# Shri Vaishnav Vidyapeeth Vishwavidyalaya
## Master of Technology (Structural Engineering)
## SEMESTER I

| SUBJECT CODE | Category | SUBJECT NAME | TEACHING & EVALUATION SCHEME | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | THEORY | | | PRACTICAL | | L | T | P | CREDITS |
| | | | END SEM | MST | Q/A | END SEM | Q/A | | | | |
| MTCE 1101 | BS | ADVANCED MATHEMATICS AND NUMERICAL ANALYSIS | 60 | 20 | 20 | 0 | 0 | 3 | 0 | 0 | 3 |

**Legends:** **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/Project/Participation in Class, given that no component shall exceed more than 10 marks.

## Course Objective

*The course aims to provide students with the specialist knowledge in advanced Numerical Analysis and Integral Transforms.*

## Course Outcomes

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

1. *Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.*
2. *Apply numerical methods to obtain approximate solutions to mathematical problems.*
3. *Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.*
4. *Analyse and evaluate the accuracy of common numerical methods.*

## Course Content:

**UNIT – I**

**Numerical solution of Partial Differential Equation (PDE):** Numerical solution of PDE of hyperbolic, parabolic and elliptic types by finite difference method.

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**UNIT – II**

**Integral transforms:** General definition; Introduction to Mellin, Hankel and Fourier transforms and fast Fourier transforms, application of transforms to boundary value problems in engineering.

**UNIT – III**

**Integral equations:** Conversion of Linear Differential equation (LDE) to an integral equation (IE); Conversion of boundary value problems to integral equations using greens function; Solution of integral equation, IE of convolution type, Abels IE, integral differential equations, IE with separable variable, solution of Fredholm; Equation with separable kernels; Solution of Fredholm and Volterra equations by method of successive approximations.

**UNIT – IV**

**Calculus of Variation:** Functional and their variation; Euler's equation for function of one and two independent variables; Application to engineering problems.

**UNIT – V**

**FEM:** Variational functional; Euler Lagrange's equation; Variational forms; Ritz methods, Galerkin's method; Descretization; Finite elements method for one dimensional problems.

**Texts:**

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
2. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Numerical Methods in engineering, Salvadori and Baron

**References:**


1. CF Froberg, Introduction to numerical analysis.
2. SS Sastry, Introductory methods of numerical analysis.
3. Krasnove, Kiselevanded Makarenho, Integral equations.
4. Buchanan, Finite element Analysis (schaum Outline S), TMH.
5. Krishnamurthy, Finite element analysis, TMH.


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| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | THEORY | | | PRACTICAL | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| **MTCE 1102** | **DCS** | **ADVANCE CONCRETE TECHNOLOGY** | 2 | 1 | 2 | 4 | 60 | 20 | 20 | 30 | 20 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Objectives:**

1. To understand the concrete material and their mechanism.
2. To study about the various parameters of fresh concrete
3. To design and developed special types of concrete.

**Course Outcomes:**

Student will able to

1. Acquire knowledge about cement and admixtures.
2. Understand the characteristics of fresh and hardened concrete.
3. Gain knowledge about different types of concrete.
4. Understand structural health monitoring using NDT.

**Syllabus:**

**UNIT I**

**Cement:** Different types of cement and their properties; Physical tests of cement; Use of cement
**Admixtures**: Different types of admixtures, their properties and uses.

**UNIT II**

**Properties of Concrete:** Properties of fresh and hardened concrete; Workability, strength, durability, fatigue, creep, shrinkage and permeability of concrete.

**UNIT III**

**High Performance Concrete:** Definition and types of high performance concrete: Mix Design of high performance concrete.

**UNIT IV**

**Light weight Concrete:** Definition and types of light weight concrete: Strength Density ratio; Mix design of light weight concrete.

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**UNIT V**

**Non –Destructive Testing:** Non destructive testing- introduction; Structural health monitoring using non destructive testing: Introduction to sensors used in structural health monitoring.

