 |

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| | | |
|---|---|---|
| 4.7 | Quality Management. | 1 |
| 5 | **Concreting Under Special Circumstances** | |
| 5.1 | Underground Construction | 1 |
| 5.2 | Concreting in Marine Environment | 1 |
| 5.3 | Under water Construction | 1 |
| 5.4 | Hot weather and Cold weather concreting | 1 |
| 5.5 | Tests on Concrete: Evaluation of Strength of existing structures-investigation Techniques | 2 |
| 5.6 | Tests on Hardened Concrete-Non Destructive Testing | 1 |
| 5.7 | Semi destructive testing techniques | 1 |
| 5.8 | Tests on fresh Concrete | 1 |
| | **Total** | **45** |

## CourseDesigners

1. Dr. S. Gunasekar – gunasekar@ksrct.ac.in

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| 60 PSE E53 | ASEISMIC DESIGN OF STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To learn the fundamentals of seismology and basic earthquake mechanisms, tectonics types of ground motion, and propagation of ground motion.
- Determine the maximum dynamic response of an elastic vibrating structure to a given forcing function
- Learn the fundamentals of building code based structural design
- Determine the static design base shear based on the type of structural system, irregularity, location and occupancy
- Recognize special conditions such as irregular buildings, building separation, P-delta

## Prerequisite

Fundamentals of Mathematics, knowledge of basic Science

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Identify the causes and effects of earthquake and describe the terms related to earthquake. | Remember, Understand, Apply |
| CO2 | Define the basic concepts of elements of vibration and behavior of structures under cyclic loading. | Remember, Understand, Analyze |
| CO3 | Practice the codal provisions for design and detailing of earthquake resistant structures. | Remember, Understand, Apply, Analyze |
| CO4 | Formulate the design principles for Non-engineered buildings and design provisions for bridges and dams. | Analyze |
| CO5 | Categorize the new concepts on different types of base isolation techniques. | Understand and Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 1 |
| CO5 | 2 | 3 | 2 | 3 | 2 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 20 | 10 | 30 |
| Analyse | 20 | 30 | 50 |
| Evaluate | - | - | - |
| Create | - | - | - |

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**K.S.Rangasamy College of Technology – Autonomous R2022**

**60 PSE E53 - ASEISMIC DESIGN OF STRUCTURES**

**M.E. STRUCTURAL ENGINEERING**

| Semester | ` Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | 45 | C | CA | ES | Total |
| III | 3 | 0 | 0 | | 3 | 40 | 60 | 100 |

**Elements of Seismology**

Elements of Engineering Seismology, Characteristics of Earthquakes, History, Seismic Susceptibility of Indian Subcontinent, Performance of structures during past earthquakes, Lessons learnt from past earthquakes. **[9]**

**Theory of Vibrations**

Theory of vibrations ,Building Systems , Rigid Frames, Braced Frames, Shear Walls, Behavior of RC, Steel and Prestressed concrete elements under cyclic loading ,Soil liquefaction and prevention methods **[9]**

**Codal Provisions for Design & Detailing**

Concept of Earthquake Resistant Design, Response Spectrum ,Design Spectrum Provisions of Seismic Code IS 1893 (Part I) – 2002 ,Structural Configuration , 3 D computer analysis of building (Theory) ,Design and Detailing of Frames, Shear Walls and Framed Walls ,Provisions of IS-13920. **[9]**

**Non Engineered Buildings**

Design of Non Engineered construction, strengthening of buildings, Design Provisions for Bridges and Dams **[9]**

**Base Isolation Techniques**

Modern Concepts –Base Isolation, Adoptive systems and Case studies. **[9]**

**Total Hours 45**

**Text book (s) :**


| | |
|---|---|
| 1 | Dr.Vinod," Earthquake-resistant design of building structures", Rajkamal Press,Delhi.First edition-2013, |
| 2 | Shashikant K.Duggal, Earthquake resistant design of structures", Oxford Higher Education India 2013,. |


**Reference(s) :**


| | |
|---|---|
| 1 | Anil K Chopra, "Dynamics of structures – Theory and applications to Earthquake Engineering", Prentice Hall Inc., 2001. |
| 2 | Minoru Wakabayashi, "Design of Earthquake Resistant Buildings", McGraw –Hill Book Company, Newyork, 1986 |
| 3 | Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition,1992 |
| 4 | Pankaj Agarwal & Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI Learning Pvt Ltd, New Delhi, 2008. |


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## Course Contents and Lecture Schedule

