Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Contents (Syllabus) for

Second Year M. Tech
(Civil Structural Engineering)
Sem. III to IV

AY 2020-21

Title of the Course: Dissertation Phase-I (3ST690)	L	T	P	Cr
	-	-	8	4

Desirable Courses: Courses of Semester I and II of F. Y. M. Tech (Civil-Structures)

References:

1. National and International journals, Conference Proceedings in Structural Engineering.
2. Technical Reports of Professional societies.
3. International and national codes of Practices and Handbooks.
4. Internet sources and Distance Learning.
5. Published Ph.D. and M.Tech Thesis of Reputed Institutes.

Course Objectives:

1. To impart knowledge for establishing objectives by carrying out extensive literature review on selected dissertation topic.
2. To develop methodology to execute the proposed research work through analytical/experimental work.
3. To analyze, interpret, debate and classify the findings of the work.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Examine** research developments through literature survey and set up research hypothesis.	III	Applying
CO2	**Construct** research methodology to evaluate the research hypothesis.	IV	Analyzing
CO3	**Critique** research idea with perspective scope.	V	Evaluating

CO-PO Mapping: (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1				**3**		**2**
CO2	**1**		**3**	**2**		**2**
CO3	**1**	**2**		**2**	**2**	**2**

Teacher Assessment: Assessment based on – Selection of topic, Literature survey, Content, Understanding, Presentation and Report writing.

Assessment	**Marks**
MSE	100

Course Contents:

It is expected that the student has well defined objectives of the dissertation by grasping and analyzing through an extensive literature review. The student shall develop methodology to execute the proposed research work through analytical/experimental work with proper validation.

Title of the Course: Dissertation Phase-II (3ST691 and 3ST692)	L	T	P	Cr
	-	-	12	2 + 4

Desirable Courses: Dissertation Phase I

References:

1. National and International journals, Conference Proceedings in Structural Engineering.
2. Technical Reports of Professional societies.
3. International and national codes of Practices and Handbooks.
4. Internet sources and Distance Learning.
5. Published Ph.D. and M.Tech Thesis of Reputed Institutes.

Course Objectives:

1. To impart knowledge for establishing objectives by carrying out extensive literature review on selected dissertation topic.
2. To develop methodology to execute the proposed research work through analytical/experimental work.
3. To analyze, interpret, debate and classify the findings of the work.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Examine** research developments through literature survey and set up research hypothesis.	III	Applying
CO2	**Construct** research methodology to evaluate the research hypothesis.	IV	Analyzing
CO3	**Critique** research idea with perspective scope.	V	Evaluating

CO-PO Mapping: (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1				**3**		**2**
CO2	**1**		**3**	**2**		**2**
CO3	**1**	**2**		**2**	**2**	**2**

Teacher Assessment: Assessment based on – Selection of topic, Literature survey, Content, Understanding, Presentation and Report writing.

Assessment	**Marks**
ISE 2	100
ESE	100

Course Contents:

It is expected that the student has well defined objectives of the dissertation by grasping and analyzing through an extensive literature review. Subsequently, outcomes based on preliminary research work, shall be reviewed critically in order to verify whether the research is in line with defined objectives and scope.

Title of the Course: Professional Elective 4 Computer Aided Analysis and Design (3ST611)	L	T	P	Cr
	3	-	-	3

Desirable Courses: Dynamics of Concrete Structures, Design of Steel Structures

Textbooks:

1. Pratap Rudra,"Getting started with MATLABTM", Oxford University press, 2010.
2. Jain M. K., Iyengar S. R. K. & Jain R. K. " Numerical Methods for Scientific and Engineering Computation ", 4th ed. 2004.
3. Pundit & Gupta "Structural Analysis", Tata MC Graw Hill Book company.

References:

1. Steve Otto and James P. Denier an Introduction to Programming and Numerical Methods in, Springer International books, 1st Edition, 2007
2. Cotes, R.C., Couties, M.G., and Kong, F.K., Structural Analysis, ELBS.
3. Chopra A. K., "Structural Dynamics for Earthquake Engineering", Pearson Publications.

