# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

## DEPARTMENT OF CIVIL ENGINEERING

### SCHEME OF INSTRUCTION & EXAMINATION

**(W.e.f Academic Year 2021-22)**

**M.E. (CIVIL Engineering)**

**I – Semester**

**Specialization in Structural Engineering**

| S. No. | Course Code | Category | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/ D | Contact Hours/Week | Maximum Marks | | Duration in Hours | |
| | | | | | | | | CIE | SEE | | |
| **Theory Course** | | | | | | | | | | | |
| 1 | P21MB111 | Mandatory Course | Research Methodology & IPR | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | P21SE101 | Program Core - I | Structural Dynamics | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 3 | P21SE102 | Program Core - II | Advanced Solid Mechanics | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 4 | - | Program Elective - I | Professional Elective – I | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 5 | - | Program Elective - II | Professional Elective – II | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 6 | - | Audit Course - I | Audit Course–I | 2 | 1 | - | 2 | 40 | 60 | 3 | 0 |
| **Practical/Laboratory Course** | | | | | | | | | | | |
| 7 | P21SE1L1 | Core Laboratory - I | Advanced Concrete Technology Lab | - | - | 3 | 3 | 50 | - | 3 | 1.5 |
| 8 | P21SE1P1 | Seminar | Seminar | - | - | 3 | 3 | 50 | - | 3 | 1.5 |
| **Total** | | | | **17** | **01** | **06** | **23** | **340** | **360** | **24** | **18** |

**L**:Lecture **T**:Tutorial **P:**Practical **D**:Drawing

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination

**Note:**

1. Each contact hour is a Clock Hour.
2. The practical class can be of three (clock hours) duration as per the requirement of a Particular Laboratory.
3. **Open Elective Subject is not offered to the students of civil department.

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## DEPARTMENT OF CIVIL ENGINEERING

### SCHEME OF INSTRUCTION & EXAMINATION

**(W.e.f Academic Year 2021-22)**

**M.E. (CIVIL Engineering)**

**II – Semester**

**Specialization in Structural Engineering**

| S.No. | Course Code | Category | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/ D | Contact Hours/ Week | Maximum Marks | | Duration in Hours | |
| | | | | | | | | CIE | SEE | | |
| **Theory Course** | | | | | | | | | | | |
| 1 | P21SE201 | Program Core – III | FEM | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | P21SE202 | Program Core - IV | Advanced Structural Analysis | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 3 | - | Program Elective – III | Professional Elective–III | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 4 | - | Program Elective - IV | Professional Elective-IV | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 5 | - | Audit Course - II | Audit Course–II | 2 | 1 | - | 3 | 40 | 60 | 3 | 0 |
| **Practical/Laboratory Course** | | | | | | | | | | | |
| 6 | P21SE2L1 | Core Laboratory - II | Structural Dynamics Lab | - | - | 3 | 3 | 50 | - | 3 | 1.5 |
| 7 | P21SE2L2 | Core Laboratory - III | Structural Design Lab-I | - | - | 3 | 3 | 50 | - | 3 | 1.5 |
| 8 | P21SE2P1 | PROJ | Mini Project | - | - | 6 | 3 | 40 | 60 | 3 | 3 |
| **Total** | | | | **14** | **01** | **12** | **24** | **340** | **360** | **24** | **18** |

**L**:Lecture **T**:Tutorial **P:**Practical **D**:Drawing

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination

**Note:**

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## DEPARTMENT OF CIVIL ENGINEERING

### SCHEME OF INSTRUCTION & EXAMINATION

**(W.e.f Academic Year2021-22)**

**M.E. (CIVIL Engineering)**

**III – Semester**

**Specialization in Structural Engineering**

| S.No. | Course Code | Category | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | Contact Hours/ Week | Maximum Marks | | Duration in Hours | |
| | | | | | | | | CIE | SEE | | |
| **Theory Course** | | | | | | | | | | | |
| 1 | - | Program Elective - V | Professional Elective-V | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | - | Open Elective | Open Elective | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 3 | P21SE3P1 | PROJ | Dissertation–I | - | - | 20 | 20 | 100 | - | 3 | 10 |
| **Total** | | | | **06** | **-** | **20** | **26** | **180** | **120** | **9** | **16** |

**L**:Lecture **T**:Tutorial **P:**Practical **D**:Drawing

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination

**Note:**

1. Each contact hour is a Clock Hour.
2. The practical class can be of three (clock hours) duration as per the requirement of a Particular Laboratory.
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## DEPARTMENT OF CIVIL ENGINEERING

### SCHEME OF INSTRUCTION & EXAMINATION

**(W.e.f Academic Year2021-22)**

**M.E. (CIVIL Engineering)**

**IV – Semester**

**Specialization in Structural Engineering**

| S.No. | Course Code | Category | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | Contact Hours/Week | Maximum Marks | | Duration in Hours | |
| | | | | | | | | CIE | SEE | | |
| **Theory Course** | | | | | | | | | | | |
| 1 | P21SE4P1 | PROJ | Dissertation–II | - | - | 32 | 32 | 50 | 150 | 3 | 16 |
| **Total** | | | | **-** | **-** | **32** | **32** | **50** | **150** | | **16** |

**L**: Lecture **T**:Tutorial **P:**Practical **D**:Drawing

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination

**Note:**

1. Each contact hour is a Clock Hour.
2. The practical class can be of three (clock hours) duration as per the requirement of a Particular Laboratory.
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# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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### List of subjects of Professional Electives I to V

| S. No. | Course Code | Course Title |
|---|---|---|
| 1 | P21SE103 | Advanced Reinforced Concrete Design |
| | P21SE104 | Theory of Plates |
| | P21SE105 | Theory of Shells and Folded Plates |
| 2 | P21SE106 | Bridge Engineering |
| | P21SE107 | Theory of Structural Stability |
| | P21SE108 | Advanced Concrete Technology |
| 3 | P21SE203 | Earthquake Resistant Design of Structures |
| | P21SE204 | Design of Pre-stressed Concrete Structures |
| | P21SE205 | Structural Optimization |
| 4 | P21SE206 | Retrofitting and Rehabilitation of Structures |
| | P21SE207 | Design of High-Rise Structures |
| | P21SE208 | Composite Construction |
| 5 | P21SE301 | Structural Health Monitoring |
| | P21SE302 | Advanced Steel Design |
| | P21SE303 | Fracture Mechanism in Concrete Structures |

### List of Open Electives

| S. No. | Course Code | Course Title |
|---|---|---|
| 1 | P21ME301 | Industrial Safety |
| 2 | P21MB311 | Business Analytics |
| 3 | P21EC301 | Embedded System Design |
| 4 | P21CE301** | Cost Management of Engineering Projects |
| 5 | P21EE309 | Waste to Energy |

**Note**:**Open Elective Subject is not to be offered to the students of civil department.

### List of subjects of Audit Course-I

| S. No. | Course Code | Course Title |
|---|---|---|
| 1 | P21CE101 | Disaster Management |
| 2 | P21EN102 | Sanskrit for Technical Education |
| 3 | P21EN103 | Value Education |
| 4 | P21EN101 | English for Research Paper Writing |

### List of subjects of Audit Course-II

| S. No. | Course Code | Course Title |
|---|---|---|
| 1 | P21EN201 | Constitution of India and Fundamental Rights |
| 2 | P21EN202 | Pedagogy Studies |
| 3 | P21EN203 | Stress Management by Yoga |
| 4 | P21EN204 | Personality Development through Life Enlightenment Skills |

# Semester-I

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21MB111** | **Research Methodology and IPR** | | | | | | **Mandatory Course** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

To make students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyse the collected data
5. Know about IPR copyrights

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyse problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

**UNIT - I**

**Research Methodology:** Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods Verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

**UNIT - II**

**Literature Survey and Report writing:** Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Need of Review, Guidelines for Review, Record of Research Review.

**Report writing:** Meaning of interpretation, layout of research report, Types of reports, Mechanism of writing a report. **Research Proposal Preparation**: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

**UNIT - III**

**Research Design:** Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

**UNIT - IV**

**Data Collection and Analysis:** Methods of data collection, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Importance of Parametric, non-parametric test, testing of variance of two normal populations, use of Chi-square, ANOVA, F-test, z-test

**UNIT - V**

**Intellectual Property Rights:** Meaning, Nature, Classification and protection of Intellectual Property, The main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

***Suggested Readings:***


1. C.R Kothari, Research Methodology, Methods & Technique‖; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers‖, MJP Publishers, 2011
3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation‖, Sterling Publications Pvt. Ltd., New Delhi, 2004
4. G.B. Reddy, Intellectual Property Rights and the Law 5th Ed. 2005 Gogia Law Agency
5. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications, Macmillan India Ltd, 2006

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE101** | **Structural Dynamics** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Study the various types as well as characteristics of loading and formulate the equations of motion.
2. Learn the response of un-damped and damped SDOF and MDOF systems under various loadings.
3. Employ the approximate and iterative methods to model continuous vibratory systems.
4. Use the seismic codes in analysis and design of civil engineering structures.
5. Understand the dynamic response by numerical methods.

