JSPM's
RAJARSHI SHAHU COLLEGE OF ENGINEERING
TATHAWADE, PUNE-33
(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Department of Civil Engineering

Structure & Syllabi

S. Y. M. Tech (2019 Pattern)

w.e.f. Academic Year 2020-2021

Index

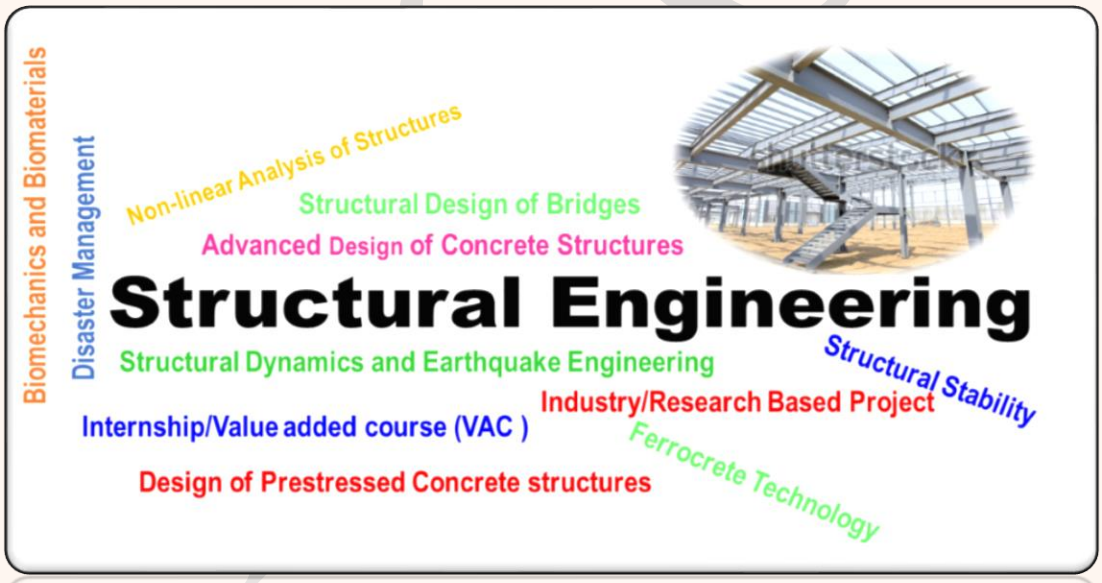
Department of Civil Engineering

Vision

"To provide an excellent academic environment for students to become competent Civil Engineer."

Mission

- To reinforce the students with fundamentals in Civil Engineering by providing scholarly and vibrant environment for successful careers.
- To explore and develop innovations that contributes to higher education, research and entrepreneurship development in applied domains of Civil Engineering.
- To serve society through knowledge and expertise in Civil Engineering.



Structural Engineers: Adding Value in Every Building.

- ***Structural engineers*** design the ***'bones and muscles'*** that create the form and shape of man-made structures
- ***Structural engineers*** concerned with the ***design and physical integrity*** of buildings and other large structures, like tunnels and bridges.
- ***Structural engineers*** understand and calculate the ***stability, strength and rigidity and earthquake evaluation*** of built structures for buildings and non-building structures.
- ***Unlike architects***, who must focus on the appearance, shape, size and use of the building, ***structural engineers*** must ***solve technical problems*** - and help the architect achieve his or her vision for the project.

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Department of Civil Engineering

Program Outcomes (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. JSPM's Rajarshi Shahu College of Engineering Department of IT Engineering.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

Upon successful completion of PG course in Civil Engineering, the students will attain following Program Specific Outcomes:

1. Satisfy the essentials in planning, analysis, design and maintenance of Civil Engineering Structures by incorporating latest technologies and modern tools.
2. Proficient in identifying and solving complex infrastructural problems, applying management and engineering techniques.
3. Provide sustainable solutions to environmental and water resources challenges.