Course Objectives:

1. To provide knowledge of numerical approach and significance of analysis by computers.
2. To impart necessary knowledge of numerical tools required for analyzing and solving problems in the field of engineering.
3. To provide pre-requisite knowledge to the students for analyzing and designing structures by professional software.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Apply** various softwares for modeling of structures	III	Applying
CO2	**Analyze** various RC and Steel structures.	IV	Analyzing
CO3	**Create** various programs for **design** of structures.	VI	Creating

CO-PO Mapping: (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1			**3**	**3**		**2**
CO2			**3**	**3**		**2**
CO3	**1**			**2**	**2**	**2**

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights, respectively.

Assessment	**Marks**
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Algorithm Development and Programming Languages	**8 Hrs.**
Basics of computer hardware and os, WWW and Apps, Algorithm essentials: problem analysis and flowcharting, fundamentals of sequential programming: Variables, data types & functions + input-output + data handling + various development units, Introduction to programming in MS EXCEL®, MATLAB®, PYTHON.	
Module 2: Matrix Methods and Programming	**6 Hrs.**
Matrix operations: product-inverse etc., Simultaneous linear equations, Eigen analysis method, Algorithm /Programming techniques of above methods.	
Module 3: Numerical Methods and Programming	**6 Hrs.**
Numerical Integration methods, Numerical differentiation methods, Regression Analysis tools and curve fitting, Numerical Methods in structural dynamics. Algorithm/Programming techniques of above methods.	
Module 4: Computer Aided Structural Analysis	**8 Hrs.**
Analysis of Trusses by Stiffness method. Analysis of CB by Stiffness method, Analysis of PF by Stiffness method. 3D Analysis issues. Algorithm development for each structural analysis type.	
Module 5: Computer Aided Structural Design	**6 Hrs.**
Design of Steel Truss members by IS-800, Design of Beam sections in RCC, Design of One way and Two-way slabs by IS-456. Algorithm development for each structural design type.	
Module 6: Commercial Software Applications	**6 Hrs.**
Application in commercial software SAP®/ABACUS®/ANSYS®: Analysis of TRUSS, Analysis of 2D frame, Analysis of 3D structure for various LOAD COMBINAIONS. Design of building members- Beam, Slab, Column, Footing by STAAD®, Introduction to other commercial soft-wares.	
Module wise Outcomes At end of each module students will be able to: 1. Apply fundamentals of Algorithm and programming. 2. Execute Matrix operations by programming. 3. Apply Numerical methods by programming 4. Perform 1D & 2D structural analysis by programming 5. Design simple RCC and STEEL members by latest IS-codes 6. Use finite element based commercial software's for analysis of structural engineering problems.	

Title of the Course: Professional Elective 4 Numerical Methods in Structural Engineering (3ST612)	L	T	P	Cr
	3	-	-	3

Desirable Courses: Applied Mathematics, Structural Engineering

Textbooks:

1. Chapra Steven and Canale Raymond, "Numerical Methods for Engineers", Mc-Graw Hill, 7th Edition, 2012.
2. Gourdin A. and Boumhrat M., "Applied Numerical Methods", Prentice Hall India, New Delhi, 2000.
3. Joe D Hoffman, "Numerical Methods for Engineers and Scientists", Marcel Dekker, 2nd Edition, 2001.

References:

1. Gilbert Strang, "Computational Science and Engineering", Wellesley-Cambridge Press.
2. Gilbert Strang, "Linear Algebra and Its Applications", Wellesley Cambridge Press, 4th Edition, 2009.
3. Philips, G. M., and Taylor P. J. "Theory and Applications of Numerical Analysis", Academic Press, 2nd Edition, 1996.