**Course Outcomes**

After completing this course, the student will be able to:

1. Know the fundamental theory of dynamic equation of motions and analysis methods for dynamic systems.
2. Understand the modelling approach of dynamic response in civil engineering applications.
3. Create the simple computer models for engineering structures using knowledge of structural dynamics.
4. Evaluate the dynamic response analysis results and understand the possible error sources. Interpret the dynamic analysis results for design, analysis and research purposes.
5. Apply the structural dynamics theory to earthquake analysis, response, and design of structures.

**UNIT – I**

**Introduction to Structural Dynamics:** Objectives of dynamic analysis – Types of prescribed dynamic loading – Characteristics of a dynamic problem – Methods of discretization: Lumped mass Procedure / Consistent mass procedure/generalised displacements – Single Degree Freedom Systems – Formulation of Equation of Motion: D'Alembert's Principle / Method of Virtual Work / Hamilton's Principle – Influence of Gravity Forces and Ground Motion on equation of motion – Generalised SDOF systems: Rigid Body Assemblage/Distributed Flexibility.

**UNIT – II**

**Single Degree of Freedom Systems:** Response of Un-damped/Damped free vibrations of SDOF systems – Un-damped/Damped vibrations of SDOF systems subjected to Harmonic loading: Dynamic equilibrium / Accelero Meters / Displacement Meters / Resonant Response / Vibration Isolation – Un- damped / Damped vibrations of SDOF systems subjected Periodic loading – Response of SDOF systems subjected Impulse loads: Half-sine pulse/Rectangular pulse/Triangular Pulse/ Shock spectra / Approximate method of impulse load analysis – Un-damped / Damped vibrations of SDOF systems subjected General dynamic loading / Duhamel Integral - Un-damped / Damped vibrations of SDOF systems subjected arbitrary dynamic loading.

**UNIT – III**

**Multi Degree Freedom Systems:** Formulation of Equations of Motion / Evaluation of Lumped Mass Matrix and consistent mass matrix/ Evaluation of Stiffness Matrix.

**Un-damped Free Vibrations:** Analysis of Frequency matrix and mode shape matrices using detrimental equation/Flexibility Formulation/Orthogonality Conditions/ Normalizing Mode shapes/Analysis of Dynamic Response/Normal Coordinates/ Uncoupled Equations of Motion for un-damped systems/Conditions for damping orthogonality – Mode super position procedure for damped forced vibrations – Time History

Analysis – Direct Integration Methods due to New Mark(average acceleration, linear acceleration), Wilson theta correction.

**UNIT – IV**

**Practical Vibration Analysis:** Stodola Method, Holtzer Method – Fundamental mode only, Reduction of degrees of freedom, basic concepts in matrix iteration.

Variatio*nal Formulation of Equations of Motion: Generalized coordinates, Lagrange's Equations of Motion, Application to simple un-damped and damped problems of 2-DOF systems.*

***UNIT – V***

***Distributed Parameter Systems:*** *Partial Differential Equation of Motion – Beam Flexure (Elementary case) – Undamped free vibrations (Elementary case) – Analysis of dynamic response – normal coordinates. Earthquake Resistant Design: Brief exposure to relevant IS Codes of Practice, Response Spectra method.*

***Suggested Readings:***

1. *Walter C. Hurty & Moshe F. Rubinstein, (1964). Dynamics of Structures, Prentice Hall India.*
2. *Clough, Ray. W, and Penzien, Joseph (1982). Dynamics of Structures, McGraw Hill Company Limited, New Delhi.*
3. *Mario Paz, (1987). Structural Dynamics, CBS Publishers.*
4. *Chopra, A. K, (1996). Dynamics of Structures, Prentice Hall India.*

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| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE102** | **Advanced Solid Mechanics** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Understand the concepts of elasticity and equip them with the knowledge to independently handle the problems of elasticity.
2. Enhance the competency level and develop the self-confidence through quality assignments in theory of elasticity.
3. Inculcate the habit of researching and practicing in the field of elasticity.

**Course Outcomes**

After completing this course, the student will be able to:

1. Solve the problems of 3-D elasticity with confidence.
2. Work independently with the problems of 2-D elasticity in Cartesian/polar coordinates.
3. Familiarize with the use of Airy's stress function in 2-D problems of elasticity in Cartesian/polar coordinates.
4. Equip with the knowledge of various theories of torsion of prismatic bars of various cross sections and can solve the problems of torsion.
5. Interpret and apply the theory of elasticity to practical problems of structural engineering.

**UNIT – I**

**Introduction:** Definition and notation for forces and stresses, components of stress and strain, Generalized Hooke's law, Stress-strain relations in three directions, Plane stress and plane strain, Equations of equilibrium and compatibility in two and three dimensions, Stress components on an oblique plane, Transformation of stress components under change of co-ordinate system.

**UNIT – II**

**Principal stresses and principal planes:** Stress invariants, Mean and Deviator stress, Strain energy per unit volume, Distortion strain energy per unit volume, Octahedral shear stress, Strain of a line element. Principal strains, Strain invariants, Volume strain, Principle of superposition, reciprocal theorem.

**UNIT – III**

**Two dimensional problems in Cartesian co-ordinates:** Solution by polynomials, St. Venant's Principle, Uniqueness of solution, Stress components in terms of Airy's stress function. Applications to Cantilever, simply supported and fixed beams with simple loading.

**UNIT – IV**

**Two dimensional problems in Polar co-ordinates:** Stress-strain components, Equilibrium equations, Compatibility equations, Applications using Airy's strain functions in polar co-ordinates for stress distributions symmetric about an axis, Effect of hole on stress distribution in a plate in tension, Stress due to load at a point on a semi-infinite straight boundary, Stresses in a circular disc under diametrical loading.

**UNIT – V**

**Torsion:** Torsion of various shapes of bars, Stress function method of solution applied to circular and elliptical bars, Torsion of rectangular bars, Solution of Torsional problems by energy method, use of soap films in solving torsion problems, Prandtl's membrane analogy. Solution of torsion of rectangular bars by (i)Raleigh Ritz method and (ii) Finite difference method.

***Suggested Readings:***


1. Theory of Elasticity, S. Timoshenko & N. Goodier, Mc Graw Hill.
2. Theory of Elasticity, Valiappan, Mc Graw Hill.
3. Theory of Elasticity, Sadhu Singh, Khanna publishers

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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## Professional Elective-I

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21SE103 | **Advanced Reinforced Concrete Design** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the analysis and design of beams curved in plan and deep beams.
2. Design and detail the deep beams.
3. Analyse, design and detail the domes, water tanks, bunkers and silos.
4. Analyse and design the raft, pile and machine foundations.

**Course Outcomes**

After completing this course, the student will be able to:

1. Design the beams curved in plan and deep beams.
2. Propose the deep beams, domes and various type water tanks.
3. Differentiate and design the bunkers.
4. Differentiate and design the silos.
5. Formulate the raft, pile and machine foundations.

**UNIT-I**

**Beams Curved in Plan:** Introduction - design principles – Terminologies, structural design of beams curved in plan of circular and rectangular type.

**UNIT-II**

**Deep Beams:** Introduction to deep beams, Flexural and Shear stresses in deep beams, IS Code provisions - design of deep beams.

**UNIT-III**

**Domes:** Introduction - Stresses and forces in domes - design of spherical and conical domes.
**Water Tanks**: Types, Codal specifications, Design of circular, rectangular and Intze type water tanks.

**UNIT-IV**

**Bunkers and Silos:** Introduction - Design principles and theories Code provisions - design of square and circular bunkers - design of cylindrical silos. IS specifications.

**UNIT-V**

**Raft and Pile Foundations:** Introduction, need for the design, Design principles - Structural design of raft and pile foundations including the design of pile caps.
**Machine Foundations:** Introduction, Types, Design Principles, Case studies, detailed designs.