| S.No | Topic | No. of Hours |
|---|---|---|
| **1** | **Elements of Seismology** | |
| 1.1 | Elements of Engineering Seismology | 1 |
| 1.2 | Characteristics of Earthquakes | 1 |
| 1.3 | Seismic Susceptibility of Indian Subcontinent | 1 |
| 1.4 | Performance of structures during past earthquakes | 2 |
| 1.5 | Lessons learnt from past earthquakes | 1 |
| **2** | **Theory of Vibrations** | |
| 2.1 | Theory of vibrations | 1 |
| 2.2 | Building Systems | 1 |
| 2.3 | Rigid Frames and Braced Frames | 2 |
| 2.4 | Behavior of RC under cyclic loading | 1 |
| 2.5 | Behavior of Steel elements under cyclic loading | 1 |
| 2.6 | Behavior of Prestressed concrete elements under cyclic loading | 1 |
| 2.7 | Soil liquefaction and prevention methods | 2 |
| 3 | **Codal Provisions for Design & Detailing** | |
| 3.1 | Concept of Earthquake Resistant Design | 1 |
| 3.2 | Response Spectrum | 1 |
| 3.3 | Design Spectrum | 1 |
| 3.4 | Provisions of Seismic Code IS 1893 (Part I) – 2002 | 1 |
| 3.5 | 3 D computer analysis of building (Theory) | 2 |
| 3.6 | Design and Detailing of Frames | 1 |
| 3.7 | Shear Walls and Framed Walls | 1 |
| 3.8 | Provisions of IS-13920 | 1 |
| **4** | **Non Engineered Buildings** | |
| 4.1 | Design of Non Engineered construction | 2 |
| 4.2 | Strengthening of buildings | 1 |
| 4.3 | Design Provisions for Bridges | 3 |
| 4.4 | Design Provisions for Dams | 3 |
| 5 | **Base Isolation Techniques** | |
| 5.1 | Modern Concepts | 1 |
| 5.2 | Base Isolation | 3 |
| 5.3 | Adoptive systems | 3 |
| 5.4 | Case studies | 2 |
| | **Total** | **45** |

## Course Designers

1. Dr.J.Abdul Bari - abdulbari@ksrct.ac.in

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| 60 PSE E54 | MAINTENANCE AND REHABILITATION OF STRUCTURES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- To study the quality assurance for concrete construction, causes of deterioration of concrete structures.
- To study the different types of techniques for repair and rehabilitation of structure.
- To design and suggest repair strategies for deteriorated concrete structures including repairing with composites.
- To understand the strength and durability properties, their effects due to climate and temperature.
- To understand the mechanism of deterioration of concrete, damage assessment, repair materials

## Prerequisite

Fundamentals of Mathematics, knowledge of properties of construction materials and its mechanics and concrete technology.

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Learn the properties related to mechanics of deterioration of concrete. | Understand |
| CO2 | Evaluate the basic concepts of the corrosion. | Evaluate |
| CO3 | Point out various types of techniques to repair crack, wear, fire and leakage. | Create |
| CO4 | Study the various types and properties of repair materials. | Remember |
| CO5 | Describe the various demolition techniques and demolition methods | Understand |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 3 | 2 | 3 |
| CO2 | 2 | 1 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 1 | 3 |
| CO4 | 2 | 2 | 1 | 2 | 3 | 3 |
| CO5 | 1 | 2 | 1 | 1 | 3 | 3 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem. Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 |
| Apply | 10 | 10 | 20 |
| Analyse | 10 | 10 | 20 |
| Evaluate | 10 | 10 | 10 |
| Create | 10 | 10 | 30 |

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**K.S.Rangasamy College of Technology - Autonomous R2022**

**60PSE E54 MAINTENANCE AND REHABILITATION OF STRUCTURES**

**M.E. STRUCTURAL ENGINEERING**

**Elective V**

| Semester | Hours / Week | | | Total Hours | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

**Introduction** [9]

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.

**Durability of Structures** [9]

Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

**Maintenance and Repair Strategies** [9]

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

**Materials for Repair** [9]

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement concrete, fibre reinforced concrete, eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete.

**Techniques for Repair and rehabilitation of structures** [9]

Rust, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for Dilapilated structures - case studies

**Total Hours:45**

**Text book (s) :**


| | |
|---|---|
| 1 | Denison Campbell, Allen and Harold Roper, “Concrete Structures – Materials, Maintenance and Repair”, Longman Scientific and Technical UK, 2001. |
| 2 | Peter H. Emmons, “Concrete Repair and Maintenance”, Galgotia Publications Ed Second, 2010. |


**Reference(s) :**


| | |
|---|---|
| 1 | R.T. Allen and S.C. Edwards, “Repair of Concrete Structures”, Blakie and Sons, UK, 2007. |
| 2 | Vidivelli, B. “Repair and Rehabilitation of Structures”, Standard Publishers & Distributors, ND,2010. |
| 3 | Robert.TRatay, “Forensic Structural Engineering Handbook”, Mc Graw Hill, 2009. |
| 4 | S Macdonald ,“Concrete – Building Pathology”, John Wiley and Sons Ed First, 2002 |



