Scheme & Syllabus of
Master of Technology

(M. Tech – Civil Engineering)

Specialization: Structural Engineering

Batch 2018 onwards

By
Board of Study Civil Engineering
Department of Academics
I.K. Gujral Punjab Technical University

I.K. Gujral Punjab Technical University

Master of Technology in Civil Engineering

Specialization: Structural Engineering

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)
Eligibility for Admission : B. Tech / B.E Civil Engineering
Courses & Examination Scheme:

Program Outcomes (POs):

After completion of the program graduates will be able to

A. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude

B. Identify, formulate and solve engineering problems in the domain of structural engineering field.

C. Use different software tools for Analysis and Design structural engineering domain.

D. Design and conduct experiments, analysis and interpret data, for development of simulation experiments.

E. Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

First Semester

Course Type	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Core Theory	MTST101-18 Advanced Structural Analysis	3	0	0	40	60	100	3
Core Theory	MTST102-18 Advanced Solid Mechanics	3	0	0	40	60	100	3
Program Elective I	Elective I MTST901- 18 Theory of Thin Plates and Shells MTST902- 18 Theory and Applications of Cement Composites MTST903- 18 Theory of Structural Stability	3	0	0	40	60	100	3
Program Elective II	Elective II MTST904- 18 Analytical and Numerical Methods for Structural Engineering MTST905- 18 Structural Health Monitoring MTST906- 18 Structural Optimization	3	0	0	40	60	100	3
Core Lab I	MTST 111 - 18 Structural Design Lab	0	0	4	60	40	100	2
Core Lab II	MTST 112 - 18 Advanced Concrete Lab	0	0	4	60	40	100	2
MLC	Research Methodology and IPR	2	0	0	40	60	100	2
Audit 1	Audit Course	2	0	0	0	0	0	0
	MTST113 - 18 Technical Seminar - I	0	0	2	60	40	100	1
Total		**16**	**0**	**10**	**380**	**420**	**800**	**19**

Second Semester

Course Type	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Core 3	MTST201-18 FEM in Structural Engineering	3	0	0	40	60	100	3
Core 4	MTST202-18 Structural Dynamics	3	0	0	40	60	100	3
Program Elective III	Elective – III MTST907- 18 Advanced Steel Design MTST908- 18 Design of Formwork MTST909- 18 Design of High Rise Structures MTST910- 18 Design of Masonry Structures	3	0	0	40	60	100	3
Program Elective IV	Elective – IV MTST911- 18 Design of Advanced Concrete Structures MTST912- 18 Advanced Design of Foundations MTST913- 18 Soil Structure Interaction MTST914 - 18 Design of Industrial Structure	3	0	0	40	60	100	3
Core Lab III	MTST 113 - 18 Model Testing Lab	0	0	4	60	40	100	2
Core Lab IV	MTST 114 - 18 Numerical Analysis Lab	0	0	4	60	40	100	2
CORE	MTST231 - 18 Mini Project	0	0	4	60	40	100	2
Audit 2	Audit Course-2	2	0	0	0	0	0	0
	MTST 115 – 18Technical Seminar - II	0	0	2	60	40	100	1
Total		**14**	**0**	**14**	**400**	**400**	**800**	**19**

Third Semester

Course Type /Code	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Program Elective-V	Elective - V	3	0	0	40	60	100	3
	MTST915 - 18 Design of Prestressed Concrete Structures							
	MTST916 - 18 Analysis of Laminated Composite Plates							
	MTST917 - 18 Fracture Mechanics of Concrete Structures							
	MTST918 - 18 Design of Plates and Shells							
Open Elective	MTST919 - 18 Business Analytics	3	0	0	40	60	100	3
	MTST920 - 18 Industrial Safety							
	MTST921 - 18 Operations Research							
	MTST922 - 18 Cost Management of Engineering Projects							
	MTST923 - 18 Composite Materials							
	MTST924 - 18 Waste to Energy							
Dissertation	MTST232 - 18 Dissertation Phase – I	0	0	20	60	40	100	10
	Total	**6**	**0**	**20**	**140**	**160**	**300**	**16**