***Suggested Readings:***


1. "Advanced Reinforced Concrete Design", by N. Krishna Raju, CBS Pub. 1986.
2. "Reinforced Concrete", by H.J. Shah, Charotar Pub. Vol. II. 2000.
3. "R.C.C. Designs" by B.C. Punmia, Laxmi Pub. 1998.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE104** | **Theory of Plates** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **Theory of Elasticity** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the analysis of rectangular and circular plates subjected to various loading conditions with different boundary conditions.
2. Understand fundamentals of buckling of plates.
3. Know the concepts of small deflection theory of laterally loaded plates.
4. Study the approximate methods of analysis of rectangular plates.
5. Derive the governing differential equations for orthotropic plates and apply them to practical problems.

**Course Outcomes**

After completing this course, the student will be able to:

1. Analyse the rectangular and circular plates subjected to various loading conditions.
2. Decipher the problems of buckling of plates with different edge conditions.
3. Work out the problems of small deflection theory of laterally loaded plates with different edge conditions.
4. Understand the various numerical and approximate methods for analysis of plate problems.
5. Apply the concepts of orthotropic plates to simply supported structures.

**UNIT-I**

**Bending of Rectangular Plates:** Pure and Cylindrical bending, differential equation, cylindrical bending of uniformly loaded rectangular plates with simply supported and built-in edges. Relations between slope and curvature of slightly bent plates, Moment-curvature relations in pure bending. Strain energy in pure bending.

**Bending of circular plates:** Symmetrical bending, differential equation of equilibrium, uniformly loaded plates at center, Circular plates with circular holes at the center.

**UNIT-II**

**Buckling of Plates:** Differential equation for bending of plate under the combined action of in-plane loading and lateral loading, Calculation of critical loads, buckling of simply supported rectangular plates uniformly compressed in one and two directions with different edge conditions.

**UNIT-III**

**Small deflections of laterally loaded plates:** Differential equation of equilibrium, Boundary conditions, Solution of simply supported rectangular plates under various loading conditions viz. uniformly distributed load (full or partial), concentrated load by Navier's approach, Levy type solution for rectangular plates under U.D.L with all four edges simply supported or two opposite edges simply supported and other two fixed.

**UNIT-IV**

**Approximate methods for Rectangular Plates:** Finite difference method for simply supported or fixed rectangular plates carrying UDL (full or partial) or central point load, Strain energy approaches Rayleigh-Ritz method.

**UNIT-V**

**Bending of Orthotropic Plates:** Differential equation of the bent plate. Application of the theory to simply supported rectangular (i) laminates; (ii) RC slabs (iii) grids.

***Suggested Readings:***

1. Theory of plates and shells, S. Timoshenko and W. Krienger, McGraw Hill.
2. Theory of plates and shells, R.H. Wood.
3. Theory of plates and shells, Zienkiwicz, McGraw Hill Co.

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| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE105** | **Theory of Shells and Folded Plates** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **Theory of Elasticity** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the analysis and design of cylindrical shells, short and long shells.
2. Study the concepts of bending theory using D.K.J. equations and Schorer theory.
3. Understand the beam theory and beam arch analysis.
4. Gain knowledge of the analysis and design of different shells of double curvature and axi-symmetrical shells by membrane theory.
5. Analyse different types of folded plates using Simpson's and Whitney's methods.

**Course Outcomes**

After completing this course, the student will be able to:

1. Analyse the cylindrical shells and design the short and long shells.
2. Solve the problems of bending theory using appropriate equations.
3. Evaluate and design the different shells using beam theory and membrane theory.
4. Analyse the numerous types of folded plates using pertinent method.
5. Analyse the types of structural behavior and plate deflections.

**UNIT-I**

**Introduction:** definition and classification of shells.

**Cylindrical Shells:** Membrane Theory – Equilibrium equations for differential shell elements – Calculation of stresses and displacement due to dead loads and snow loads for circular cylindrical shell.

**UNIT-II**

**Bending Theory:** Necessity of bending theory (i) D.K.J theory Assumption – Equilibrium equations for a differential element - stress strain relations - Moment curvature relations – Derivation of D.K.J. Differential and characteristics equations – Roots of the Characteristic equation – Expression for defection. (ii) Schorer theory – assumptions – Equilibrium equations for a differential shell element – stress strain relations – Moment curvature relations – Derivation of Schorer differential and characteristic equation – Roots of the characteristic equation – Expression of defection.

**UNIT-III**

**Beam Theory of cylindrical shells:** Assumptions and range of their validity – Outline of the beam arch analysis – Advantages of beams theory over other theories.

**UNIT-IV**

**Shells of Doubles Curvature:** Membrane theory of shells of revolution- Equilibrium equations for a differential shell element – Calculation of stresses in a spherical dome due to uniform load over the surface and due to concentrated load around a skylight opening. Shells of translation equilibrium equations for a differential shell element. Pucher's stress function, derivation of a differential equation from equations of equilibrium using Pucher's stress function calculation of stresses in hyperbolic parabolids with straight edges under uniform load over the surface.

**UNIT-V**

**Folded Plates:** Assumptions – Structural behavior – Resolutions of ridge loads – Edge shears – Stress distribution – Plate deflections and rotations. Effect of joint moments – Analysis of V shaped folded plates using (i) Simpson and (ii) Whitney methods.

***Suggested Readings:***

1. Theory of plates and shells, S. Timoshenko and W. Krienger, Mc Graw Hill.1959
2. Design and construction of concrete shell roofs, G.S. Ramaswamy, CBS Pub 1986
3. Thin Shells Theory and Problems, J. Ramchandran, Universities press, 1993.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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## Professional Elective-II

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE106** | **Bridge Engineering** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the hydraulic, geological and geo-technical aspects in bridge design.
2. Analyse, design and detail the bridge deck and box girder systems, steel and composite bridges.
3. Analyse and design the sub-structures, bridge bearings and various long span bridges.

**Course Outcomes**

After completing the course, the students will able to

1. Understand the fundamentals and codes of practice of bridge design.
2. Design the bridge deck and box girder systems using appropriate method.
3. Devise the steel truss and composite steel-concrete bridges.
4. Propose the sub-structure components such as pier, abutments, etc. and bridge bearings.
5. Design the various types of long span bridges, curved and skew bridges.

**UNIT – I**

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

**UNIT – II**

**Concrete Bridges:** Bridge deck and approach slabs, Slab design methods, design of bridge deck systems, slab-beam systems (Guyon-Massonet and Hendry Jaeger Methods), box girder systems, analysis and design. Detailing of box girder systems.

**UNIT – III**

**Steel and Composite Bridges:** Introduction to composite bridges, Advantages and disadvantages, Orthotropic decks, box girders, composite steel-concrete bridges, analysis and design, truss bridges.

**UNIT – IV**

**Sub-Structure:** Piers, columns and towers, analysis and design, shallow and deep foundations, caissons, abutments and retaining walls. **Bridge appurtenances:** Expansion joints, design of joints, types and functions of bearings, design of elastomeric bearings, railings, drainage system, lighting.

**UNIT – V**

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

***Suggested Readings:***

1. "Bridge Engineering Handbook", Wai-Fah Chen Lian Duan, CRC Press, USA, 2000.
2. "Design of Highway Bridges", Barker, P.M. and Puckett, J.A., John Wiley & Sons, New York, 1997.
3. "Theory and Design of Bridges", Xanthakos, P.P., John Wiley & Sons, New York, 1994.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE107** | **Theory of Structural Stability** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the buckling of columns, analysis using equilibrium, energy and approximate methods.
2. Know the stability analysis of beam-columns and frames with different loads.
3. Analyse for torsional, flexural and lateral buckling of beams.
4. Perform the buckling analysis of thin plates using different approaches.
5. Study the inelastic buckling analysis of plates.

**Course Outcomes**

After completing this course, the student will be able to:

1. Understand the analysis of buckling of columns using appropriate method.
2. Analyse the practical problems of beam-columns and frames.
3. Analyse the beams for torsional, flexural and lateral buckling.
4. Perform buckling analysis of thin plates.
5. Analyse the plates for inelastic buckling and understand the post-buckling behaviour of plates.

**UNIT-I**

**Buckling of columns:** States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkin's approach - Numerical Techniques - Finite difference method - Effect of shear on buckling.

**UNIT-II**

**Buckling of beam-columns and frames:** Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway - Moment distribution - Slope deflection and stiffness method.

**UNIT-III**

**Torsional and lateral buckling:** Torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported beam and cantilever beam.