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Highlights of the Syllabus

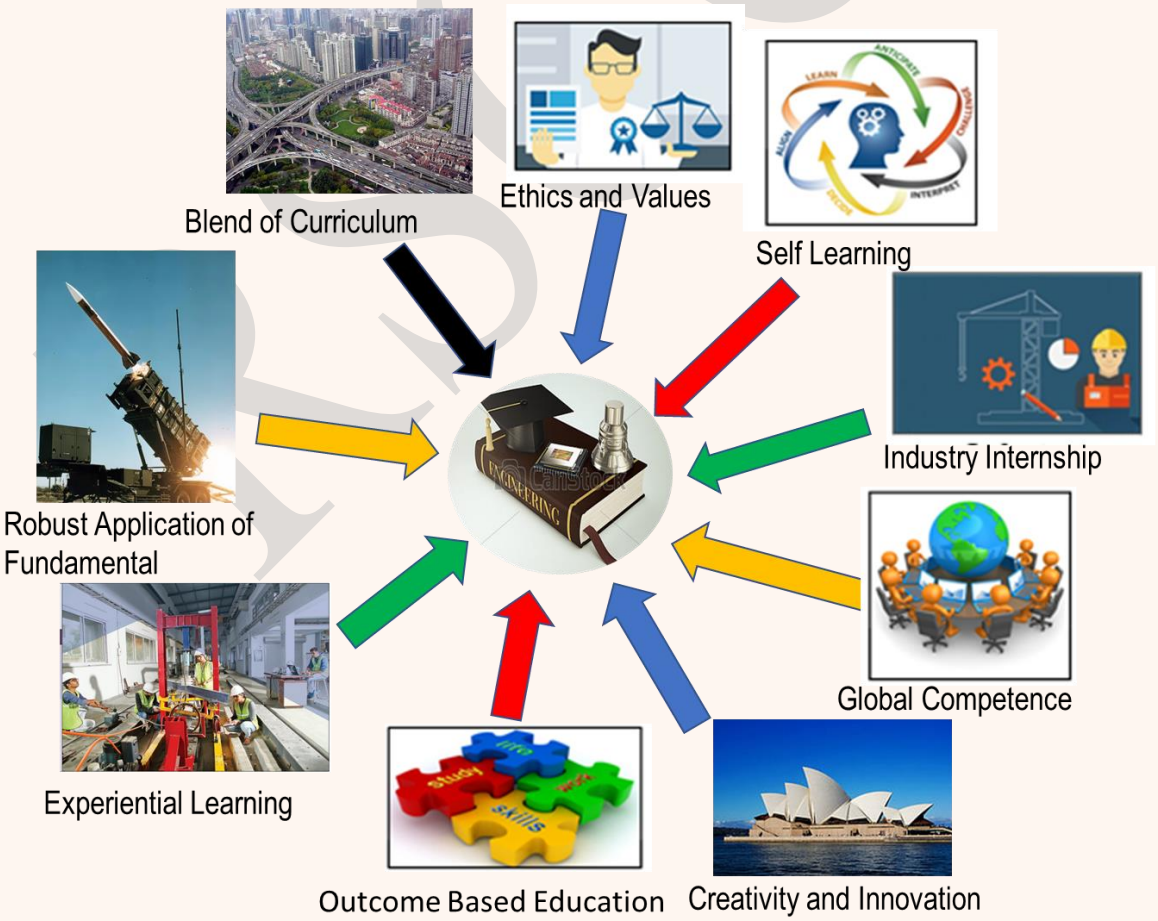
Curriculum of MTech in Structural Engineering Department is designed in consultation with:

Academic Experts

Distinguished Alumni

Industry/Corporate Experts

The curriculum of the PG Program of Civil Engineering designed in association with the Bentley Systems; Construction Diagnostic Centre, Pune; G A Bhilare Consultants Private Limited, Pune; L&T Construction Ltd. Mumbai; Tata Consultancy Services Limited, Pune; Mercedes-Benz India Pvt Ltd, Pune.