Forth Semester

Course Type /Code	Course Name	Load Allocations			Marks Distribution			Credits
		L	T	P	Internal	External	Total Marks	
Dissertation	MTST233 - 18 Dissertation Phase – II	**0**	**0**	**32**	**-**	**-**	**S/US**	**16**

List of Audit Course
1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Addition
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Semester I

MTST101 - 18 Advanced Structural Analysis (Credits - 3:0:0 = 3)

Course outcomes: At the end of the course, students will be able to
1. Analyze the skeleton structures using stiffness analysis code.
2. Use direct stiffness method understanding its limitations

Syllabus Contents:
Influence Coefficients: Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.
Stiffness Method applied to Large Frames: Local Coordinates and Global Coordinates.
Stiffness Matrix Assembly of Structures: Stiffness Matrix in Global Coordinates, Boundary Conditions ,Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.
Applications to Simple Problems: Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.
Boundary Value Problems (BVP): Approximate Solution of Boundary Value Problems ,Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation of the Modified Galerkin Method.
Linear Element: Shape Functions, Solution for Poisson's Equation, General One Dimensional Equilibrium Problem.

References:

• Matrix Analysis of Framed Structures, Weaver and Gere.
• The Finite Element Method, Lewis P. E. and Ward J. P., Addison-Wesley Publication Co.
• Computer Methods in Structural Analysis, Meek J. L., E and FN, Span Publication.
• The Finite Element Method, Desai and Able, CBS Publication.

MTST102 – 18Advanced Solid Mechanics (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to
1. Solve simple problems of elasticity and plasticity understanding the basic concepts.
2. Apply numerical methods to solve continuum problems.

Syllabus Contents:
Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.
Strain and Stress Field: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.
Equations of Elasticity: Equations of Equilibrium, Stress- Strain relations, Strain Displacement And Compatibility Relations, Boundary Value Problems, Co-axialityof the Principal Directions.
Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy'sstress unction, Two-Dimensional Problems in Polar Coordinates.
Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of rectangular Bar, Torsion of Thin Tubes.
Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, Von - Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.
References:

• Theory of Elasticity, Timoshenko S. andGoodierJ. N., McGraw Hill, 1961.
• Elasticity,SaddM.H.,Elsevier,2005.
• Engineering Solid Mechanics, RagabA.R., Bayoumi S.E., CRC Press,1999.
• Computational Elasticity, AmeenM., Narosa,2005.
• Solid Mechanics, KazimiS. M. A., Tata McGraw Hill,1994.
• Advanced Mechanics of Solids, SrinathL.S., Tata McGraw Hill,2000.

Program Elective I

MTST901 - 18 Theory of Thin Plates and Shells (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Use analytical methods for the solution of thin plates and shells.
2. Use analytical methods for the solution of shells.
3. Apply the numerical techniques and tools for the complex problems in thin plates.
4. Apply the numerical techniques and tools for the complex problems in shells.

Syllabus Contents:

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle ofVirtual Work, Boundary Conditions.

Static Analysis of Plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

Circular Plates: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

Static Analysis of Shells: Membrane Theory of Shells- Cylindrical, Conical and Spherical Shells,

Shells of Revolution: with Bending R**esistance** - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.

Thermal Stresses in Plate/ Shell

References:

• Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
• Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
• Thin Elastic Shells, KrausH., John Wiley and Sons.
• Theory of Plates, ChandrashekharaK., Universities Press.
• Design and Construction of Concrete Shells, RamaswamyG.S.

Program Elective I

MTST902 - 18- Theory and Applications of Cement Composites (Credits- 3:0:0=3)

Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.

2. Classify the materials as per orthotropic and anisotropic behaviour.

3. Estimate strain constants using theories applicable to composite materials.

4. Analyse and design structural elements made of cement composites.

Syllabus Content:

Introduction: Classification and Characteristics of Composite Materials- Basic Terminology,Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, EngineeringConstants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem,Biaxial Strength, Theories for an Orthotropic Lamina.