**Text Books:**


1. M.S. Shetty, Concrete Technology, S Chand publication, 2006
2. A. M. Neville and J.J. Brooks, Concrete Technology, Prentice Hall, 2 edition, 2010
3. M.L Gambhir, Concrete Technology, Tata Mc Graw Hill Book Co. 2010


**Reference Books:**


1. R. Jones, Non Destructive Testing of Concrete, Cambridge University Press.
2. Pierre-Claude Aïtcin and Robert J Flatt, Science and Technology of Concrete Admixtures, Woodhead Publishing, 2015.


**List of Practicals:**

1. Basic test on cement and aggregate.
2. The assess quality of hardened concrete as per IS standard specification using rebound hammer
3. Non destructive testing of concrete sample using Ultra Sonic Test

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| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | THEORY | | | PRACTICAL | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| **MTCE 1103** | **DCS** | **THEORY AND DESIGN OF CONCRETE STRUCTURES** | 2 | 1 | 0 | 3 | 60 | 20 | 20 | 0 | 0 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Objectives:**
Student (A) will be able to analyze various loads acting on structure and design different components of RCC structure (B) at particular site (C) economically & safely.

**Course Outcomes:**

1. To provide a coherent development to the students for the courses in sector of reinforced concrete designing.
2. To present the foundations of many basic engineering concepts related designing of structures.
3. To give an experience in the implementation of designing concepts which are applied in field of structural engineering
4. To involve the application of scientific and technological principles of design of buildings according to limit state method of design

**Syllabus:**

**UNIT I**
**Design Philosophies**: Introduction to various design philosophies; Merits and drawbacks of design philosophies; Code provision and their meaning; Introduction to pre-stressed concrete.

**UNIT II**
**Grid Structures**: Types of R.C.C Grids; Behavior; Design by approximate and exact methods.

**UNIT III**
**Flat Slab**: Definition; Types; Behavior; Direct design method; Equivalent frame method.

**UNIT IV**
**Circular Cylindrical Shells**: Behavior and design using ASCE Manual Method.

**UNIT V**
**Concept of Ductility**: Detailing of ductility as per IS13920 for earthquake loads.

**Text Books:**
1. Shah and Kale, RCC Theory and Design, Laxmi Publications, 2014
2. B.C. Punamia, RCC designs, Laxmi Publications; Tenth edition, 2015
3. Varghese, Advanced Reinforced Concrete Design, Prentice Hall India Learning Private Limited; 2 edition, 2005
4. IS 13920 (2016): Ductile detailing of reinforced concrete structures subjected to seismic forces

**Reference Books:**
1. Devdas Menon, S. Pillai, Reinforced Concrete Design, McGraw Hill Education; 3 edition, 2017
2. N. Subramanian, Design of Reinforced Concrete Structures, Oxford Publication, 2013

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## Master of Technology (Structural Engineering)

## SEMESTER I

| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | THEORY | | | PRACTICAL | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| MTCE 1104 | DCS | ADVANCED STRUCTURAL AND ANALYSIS | 2 | 1 | 0 | 3 | 60 | 20 | 20 | 0 | 0 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Objectives:**
The objectives of the course are to build on the student's knowledge on the theory and application of structures in buildings and to introduce the students to concept of structural stability, methods in structural analysis.

**Course Outcomes:**
1. Ability to analyze statically determinate trusses, beams, and frames and obtain internal loading
2. Ability to analyze cable and arch structures
3. Ability to obtain the influence lines for statically determinate and indeterminate structures
4. Ability to determine deflections of beams and frames using classical methods
5. Ability to solve statically indeterminate structures using classical methods
6. Ability to solve statically indeterminate structures using matrix (stiffness) method

**Syllabus:**

**UNIT I**
**Matrix Method (Flexibility Method):** Force methods; Basic concepts; Evaluation of flexibility; transformation; Analysis of a single member of different types; Transformation of single member.

**UNIT II**
**Plane and Space Frames**: Applications to plane and space structures with pin joints and rigid joints; Energy approach in flexibility method; Effect of support displacement.