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Unique features of the curriculum

1. **Curriculum centered at Outcome Based Education:**
   The new Curriculum is based on student-centered instruction models that focus on measuring student performance through outcomes. The outcomes include subject knowledge, industry required skills and aptitude development of students.
2. **Robust application of Fundamentals:**
   The nature of the new curriculum is rigorous and well prescribed so that the students can spend more time on preparation and self-study. The students have to apply knowledge of core subjects, solve practical based assignments and must attempt periodical quizzes. This will benefit them to utilize and keep a strong hold on fundamentals of applied Engineering in the most effective way.
3. **Experiential Learning:**
   The curriculum emphasizes on hands-on sessions along with theoretical information. The new curriculum considers Problem Based Experiential Learning (PBL) as a teaching pedagogy and includes different subjects that encourage the students for hands on learning through virtual labs, mini-projects, literature and field surveys. Accordingly, the curriculum maintains good balance between theory and laboratory credits.
4. **Promote Creativity and Innovation:**
   Along with experiential learning, the curriculum also motivates the students to inculcate creativity and innovation. Apart from conventional lab, the curriculum provides a freedom for students to perform industry assignments, pilot projects, innovative self-development by patenting their creativity.
5. **Inculcating Ethics and Values:**
   To improvise student's behaviour, the curriculum has included systematic courses on ethics and values. The moral principles can help students to make right decisions, lead their professional lives and become ethical citizen.
6. **Blend of Curricular and Noncurricular Activities:**
   The curriculum also gives importance of different activities like co-curricular, extra-curricular, sports, culture, etc. This will help to do all round development of students in all possible ways.
7. **Flexibility:**
   The curriculum provides flexibility by offering various courses/electives in choosing mentorship to work in specialized field in the curriculum as, Capstone Projects, Entrepreneurship, Perusing Research and higher studies and industry internships.
8. **Global Competence:**
   The curriculum provides a unique opportunity for students to learn and engage in open and effective interaction with people from diverse and interconnected world. The provision of international internships in the curriculum help the students to build a capacity to examine global and intercultural issues and to propose perspectives and views.
9. **Industry Induced Internship Program**
   To support ever demanding industry requirements, the curriculum has included an industry internship with an objective to learn technologies pertaining to their discipline and enhance their technical knowledge with a support of the live platform of Industry.
10. **Motivation for Self-Learning:**
    The curriculum also offers a freedom to students to take the initiatives in their learning needs and set the goals with the help of online learning platforms like MOOCs, NPTEL, Swayam, etc.

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S. Y. M. Tech (Civil Structural Engineering)
Academic Year – 2020-2021 Semester -III

Course Code	Course	Teaching Scheme			Examination Schemes						Credits
					Theory			TW	Lab	Total	
		TH	Tut	Lab	ISE (15)	MSE (25)	ESE (60)				
CE6101	Elective-V	3	--	--	15	25	60	--	--	100	3
CE6102	Internship/Value added Course (VAC)	--	--	--	--	--	--	50	50	100	3
CE6103	Dissertation Phase-I	--	--	--	--	--	--	150	50	200	6
Total		**3**	--	--	**15**	**25**	**60**	**200**	**100**	**400**	**12**

Elective-V	
Code No.	**Title**
CE6101A	Design of Composite and Smart Materials
CE6101B	Non-linear Analysis of Structures
CE6101C	Design of Industrial Steel Structures
CE6101D	Interdisciplinary Elective Subject offered by another department

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S. Y. B. Tech (Civil Engineering)
Academic Year – 2020-2021 Semester -IV

Course Code	Course	Teaching Scheme			Examination Schemes						Credits
		TH	Tut	Lab	Theory			TW	Lab	Total	
					ISE (15)	MSE (25)	ESE (60)				
CE6104	Internship/Value added Course (VAC)	--	--	--	--	--	--	50	50	100	3
CE6105	Dissertation Phase-II (Industry/Research)	--	--	--	--	--	--	250	150	400	17
Total		--	--	--	--	--	--	**300**	**200**	**500**	**20**

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Second Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester -III

[CE6101A]: Composite and Smart Materials

Teaching Scheme: TH: - 03 Hours/Week	Credit 03	Examination Scheme: In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites: Basic concept of isotropic materials, stress strain relationship concept.