Mechanical Behaviour: Mechanics of Materials Approach to Stiffness- Determination ofRelations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques ofElasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations,Comparison of approaches to Stiffness.

Cement Composites: Types of Cement Composites, Terminology, Constituent Materialsandtheir Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement,SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

Mechanical Properties of Cement Composites: Behavior of Ferrocement, Fiber ReinforcedConcrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

Application of Cement Composites: FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour,Constitutive relationship, Elastic Constants.

Analysis and Design of Cement Composite Structural Elements - Ferrocement, SIFCON and Fibre Reinforced Concrete.

Reference Books:

- Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
- Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
- New Concrete Materials, Swamy R.N., 1st Ed., Blackie, Academic and Professional, Chapman Hall, 1983.

Program Elective I

MTST903 - 18 - Theory of Structural Stability (Credits- 3:0:0 = 3)

Lectures: 3 hrs/week

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 analysing discrete and continuous systems,

Syllabus Contents:
Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.
Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.
Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.
Stability of Beams: lateraltorsion buckling.
Stability of Plates: axialflexural buckling, shearflexural buckling, buckling under combinedloads.
Introduction to Inelastic Buckling and Dynamic Stability.

Reference Books:

- Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
- Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
- Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
- Strength of Metal Structures,Bleich F. Bucking, Tata McGraw Hill, New York.

Program Elective II
MTST904– 18- Analytical and Numerical Methods for Structural Engineering (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Solve ordinary and partial differential equations in structural mechanics using numerical methods.
2. Write a program to solve a mathematical problem.

Syllabus Contents:

Fundamentals of Numerical Methods: Error Analysis, Polynomial Approximations andInterpolations, **Curve Fitting;** Interpolation and extrapolation.
Solution of Nonlinear Algebraic and Transcendental Equations
Elements of Matrix Algebra: Solution of Systems of Linear Equations, Eigen Value Problems.
Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations.
Finite Difference scheme: Implicit & Explicit scheme.
Computer Algorithms: Numerical Solutions for Different Structural Problems, Fuzzy Logic andNeural Network.

Reference Books:

- An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
- Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (ShaumSeries), 1988.
- Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

Program Elective II

MTST905 - 18– Structural Health Monitoring (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Suggest repairs and rehabilitation measures of the structure

Syllabus Contents:

Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.
Structural Health Monitoring: Concepts ,Various Measures, Structural Safety in Alteration.
Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.
Dynamic Field Testing : Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.
Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Reference Books:

- Structural Health Monitoring, Daniel Balageas, ClausPeterFritzen, Alfredo Güemes, John Wiley and Sons, 2006.
- Health Monitoring of Structural Materials and Components Methods with Applications,
- Douglas E Adams, John Wiley and Sons, 2007.
- Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan,Taylor and Francis Group, London, UK, 2006.
- Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc,2007.

Program Elective II
MTST906 - 18 – Structural Optimization (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Use Variational principle for optimization
2. Apply optimization techniques to structural steel and concrete members.
3. Design using frequency constraint.

Introduction: Simultaneous Failure Mode and Design, Classical External Problems.
Calculus of Variation: Variational Principles with Constraints,
Linear Programming, Integer Programming, Nonlinear Programming, Dynamic Programming,
Geometric Programming **and** Stochastic Programming.
Applications: Structural Steel and Concrete Members, Trusses and Frames.
Design: Frequency Constraint, Design of Layouts.

Reference Books:

- Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer.
- Variational methods for Structural optimization, Cherkaev Andrej, Springer

Core Lab1

MTST111– 18–Structural Design Lab (Credits - 0:0:4 = 2)

Teaching Scheme
Lab: 4hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Design and Detail all the Structural Components of Frame Buildings.
2.Design and Detail complete Multi-Story Frame Buildings.

Syllabus Content:
Design and detailed drawing of complete+ 3 structures by individual student using latest relevant IS codes.

Core Lab2

MTST112– 18– Advanced Concrete Lab (Credits - 0:0:4 = 2)

Teaching Scheme
Lab: 4hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Design high grade concrete and study the parameters affecting its performance.
2. Conduct Non-Destructive Tests on existing concrete structures.
3. Apply engineering principles to understand behavior of structural/ elements.