**UNIT III**
**Matrix Method (stiffness Method):** Displacement methods; Basic concepts; Evaluation of stiffness coefficients; Direct stiffness method; Energy approach in stiffness method; Effect of support displacement and temperature.

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**UNIT IV**

**Symmetrical and Anti-Symmetrical Problems**: Stiffness of plane and space frames solution of problems; Comparison of force and displacement methods of solution

**UNIT V**

**Space Frame**: Tension coefficient method for analysis of pin jointed structural frames.

**Text Books:**

1. C.S. Reddy, Basic Structural Analysis, McGraw Hill Education; McGraw Hill Education, 2017
2. , Pandit, Structural Analysis: A matrix approach McGraw Hill Education, 2008

**Reference Books:**

1. V. K. Manicka Selvam, Elements of Matrix and Stability Analysis of Structures, Khanna Publishers; Seventh Edition, 2010
2. W Wearer Jr. & James M. Gere, Matrix Analysis of Framed Structures, CBS Publication, 2004

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## Master of Technology (Structural Engineering)

## SEMESTER I

| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | THEORY | | | PRACTICAL | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| **MTCE 1105(1)** | **DCS** | **THEORY OF ELASTICITY AND PLASTICITY** | 2 | 1 | 0 | 3 | 60 | 20 | 20 | 0 | 0 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Objectives:**

1. To impart knowledge of Principal stresses and strains.
2. To develop analytical skills of solving problems using plain stress and plain strain.
3. To impart knowledge of engineering application of plasticity.

**Course Outcomes:**

1. The students shall be able to demonstrate the application of plane stress and plane strain in a given situation.
2. The student will demonstrate the ability to analyze the structure using plasticity.
3. To impart the knowledge of stress-strain relations for linearly elastic solids, and Torsion.

**Syllabus:**

**UNIT I**

**Plane Stress & Plane Strain**: Plane Stress; Plane Strain; Stress and Strain at a points; Differential equations of equilibrium; Anisotropic materials; Linear elasticity; Stress, strain, Constitutive relations; Boundary conditions; Generalized Hooke’s law; Elastic Constants; Compatibility equation; Stress function.

**UNIT II**

**Two Dimensional Problems in Rectangular Co-ordinates**: Solutions by Polynomials; Saint-Venant’s Principle; Determination of displacements; Bending of beams; Solution of two dimensional problems in Fourier series

**UNIT III**

**Two Dimensional Problems in Polar Coordinates**: General equations in Polar coordinate; Pure bending of curved bars; Analysis of stress and strain in three dimensions; Principal stress and strain; Shearing stress and strains; Elementary equation of equilibrium; Compatibility conditions

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**UNIT IV**

**Theory of Plasticity:** Basic experiments of monotonic loading tension and compression tests; Loading-Unloading reloading types; Loading-Unloading reverse loading types and their observations; Definition of nominal stress, strain, true stress, natural Strain etc and their relations; Bauschinger's effects; Strain hardening; Stress strain curve and their empirical equations.

**UNIT V**

Stress and strain tensors; Principal stresses and strains; Stress and strain invariants; Maximum and octahedral shear stresses and strains; Stress and strain deviator tensor; assumptions; Yield Criteria like Rankine's, Saint Venant's, Trescas and Von mises and their two Dimensional representation; Failure Theories.

**Text Books:**

1. Timoshenko, Theory of Elasticity, McGraw Hill Book Company.
2. Iyenger N.G.R., Structural Stability of Columns & Plates, Prentice Hall,1998

**Reference Books:**

1. J. Chakrabarty, Theory of Plasticity, Elsevier/Butterworth-Heinemann, 2006
2. Sukhvarsh Jerath, Structural Stability Theory and Practice: Buckling of Columns, Beams, Plates, and Shells, John Wiley & Sons, 2020

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## Master of Technology (Structural Engineering)