Course Objective: To make the students familiarize with utilization composite material to engineering solutions.

Course Outcome:
On completion of the course, student will be able to–
CO1: Understand basic information about composite material.
CO2: Classify Composite materials and its applications.
CO3: Application of smart materials in structural elements.
CO4: Understand Behavior of Actuators and sensors.
CO5: Apply the knowledge of control systems in structural elements.
CO6: Understand Structural characterization of nanomaterial.

Course Contents

UNIT-I	Introduction to the Composite materials	06 Hours

Classifications and Applications. Anisotropic elasticity unidirectional and anisotropic laminate, thermo-mechanical properties, micro-mechanical analysis, characterization tests.

UNIT-II	Composite laminate	06 Hours

Classical composite lamination theory, cross and angle-play laminates, symmetric, antisymmetric and general symmetric laminates, mechanical coupling. Analysis of simple laminated structural elements ply-stress and strain, lamina failure theories- first fly failure, vibration and buckling analysis. Sandwich structure face and core materials, secondary failure modes environmental effects, manufacturing of composites.

UNIT-III	Introduction to smart materials and structures	08 Hours

Piezoelectric materials-coupled electro mechanical constitutive relations- deposing and coercive field-field-strain relation-hysterics-creep-strain rate effects-manufacturing.

UNIT-IV	Numerical differentiation and integration	08 Hours

Single and dual actuators-pure extension, pure bending-bending extension relations-uniform strain beam model-symmetric induced strain actuators-bond shearing force-Bernoulli's-Euler (BE) beam models- embedded actuators- Asymmetric induced strain actuators in uniform strain and Euler-Bernoulli models. Uniform strain model –energy principle formulation-BE model- single and dual surface bonded actuators-Extension-bending and torsion model.

UNIT-V	Introductions to control systems	08 Hours

Open loop and close loop transfer functions-stability criteria deflection control of beams like structures-using piezoelectric sensors and actuators-shape memory alloy.

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UNIT-VI	Introduction to Nanostructured materials	06 Hours
Chemical and structural characterization, material behavior and technological implications to these materials.		

Reference Books:

R1: Robert M Jones, "Mechanic of Composite Materials", McGraw Hill Publishing Co.
R2: Bhagwan D Agaravalam & Lawrence J Brutman, "Analysis and Performance of Fiber Composites", John Wiley and Sons.
R3: Lecture notes on, "Smart Structures", by Inderjith Chopra, Department of Aerospace Engg. University of Maryland
R4: Crawley E & Anderson E, "Detailed Models of Piezocermic actuation of Beams", proceedings of the 30th AIAA/ASME/ASME/ ASCE/AHS/ASC- Structural dynamics and Material conference, AIAA Washington DC, April 1989.
R5: Crawley E & De Luis J, "Use of Piezoelectric actuators as elements of Intelligent Structures", AIAA Journal, Vol. 25, No 10, Oct 1987, pp 1373-1385.

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Second Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester -III

[CE6101B]: Non-linear Analysis of Structures

Teaching Scheme: TH: - 03 Hours/Week	Credit 03	Examination Scheme: In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites: Basic concept of linear and nonlinear analysis of structure.

Course Objective: To make the students acquaint with nonlinear analysis of various types of structures**.**

Course Outcome:

On completion of the course, student will be able to–

CO1: Understand various types of nonlinearities and nonlinear analysis of beams.