List of Experiments/Assignments:
1.Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
2. Effect of cyclic loading on steel.
3. Non-Destructive testing of existing concrete members.
4. Behavior of Beams under flexure, Shear and Torsion.

Reference Books:

- Properties of Concrete, Neville A. M., 5^{th} Edition, Prentice Hall, 2012.
- Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Research Methodology and IPR

Teaching Scheme
Lectures: 2 hrs/week

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but
- tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals
- & nation, it is needless to emphasis the need of information about Intellectual Property
- Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research
- work and investment in R & D, which leads to creation of new and better products, and
- in turn brings about, economic growth and social benefits.

Syllabus Contents:
Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.
Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics.
Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.
Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
Unit 6: New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.
References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for
- science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for
- beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.
- Niebel , "Product Design", McGraw Hill, 1974.
- Asimov , "Introduction to Design", Prentice Hall, 1962.

- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New
- Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Semester II
Core 3 –
MTST201 - 18 Finite Element Method in Structural Engineering (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Use Finite Element Method for structural analysis.
2. Execute the Finite Element Program/ Software.
3. Solve continuum problems using finite element analysis.

Syllabus Contents:

Introduction: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.
Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector.
Method of Weighted Residuals: GalerkinFinite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.
Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoperimetric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.
Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.
Computer Implementation: FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.

Reference Books:

- Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
- Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
- Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
- Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
- Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
- Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice HallIndia, 1991.

Core 4

MTST202 - 18 – Structural Dynamics (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Analyze and study dynamics response of single degree freedom system using fundamental equation of motion.
2. Analyze and study dynamics response of Multi degree of freedom system using fundamental theoryand equation of motion.
3. Use the available software for dynamic analysis.

Syllabus Contents:

Introduction: Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling ofDynamic Systems.
Single Degree of Freedom System: Free and Forced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading, State Space Solution for Response.
Numerical Solution to Response using Newmark _ Method and Wilson _ Method, Numerical Solution for State Space Response using Direct Integration.
Multiple Degree of Freedom System (Lumped parameter): Two Degree of Freedom System, Multiple Degree of Freedom System, Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of Equation of Motion.
Multiple Degree of Freedom System (Distributed Mass and Load): Single Span Beams, Free and Forced Vibration, Generalized Single Degree of Freedom System.
Special Topics in Structural Dynamics(Concepts only): Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Base Isolation.

Reference Books:

- Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
- Structural Dynamics andIntroduction to Earthquake Engineering, Chopra A. K.
- Vibration ofStructures - Application in Civil Engineering Design, Smith J. W., Chapman andHall.
- Dynamics of Structures, Humar J. L., Prentice Hall.
- Structural Dynamics - Theory andComputation, Paz Mario, CBS Publication.
- Dynamics ofStructures, Hart and Wong.

Program Elective III

MTST907 - 18– Advanced Steel Design (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Design steel structures/ components by different design processes.
2. Analyze and design beams and columns for stability and strength, and drift.
3. Design welded and bolted connections.

Syllabus Contents:

Properties of Steel: Mechanical Properties, Hysteresis, Ductility.
HotRolled Sections: compactness and non-compactness, slenderness, residual stresses.
Design of Steel Structures: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift.
Stability of Beams: Local Buckling of Compression Flange &Web, Lateral Torsional Buckling.
Stability of Columns: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.
Method of Designs: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design;
Strength Criteria: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor,Effective Length,PM Interaction, Biaxial Bending, Joint Panel Zones.
Drift Criteria: P Effect, Deformation Based Design;
Connections: Welded, Bolted, Location Beam Column, Column Foundation, Splices.

Reference Books:

- Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand Bros., Roorkee.
- The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., HeymanJ., ELBS.
- Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
- IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
- SP – 6 - Handbook ofStructural Steel Detailing, BIS,1987.

Program Elective III
MTST908 - 18 – Design of Formwork (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Select proper formwork, accessories and material.
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures.
4. Understand the working of flying formwork.
5. Judge the formwork failures through case studies.