**UNIT-IV**

**Buckling of plates:** Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach - Approximate and Numerical techniques.

**UNIT-V**

**Inelastic buckling:** Double modulus theory - Tangent modulus theory – Shanley's model – Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behavior of plates

***Suggested Readings:***

1. Timoshenko, S., and Gere., Theory of Elastic Stability, McGraw Hill Book Company, 1963.
2. Chajes, A. Principles of Structures Stability Theory, Prentice Hall, 1974.
3. Ashwini Kumar, Stability Theory of Structures, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1995.
4. Iyenger.N.G.R., Structural stability of columns and plates, Affiliated East West Press,1986.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE108** | **Advanced Concrete Technology** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

The objective of this course is to impart knowledge of

1. Learn the concept of cement and its properties, mechanical and thermal properties of aggregates.
2. Study the properties and testing of concrete in fresh and hardened state.
3. Learn the shrinkage and creep mechanisms, curing and durability of concrete.
4. Design concrete mix by various methods as per different codes.
5. Study the different types of admixtures, mix design, properties and applications of special concretes.

**Course Outcomes**

After completing this course, the student will be able to:

1. Learn hydration of cement and tests on properties of cement and aggregates.
2. Comprehend the properties and testing of concrete in fresh and hardened state.
3. Understand the shrinkage and creep mechanisms, curing and durability of concrete.
4. Design concrete mixes by various methods.
5. Familiarize with the types of admixtures, and applications of special concretes.

**UNIT - I**

**Cement:** Types of cement and their composition, manufacture of Portland cement, hydration of cement and hydration product, structure of hydrated cement, heat of hydration, gel theories, review of tests on properties of cement.

**Aggregate:** Classification of aggregates, particle shape and texture, bond and strength of aggregate and its influence on strength of concrete, porosity, absorption and moisture content and their influence, soundness of aggregate, alkali aggregate reaction, sieve analysis and grading of aggregate, review of tests on properties of aggregate.

**UNIT - II**

**Properties of Concrete:** Mixing and batching, workability, factors affecting workability, measurements of workability, various tests and procedures, segregation and bleeding, vibration of concrete, types of vibrators and their influence on composition, analysis of fresh concrete, strength of concrete, water-cement ratio, gel space ratio, effective water in the mix, mechanical properties of concrete, tests and procedure, influence of various parameters on strength of concrete, relationship between various mechanical strengths of concrete.

**UNIT - III**

**Shrinkage and Creep of Concrete:** Types of shrinkage, mechanism of shrinkage, factors affecting shrinkage, creep mechanism, factors influencing creep, rheological model, effects of creep.

**Curing of Concrete:** Methods of curing, maturity concept, influence of temperature on strength of concrete.

**Durability of Concrete:** Permeability of concrete, chemical attack of concrete, tests on sulphate resistance, effect of frost, concreting in cold weather, hot weather concreting, and air entrained concrete.

**UNIT - IV**

**Mix Design of Concrete:** Basic considerations, process of mix design, factors in the choice of mix proportions and their influence, quality control, various methods of mix design, I.S. Code method, British and ACI methods.

**UNIT - V**

**Admixtures:** Classification of admixtures, chemical and mineral admixtures, influence of various admixtures on properties of concrete, their applications. Fly Ash Concrete: Mix design, properties and its applications. High Strength Concrete: Mix design, properties and its applications. Fiber Reinforced Concrete: Mix design, properties and its applications. Ferro cement, lightweight concrete, high-density concrete, recycled aggregate concrete and their applications.

***Suggested Readings:***

1. Neville. A.M, (1988), Properties of Concrete, English Language Book Society/Longman Publications.
2. Mehta. P.K and Paulo. J.M.M, (1997), Concrete – Microstructure – Properties and Material, McGraw-Hill.
3. Krishna Raju. N., (1985), Design of Concrete Mix, CBS Publications

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

## Audit Course-I

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21CE101** | **Disaster Management** | | | | | | **Audit I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | - |

**Course Objectives**

1. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
2. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
3. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response
2. Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response
4. Develop an understanding of standards of practical relevance inspecific types of disasters and conflict situations.
5. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

**UNIT-I**

**Introduction:** Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**UNIT-II**

**Repercussions of Disasters and Hazards**: 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.

**UNIT-III**

**Disasters Prone Areas in India:** 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

**UNIT-IV**

**Disaster 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.

**UNIT-V**

**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. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

***Suggested Readings:***

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal Book Company.
2. Sahni, Pardeep (Eds.), "Disaster Mitigation Experiences and Reflections", PHI, New Delhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21EE101** | **Sanskrit for Technical Knowledge** | | | | | | **Audit I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

**UNIT-I**

**Introduction to Sanskrit Language:** Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of Speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive Voice-Past/Present/Future Tense-Syntax-Simple Sentences (elementary treatment only)

**UNIT-II**

**Role of Sanskrit in Basic Sciences:** Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba, sutram or baudhayana theorem (origination of Pythagoras theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).

The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of Michaelson and Morley theory).

**UNIT-III**

**Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):**

Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

**UNIT-IV**

**Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology):** Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

**UNIT-V**

**Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering):** Classification of plants- plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout- equipment-distillation vessel-kosthi yanthram.

***Suggested Readings:***

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. M.R. Kale, A Higher Sanskrit Grammar: For the Use of School and College Students, Motilal Banarsidass Publishers, 2015.
3. Kapail Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN- 10: 8171880649, 1994.
4. Pride of India, Samskrita Bharati Publisher, ISBN: 81-87276 27-4, 2007.
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers, 2005.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21EN102** | **Value Education** | | | | | | **Audit I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

1. Understand the need for and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

**Course Outcomes**

After completion of the course, students will be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day-to-day professional life.
3. Appreciate the need for and importance of interpersonal skills for successful career and sociallife
4. Emphasize the role of personal and social responsibility of an individual for all-roundgrowth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

**UNIT-I**

**Human Values, Ethics and Morals:** Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

**UNIT-II**

**Value Cultivation, and Self-management:** Need for and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

**UNIT-III**

**Spiritual outlook and social values:** Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

**UNIT-IV**

**Values in Holy Books:** Self-management and Good health; internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

**UNIT-V**

**Dharma, Karma and Guna:** Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

***Suggested Readings:***

1. Chakroborty, S.K., Values & Ethics for organizations Theory and practice‖, Oxford University Press, New Delhi, 1998.
2. Jaya Dayal Goyandaka, Srimad Bhagavad Gita with Sanskrit Text, Word Meaning and Prose Meaning‖, Gita Press, Gorakhpur, 2017.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21EN101** | **English for Research Paper Writing** | | | | | | **Audit I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

1. Understand that how to improve your writing skills and level of readability
2. Understand the nuances of language and vocabulary in writing a Research Paper.
3. Develop the content, structure and format of writing a research paper.
4. Produce original research papers without plagiarism

**Course Outcomes**

After completing this course, the student will be able to:

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

**UNIT - I**

**Academic Writing:** Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits, Limitations – outcomes.

**UNIT - II**

**Research Paper Format:** Title – Abstract – Introduction – Discussion – Findings, Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

**UNIT - III**

**Research Methodology:** Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

**UNIT - IV**

**Process of Writing a research paper:** Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

**UNIT - V**

**Research Paper Publication:** Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – Advantages/Benefits

**Presentation Skills:** Developing Persuasive Presentations, Structure of Presentation, Presentation Slides, Presentation Delivery, role of the audience, what to search and cite, how to establish credibility.

***Suggested Readings:***

1. C. R Kothari, Gaurav, Garg, ―Research Methodology Methods and Techniques‖, 4/e, New Age International Publishers.
2. Day R, ―How to Write and Publish a Scientific Paper**",** Cambridge University Press, 2006
3. MLA Hand book for writers of Research Papers‖, 7/e, East West Press Pvt. Ltd, New Delhi
4. Lauri Rozakis, Schaum's, Quick Guide to Writing Great Research Papers‖, Tata McGraw Hills Pvt. Ltd, New Delhi.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21SE2L1 | **Advanced Concrete Lab** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **-** | **-** | **-** | **3** | **50** | **-** | **1.5** |

**Course Outcomes**

After completing this course, the student will be able to:

1. Understand the rheology of special Concrete- fly ash-based Concrete- geo-polymer Concrete and Fiber Reinforced Concrete.
2. High strength – Mix design.
3. Conduct cube, cylinder strength and modulus of rupture of high strength.
4. Conduct of NDT of concrete.
5. Understanding the importance of Destructive and Non-Destructive tests.