CO2: Understand and do nonlinear analysis of columns.

CO3: Analyze the trusses and frames for various types of nonlinearities.

CO4: Analyze the plates for various types of nonlinearities.

CO5: Analyze the shells for various types of nonlinearities.

CO6: Analyze the structures with composite materials for various types of nonlinearities.

Course Contents

UNIT-I	Nonlinear analysis of Beams	06 Hours

Types of Nonlinearities: Geometric, Material, Nonlinear equations for beams: Moment- curvature nonlinearity, Geometric nonlinearity due to stretching, Material nonlinearity. Geo metric nonlinear beam problems: Moment curvature nonlinearity of cantilever beam, centrally loaded beam with two supports, Cantilever beam subjected to tip load.

UNIT-II	Nonlinear analysis of Columns	06 Hours

Nonlinear analysis of Columns: Double modulus theory, Tangent modulus theory, Empirical relations for short column, Post buckling of cantilever column, Large deflection of column with both ends hinged.

UNIT-III	Nonlinear analysis of Trusses and Frames	08 Hours

Nonlinear analysis of Trusses and Frames: Beam column, Triangulated frames, Derivation of nonlinear stiffness matrix, Matrix displacement method for nonlinear analysis of structures, nonlinear analysis of plane frame.

UNIT-IV	Nonlinear Static Analysis of Plates	08 Hours

Nonlinear Static Analysis of Plates: Geometric and material nonlinearities, Governing nonlinear equations of plates: Stress function approach, Displacement equations approach. Nonlinear static analysis of plates: Boundary conditions and method of solution, Large deflection of rectangular plates.

UNIT-V	Nonlinear Analysis of Shells	08 Hours

Nonlinear Analysis of Shells: Derivation of governing equations, Circular cylindrical shells large

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deflections, Post buckling of shells: Circular cylindrical shells, Spherical shells with finite deflections.		
UNIT-VI	**Nonlinear analysis of structures with composite materials**	**06 Hours**
Nonlinear analysis of structures with composite materials: Composite beams large deflection, Composite plates governing equations, Displacement equations, Laminated plates-cylindrical bending, symmetrically laminated plates.		
Reference Books: **R1**:M Sathyamoorthy, Nonlinear Analysis of Structures- CRC New York. **R2**: K I Majod, Nonlinear Structures- Butter Worth, London.		

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Second Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester -III
[CE6101C]: Design of Industrial Steel structures

Teaching Scheme: TH: - 03 Hours/Week	Credit 03	Examination Scheme: In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks Total: 100 Marks

Course Prerequisites: Basic concept of static and dynamic analysis of steel structures..

Course Objective: To make the students acquaint with analysis and design of various types of industrial steel structures.

Course Outcome:
On completion of the course, student will be able to–

CO1: Analyze and design of knee braced trussed bent, column and its base.

CO2: Analyze and design of knee braced trussed bent with gantry loads, stepped columns and its base.

CO3: Analyze and design gable portal frame and bracket connections.

CO4: Understand and analyze open web frames for industrial shed and trussed purlins.

CO5: Understand and analyze Mobile gantry structure and machine foundations.

CO6: Analyze and design of various bracing systems in industrial shed structure and industrial flooring

Course Contents

UNIT-I	**Industrial Structures without Gantry**	**06 Hours**
Analysis and design of knee braced trussed bent with hinged, fixed and partially fixed bases without gantry, design of knee brace, roof column and its base.		
UNIT-II	**Industrial Structures with Gantry**	**06 Hours**
Various types of column configurations in case of knee braced trussed bent with gantry loads, design of stepped columns and bases under various load combinations.		
UNIT-III	**Gable Portal Frame and Bracket Connections**	**08 Hours**
Analysis and design of gable portal frame with and without gantry loads, design of bracket supporting gantry loads.		
UNIT-IV	**Open web frames and Trussed Purlins**	**08 Hours**
Open web frames for industrial shed, trussed purlins.		
UNIT-V	**Mobile Gantry Structure and Machine Foundations**	**08 Hours**
Mobile gantry structure, machine foundations.		
UNIT-VI	**Bracing Systems and Industrial Flooring**	**06 Hours**
Analysis and design of various bracing systems in industrial shed structure and industrial flooring.		