Syllabus Content:
Introduction: Requirements and selection of Formwork.
Formwork Materials- Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.
Formwork Design: Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.
Formwork Design for Special Structures: Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.
Flying Formwork: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.
Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.

Reference Books:

- Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
- Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.
- IS 14687: 1999, False workfor Concrete Structures - Guidelines, BIS.

Program Elective III

MTST909 - 18 – Design of High Rise Structures (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.

2. Analyse, design and detail the RC and Steel Chimney.

3. Analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes.

Syllabus Content:

Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata.

Tall Buildings: Structural Concept, Configurations, various systems, Wind and Seismic loads, Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.

Applicationof software in analysis and design.

Reference Books:

- Structural Design of Multi-storeyed Buildings, VaryaniU. H., 2nd Ed., South Asian Publishers,New Delhi, 2002.
- Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
- Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R.,Structures Publications, Pune, 2013.
- Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.
- Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.
- High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
- Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi

Program Elective III

MTST910 - 18 – Design of Masonry Structures (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to

1. Understand the masonry design approaches.
2. Analyse Reinforced Masonry Members.
3. Determine interactions between members.
4. Determine shear strength and ductility of Reinforced Masonry members.
5. Check the stability of walls
6. Perform elastic and Inelastic analysis of masonry walls.

Syllabus Contents:

Introduction: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.
Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading.
Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation.
Shear Strength and Ductility of Reinforced Masonry Members.
Prestressed Masonry - Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.
Elastic and In - elastic Analysis, Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra.

Reference Books:

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
4. Earthquake-resistant Design of Masonry Buildings,Tomaevi Miha, Imperial College Press, 1999.

Program Elective IV

MTST911 - 18– Design of Advanced Concrete Structures (Credits - 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Analyse the special structures by understanding their behaviour.
2. Design and prepare detail structural drawings for execution citing relevant IS codes.

Syllabus Contents:

Design philosophy, Modeling of Loads, Material Characteristics.
Reinforced Concrete - P-M, M-phi Relationships, Strut-and- Tie Method, Design of Deep Beamand Corbel, Design of Shear Walls, Compression Field Theory for Shear Design, Design againstTorsion; IS, ACI and Eurocode.
Steel Structures -- Stability Design, Torsional Buckling - Pure, Flexural and Lateral, Design of Beam-Columns, Fatigue Resistant Design, IS code, AISC Standards and Eurocode.

References Books:

- Reinforced Concrete Design, Pillai S. U. and MenonD., Tata McGraw-Hill, 3rd Ed, 1999.
- Design of Steel Structures, SubramaniamN., Oxford University Press, 2008.
- Reinforced Concrete Structures, Park R.andPaulayT. , John Wiley & Sons, 1995.
- Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi.
- Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010.
- Steel Structures Design and Behavior Emphasizing Load and Resistance Factor Design, Salmon
- C. G., Johnson J. E. and Malhas F. A., Pearson Education, 5th Ed, 2009.
- Design ofSteel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Plastic Methods of Structural Analysis, Neal B.G., Chapman and Hall London.

Program Elective IV
MTST912 - 18 – Advanced Design of Foundations (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Decide the suitability of soil strata for different projects.
2. Design shallow foundations deciding the bearing capacity of soil.
3. Analyze and design the pile foundation.
4. Understand analysis methods for well foundation.

Syllabus Contents:
Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.
Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.
Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations,Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load-Settlement Behaviorof Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.
Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.
Tunnels and Arching in Soils, Pressure Computations around Tunnels.
Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.
Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structureInteraction

Reference Books:

- Design of foundation system, N.P. Kurian, Narosa Publishing House
- Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
- Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, NewDelhi.

Program Elective IV
MTST913 - 18 – Soil Structure Interaction (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to
1. Understand soil structure interaction concept and complexities involved.
2. Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
3. Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.
4. Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.
5. Evaluate action of group of piles considering stress-strain characteristics of real soils.