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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Introduction | 1 |
| 1.2 | Quality assurance for concrete | 1 |
| 1.3 | Permeability of Concrete | 1 |
| 1.4 | Thermal Properties and Cracking | 2 |
| 1.5 | Effects due to climate, temperature, chemicals, wear and erosion | 2 |
| 1.6 | Design and construction errors | 2 |
| **2** | **Durability of Structures** | |
| 2.1 | Corrosion Mechanism | 1 |
| 2.2 | Causes and Effectsof Corrosion | 1 |
| 2.3 | Cover Thickness and Cracking | 2 |
| 2.4 | Measurements for Corrosion | 1 |
| 2.5 | Methods of Corrosion Protection | 1 |
| 2.6 | Corrosion Inhibitors | 1 |
| 2.7 | Corrosion Resistant Steels | 1 |
| 2.8 | Coatings for reinforcement | 1 |
| 2.9 | Cathodic Protection | 2 |
| **3** | **Maintenance and Repair Strategies** | |
| 3.1 | Various types of Repair and Rehabilitation Techniques | 2 |
| 3.2 | Maintenance of Structures | 2 |
| 3.3 | Facets of Maintenance | 1 |
| 3.4 | Importance of Maintenance and Their Preventive Measures | 1 |
| 3.5 | Inspection and their types | 1 |
| 3.6 | Assessment procedure for evaluating a damaged structures | 1 |
| 3.7 | Testing Techniques. | 1 |
| **4** | **Materials for Repair** | |
| 4.1 | Special concretes and mortar | 2 |
| 4.2 | Concrete Chemicals | 1 |
| 4.3 | Special Elements for Accelerated Strength Gain | 1 |
| 4.4 | Expansive cement | 1 |
| 4.5 | Polymer Concrete, Sulphur Infiltrated Concrete | 1 |
| 4.6 | Ferro Cement Concrete, Fibre Reinforced Concrete | 1 |
| 4.8 | Foamed Concrete, Mortar and Dry Pack, Vacuum Concrete | 1 |
| **5** | **Techniques for Repair and rehabilitation of structures** | |
| 5.1 | Rust, Gunite and Shotcrete Epoxy injection | 2 |
| 5.2 | Mortar Repair for Cracks | 1 |
| 5.3 | Shoring and Underpinning | 1 |

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| | | |
|---|---|---|
| 5.4 | Repairs to overcome low member strength | 1 |
| 5.5 | Deflection, Cracking, Chemical Disruption, Weathering Wear | 1 |
| 5.6 | Fire and Leakage | 1 |
| 5.7 | Marine Exposure Engineered Demolition Techniques for Dilapilated Structures | 1 |
| 5.8 | Case Studies | 1 |
| | **Total** | **45** |

## CourseDesigners

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in



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| 60 PSE E55 | MODERN CONSTRUCTION MATERIALS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To gain knowledge of modern construction materials to be used in the field.
- To study about special concrete commonly used in civil engineering construction.
- To understand the properties of metals and its applications.
- To study about the properties of various water proofing materials.
- To adopt smart materials for smart structures.

**Pre requisite**

Basic knowledge of properties of construction materials.

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Understand the properties of special concrete and its applications. | Analyse/ Apply |
| CO2 | Learn about various types of metals and its properties. | Knowledge |
| CO3 | Gain knowledge about various composite materials and its applications in concrete construction. | Knowledge/ Analyse/ |
| CO4 | Learn about various water proofing materials and its functions. | Knowledge |
| CO5 | Study about types of smart materials and its applications. | Knowledge |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | | | 2 | 1 |
| CO4 | 2 | 2 | | 3 | 3 | 1 |
| CO5 | 3 | 2 | 2 | 3 | 3 | 1 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |



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|---|---|---|---|---|---|---|---|
| **60PSEE55 - MODERN CONSTRUCTION MATERIALS** | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | |
| **Semester** | **Hours / Week** | | | **Total Hours** | **Credit** | **Maximum Marks** | |
| | **L** | **T** | **P** | | **C** | **CA** | **ES** | **Total** |
| **III** | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Special Concretes**<br>Concretes, Behaviour of concretes - High Strength and High Performance Concrete – Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete. | [9] |
| **Metals**<br>Steels - New Alloy Steels – Aluminum and its Products –Coatings to reinforcement – Applications. | [9] |
| **Composites**<br>Plastics –Reinforced Polymers – FRP – Applications | [9] |
| **Other Materials**<br>Water Proofing Compounds – Non-weathering Materials – Flooring and Facade Materials | [9] |
| **Smart and Intelligent Materials**<br>Smart and Intelligent Materials for intelligent buildings - Special features | [9] |
| | **Total Hours:45** |

**Text book(s):**

| | |
|---|---|
| 1 | Ganapathy, C., Modern Construction Materials, Eswar Press, 2015. |
| 2 | Shetty M.S, “Concrete Technology: Theory and Practice”, S.Chand & Company Ltd., 2005. |

**Reference(s) :**

| | |
|---|---|
| 1 | Shan Somayaji, “Civil Engineering Materials”, Prentice Hall Inc., 2001. |
| 2 | Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi, 2005. |
| 3 | S K Sharma, "Civil Engineering and construction material," Khanna Publuishing House, 2016. |
| 4 | ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002. |

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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Special Concretes** | |
| 1.1 | Concretes – introduction | 1 |
| 1.2 | Types of concrete | 1 |
| 1.3 | Behaviour of concretes | 1 |
| 1.4 | Behaviour of concretes | 1 |
| 1.5 | High Strength and High Performance Concrete | 1 |
| 1.6 | High Strength and High Performance Concrete | 1 |
| 1.7 | Fibre Reinforced Concrete | 1 |
| 1.8 | Self-compacting concrete | 1 |
| 1.9 | Alternate Materials to concrete | 1 |
| **2** | **Metals** | |
| 2.1 | Steels – Introduction and Manufacturing | 1 |
| 2.2 | New Alloy Steels | 2 |
| 2.3 | Aluminum and its Products | 2 |
| 2.4 | Coatings to reinforcement | 2 |
| 2.5 | Applications | 2 |
| **3** | **Composites** | |
| 3.1 | Plastics - Introduction | 2 |
| 3.2 | Plastics - Applications and Types | 2 |
| 3.3 | Reinforced Polymers | 2 |
| 3.4 | FRP | 2 |
| 3.5 | Applications | 1 |
| **4** | **Other Materials** | |
| 4.1 | Water Proofing Compounds | 1 |
| 4.2 | Non-weathering Materials | 3 |
| 4.3 | Flooring Materials | 3 |
| 4.4 | Facade Materials | 2 |
| 5 | **Smart and Intelligent Materials** | |
| 5.1 | Smart Materials - Introduction | 1 |
| 5.2 | Smart and Intelligent Materials for intelligent buildings | 3 |
| 5.3 | Smart and Intelligent Materials for intelligent buildings | 3 |
| 5.4 | Special features | 2 |
| | **Total** | **45** |