**List of Experiments**

1. To design the mix for High Strength Concrete.
2. To determine fresh properties of High Strength Concrete.
3. Study of stress-strain curve of high strength concrete, correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
4. Behavior of beams under flexure and shear.
5. Mix proportion on fly-ash based concrete for compressive strength.
6. Mix proportion on Geo-polymer concrete for compressive strength.
7. Mix proportion on FRC for compressive strength.
8. Cube compressive strength of fly-ash and geo polymer concrete.
9. Split tensile strength and modulus of rupture for fly-ash concrete/geo-polymer concrete.
10. Development of correlation between Non-Destructive and Destructive Tests using Rebound Hammer and UPV instruments

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21SE1P1 | **Seminar** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | - | - | - | **3** | **50** | - | **1.5** |

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Develop the habit of referring the journals for literature review.
2. Understand the gist of the research paper.
3. Identify the potential for further scope.
4. Present the work in an efficient manner.
5. Write the documentation in standard format.

Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

**The seminar must be clearly structured, and the power point presentation shall include following aspects:**

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

**Each student is required to:**

1. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
2. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the Department.

| **Guidelines for awarding marks** | | |
|---|---|---|
| **S. No.** | **Description** | **Max. Marks** |
| 1 | Contents and relevance | 10 |
| 2 | Presentation skills | 10 |
| 3 | Preparation of PPT slides | 05 |
| 4 | Questions and answers | 05 |
| 5 | Report in a prescribed format | 20 |

**Note:**

1. The seminar presentation should be a gist of at least five research papers from **Peer-reviewed** or **UGC recognised** journals.
2. **The seminar report should be in the following order:** Background of work, literature review, techniques used, prospective deliverables, discussion on results, conclusions, critical appraisal and reference.
3. At least two faculty members will be associated with the seminar presentation to evaluate and award marks.
4. Attendance of all the students for weekly seminar presentations is compulsory. If the student fails to secure minimum attendance as per O.U. rules, the marks awarded in the seminar presentation shall remain void.

# Semester-II

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21SE201 | **Finite Element Methods** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

The objective of this course is to impart knowledge of

1. Learn the rudiments of finite element analysis.
2. Study the fundamentals of domain discretization, interpolation, application of boundary conditions, assembly of global matrices, and solution of the resulting algebraic systems.
3. Explain the core concepts of variational and weighted residual methods in FEM.
4. Derive the element stiffness matrix for 1-D, 2-D and 3-D problems.
5. Formulate the simple structural problems in to finite elements.

**Course Outcomes**

After completing this course, the student will be able to:

1. Build and analyse the FEA models for various engineering problems.
2. Identify the information requirements and sources for analysis, design and evaluation.
3. Use the standard finite element software to solve the structural engineering problems.
4. Interpret the results obtained from FEA software, not only in terms of conclusions but also awareness of limitations.

**UNIT – I**

**Introduction to FEM:** Types of Problems – Types of Materials – Elastic / Inelastic situations – Types of forces: Body forces / Surface Traction / Point loads – Deformable bodies – Types of Deformations – Homogeneous / Non homogeneous Problems – Equations of equilibrium for elastic 2-D / 3-D continua - Equilibrium equations for 2-D / 3-D boundary elements – Boundary conditions – Strain-displacement relation for 2-D / 3-D – Stress-strain relation for 2-D / 3-D – Plane stress / Plane strain problems.

**Virtual Work Formulation:** Application to problems of plane trusses with static indeterminacy not exceeding three.

**Finite Difference Method with Central Differences:** Solving ODE's and PDE's with central differences. Application to beam and plate bending problems of simple geometry.

**UNIT – II**

**Variational Formulation:** Finite Element Formulation - Stationarity of Functional – Given the Functional or Differential equation – Number of elements limited to two.

**Elements:** Strain-displacement relation matrix / stiffness matrix / Minimum Potential Energy Approach / Rayleigh-Ritz Method / introduction to natural coordinates / stiffness matrix of second order bar element / Axial bar subjected to point loads, body forces and surface traction forces / Problems with kinematic indeterminacy not exceeding two.

**Triangular Elements:** Displacement models / criterion for convergence / geometric invariance / conforming and non-conforming elements - 3-node triangular elements (CST) / determination of strain- displacement matrix / area coordinates-shape functions / determination of element stiffness and load matrices, assembling global stiffness and load matrices / Problems with kinematic indeterminacy not exceeding three.

**2nd Order triangular elements:** Shape functions – degradation technique / strain-displacement matrix / Expression for stiffness matrix / Load matrices due to body forces and surface traction.

**UNIT – III**

**Iso-parametric elements:**

**Quadrilateral elements:** Construction of shape functions using natural coordinates/Strain-displacement matrices/Load matrices for body force and surface traction/ Expressions for stiffness matrix, load matrices for 4-noded quadrilateral elements/ Gauss Quadrature of numerical integration / Problems with rectangular elements, kinematic indeterminacy not exceeding three.

**2nd Order Quadrilateral elements:** Determination of shape functions for 2nd order quadrilateral elements and for elements of with serendipity / Strain-displacement matrices / Load matrices for body force and surface traction.

**UNIT – IV**

**Method of Weighted Residuals:**

**Galerkin's Method of Weighted Residuals:** Application to problems of mathematics / structural engineering, number of trial functions not exceeding two.

**Galerkin's Finite Element Method:** Weak form of Trial Function - Application to problems of mathematics / structural engineering, number of elements limited to two.

**Axi-symmetric Problems:** Strain-displacement relationship/stress-strain relationship / determination of stiffness matrix for 3-noded ring element and load matrices for body force and surface traction/ Problems with kinematic indeterminacy not exceeding three for 3-noded ring elements only.

**UNIT – V**

**Tetrahedron elements:** Volume coordinates, Strain-displacement matrix, stiffness matrix, load matrices due to body force and surface traction/ introduction to Hexahedron (brick) elements.

**Non-linear Finite element analysis:** Introduction – problems with material non-linearity – problems with geometric non-linearity – problems with both material and geometric non-linearity.

**Introduction to MSC Nastran:** Illustration on different modules of Nastran / Structural engineering applications of the package/Creation of a simple 1-D model, 2-D model and a 3-D model/ analysis and post processing of the results.

***Suggested Readings:***


1. Cook, R. D. (1981). Concepts and Application of Finite Element Analysis, John Wiley and Sons.
2. Zienkiewicz, O. C. And Taylor, R. L, (1989). The Finite Element Method, Vol.1, McGraw Hill Company Limited, London.
3. Reddy, J. N, (1993). An Introduction to the Finite Element Method, McGraw Hill, New York.
4. Chandrupatla, T. R. And Belegundu, A. D, (2001). Introduction to Finite Elements in Engineering, Prentice Hall of India, New Delhi.
5. Seshu. P, (2003). Finite Element Analysis, Prentice Hall of India Private Limited, New Delhi.
6. David V. Hutton, (2005). Fundamentals of Finite Element Analysis, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Bathe, K. J, (2006). Finite Element Procedures, Prentice Hall of India, New Delhi.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE202** | **Advanced Structural Analysis** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Understand the concepts of matrix methods of analysis and equip them with the knowledge to independently handle the problems of structural analysis.
2. Enhance the competency level in analysis of continuous beam, portal frames, pin jointed structures by flexibility and stiffness matrix methods.
3. Understand the formation of global stiffness matrix from local stiffness matrix and equation solving techniques using direct stiffness method.
4. Gain an insight into the nonlinear analysis of structures.
5. Learn the concepts of beams on elastic foundation.

**Course Outcomes**

After completing this course, the student will be able to:

1. Analyse the continuous beams, rigid jointed frames and pin jointed structures by stiffness method.
2. Analyse the continuous beams, rigid jointed frames and pin jointed structures by flexibility method.
3. Formulate the element and global stiffness matrices by direct stiffness method and learn equation solution techniques.
4. Understand and differentiate between the linear and nonlinear analyses.
5. Solve the problems pertaining to beams on elastic foundation.

**UNIT-I**

**Introduction to Matrix Methods of Analysis:** Static indeterminacy and kinematic indeterminacy, Coordinate systems, displacement and force transformation matrices, element and structure stiffness matrices, equivalent joint loads and fixed end forces.

**Stiffness Method:** Stiffness of prismatic member, Analysis of bar element, plane truss, continuous beams, plane frames and grid frames, also dealing with effect of settlements, internal hinges and guided fixed end supports.

**UNIT-II**

**Flexibility Method:** Flexibility of prismatic member, Analysis of bar element, plane truss, continuous beams, plane frames and grid frames, also dealing with effect of settlements, internal hinges and guided fixed end supports.