Syllabus Contents:
Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.
Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.
Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.
Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.
Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.
Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

Reference Books:

- Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., NewYork, 1974.
- Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw HillBook Co., New York.
- Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
- Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17,Elsevier Scientific Publishing Company.
- Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific
- Publishing Company.
- Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
- Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

Program Elective IV
MTST914 - 18 - Design of Industrial Structure (Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student will be able to:
1. Design Steel Gantry Girders.
2. Design Steel Portal, Gable Frames.
3. Design Steel Bunkers and Silos.
4. Design Chimneys and Water Tanks.

Syllabus Contents:
Steel Gantry Girders – Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.
Portal Frames – Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures – Lightweight Structures
Steel Bunkers and Silos – Design of square bunker – Jansen's and Airy's theories – IS Codeprovisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.
Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.
Water Tanks – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchorbolts –
Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation.

Reference Books:

- Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
- Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.
- Design of Steel Structures, Subramaniyam.

Core Lab 3 –
MTST113 – 18 - Model Testing Lab(Credits- 0:0:4 = 2)

Teaching Scheme
Lectures: 4hrs/week,

Course Outcomes: At the end of the course, students will be able to
1. Understand the response of structures.
2. Prepare the models.
3. Conduct model testing for static loading
4. Conduct model testing for free and forced vibrations

Syllabus Content:

- Response of structures and its elements against extreme loading events.
- Model Testing: Static - testing of plates, shells, and frames models.
- Model Testing: Free and forced vibrations, Evaluation of dynamic modulus.
- Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domain study, Vibration Characteristics of RC Beams using Piezoelectric Sensors etc.

Core Lab 4

MTST114 – 18 – Numerical Analysis Lab (Credits- 0:0:4 = 2)

Teaching Scheme
Lectures: 4hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Find Roots of non-linear equations by Bisection method and Newton's method.
2. Do curve fitting by least square approximations
3. Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/ Gauss - Jorden Method
4. To Integrate Numerically Using Trapezoidal and Simpson's Rules
5. To Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- Kutta Method.

Syllabus Contents:

- Find the Roots of Non-Linear Equation Using Bisection Method.
- Find the Roots of Non-Linear Equation Using Newton's Method.
- Curve Fitting by Least Square Approximations.
- Solve the System of Linear Equations Using Gauss - Elimination Method.
- Solve the System of Linear Equations Using Gauss - Seidal Iteration Method.
- Solve the System of Linear Equations Using Gauss - Jorden Method.
- Integrate numerically using Trapezoidal Rule.
- Integrate numerically using Simpson's Rules.
- Numerical Solution of Ordinary Differential Equations By Euler's Method.
- Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method.

Core

MTST231 – 18 Mini Project (Credits- 0:0:4 = 2)

Teaching Scheme
Lectures: 4hrs/week

Course Outcomes: At the end of the course, the student will be able to:

1. Identify structural engineering problems reviewing available literature.
2. Study different techniques used to analyze complex structural systems.
3. work on the solutions given and present solution by using his/her technique applying engineering principles.

Syllabus Contents:

- Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.
- Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Program Elective V

MTST915 – 18 - Design of Prestressed Concrete Structures(Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to

1. Find out losses in the prestressed concrete. Understand the basic aspects of prestressed concrete fundamentals, including pre and post-tensioning processes.
2. Analyses prestressed concrete deck slab and beam/ girders.
3. Design prestressed concrete deck slab and beam/ girders.
4. Design of end blocks for prestressed members.

Syllabus Contents:

Introduction to prestressed concrete: types of prestressing, systems and devices, materials,losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer andservice loads, ultimate strength in flexure, code provisions.

Statically determinate PSC beams: design for ultimate and serviceability limit states forflexure, analysis and design for shear and torsion, code provisions.

Transmission of prestress in pretensioned members; Anchorage zone stresses for posttensionedmembers.

Statically indeterminate structures - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordance.

Composite construction with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations

Analysis and design of prestressed concrete pipes, columns with moments.

References:

• Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
• Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
• Limited State Design of PrestressedConcrete,GuyanY., Applied Science Publishers, 1972.
• IS: 1343- Code of Practice for Prestressed Concrete
• IRC: 112

Program Elective V
MTST916 – 18 - Analysis of Laminated Composite Plates(Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course out comes: At the end of the course, students will be able to
1. Analyse the rectangular composite plates using the analytical methods.
2. Analyse the composite plates using advanced finite element method.
3. Develop the computer programs for the analysis of composite plates.