## CourseDesigners

1. Dr. S.Gunasekar – gunasekar@ksrct.ac.in

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| 60PSE E56 | REMOTE SENSING AND GIS FOR HYDROLOGY AND WATER RESOURCES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Objective

- The fact related to hydrology
- Acquired the knowledge about important terms and definitions related to drainage basin.
- Familiar to use the remote sensing and GIS as a tool in the field of assessing the water resources.
- Groundwater quality and potential can be studied through modeling.
- Knowledge on effective management over the surface groundwater by mapping and modeling.

## Pre requisite

Basic knowledge of Remote Sensing and GIS courses

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Understand about hydrological cycle and its various stages. | Knowledge/ Analyse/ Apply |
| CO2 | Acquired knowledge on remote sensing and GIS techniques effective usage in water resources application oriented data interpretation model creation. | Knowledge/ Analyse/ Apply |
| CO3 | Understand the fundamental procedure which are most necessary for water shed management | Knowledge/ Analyse/ Apply |
| CO4 | Familiar to GIS mapping concept through which multiple levels of assessment could be done in the field of natural disasters. | Knowledge/ Analyse/ Apply |
| CO5 | Understand about thematic mapping preparation for groundwater related GIS analysis of spatial and temporal distribution | Knowledge/ Analyse/ Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | | | 3 | 2 |
| CO4 | 3 | 2 | | 2 | 3 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 2 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## Assessment Pattern

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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**K.S.Rangasamy College of Technology–Autonomous R2022**

**60PSE E56 – REMOTE SENSING AND GIS FOR HYDROLOGY AND WATER RESOURCES.**

**M.E. STRUCTURAL ENGINEERING**

| Semester | Hours/Week | | | Totalhrs | Credit | MaximumMarks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| .**Basics of Hydrology**<br>Hydrological cycle – estimation of various components of hydrology cycle – clouds –rainfall – runoff – evaporation – transpiration – evapo–transpiration – interception – depression storage – spectral properties of water – GIS application in surface water modeling – case studies. | **[09]** |
| **Drainage Basin**<br>Watershed divide – stream networks – Delineation and codification of watersheds morphometric analysis – linear – areal –relief aspects – Rainfall- runoff modeling – urbanhydrology – case studies. | **[09]** |
| **Areal Assessment**<br>Mapping of snow covered area – snow melt runoff – flood forecasting, risk mapping and flood damage assessment soil moisture area – drought forecasting and damage assessment – GIS application in aerial assessment – case studies | **[09]** |
| **Ground Water and Water Quality**<br>Ground water prospects – surface water indicators – vegetation , geology, soil aquifer – aquifer parameters – well hydraulics – estimation of ground water potential – hydrologic budgeting – mathematical models – GIS application in ground water modeling – study on sea water intrusion – modeling of sea water intrusion – water quality parameters – physical, chemical, biological properties. Water quality mapping and monitoring – correlation model for pollution detection and suspended sediment concentration– case studies. | **[09]** |
| **Irrigation and Watershed Management**<br>Project investigation, implementation, maintenance stage- location of storage/ diversion works – canal alignment –depth-area capacity curve generation, - conjunctive use of surface and ground water – Mapping and monitoring the catchment command area – artificial recharge of groundwater – water harvesting structures – sediment yield – modeling of reservoir siltation – prioritization of watershed –modeling of sustainable development – Development of information system for Natural resource management – case studies. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. U M Shamsi, “GIS Applications for Water, Wastewater”, and Storm water Systems,CRC, 1st Edition 2005.
2. Andy D Ward and Stanley W Trimble, “Environmental Hydrology”, Lewis Publishers, 2004.


**Reference(s):**


1. David Maidment, Dean Djokic, “Hydrologic and Hydraulic Modeling Support with Geographic Information Systems”, Esri Press, 2000.
2. Wilfried Brutsaert, “Hydrology: An Introduction”, Cambridge University Press, 2005.
3. C Eri, Barrett, Clare H Power, “Satellite Remote Sensing for Hydrology and Water Management”, Gordon @ Breach Science publications, Newyork 1990.
4. Yangbo Chen, Christopher Neale, Ian Cluckie, Z Su Jianzhong, Zhou Qiang Huang and Zongxue Xu “Remote Sensing and GIS for Hydrology and Water Resources” IAHS Proceedings & Reports, Paperback – Import, 2015.