Course Objectives:

1. To provide knowledge of Matrix methods and statistical tools for solution of problems.
2. To impart knowledge of numerical differentiation, integration, root finding, curve fitting and other numerical approximations.
3. To provide exposure to field application of numerical methods in structural engineering.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Execute** numerical recipes for problem solving in engineering.	III	Apply
CO2	**Examine** different numerical tools for solution of engineering problems.	IV	Analyze
CO3	**Discuss** numerical schemes for modeling and solving field applications.	V	Evaluate

CO-PO Mapping: (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1			**3**	**2**		**2**
CO2	**1**		**2**	**3**		**2**
CO3			**2**	**2**	**2**	**2**

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Solving Linear Algebraic Equations and Eigen Analysis	**8 Hrs.**
System of linear algebraic equations, conditions for existence of solution, Classification of solution approaches as direct and iterative, solution by matrix decomposition, Introduction to methods for solving Block-diagonal, triangular, block-triangular systems. Introduction to sparse linear systems: Thomas algorithm for tridiagonal and block tridiagonal matrices, Iterative methods: Jacobi, Gauss-Siedel and successive over relaxation methods, Convergence of iterative solution schemes. Ill conditioning of equations. Eigen Analysis by Jacobi and other Methods.	
Module 2: Solving Nonlinear Algebraic Equations [Root Locating methods]	**7 Hrs.**
Method of successive substitutions derivative free iterative solution approaches, Secant method, regula falsi method, Modified Newton's method and qausi-Newton method with Broyden's update, Optimization based formulations and Leverberg-Marquardt method.	
Module 3: Solving Ordinary Differential Equations and Approximations	**6 Hrs.**
Solutions of Linear ODE-IVPs by implicit and explicit methods, Taylor series based and Runge-Kutta methods, Multi-step approaches, Stability issues. Problem discretization using approximation theory, polynomial approximations, Finite difference method for solving ODE-BVP with examples, Polynomial and function interpolations, Least square approximations, Model Parameter Estimation using linear least squares method, Gauss Newton Method.	
Module 4: Probability, Statistics, Reliability Analysis	**8 Hrs.**
Probability basics and applications in engineering, Statistical parameters, distributions, methods and applications. Reliability analysis in structural engineering.	
Module 5: Numerical Integration	**7 Hrs.**
Newton-Cotes schemes, Romberg, Gauss-quadrature, Multiple Integrals.	
Module 6: Structural Engineering Applications	**6 Hrs.**
Digital Signal Processing, Nonlinear structural analysis, Structural dynamics and Earthquake engineering applications. SHM.	
Module wise Outcomes At end of each module students will be able to: 1. Execute Linear algebra analysis in structural engineering 2. Calculate roots of nonlinear equations. 3. Execute solution of IVP and BVP by different numerical analysis. 4. Discuss statistics and probability methods in engineering. 5. Devise Numerical integration methods in engineering. 6. Execute numerical solutions to different structural engineering problems in field.	

Title of the Course: Professional Elective 4 Advances in Composites (3ST613)	L	T	P	Cr
	3	-	-	3

Desirable Courses: Concrete Technology

Textbooks:

1. Siddique Rafat, "Special Structural Concretes", Galgotia Publication Private Ltd.,2000
2. Swamy R. N., "Concrete Technology & Design", Surrey University Press., illustrated, 1984.

References:

1. Balaguru P. N., Shah S.P., "Fiber Reinforced Cement Composites, McGraw Hill., illustrated, 1992.
2. Hannant D. J., "Fiber Cement and Fiber Concrete", John Wiley & Sons. Illustrated, 1978.

Course Objectives:

1. To illustrate various concrete composites used in practice.
2. To impart knowledge of variations in strength of concrete composites.
3. To provide knowledge of various advanced types of concrete in modern construction industry.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Illustrate** engineering properties, behavior and applications of FRC and Ferro cement.	III	Applying
CO2	**Appraise** applications of silica fume concrete and polymer concrete by knowing their properties**.**	IV	Analyzing
CO3	**Justify** use of light weight and high strength concrete in modern constructions.	V	Evaluating

CO-PO Mapping: (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1			**2**			**2**
CO2	**2**		**2**	**1**		**2**
CO3	**1**		**3**			**2**