Syllabus Contents:
Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bendingof Rectangular Laminated Plates using CLPT.
Governing Equations. Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT.
Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT.
Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses.
Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C0Element Formulation, Post Computation of Stresses. Analysis of Rectangular Composite Plates using Analytical Methods.

References:

Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.

Program Elective V
MTST917 – 18 - Fracture Mechanics of Concrete Structures(Credits- 3:0:0 = 3)

Teaching Scheme
Lectures: 3 hrs/week

Course outcomes: At the end of the course, students will be able to
1. Identify and classify cracking of concrete structures based on fracture mechanics.
2. Implement stress intensity factor for notched members
3. apply fracture mechanics models to high strength concrete and FRC structures.
4. Compute J-integral for various sections understanding the concepts of LEFM.

Syllabus Contents:
Introduction: Basic Fracture Mechanics, Crack in a Structure, Mechanisms ofFracture and rack Growth, Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment assisted racking, Service Failure Analysis.
Stress at Crack Tip: Stress at Crack Tip, Linear Elastic Fracture Mechanics, Griffith's Criteria, Stress Intensity Factors, Crack Tip Plastic Zone, Erwin's Plastic Zone Correction, R curves, Compliance, J Integral, Concept of CTOD and CMD.
Material Models: General Concepts, Crack Models, Band Models, Models based on Continuum Damage Mechanics, Applications to High Strength Concrete, Fibre Reinforced Concrete, Crack Concepts and Numerical Modeling.

Reference Books:
1. Fracture Mechanics, Suri C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012.
2. Elementary Engineering Fracture Mechanics, BroekDavid, 3rd Rev. Ed. Springer, 1982.
3. Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall, 1989.
4. Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989.

Program Elective V
MTST918 – 18- Design of Plates and Shells(Credits- 3:0:0 = 3)

Teaching Scheme

Lectures: 3 hrs/week.

Course Outcomes: At the end of the course, the student will be able to:
1. Analyse and design prismatic folded plate systems.
2. Analyse and design shells using approximate solutions
3. Analyse and Design Cylindrical Shells
4. Design Doubly Curved Shells using Approximate Solutions.

Syllabus Contents:

Prismatic folded Plate Systems
Shell Equations
Approximate Solutions
Analysis and Design of Cylindrical Shells
Approximate Design methods for Doubly Curved Shells.

Reference Books:

- Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill
- Edition, 2010.
- Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005.
- Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI.
- Design of Plate and Shell Structures, Jawad Maan H., Springer Science.

Core –

MTST – 232 – 18 Dissertation I (Credits- 0:0:20 = 10)

Teaching Scheme
Lectures: 3hrs/week Mid Sem Evaluation weightage - 30%
End Sem Evaluation weightage - 70%

Course Outcomes: At the end of the course, the student will be able to:

- Identify structural engineering problems reviewing available literature.
- Identify appropriate techniques to analyze complex structural systems.
- Apply engineering and management principles through efficient handling of project
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Syllabus Contents:

- Dissertation-I will have mid semester presentation and end semester presentation. Mid semester
- presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.
- Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be evaluated by the departmental committee.

Core –
MTST233 – 18 - Dissertation II (Credits- 0:0:32 = 16)

Teaching Scheme
Contact Hours: 3hrs/week

Course Outcomes: At the end of the course, the student will be able to:
1. Solve complex structural problems by applying appropriate techniques and tools.

2. Exhibit good communication skill to the engineering community and society.
3. Demonstrate professional ethics and work culture.

Syllabus Contents:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I.Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc.There will bepre - submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

OPEN ELECTIVES
MTST919 – 18 Business Analytics

Teaching scheme
Lecture: - 3 h/week

Course objective
1. Understand the role of business analytics within an organization.