**UNIT-III**

**Direct Stiffness Method:** Assemblage of global stiffness matrix, Analysis of plane truss, continuous beams, plane frame and grid frames, also dealing with effect of settlements, internal hinges and guided fixed end supports.

**UNIT-IV**

**Introduction to Nonlinear Analysis:** Geometric and material nonlinearity, P-Δ effect, Effects of axial force on flexural stiffness – buckling of ideal columns, buckling behaviour of real columns,

**Beam Column:** Flexural behaviour of beam columns, flexural stiffness measures for braced prismatic beam

columns, effect of axial tension, flexural stiffness measures for unbraced prismatic beam columns. Slope-deflection method of analysis – slope deflection equations for prismatic beam-columns, fixed end moments in beam-columns. Matrix method of Analysis – Stiffness matrix for prismatic beam column elements, estimation of critical elastic buckling loads, second order analysis.

**UNIT-V**

**Beams on Elastic Foundations:** Introduction-Modulus of foundation & Basic equation. Beams of infinite length under concentrated & uniformly distributed loads, Analysis of semi-infinite beams making use of functions for infinite beams.

***Suggested Readings:***

1. Advanced Structural Analysis by Ashok. K. Jain, New Channel Brothers.
2. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
3. Asslam Kassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
4. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
5. William Weaver, Jr & James M. Gere, Matrix Analysis of Framed Structures, CBS Publishers & Distributors, Delhi. 2. Wang C.K., Matrix methods of Structural Analysis Mc Graw Hill book Company, New Delhi. 3.
6. Advanced mechanics of solids & structures, N. Krishna Raju, D.R Gururaja Narosa publishing house New Delhi.
7. Advanced Mechanics of Materials, Seely and Smith

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

### Professional Elective - III

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE203** | **Earthquake Resistant Design of Structures** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the causes of earthquake and effects of ground motion and modelling of structures.
2. Study the response spectra and structural dynamics of MDOF systems.
3. Discover the different analysis and design approaches like equivalent lateral force method and inelastic time history analysis.
4. Be trained in the ductile detailing of reinforced concrete structures as per IS 4326 and IS 13920.
5. Learn the seismic analysis of masonry buildings.

**Course Outcomes**

After completing this course, the student will be able to:

1. Apply the concepts of structural dynamics of MDOF systems for analysis of structures.
2. Model and analyse the structures to resist earthquake forces by different methods.
3. Design the various structural elements resisting earthquake forces as per IS Codes.
4. Practice ductile detailing of reinforced concrete and masonry buildings as per codal provisions.

**UNIT-I**

**Earthquake Ground Motion:** Engineering seismology, Seismic zoning map of India, Strong motion studies in India, Strong motion characteristics, Evaluation of seismic design parameters.

**Structural Dynamics:** Initiation into structural dynamics, Dynamics of SDOF systems, Theory of seismic pickup, Numerical evaluation of dynamic response, Response spectra, Dynamics of MDOF systems.

**UNIT-II**

**Concepts of Earthquake Resistant Design of RCC Structures:** Basic elements of earthquake resistant design, Identification of seismic damages in RCC buildings, Effect of structural irregularities on performance of RCC buildings during earthquakes, earthquake resistant building architecture.

**UNIT-III**

**Seismic Analysis and Modelling of RCC Structures:** Code based procedure for determination of design lateral loads, Infill walls, Seismic analysis procedure as per IS 1893 code, Equivalent static force method, Response spectrum method, Time history analysis, Mathematical modelling of multi-storey RCC buildings.

**UNIT-IV**

**Earthquake Resistant Design of RCC Structures:** Ductility considerations, Earthquake resistant design of multi-storey RCC buildings and shear walls based on IS 13920 code, Capacity based design.

**UNIT-V**

**Earthquake Resistant Design of Masonry Structures:** Identification of damages and non-damages in masonry buildings, Elastic properties of structural masonry, Lateral load analysis of masonry buildings, Seismic analysis and design of one-storey and two-storey masonry buildings.

***Suggested Readings:***

1. Bruce A Bolt, Earthquakes, W H Freeman and Company, New York, 2004.
2. C. A. Brebbia, Earthquake Resistant Engineering Structures, WIT Press, 2011.
3. Mohiuddin Ali Khan, Earthquake-Resistant Structures: Design, Build and Retrofit, Elsevier Science & Technology, 2012.
4. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall of India, 2009.
5. Paulay, T and Priestley, M.J.N., Seismic Design of Reinforced Concrete and Masonry buildings, John Wiley and Sons, 1992.
6. S K Duggal, Earthquake Resistant Design of Structures, Oxford University Press, 2007.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE204** | **Design of Prestressed Concrete Structures** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

The objective of this course is to impart knowledge of

1. Learn the concept of pre-stressed concrete, methods and systems of pre-stressing, losses of pre-stress.
2. Analyse and design the sections for flexure, torsion and shear using different methods.
3. Learn the design of sections for bond and anchorage and deflections of pre-stressed concrete beams.
4. Study the analysis and design of statically indeterminate beams.

**Course Outcomes**

After completing this course, the student will be able to:

1. Familiarize with fundamentals of pre-stressed concrete, methods and systems of pre-stressing and losses of pre-stress.
2. Analyse and design the sections for flexure, shear bond and anchorages.
3. Estimate the deflections of pre-stressed concrete elements.
4. Know the circular pre-stressing, analysis and design of statically indeterminate beams.
5. Solve the problems pertaining to axial members, slabs and grid floors.

**UNIT-I**

**Introduction:** Basic concepts, materials, permissible stress – Advantages and types of prestressing, Systems and devices of pre-stressing and post-tensioning, Prestressing steel

**Losses in pre-stress:** Loss of prestress in pre-tensioned and post-tensioned members – Analysis of sections for flexure

**UNIT-II**

**Deflections:** Importance of deflections, factors influencing deflections, codal provisions, short term and long term deflections.

**Shear:** Shear in principal stresses – cracked and un-cracked sections - codal provisions – Design of shear reinforcement.

**Torsion:** Torsion for cracked and un-cracked sections, codal provisions and design.

**UNIT-III**

**End Blocks:** Nature of stresses, Stress distribution – IS Code Method -codal provisions - Design.

**Continuous beams:** Advantages of Continuous members – Code provisions – Design of two span Continuous beams – concordant cable profiles.

**UNIT-IV**

**Tension Members:** Introduction, Ties, Circular pre-stressing – Design of PSC pipes.

**Compression Members:** Introduction – Design of PSC columns.

**UNIT-V**

**Slabs:** Introduction – Types – rectangular and flat slabs – Codal provisions – Design of PSC floor slabs - one way and two way slabs, and simple flat slabs. Grid Floors: Introduction.

***Suggested Readings:***

1. Prestressed Concrete‖ by N. Krishna Raju, Tata Mc Graw Hill, 2001.
2. Prestressed Concrete‖ by G.S. Pandit and S.P. Gupta, CBS Pub., 1995.
3. Design of prestressed Concrete‖ by Arthur H. Nilson, John Wiley, 1987

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE205** | **Structural Optimization** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the optimization techniques and linear optimization.
2. Study the non-linear optimization and non-linear constrained optimization.
3. Understand the dynamic programming, decision theory and simulations.
4. Apply optimization techniques for simple structures.

**Course Outcomes**

After completing this course, the student will be able to:

1. Become confident at optimization techniques, linear optimization, algorithm, etc.
2. Learn the nonlinear optimization and one dimensional minimization methods.
3. Study the non-linear optimization-II by different methods.
4. Use the optimization techniques for simple structures.

**UNIT – I**

**Introduction to optimization:** Introduction, basic theory and elements of Optimization, Terminology and definitions, Basic principles and procedure of optimization, Engineering applications of Optimization.

**Classical Methods of Optimization:** Trial and error method, Monte-Carlo method, Lagrangian multiplier method, illustrative examples

**Linear Programming:** Introduction, terminology, formulation of LPP, graphical and algebraic methods of solving LPP, standard form and canonical form of linear programming, geometrical interpretation, illustrative examples.

**UNIT – II**

**Linear Programming:** Simplex methods, Artificial variable techniques, solution of simultaneous equations, Dual formulations - illustrative examples.

**Network analysis:** Modifications and improvements on CPM/PERT

**Transportation and Assignment problem:** Introduction, terminology, formulation and solution of mathematical models, illustrative examples.