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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Basics of Hydrology** | |
| 1.1 | Hydrological cycle | 1 |
| 1.2 | estimation of various components of hydrology cycle | 2 |
| 1.3 | Rainfall and runoff | 1 |
| 1.4 | evaporation & transpiration | 1 |
| 1.5 | Evapo-transpiration and interception | 1 |
| 1.6 | spectral properties of water | 1 |
| 1.7 | GIS application in surface water modeling | 2 |
| **2** | **Drainage Basin** | |
| 2.1 | Introduction to watershed management | 1 |
| 2.2 | Delineation and codification of watersheds morphometric analysis | 4 |
| 2.3 | relief aspects | 1 |
| 2.4 | runoff modeling | 2 |
| 2.5 | urban hydrology | 1 |
| **3** | **Areal Assessment** | |
| 3.1 | Mapping of snow covered area | 2 |
| 3.2 | snow melt runoff | 1 |
| 3.3 | flood forecasting | 1 |
| 3.4 | flood damage assessment | 1 |
| 3.5 | drought forecasting and damage assessment | 2 |
| 3.6 | GIS application in aerial assessment | 2 |
| **4** | **Ground Water and Water Quality** | |
| 4.1 | surface water indicators | 1 |
| 4.2 | aquifer parameters | 1 |
| 4.3 | estimation of ground water potential | 1 |
| 4.4 | hydrologic budgeting | 1 |
| 4.5 | GIS application in ground water modeling | 2 |
| 4.6 | water quality parameters | 1 |
| 4.7 | correlation model for pollution detection and suspended sediment concentration | 2 |
| 5 | **Irrigation and Watershed Management** | |
| 5.1 | Project investigation | 1 |
| 5.2 | location of storage/ diversion works | 1 |
| 5.3 | canal alignment | 2 |
| 5.4 | Mapping and monitoring the catchment command area | 1 |
| 5.5 | artificial recharge of groundwater | 1 |
| 5.6 | modeling of reservoir siltation | 2 |

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| | | |
|---|---|---|
| 5.7 | Development of information system for Natural resource management | 1 |
| | **Total** | **45** |

## CourseDesigners

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| 60PSE E57 | PRINCIPLES AND DESIGN OF PHYSiCO-CHEMICAL TREATMENT SYSTEMS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

**Objective**

- To know the working principles and characteristics of physio-chemical treatment.
- To design of various physical treatment systems for water and wastewater.
- To find the chemical treatment systems for water and wastewater.
- To understand and design of municipal water treatment plant
- **To design the wastewater treatment plant**

**Pre requisite**

Basic knowledge of Environmental Engineering courses

**Course Outcomes**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Know about pollutant in water and wastewater | Remember / Analyse/ Apply |
| CO2 | Able to develop conceptual schematics required for the physical treatment of water and wastewater | Remember / Analyse/ Apply |
| CO3 | Ability to create the principles and applications of chemical treatment | Remember /Analyse/ Apply |
| CO4 | Formulate the preliminary design of municipal water treatment plant | Remember / Analyse/ Apply |
| CO5 | To gain knowledge about design of wastewater treatment plant | Remember / Analyse/ Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | | 2 | 2 |
| CO4 | 3 | 3 | | 3 | 3 | 2 |
| CO5 | 2 | 2 | | 3 | 3 | 2 |
| 3- Strong;2-Medium;1-Some | | | | | | |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Tests (Marks) | | End Sem Examination (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (Re) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 20 | 50 |
| Analyse (An) | 10 | 20 | 20 |
| Create (Cr) | | - | - |

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|---|---|---|---|---|---|---|---|---|
| **60PSE E57 - PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS** | | | | | | | | |
| **M.E. STRUCTURAL ENGINEERING** | | | | | | | | |
| Semester | Hours/Week | | | Totalhrs | Credit | MaximumMarks | | |
| | L | T | P | | C | CA | ES | Total |
| III | 3 | 0 | 0 | 45 | 3 | 40 | 60 | 100 |

| | |
|---|---|
| **Classification of Pollutants**<br>Pollutants in water and wastewater – characteristics, Standards for performance Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch-continuous type-kinetics. | **[09]** |
| **Physical Treatment Principles**<br>Principles of Screening – Mixing, Equalization – Sedimentation – Filtration – Modeling back washing – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Principles, kinetics, regeneration membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electrodialysis, distillation – stripping and crystallization – Recent Advances. | **[09]** |
| **Chemical Treatment Principles**<br>Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends | **[09]** |
| **Design of Municipal Water Treatment Plant**<br>Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifies – tube settling – filters – Rapid sand filters slow sand filter, pressure filter, Dual media inlets Displacement and gaseous type. Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –flow charts – Layouts –Hydraulic Profile PID construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends – Software application. | **[09]** |
| **Design of Wastewater Treatment Plants**<br>Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks-sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers-floatation units-oil skimmer- flow charts – Layouts –Hydraulic Profile PID construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends – Software application. | **[09]** |
| **TotalHours** | **45** |

**Textbook(s):**


1. Metcalf and Eddy, “Wastewater Engineering”, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
2. Sincero and Sincero, Environmental Engineering: A Design Approach, Prentice Hall India Learning, 2009