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Module 1: Fiber Reinforced Concrete	**7 Hrs.**
Introduction, Properties of constituent materials, Mix proportion, mixing, casting methods, properties of freshly mixed concrete (fiber reinforced concrete), workability tests, mechanical properties, behavior of fiber reinforced concrete under compression, tension flexure, research findings, and application of fiber reinforced concrete.	
Module 2: Ferro Cement	**6 Hrs.**
Introduction, materials used, mechanical properties, construction techniques, design in direct tension, applications, and merits as structural materials.	
Module 3: Silica Fume Concrete	**7 Hrs.**
Introduction, physical and chemical properties of silica Hume, reaction mechanism of silica fume, properties of silica fume concrete in fresh state, mechanical properties and durability of silica fume concrete.	
Module 4: Polymer Concrete	**6 Hrs.**
Introduction, classification, properties of constituent materials, polymer impregnated concrete, polymer concrete, application.	
Module 5: Light Weight Concrete	**6 Hrs.**
Introduction, classification, properties of constituent materials, artificial aggregates, application.	
Module 6: High Strength Concrete	**7 Hrs.**
Introduction, properties of constituent materials, Mix Design, application.	
Module wise Outcomes At end of each module students will be able to: 1. Illustrate the change in concrete properties due to fiber reinforcements. 2. Illustrate the use of Ferro cement. 3. Appraise the effect of silica fumes in concrete application. 4. Appraise the use of polymer in concrete. 5. Justify use of light weight concrete in field. 6. Justify the use of high strength concrete in field.	

Title of the Course: Dissertation Phase-III (3ST693)	L	T	P	Cr
	-	-	8	4

Desirable Courses: Dissertation Phase II

References:

1. National and International journals, Conference Proceedings in Structural Engineering.
2. Technical Reports of Professional societies.
3. International and national codes of Practices and Handbooks.
4. Internet sources and Distance Learning.
5. Published Ph.D. and M.Tech Thesis of Reputed Institutes.

Course Objectives:

1. To analyze / experiment selected research problem further.
2. To review, classify and consolidate observations / results based on the detail analytical / experimental work.
3. To document the research work in the prescribed format and present it effectively.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Apprise** analytical / experimental work in detail for the selected research problem.	IV	Analyzing
CO2	**Classify and assess** research outcomes critically.	V	Evaluating
CO3	**Compose and conclude** the results for presentation and dissertation writing.	VI	Creating

CO-PO Mapping: (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1	**2**			**3**	**2**	**2**
CO2	**1**			**2**	**2**	**2**
CO3	**2**	**3**		**2**	**2**	**2**

Teacher Assessment: Assessment based on – Literature survey, Content, Understanding, Analysis, Modeling, Presentation and Report writing.

Assessment	**Marks**
MSE	100

Course Contents:

In continuation with the research work carried out in semester III, student shall carry out numerical / experimental work in detail. Based on this work, student shall classify and assess the research outcomes critically.

Title of the Course: Dissertation Phase-IV (3ST694 and 3ST695)	L	T	P	Cr
	-	-	24	4 + 8

Desirable Courses: Dissertation Phase III

References:

1. National and International journals, Conference Proceedings in Structural Engineering.
2. Technical Reports of Professional societies.
3. International and national codes of Practices and Handbooks.
4. Internet sources and Distance Learning.
5. Published Ph.D. and M.Tech Thesis of Reputed Institutes.

Course Objectives:

1. To analyze / experiment selected research problem further.
2. To review, classify and consolidate observations / results based on the detail analytical / experimental work.
3. To document the research work in the prescribed format and present it effectively.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Apprise** analytical / experimental work in detail for the selected research problem.	IV	Analyzing
CO2	**Classify and assess** research outcomes critically.	V	Evaluating
CO3	**Compose and conclude** the results for presentation and dissertation writing.	VI	Creating

CO-PO Mapping: (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1	**2**			**3**	**2**	**2**
CO2	**1**			**2**	**2**	**2**
CO3	**2**	**3**		**2**	**2**	**2**

Teacher Assessment: Assessment based on – Literature survey, Content, Understanding, Analysis, Modeling, Presentation and Report writing.

Assessment	**Marks**
ISE II	100
ESE	100

Course Contents:

Student shall carry out numerical / experimental work in detail. Based on this work, student shall classify and assess the research outcomes critically. Student shall compose the results and conclude research findings. Finally, student shall document research work in appropriate format and present it effectively.