## SEMESTER I

| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | THEORY | | | PRACTICAL | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| MTCE 1105(2) | DCS | THEORY OF VIBRATIONS | 2 | 1 | 0 | 3 | 60 | 20 | 20 | 0 | 0 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Objectives:**
The objective of this course is to cover comprehensive fundamental principles of vibration theory Formulate mathematical models of problems in vibrations using Newton's second law or energy principles determine a complete solution to mechanical vibration problems using mathematical or numerical techniques, and Determine physical and design interpretations from the results

**Course Outcomes:**
1. Students will be able to construct the equations of motion from free-body diagrams.
2. Students will be able to solve for the motion and the natural frequency of a freely vibrating single degree of freedom un-damped motion and a freely vibrating single degree of freedom damped motion.
3. Students will be able to construct the governing differential equation and its solution for a vibrating mass subjected to an arbitrary force.
4. Students will be able to decompose any periodic function into a series of simple harmonic motions using Fourier series analysis.
5. Students will be able to solve for the motion and the natural frequency for forced vibration of a single degree of freedom damped or un-damped system.
6. Students will have an ability to obtain the complete solution for the motion of a single degree of freedom vibratory system (damped or un-damped) that is subjected to non-periodic forcing functions.
7. Students will be able to solve vibration problems that contain multiple degrees of freedom.
8. Students will be able to obtain design parameters and indicate methods of solution for a complicated vibratory problem.

**Syllabus:**

**UNIT I**
Single degree of freedom system; Free and forced vibrations; Linear Viscous Damper; Coulomb Damper; Response to harmonic excitation; Rotating unbalance and support excitations; Vibration isolation and transmissibility; Single degree of freedom system as vibro-meter and accelerometer; Response to periodic and arbitrary excitation.

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**UNIT II**
Duhamel's integral; Impulse response function; Laplace transform Fourier transform methods; Frequency response function; Phase-Plane techniques; Critical speed of rotors; Energy methods; Rayleigh's method; Equivalent viscous damping

**UNIT III**
Two degree of freedom system; Matrix Formulation; Free Vibration; Beat phenomenon; Principle of damped and un-damped vibration absorbers

**UNIT IV**
Multi degree of freedom system; Matrix formulation; Stiffness and flexibility influence coefficients; Eigen value problem; Normal modes and their properties; Matrix iteration technique for Eigen value and Eigen vectors; Free and forced vibration by modal analysis.

**UNIT V**
Continuous System; Axial vibration of bar; Torsion of shafts; Transverse vibration of strings and bending vibration beams; Forced vibration; Normal mode method; Lagrange's equation; Approximate methods of Rayleigh-Ritz, Galerkin's etc.

**Text Books:**

1. Ray W. Clough and Joseph Penzien, Dynamics of structures, 2nd edition, McGraw-Hill, New York
2. William Thomson, Theory of Vibration with Applications CRC Press, 2010

**Reference Books:**

1. Mario Paz , Structural Dynamics: Theory and Computation, Springer Science & Business Media
2. Anil K. Chopra, Dynamics of Structures: Theory and Applications to Earthquake Engineering, Prentice Hall, 2000

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## Master of Technology (Structural Engineering)

## SEMESTER I

| COURSE CODE | CATEGORY | COURSE NAME | L | T | P | CREDITS | TEACHING & EVALUATION SCHEME | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | THEORY | | | PRACTICAL | |
| | | | | | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* |
| MTCE 1105(3) | DCS | STABILITY THEORY IN STRUCTURAL ENGINEERING | 2 | 1 | 0 | 3 | 60 | 20 | 20 | 0 | 0 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

**Course Outcomes:**

At the end of the course, students will be able to

1. Determine stability of columns and frames
2. Determine stability of beams and plates
3. Use stability criteria and concepts for analyzing discrete and continuous systems,

**Syllabus:**

**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

**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.

**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 behaviour of plates

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**Text Books:**

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

**Reference Books:**

1. Iyenger.N.G.R., Structural stability of columns and plates, Affiliated East West Press,1986.
2. Gambhir, Stability Analysis and Design of Structures, Springer, New York , 2004.

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