**Reference(s):**


1. Qasim, S.R., Motley, E.M. and Zhu.G. “Water works Engineering – Planning, Design and Operation”, Prentice Hall, New Delhi, 2002.
2. Lee, C.C. and Shun dar Lin, “Handbook of Environmental Engineering Calculations”, Mc Graw Hill, Newyork, 1999.
3. Hendricks, D. ‘Water Treatment Unit Processes – Physical and Chemical’ CRC Press, Newyork, 2006.
4. Larry D Benefield, “Process Chemistry for water and wastewater Treatment”, Prentice Hall Publications



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## Course Contents and Lecture Schedule

| S.No | Topic | No.of Hours |
|---|---|---|
| **1** | **Classification of Pollutants** | |
| 1.1 | Pollutants in water and wastewater | 1 |
| 1.2 | Characteristics, standards for performance | 2 |
| 1.3 | Significance of physico-chemical treatment | 2 |
| 1.4 | Selection criteria and types of reactor | 2 |
| 1.5 | Batch-continuous type | 2 |
| **2** | **Physical Treatment Principles** | |
| 2.1 | Principles of Screening | 1 |
| 2.2 | Sedimentation | 2 |
| 2.3 | Filtration | 2 |
| 2.4 | Evaporation and Incineration | 1 |
| 2.5 | Mass transfer coefficient Adsorption | 1 |
| 2.6 | Principles and kinetics | 1 |
| 2.7 | Reverse Osmosis | 1 |
| 2.8 | Nano filtration, ultra filtration and hyper filtration | 1 |
| 2.9 | Electrodialysis and distillation | 1 |
| **3** | **Chemical Treatment Principles** | |
| 3.1 | Principles of Chemical treatment | 1 |
| 3.2 | Coagulation flocculation | 2 |
| 3.3 | Precipitation | 1 |
| 3.4 | Flotation solidification and stabilization | 2 |
| 3.5 | Disinfection | 1 |
| 3.6 | Electrolytic methods | 2 |
| 3.7 | Advanced oxidation /reduction | 1 |
| **4** | **Design of Municipal Water Treatment Plant** | |
| 4.1 | Selection of Treatment | 1 |
| 4.2 | Design of municipal water treatment plant units | 2 |
| 4.3 | Aerators | 1 |
| 4.4 | Flocculation | 1 |
| 4.5 | Rapid sand filter and slow sand filter | 2 |
| 4.6 | O&M aspects | 1 |
| 4.7 | Residue management | 1 |
| 5 | **Design of Wastewater Treatment Plants** | |
| 5.1 | Screens | 1 |
| 5.2 | Grit chamber | 1 |
| 5.3 | Settling tanks | 2 |
| 5.4 | Sludge thickening | 1 |

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| | | |
|---|---|---|
| 5.5 | Dewatering systems | 1 |
| 5.6 | Design of Industrial Wastewater Treatment Units | 1 |
| 5.7 | Equalization and Neutralization | 1 |
| 5.8 | Chemical Feeding Devices | 1 |
| | **Total** | **45** |

## Course Designers

1. Dr.P.MAGESHKUMAR - mageshkumarp@ksrct.ac.in

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| 60 PAC 001 | ENGLISH FOR RESEARCH PAPER WRITING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 0 | 0 | 0 |

## Objectives

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

## Pre-requisite

-NIL-

## Course Outcomes

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| CO1 | Understand that how to improve your writing skills and level of readability | Remember, Understand &Apply |
| CO2 | Learn about what to write in each section | Remember, Understand &Apply |
| CO3 | Understand the skills needed when writing a Title | Remember, Understand &Apply |
| CO4 | Understand the skills needed when writing the Conclusion | Remember, Understand &Apply |
| CO5 | Ensure the good quality of paper at very first-time submission | Remember, Understand &Apply |

## MappingwithProgrammeOutcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 1 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## AssessmentPattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | Model Exam (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (R) | 10 | 10 | 20 |
| Understand (U) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 30 | 50 |
| Analyze (An) | 0 | 0 | 0 |
| Evaluate (Ev) | 0 | 0 | 0 |
| Create (Cr) | 0 | 0 | 0 |
| Total | 60 | 60 | 100 |

## Syllabus

**K.S. Rangasamy College of Technology – Autonomous R 2022**

**60 PAC 001 - ENGLISH FOR RESEARCH PAPER WRITING**

**M.E. STRUCTURAL ENGINEERING**

| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | L | T | P | | C | CA | ES | Total |
| II | 2 | 0 | 0 | 30 | 0 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction to Research Paper Writing**<br>Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness | [6] |
| **Presentation Skills**<br>Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction | [6] |
| **Title Writing Skills**<br>Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check | [6] |
| **Result Writing Skills**<br>Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions | [6] |
| **Verification Skills**<br>Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first time submission | [6] |
| **Total Hours:** | **30** |

**TextBook(s):**

| | |
|---|---|
| 1. | Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011 |
| 2. | Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006 |

**Reference(s):**

| | |
|---|---|
| 1. | Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006 |
| 2. | Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998. |
| 3. | Phill Williams, Advanced Writing skills for students of English, Rumian Publishers, 2018 |
| 4. | Sudhir S. Pandhye, English Grammar and Writing Skills, Notion Press, 2017. |