**UNIT – III**

**Non-Linear Programming:** local and global optimum, problem formulation, Unconstrained and constrained methods of Optimization-Kuhn Tucker conditions, Lagrangian Multiplier methods, graphical method, Univariate search method, Steepest Descent Methods, quadratic programming problem, Wolfs modified simplex method, illustrative examples.

**UNIT – IV**

**Dynamic programming:** Introduction, terminology, need and characteristics of dynamic programming, formulation, solution of LPP, applications, illustrative examples

**Decision theory:** Introduction, types, decision trees.

**Simulation:** Introduction, advantages, limitations, types, applications.

**UNIT – V**

**Structural Optimization:** Optimum structural design of rectangular timber beam, reinforced concrete rectangular, T and L beams, concrete mix proportioning, reinforced concrete deep beams, planner trusses, Procedure of optimization for structural grid and slab.

***Suggested Readings:***

1. Engineering Optimization‖, S.S. Rao, New Age Internationals (1999).
2. Systems Analysis for Civil Engineers‖, Paul, J.O., john Wiley & Sons (1988)
3. Fundamentals of Optimum Design in Engineering‖ S.S. Bhavikatti, New Age International Publishers.
4. Operation Research‖, S. Kalavathy, Vikas Publishing house Pvt Ltd. Second edition

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

**Professional Elective - IV**

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE206** | **Retrofitting and Rehabilitation of Structures** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Learn the fundamentals of maintenance and repair strategies.
2. Study the quality assurance, serviceability and durability of concrete.
3. Know the various materials and techniques used for repair of structures.
4. Educate the different repair, strengthening, rehabilitation and retrofitting techniques.
5. Instruct the various health monitoring and demolition techniques.

**Course Outcomes**

After completing this course, the student will be able to:

1. Understand the fundamentals of maintenance and repair strategies.
2. Diagnose for serviceability and durability aspects of concrete.
3. Know the materials and techniques used for repair of structures.
4. Decide the appropriate repair, strengthening, rehabilitation and retrofitting technique required for a case study building.
5. Use an appropriate health monitoring and demolition techniques.

**UNIT - I**

**Maintenance:** Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration.

**Repair Strategies:** Causes of distress in concrete structures, Construction and design failures, Condition assessment and distress-diagnostic techniques, Assessment procedure for Inspection and evaluating a damaged structure.

**UNIT - II**

**Serviceability and Durability of Concrete:** Quality assurance for concrete construction, concrete properties – strength, permeability, thermal properties and cracking. – Effects due to climate, temperature, chemicals, corrosion – design and construction errors – Effects of cover thickness and cracking.

**UNIT - III**

**Materials and Techniques for Repair:** Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete. Bacterial concrete, Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coating and cathodic protection

**UNIT - IV**

**Repair, Rehabilitation and Retrofitting Techniques:** Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure, Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shot Create – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

**UNIT – V**

**Health Monitoring and Demolition Techniques:** Long term health monitoring techniques, Engineered demolition techniques for dilapidated structures, Use of Sensors – Building Instrumentation.

***Suggested Reading:***


1. Concrete Technology by A.R. Santakumar, Oxford University press
2. Defects and Deterioration in Buildings, E F & N Spon, London
3. Non-Destructive Evaluation of Concrete Structures by Bungey - Surrey University
4. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
5. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, 1981.
6. Building Failures: Diagnosis and Avoidance, EF & N Spon, London, B
7. Mehta, P.K and Montevic. P.J., Concrete- Microstructure, Properties and Materials, ICI, 1997.
8. Jackson, N., Civil Engineering Materials, ELBS, 1983.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE207** | **Design of High-Rise Structures** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. To study the functioning and behaviour of high-rise buildings.
2. To understand the characteristics and effect of wind loads on buildings.
3. To understand the effect of earthquake on buildings and to learn the techniques for earthquake resistance.
4. To analyse tall buildings subjected to lateral loads.
5. To understand the interaction between the various structural components of high-rise structures.

**Course Outcomes**

After completing this course, the student will be able to:

1. Understand the concepts of high-rise building structures.
2. Analyse and design high rise structures subjected to wind loads.
3. Familiarize with the different structural systems used in high rise buildings.
4. Analyse and design high rise structures subjected to earthquake loads.
5. Understand the behaviour and response of slab column frames.

**UNIT-I**

**Introduction:** Design Principles for Lateral Load resistance, ductility considerations in earthquake resistant design of concrete buildings, construction methods, choice of materials, cladding systems and their design principles, types of foundations for tall buildings.

**UNIT-II**

**Wind:** Introduction to wind, characteristics of wind, impact on structures, wind pressure, internal and external wind, dynamic action of wind, aerodynamic forces, natural frequencies, wind tunnels, types of wind tunnel tests, Introduction to computational fluid dynamics, behaviour of tall buildings subjected to wind, National standards, maximum design loads for buildings and other structures. Calculation of wind loads, special winds, gust, wind speed data and importance. Wind resistant design.

**UNIT-III**

**Earthquake:** Introduction to earthquake, characteristic, impact of earthquake on ground, foundations and structural elements, response of elements attached to buildings, ground motion, quasi-static approach, dynamic analysis, performance criteria, Vibration Control – active control and passive control, liquefaction effects of earthquakes, Introduction to time history analysis and pushover analysis.

**UNIT-IV**

**Structural Systems:** Necessity of special structural systems for tall buildings, Structural Systems for Steel Buildings - Braced frames, Staggered Truss System, Eccentric Bracing System, Outrigger & Belt truss system, Tube Systems; Structural Systems for Concrete Buildings - shear walls, frame tube structures, bundled tube structures; Design of shear wall as per IS code.

**UNIT-V**

**Special Topics:** Second order effects of gravity loading, Creep and shrinkage in columns, Differential shortening of columns, Floor levelling problems, Panel zone effects, P-Delta analysis.

***Suggested Readings:***

1. Tall Building Structures: Analysis and Design, Smith, B. S. and Coull, A., John Wiley & Sons, 1991.
2. Reinforced Concrete Design of Tall Buildings, Taranath, B. S., CRC Press, 2010.
3. Tall Building Design: Steel, Concrete and Composite Systems, Taranath, B. S., CRC Press, 2017.
4. Wind Effect on Structures: Modern Structural Design for Wind, Simiu, E. and Yeo, D., Wiley Blackwell, 2019.
5. Handbook of Concrete Engineering, M. Fintel, Von Nostrand Reinhold Company, 1985.
6. Design of Earthquake Resistant Structures, Emilio Rosenblueth, Pentech Press Ltd., 1990.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21SE208** | **Composite Construction** | | | | | | **Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

1. Study the concepts of composite construction.
2. Learn analysis and designs of composite beams, floors, columns and trusses as per the recommendations of IS codes of practice.
3. Apply the concepts for design of multi-storey composite buildings.
4. Scope of analysis is restricted to skeletal structures subjected to prescribed dynamic loads.

**Course Outcomes**

After completing this course, the student will be able to:

1. Understand the fundamentals of composite construction, and analysis and designs of composite beams.
2. Analyse and design the composite floors and columns, composite trusses and understand connection details.
3. Analyse and design the multi-storey composite buildings.

**UNIT-I**

**Introduction of Composite Constructions:** Benefits of composite construction, Introduction to IS, BS and Euro codal provisions.

**Composite Beams:** Elastic behaviour of composite beams, No and Full Interaction cases, Shear connectors, Ultimate load behaviour, Serviceability limits, Effective breadth of flange, Interaction between shear and moment, Basic design consideration and design of composite beams.

**UNIT-II**

**Composite Floors:** Structural elements, Profiled sheet decking, Bending resistance, Shear resistance, Serviceability criterion, Analysis for internal forces and moments, Design of composite floors.

**UNIT-III**

**Composite Columns:** Materials, Concrete filled circular tubular sections, Non-dimensional slenderness, Local buckling of steel sections, Effective elastic flexural stiffness, Resistance of members to axial compressions, Composite column design, Fire resistance.

**UNIT-IV**

**Composite Trusses:** Design of truss, Configuration, Truss members, Analysis and design of composite trusses and connection details.

**UNIT-V**

**Design of Multi-Storey Composite Buildings:** Design basis, load calculations, Design of composite slabs with profile decks, composite beam design, design for compression members, vertical cross bracings, design of foundation.