Reference Books:

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R1: Ramchandra, Design of Steel Structures Vol – II, Standard Book House, Delhi.
R2: A. S. Arya and J. L. Ajmani, Design of Steel Structures, Nemchand & Bros., Roorkee.
R3: Teaching Resource for Structural Steel Design, INSDAG Kolkata.
R4: IS: 800 – 1984, Code of Practice for General Construction in Steel.
R5: IS: 875 – 1964, Code of Practice for Structural Safety of Building: Loading Standards (Revised).
R6: IS: 4137 – 1967, Code of practice for Heavy Duty electric Overhead Traveling Crane.
R7: Steel Designers Manual, ELBS.
R8: John E. Lotheres, Advanced Design in Structural Steel, Prentice Hall.

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Second Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester -III
[CE6102]: Internship/Value added course (VAC)

Teaching Scheme: TH: 00 Hours/Week	Credit: 03	Examination Scheme: Term work : 50 Marks Oral/ Presentation: 50 Marks Total :100 Marks

Course Prerequisites: Knowledge of Civil Structural Engineering.

Course Objective:

1. To identify the field of interest.
2. To enhance the knowledge in the selected field.
3. Promoting learning through Do-It-Yourself (DIY).

Course Outcome:

On completion of the course, student will be able to–

CO1: Enhance existing knowledge through Do-It-Yourself activity.
CO2: Real life problem identification and problem solving.

Course Contents

A. Internship: Carry out the internship in well reputed Civil Engineering Design Consultancy firm. Student should be able to do the analysis and design of different Civil Engineering Structures using different techniques like mathematical modeling, programming, software's, experimental and analytical studies etc. Students should also do the various site visits for the checking of reinforcement detailing of various structures during construction under processes.

B. Value added course (VAC): To do any Value-added course in Civil Structural Engineering Field. Following are the options for value added course:

1. NPTEL 12-week course with certification.
2. Online civil structural engineering related software (project based) course with certification.
3. Any patented idea in Structural engineering which will have analytical and mathematical modelling and clarity for independent publication.

C. Assessment:

- Student has to maintain and submit a record of design and analysis procedures of all projects handled by them during internship period.
- Every week, student will submit the report to PG Coordinator about learning and work carried out during that week.
- At the end of semester project submitted for course certification will be used for assessment and external oral examination of individual student will be conducted based on that. The external examiner for the oral will be from the company from where they did the internship and the internal examiner will be from the institute.

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Second Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester -III
[CE6103]: Dissertation Phase-I

Teaching Scheme: TH: 00 Hours/Week	Credit: 06	Examination Scheme: Term work : 50 Marks Oral/ Presentation: 150 Marks Total :200 Marks

Course Prerequisites: Knowledge of Civil Structural Engineering.

Course Objective:

1. To identify the field of interest.
2. To enhance the knowledge in the selected field.
3. Promoting learning through Do-It-Yourself (DIY).

Course Outcome:

On completion of the course, student will be able to–

CO1: Enhance existing knowledge through Do-It-Yourself activity.
CO2: Real life problem identification and problem solving.

Course Contents

A. Report Writing: Dissertation Phase-I is the integral part of the dissertation project. The project should be based on the knowledge acquired by the students during the coursework and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in an area where the students like to acquire specialized skills.