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## Course Contents and Lecture Schedule

| S.No. | Topics | No.of hours |
|---|---|---|
| **1.0** | **Introduction to Research Paper Writing** | |
| 1.1 | Planning and Preparation, Word Order | 2 |
| 1.2 | Breaking up long sentences, Structuring Paragraphs and Sentences | 1 |
| 1.3 | Being Concise and Removing Redundancy | 2 |
| 1.4 | Avoiding Ambiguity and Vagueness | 1 |
| **2.0** | **Presentation Skills** | |
| 2.1 | Clarifying Who Did What, Highlighting Your Findings | 2 |
| 2.2 | Hedging and Criticizing | 2 |
| 2.3 | Paraphrasing and Plagiarism, Sections of a Paper | 1 |
| 2.4 | Abstracts, Introduction | 1 |
| **3.0** | **Title Writing Skills** | |
| 3.1 | Key skills are needed when writing a Title | 1 |
| 3.2 | Key skills are needed when writing an Abstract, key skills are needed when writing an Introduction | 2 |
| 3.3 | Skills needed when writing a Review of the Literature | 2 |
| 3.4 | Methods, results, discussion, conclusions, the final check | 1 |
| **4.0** | **Result Writing Skills** | |
| 4.1 | Skills are needed when writing the Methods | 2 |
| 4.2 | Skills needed when writing the Results | 1 |
| 4.3 | Skills are needed when writing the Discussion | 1 |
| 4.4 | Skills are needed when writing the Conclusions | 2 |
| **5.0** | **Verification Skills** | |
| 5.1 | Useful phrases | 2 |
| 5.2 | Checking Plagiarism | 2 |
| 5.3 | How to ensure paper is as good as it could possibly be the first time submission | 2 |

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| 60 PAC 002 | DISASTER MANAGEMENT | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 0 | 0 | 0 |

## Objectives

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches Teach how to improve writing skills and level of readability

## Pre-requisite

-NIL-

## Course Outcomes

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Ability to summarize basics of disaster | Remember, Understand &Apply |
| CO2 | Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response. | Remember, Understand &Apply |
| CO3 | Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. | Remember, Understand &Apply |
| CO4 | Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. | Remember, Understand &Apply |
| CO5 | Ability to develop the strengths and weaknesses of disaster management approaches | Remember, Understand &Apply |

## MappingwithProgrammeOutcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 1 |
| 3- Strong;2-Medium;1-Some | | | | | | |

## AssessmentPattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | Model Exam (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (R) | 10 | 10 | 20 |
| Understand (U) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 30 | 50 |
| Analyze (An) | 0 | 0 | 0 |
| Evaluate (Ev) | 0 | 0 | 0 |
| Create (Cr) | 0 | 0 | 0 |
| Total | 60 | 60 | 100 |

## Syllabus

| K.S. Rangasamy College of Technology – Autonomous R 2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 60 PAC 002 – DISASTER MANAGEMENT | | | | | | | | |
| M.E STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 2 | 0 | 0 | 30 | 0 | 40 | 60 | 100 |

| | |
|---|---|
| **Introduction**<br>Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. | [6] |
| **Repercussions of Disasters and Hazards**<br>Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts. | [6] |
| **Disaster Prone Areas In India**<br>Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics | [6] |
| **Disaster Preparedness and Management**<br>Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness. | [6] |

| | |
|---|---|
| **Risk Assessment**<br>Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. | [6] |
| **Total Hours:** | **30** |

| **TextBook(s):** | |
|---|---|
| 1. | Goel S. L., Disaster Administration and Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009. |
| 2. | NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company,2007. |
| **Reference(s):** | |
| 1. | Sahni, Pardeepet.al.," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, 2001. |
| 2. | Subramanian R,"Disaster Management", Vikas publishing Housing Pvt. Ltd., 2018. |
| 3. | Chu-huaKuei, Christian N Madu, Handbook of Disaster Management Risk Reduction & Management: Climate change and Natural Disaster, world scientific, 2017. |
| 4. | JankiAndharia, Disaster studies: Exploring Intersectional ties in Disaster Discourse, Springer, 2020. |

**Course Contents and Lecture Schedule**

| S.No. | Topics | No.of hours |
|---|---|---|
| **1.0** | **Introduction** | |
| 1.1 | Disaster: Definition, Factors and Significance | 2 |
| 1.2 | Difference between Hazard and Disaster | 2 |
| 1.3 | Natural and Manmade Disasters | 2 |
| 1.4 | Difference, Nature | 2 |
| 1.5 | Types and Magnitude | 1 |
| **2.0** | **Repercussions of Disasters and Hazards** | |
| 2.1 | Economic Damage, Loss of Human and Animal Life | 2 |
| 2.2 | Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones | 2 |
| 2.3 | Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches | 2 |
| 2.4 | Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents | 1 |
| 2.5 | Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts | 2 |
| **3.0** | **Disaster Prone Areas In India** | |
| 3.1 | Study of Seismic Zones | 1 |

| | | |
|---|---|---|
| 3.2 | Areas Prone to Floods and Droughts | 2 |
| 3.3 | Landslides and Avalanches | 2 |
| 3.4 | Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami | 2 |
| 3.5 | Post-Disaster Diseases and Epidemics | 2 |
| **4.0** | **Disaster Preparedness and Management** | |
| 4.1 | Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard | 2 |
| 4.2 | Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches | 2 |
| 4.3 | Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches | 2 |
| 4.4 | Application of Remote Sensing, Data from Meteorological and other Agencies | 2 |
| 4.5 | Media Reports: Governmental and Community Preparedness | 1 |
| **5.0** | **Risk Assessment** | |
| 5.1 | Disaster Risk: Concept and Elements | 2 |
| 5.2 | Disaster Risk Reduction, Global and National Disaster Risk Situation | 2 |
| 5.3 | Techniques of Risk Assessment | 2 |
| 5.4 | Global Co-Operation in Risk Assessment and Warning | 2 |
| 5.5 | People's Participation in Risk Assessment. Strategies for Survival | 1 |