***Suggested Readings:***

1. R. P. Johnson, Composite Structures of Steel and Concrete, Vol-I, Beams, Columns and Frames in Buildings, Oxford Blackwell Scientific Publications.
2. INSDAG Teaching Resources for Structural Steel Design, Vol-2, Institute for Steel Development and Growth Publishers, Calcutta.
3. INSDAG Handbook on Composite Construction – Multi-Storey Buildings, Institute for Steel Development and Growth Publishers, Calcutta.
4. INSDAG Design of Composite Truss for Building, Institute for Steel Development and Growth Publishers, Calcutta.
5. INSDAG Handbook on Composite Construction – Bridges and Flyovers, Institute for Steel Development and Growth Publishers, Calcutta.
6. IS:11384, 1985 Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
**(An Autonomous Institution)**

# Audit Course-II

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21EN201 | **Constitution of India and Fundamental Rights** | | | | | | **Audit II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and 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 of nationhood in the early years of Indian nationalism.

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. 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.
4. Discuss the passage of the Hindu Code Bill of 1956.

**UNIT-I**

**History of Making of the Indian Constitution**: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features.

**UNIT-II**

**Contours of Constitutional Rights & Duties**: 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.

**UNIT-III**

**Organs of Governance**: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions.

**UNIT-IV**

**Local Administration**: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayat raj: Introduction, PRI: Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

**UNIT-V**

**Election Commission**: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

***Suggested Readings:***


1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21EN202** | **Pedagogy Studies** | | | | | | **Audit II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

**UNIT-I**

**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions, Overview of methodology and Searching.

**UNIT-II**

**Thematic Overview:** Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education

**UNIT-III**

**Evidence on the Effectiveness of Pedagogical Practices:** Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches – Teachers attitudes and beliefs and pedagogic strategies.

**UNIT-IV**

**Professional Development:** alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

**UNIT-V**

**Research Gaps and Future Directions:** Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

**Suggested Readings:**

1. Ackers J, Hardman F, Classroom Interaction in Kenyan Primary Schools, Compare‖, 31 (2): 245 – 261, 2001.
2. Agarwal M, Curricular Reform in Schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.
3. Akyeampong K, Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER), Country Report 1. London: DFID, 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count? International Journal Educational Development, 33 (3): 272- 282, 2013.
5. Alexander R J, Culture and Pedagogy: International Comparisons in Primary Education, Oxford and Boston: Blackwell, 2001.
6. Chavan M, Read India: A mass scale, rapid, learning to read campaign, 2003.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21EN203** | **Stress Management by Yoga** | | | | | | **Audit II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

The Course will introduce the students to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social andspiritual).
3. Prevention of stress related health problems by yoga practice.

**Course Outcomes**

After successful completion of the course, the students will be able to:

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas.
5. Improve work performance and efficiency.

**UNIT - I**

**Meaning and Definition of Yoga -** Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

**UNIT - II**

**Meaning and Definition of Stress** - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

**UNIT - III**

**Concept of Stress According to Yoga** - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

**UNIT - IV**

**Asanas**- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar.

**UNIT - V**

**Pranayama-** Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

**Meditation Techniques:** Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

***Suggested Readings:***


1. "Yogic Asanas for Group Training - Part-I", Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R and Nagaratna R, "Yoga Perspective in Stress Management", Swami Vivekananda Yoga Prakashan, Bangalore.

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P21EN204** | **Personality Development Through Life Enlightenment Skills** | | | | | | **Audit II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self-regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

**UNIT - I**

**Neetisatakam – Holistic Development of Personality** - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

**UNIT - II**

**Neetisatakam – Holistic Development of Personality (cont'd**) - Verses 52, 53, 59 (don'ts) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

**UNIT - III**

**Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagavadgeetha**: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 –Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

**UNIT - IV**

**Statements of Basic Knowledge - Shrimad Bhagavadgeetha**: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

**UNIT - V**

**Role of Bhagavadgeetha in the Present Scenario -** Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

***Suggested Readings:***


1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi


Online Resources: NTPEL: http://nptel.ac.in/downloads/109104115/

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

### Practical/Laboratory Course

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21SE1L1 | **Structural Design Lab** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **-** | **-** | **-** | **3** | **50** | **-** | **1.5** |

**Course Outcomes**

After completing this course, the student will be able to:

1. Design and detail all the structural components of frame buildings for seismic and wind force.
2. Design and detail complete multi-storey building.
3. Application of design software for multi-storey frames.
4. Analysis wind pressures and walls and roof of a rectangular building.
5. Design of wind forces on a RC buildings by different methods.

**Syllabus Content:**

**Seismic & Wind Analysis and Design:**

1. Calculation of design seismic force by static and dynamic methods of IS 1893.
2. Calculation of lateral force distribution as per Torsion provisions of IS 1893.
3. Beam design of an RC frame building as per IS 13920.
4. Column design of an RC frame building as per IS 13920.
5. Beam-column joint design of an RC frame building as per IS 13920.
6. Complete manual seismic analysis, design and detailing of a simple G+3 storied building and its comparison with any structural analysis and design software.
7. Calculation of wind pressures and design forces on walls and roof of a rectangular building.
8. Calculation of design wind forces on a RC building using force coefficient method.
9. Calculation of design wind forces on a RC building using Gust Factor Approach.
10. Complete manual wind analysis and design of a simple G+3 storied structure using any structural analysis and design software and its comparison with any structural analysis and design software.

**Note:** All the experiments/assignments should be done manually by individual student and the analysis & design results should be compared using latest structural analysis and design software.

## Software:

1. **ETABS**
2. **STAAD Pro Connect Edition**
3. **ANSYS**
4. **MATLAB**

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21SE2L2 | **Virtual Smart Structures and Dynamics Lab** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **Structural Dynamics** | **-** | **-** | **-** | **3** | **50** | **-** | **1.5** |

**Course Outcomes**

After the completion of the course, the student will be able to:

1. Understand the behaviour of structures subjected to dynamic loadings like wind, earthquake and blasting.
2. Understand the dynamic characteristics of structures instrumented with smart piezoelectric sensors.
3. Visualize shear lag effect and Rebar Corrosion
4. Draw response spectrum curve for given condition
5. Measure displacements using Photogrammetry

**List of Experiments:**

**Simulation based:**

1. Free Vibration of S.D.O.F System
2. Forced Vibration of S.D.O.F System
3. Impulse Response of S.D.O.F System
4. Concept of Response Spectrum
5. Vibration of M.D.O.F System
6. Behavior of Rigid Blocks
7. Torsional Response of Building
8. Continuous Systems
9. Vibration Control
10. Modes of Vibration of Simply Supported Beam Under Flexure
11. Modes of Vibration of Simply Supported Plate
12. Damage Detection and Qualitative Quantification Using Electro-Mechanical Impedance (EMI) Technique
13. Dynamics of Bandra Worli Sea Link Bridge
14. Piezoelectric Energy Harvesting and Structural Health Monitoring Using Thin Surface Bonded PZT Patches.
15. Shear Lag Effect in Electro-Mechanical Impedance (EMI) Technique
16. Rebar Corrosion Detection and Assessment Using Electro-Mechanical Impedance (EMI) Technique.

**Simulation based:**

17. Vibration Characteristics of Aluminum Cantilever Beam Using Piezoelectric Sensors
18. Identification of High Frequency Axial Modes of Beam in "Free-Free" Condition Using Electro-Mechanical Impedance (EMI) Technique
19. Forced Excitation of Steel Beam Using Portable Shaker
20. Photogrammetry for displacement measurement.

***e-resources:***

21. http://sd-iiith.vlabs.ac.in/Introduction.html (For Experiments 1 to 9)
22. http://vssd-iitd.vlabs.ac.in/home.html (For Experiments 10 to 20)

# LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (An Autonomous Institution)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P21SE2P1 | **Mini Project** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **-** | **-** | **-** | **6** | **40** | **60** | **3** |

**Course Outcomes**

At the end of this course, students will be able to**:**

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

**Guidelines:**

- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter-disciplinary/ industry relevance.
- The students c
- All the investigations should be clearly stated and documented with the reasons/explanations.
- The mini project shall an select a mathematical modeling based/Experimental investigations or Numerical modeling
- contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference

**Departmental committee: Supervisor and a minimum of two faculty members**

| **Guidelines for awarding marks in CIE (Continuous Internal Evaluation) & SEE (Semester End Evaluation)** | | |
|---|---|---|
| **Evaluation by** | **Max. Marks** | **Evaluation Criteria / Parameter** |
| Supervisor (CIE) | 30 | Progress and Review |
| | 10 | Report |
| Departmental Committee (SEE) | 10 | Relevance of the Topic |
| | 10 | PPT Preparation |
| | 20 | Presentation |
| | 10 | Question and Answers |
| | 10 | Report Preparation |