2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Unit1:
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review ofprobability distribution and data modelling, sampling and estimation methods overview.
Unit 2:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models for Businessanalytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
Unit 3:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes.Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analyticsanalysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
Unit 4:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.
Unit 6:
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.
COURSE OUTCOMES

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep
- analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling
- to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
- Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

OPEN ELECTIVES
MTST920 – 18 Industrial Safety

Teaching scheme
Lecture: - 3 h/week

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressurevessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.
Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.
Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.
Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:
1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVES
MTST9241 – 18 Operations Research

Teaching Scheme
Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student should be able to
1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.

2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Syllabus Contents:

Unit 1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, SimplexTechniques, Sensitivity Analysis, Inventory Control Models.

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplexmethod - sensitivity analysis - parametric programming.

Unit 3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Open Elective
MTST922 – 18 -Cost Management of Engineering Projects

Teaching scheme
Lecture: - 3 h/week

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre-project execution main clearances and

documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Open Elective

MTST923 – 18 Composite Materials

Teaching scheme

Lecture: - 3 h/week

Advantages and application of composites. Functional requirements of reinforcement and matrix.

Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glassfibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particlereinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic MatrixComposites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compressionmoulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective

MTST924 – 18 Waste to Energy

Teaching scheme

Lecture: - 3 h/week

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors
Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kineticconsideration in gasifier operation.
Unit-IV: Biomass Combustion: Biomass stoves – Improved challahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.
Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

References:
1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II,
Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley &Sons, 1996.

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section

3. Understand the skills needed when writing a Title
Ensure the good quality of paper at very first-time submission

Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness (4 Hours)

Unit 2 : Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction (4 Hours)

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, (4 Hours)

Unit 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions(4 Hours)

Unit 6: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission(4 Hours)

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3.Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.Highman'sbook.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -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 and practical relevance in

specific types of disasters and conflict situations.
4. 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

Introduction
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughtsand Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.
Disaster 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
Disaster Preparedness and Management
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.
Risk Assessment
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation inRisk Assessment and Warning, People's Participation In Risk Assessment. Strategies for Survival.
Disaster Mitigation
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 "'NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall ofIndia, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power

4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Content

Unit 1

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

Unit 2

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

Unit 3

- Technical concepts of Engineering-Electrical, Mechanical,
- Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1**.**Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit 1 (4 Hours)

- Values and self-development –Social values and individual attitudes.
- Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

Unit 2 (6 Hours)

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration.
- Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism, Love for nature, Discipline

Unit 3(6 Hours)

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

Unit 4 (6 Hours)

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Suggested*Reading*

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress, New Delhi.

Course outcomes

Students will be able to1.Knowledge of self-development
2.Learn the importance of Human values
3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. 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 inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit 1 (4 Hours)

- **History of Making of the Indian Constitution:**
  History, Drafting Committee, (Composition& Working)

Unit 2 (4 Hours)

- **Philosophy of the Indian Constitution:**

Preamble
Salient Features

Unit 3 (4 Hours)

- **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 4 (4 Hours) 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 5 (4 Hours)

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of
- Municipal Corporation.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.

- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- **Importance of grass root democracy**

Unit 6 (4 Hours)

- **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 reading

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.

Course Outcomes:

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 thenceptualization 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.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Unit 1 (4 Hours)

- **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 2 (4 Hours)

- Thematic overview: Pedagogical practices are being used by teachers in formal

- and informal classrooms in developing countries.
- Curriculum, Teacher education.

Unit 3 (4 Hours)

- 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 materials 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 4 (4 Hours)

- Professional development: alignment with classroom practices and follow up
- support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit 5 (4 Hours)

- Research gaps and future directions
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:
Students will be able to understand:
1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives
1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit 1 (8 Hours)

- Definitions of Eight parts of yog. (Ashtanga)

Unit 2 (8 Hours)

- Yam and Niyam.
- Do`s and Don't's in life.
- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3 (8 Hours)

- Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency.

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENTSKILLS

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

Syllabus

Unit 1 (8 Hours)

- Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Unit 2 (8 Hours)

- Approach to day to day work and duties.
- Shrimad BhagwadGeeta: 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.

Unit 3 (8 Hours)

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested reading

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

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.