**CourseDesigner**

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**R1/ w.e.f. 12.07.2023**
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| 60 PAC 003 | CONSTITUTION OF INDIA | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 0 | 0 | 0 |

## Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional. Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

## Pre-requisite

-NIL-

## Course Outcomes

Onthesuccessful completion ofthecourse,studentswill beable to

| | | |
|---|---|---|
| CO1 | Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics. | Remember, Understand &Apply |
| CO2 | Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India | Remember, Understand &Apply |
| CO3 | Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. | Remember,Understand &Apply |
| CO4 | Discuss the passage of the Hindu Code Bill of 1956. | Remember, Understand &Apply |
| CO5 | Discuss the role and functioning of election commission of India. | Remember, Understand &Apply |

## MappingwithProgrammeOutcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 1 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 1 |
| 3- Strong;2-Medium;1-Some | | | | | | |

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## AssessmentPattern

| Bloom'sCategory | ContinuousAssessmentTests (Marks) | | Model Exam (Marks) |
|---|---|---|---|
| | 1 | 2 | |
| Remember (R) | 10 | 10 | 20 |
| Understand (U) | 20 | 20 | 30 |
| Apply (Ap) | 30 | 30 | 50 |
| Analyze (An) | 0 | 0 | 0 |
| Evaluate (Ev) | 0 | 0 | 0 |
| Create (Cr) | 0 | 0 | 0 |
| Total | 60 | 60 | 100 |

## Syllabus

| K.S. Rangasamy College of Technology – Autonomous R 2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 60 PAC 003 – CONSTITUTION OF INDIA | | | | | | | | |
| M.E STRUCTURAL ENGINEERING | | | | | | | | |
| Semester | Hours/Week | | | Total hrs | Credit | Maximum Marks | | |
| | L | T | P | | C | CA | ES | Total |
| II | 2 | 0 | 0 | 30 | 0 | 40 | 60 | 100 |

| | |
|---|---|
| **History of Making of The Indian Constitution**<br>History, Drafting Committee, (Composition & Working) | [3] |
| **Philosophy of The Indian Constitution**<br>Preamble, Salient Features | [3] |
| **Contours of Constitutional Rights and Duties**<br>Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties. | [6] |
| **Organs of Governance**<br>Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions. | [6] |
| **Local Administration**<br>District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayat raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. | [6] |
| **Election Commission**<br>Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women. | [6] |
| **Total Hours:** | **30** |

**TextBook(s):**


1. The Constitution of India,1950 (Bare Act),Government Publication.
2. Busi S N, Ambedkar B R, "Framing of Indian Constitution",1st Edition, 2015.


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| Reference(s): | |
|---|---|
| 1. | Jain, M P, “Indian Constitution Law”, 7th Edition, Lexis Nexis,2014 |
| 2. | Basu, D D, “Introduction to the Constitution of India”, Lexis Nexis, 2015. |
| 3. | Bhansali S R., “Textbook on The Constitution of India”, Universal Publishers, 2015 |
| 4. | Jain, M P., ”Outlines of Indian Legal and Constitutional History”, Lexis Nexis, 2014 |

## Course Contents and Lecture Schedule

| S.No. | Topics | No.of hours |
|---|---|---|
| **1.0** | **History of Making of The Indian Constitution** | |
| 1.1 | History | 1 |
| 1.2 | Drafting Committee, (Composition & Working) | 2 |
| **2.0** | **Philosophy of The Indian Constitution** | |
| 2.1 | Preamble, Salient Features | 3 |
| **3.0** | **Contours of Constitutional Rights and Duties** | |
| 3.1 | Fundamental Rights, Right to Equality, Right to Freedom | 1 |
| 3.2 | Right against Exploitation, Right to Freedom of Religion | 1 |
| 3.3 | Cultural and Educational Rights | 1 |
| 3.4 | Right to Constitutional Remedies | 1 |
| 3.5 | Directive Principles of State Policy, Fundamental Duties | 2 |
| **4.0** | **Organs of Governance** | |
| 4.1 | Parliament, Composition, Qualifications and Disqualifications | 2 |
| 4.2 | Powers and Functions, Executive | 1 |
| 4.3 | President, Governor, Council of Ministers | 1 |
| 4.4 | Judiciary, Appointment and Transfer of Judges | 1 |
| 4.5 | Qualifications, Powers and Functions | 1 |
| **5.0** | **Local Administration** | |
| 5.1 | District’s Administration head: Role and Importance Municipalities | 1 |
| 5.2 | Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation | 1 |
| 5.3 | Panchayat raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles | 1 |
| 5.4 | CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments) | 1 |
| 5.5 | Village level: Role of Elected and Appointed officials, Importance of grass root democracy | 2 |

## Course Designer

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