The student shall submit the report (printed on both sides) of project work completed partly in standard format approved by the Institute as per the following:

1. Introduction including aim and objective of the dissertation topic
2. Review of literature
3. Problem statement and methodology
4. Theoretical contents associated with the dissertation topic
5. Data collection from field or organization / experimental set-up developed if any / part analysis
6. Limitations of study / difficulties encountered if any
7. Progress achieved
8. Future plan of action
9. References

B. Assessment:

- The candidate shall deliver a presentation as a part of the progress report of Dissertation Phase-I in front of panel of examiners.
- It is recommended that at least one research/literature review paper on the dissertation topic to be presented in a conference or published in a referred journal as a part of the progress report of Dissertation Phase-I

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Second Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester -IV
[CE6104]: Internship/Value added course (VAC)

Teaching Scheme: TH: 00 Hours/Week	Credit: 03	Examination Scheme: Term work : 50 Marks Oral/ Presentation: 50 Marks Total :100 Marks

Course Prerequisites: Knowledge of Civil Structural Engineering.

Course Objective:

1. To identify the field of interest.
2. To enhance the knowledge in the selected field.
3. Promoting learning through Do-It-Yourself (DIY).

Course Outcome:

On completion of the course, student will be able to–

CO1: Enhance existing knowledge through Do-It-Yourself activity.
CO2: Real life problem identification and problem solving.

Course Contents

A. Internship: Carry out the internship in well reputed Civil Engineering Design Consultancy firm. Student should be able to do the analysis and design of different Civil Engineering Structures using different techniques like mathematical modeling, programming, software's, experimental and analytical studies etc. Students should also do the various site visits for the checking of reinforcement detailing of various structures during construction under processes.

B. Value added course (VAC): To do any Value-added course in Civil Structural Engineering Field. Following are the options for value added course:

1. NPTEL 12-week course with certification.
2. Online civil structural engineering related software (project based) course with certification.
3. Any patented idea in Structural engineering which will have analytical and mathematical modeling and clarity for independent publication.

C. Assessment:

- Student has to maintain and submit a record of design and analysis procedures of all projects handled by them during internship period.
- Every week, student will submit the report to PG Coordinator about learning and work carried out during that week.
- At the end of semester project submitted for course certification will be used for assessment and external oral examination of individual student will be conducted based on that. The external examiner for the oral will be from the company from where they did the internship and the internal examiner will be from the institute.

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Second Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester -IV
[CE6105]: Dissertation Phase-II

Teaching Scheme: TH: 00 Hours/Week	Credit: 17	Examination Scheme: Term work : 150 Marks Oral/ Presentation: 250 Marks Total :400 Marks

Course Prerequisites: Knowledge of Civil Structural Engineering.

Course Objective:

1. To identify the field of interest.
2. To enhance the knowledge in the selected field.
3. Promoting learning through Do-It-Yourself (DIY).

Course Outcome:

On completion of the course, student will be able to–

CO1: Enhance existing knowledge through Do-It-Yourself activity.
CO2: Real life problem identification and problem solving.

Course Contents

A. Report Writing: In Project Work Stage II, the student shall complete the dissertation. The student shall prepare the final report of dissertation work in standard format duly certified for satisfactory completion of the work by the concerned guide and Head of the Department/Institute.

1. The report shall consist of the following as applicable:
2. Introduction including aim and objective of the dissertation topic
3. Review of literature
4. Problem statement
5. Theoretical contents associated with the dissertation topic
6. Methodology adopted
7. Data collection from field or organization / experimental set up preparation ifany/analysis
8. Results and discussion
9. Validation of results if applicable
10. Conclusions and future scope of work
11. References

B. Assessment:

- The final dissertation shall be submitted in hard bound copy as well as a soft copy on CD. The Term Work of Dissertation of semester IV shall be assessed jointly by the pair of internal and external examiners, along with oral examination of the same. The candidate shall deliver a presentation on report of Dissertation Stage-II (Project work) in front of external and internal examiner.
- It is recommended that at least one paper on the dissertation topic to be presented in a conference or published in a referred journal as a part of the progress report of Dissertation Phase-II.

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