Academic Program: PG

Academic Year 2023-24

Syllabus

III&IVSemesterM.Tech.

COMPUTER AIDED DESIGN OF STRUCTURES

Department of Civil Engineering

ACADEMIC AUTONOMY

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Ph: **0836-2447465Fax: 0838-2464638 Web: www.sdmcet.ac.in**

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for III &IV semester M.Tech. Computer Aided Design of Structures is recommended by the Board of Studies of Civil Engineering and approved by the Academic Council, SDM College of Engineering &Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2023-24 till further revision.

Principal Chairman BoS&HoD

SDM College of Engineering & Technology, Dharwad

VISION AND MISSION

VISION:

To develop competent professionals with human values

MISSION:

- To have contextually relevant curricula.
- To promote effective teaching learning practices supported by modern educational tools and techniques.
- To enhance research culture.
- To involve industrial expertise for connecting classroom content to real life situations.
- To inculcate ethics andsoft skills leading to overall personality development.

SDM College of Engineering & Technology, Dharwad

Civil Engineering Department

DEPARTMENT VISION AND MISSION

Vision:

To be the center of excellence providing the state of art civil engineering education developing competent engineers responsible for serving modern society.

Mission:

The stated vision can be achieved through:

- The development of robust curricula to meet the industrial expectations.
- Interactive teaching-learning process with modern educational tools and soft skills.
- Establishing synergy between teaching and research
- Industry-Institute interaction.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To provide proficiency in the basic principles and advanced courses of technology in Computer Aided Design of Structures so that students are able to formulate, analyze and solve the societal problems for sustainable development related to Structural Engineering.

2. To expose students to the latest innovations and trends with a view to inculcate strong research orientation in Computer Aided Design of Structures as well as in multidisciplinary streams.

3. To create a congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups in professional, industry and research organizations.

4. To produce Structural Engineers who integrate and build on the program's core curricular concepts in the pursuit of professional leadership, teamwork, life-long learning, and successful career advancement.

PROGRAMME OUTCOMES (POs):

PO1: An ability to independently carry out design /research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over design of structures using software tools as per the specialization of the program.

Scheme of Teaching and Examinations – 2023-24
M.Tech., Computer Aided Design of Structures (CADS)
III Semester M. Tech.

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
22PCDC301	AnalysisofPlatesand Shells–ClassicalandFE Approach	4-0-0	4	50	100	3		
22PCDEXXX	Elective 5	3-0-0	3	50	100	3		
22PCDEXXX	Elective 6	3-0-0	3	50	100	3		
22PCDEXXX	Elective 7	4-0-0	4	50	100	3	-	-
OR								
22PCDL302	Internship in Industry or R&D organization	** Min 4 weeks during vacation after 2nd sem	4	50	-	-	100	3
22PCDL303	*** Project phase 1	0-0-6	6	50	-	-	50	3
Total		**14-0-6/ 10-4weeks-6**	**20**	**250**	**400/ 300**		**50/150**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination **L**: Lecture **T**: Tutorials **P**: Practical ***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

**** The students are expected to undergo training in industry for a period of ***four weeks*** during the vacation immediately after completion of II Semesterexamination. A faculty is to be allotted to guide the student. A committee consisting of three faculty members shall evaluate the work carried out and the knowledge the students have acquired.**OR The students can take one elective course if they do not undergo internship.**

*****Project phase-I: The students are expected to formulate the problem and carry out the intensive literature survey along with preliminary investigations supporting the project phase-II in IV semester.

List of Electives

Course Code	Elective Courses
22PCDE325	Design of Precast & Composite Structures
22PCDE326	Advanced Design of Pre-Stressed Concrete Structures
22PCDE327	Design of Substructures
22PCDE328	Design of Structural Systems in Bridges
22PCDE329	Composite and Smart Materials

Scheme of Teaching and Examinations – 2023-24
M.Tech., Computer Aided Design of Structures (CADS)
IV Semester M. Tech.

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
22PCDL401	**Project phase-II	0-0-22	18	100	--	--	100	3
22PCDEOA1	***BOS recommended ONLINE course	-	Audit (PP)	-	-	-	-	-
22PCDEOA2	***BOS recommended ONLINE course	-	Audit (PP)	-	-	-	-	-
Total		**0-0-22**	**18**	**100**	**--**	**--**	**100**	

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

L: Lecture **T**: Tutorials **P**: Practical

***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Project phase-II: The students are expected to work on a project for the full semester in an industry or an institution

*** Classes and evaluation procedures are as per the policy prescribed for online courses by the institution.

Total Credits offered for the first year: 42

Total Credits offered for the Second year: 38

III Semester

22PCDC301	**Analysis of Plates and Shell (3-0-0) 3 - Classical and FE Approach**

Contact Hours: 52

Course Learning Objectives: The primary objective of this course is to learn classical methods in theory of plates and shell structures. Applyknowledgeof mathematics,scienceandengineeringrelatedto platetheory. Analyzethe structuralelementsconsistingofcurvedsurfaces. Usefiniteelementmethodsin plate and shellanalysis.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Formulate, analyze and solve two dimensional plate elements.	**1**	**3**	
CO-2	Formulate, analyze and solve circular plate			
CO-3	Formulate, analyze and design Membrane theory of cylindrical shells and spherical domes	**1**	**3**	
CO-4	Formulate, analyze and design Membrane theory for shells of revolution and Folded plates	**1**	**3**	
CO-5	Formulate FEM for plate and shell element	**1**	**3**	

POs	PO-1	PO-2	PO-3
MappingLevel	3		2

Contents:

Module 1: Introductiontoplatetheory,smalldeflectionoflaterallyloadedthin rectangularplates forpurebending.Navier'sandLevy'ssolutionforvariouslateralloadingandboundary

conditions (Noderivation), NumericalexamplesStrain energy in pure bending-Expression for total energy, Analysis of plates subjected to uniformly distributed load by energy method. **11 Hours**

Module 2: Circular Plates: Differential equation for symmetrical bending of laterally loaded circular plates — uniformly loaded circular plates with and without central cutouts, with two different boundary conditions (simply supported and clamped). Centrally loaded clamped circular plate. **10 Hours**

Module 3: Membrane Theory of Cylindrical Shells and Spherical Domes: Cylindrical Shells: Elements, IS 2210 specifications, equations of equilibrium, Stresses in a Simply Supported Shell, Stress Resultants under Dead Load and Live Load for circular, cycloid, catenary, parabola and semi ellipse directrix. Spherical Domes: Notations, equations of equilibrium, expressions for stress resultants and ring tension for Dead, Live and Concentrated Load in domes with and without skylight, Proportioning and general detailing rules. Design Examples with and without skylight. **11 Hours**

Module 4: Membrane Theory for shells of Revolutions: Geometry of shell of revolutions, Equation of equilibrium for axi-symmetrically loaded shells, Solution of equation of equilibrium, Membrane Analysis and design of Conical shells, HyperbolicParaboloid

Folded Plate Roofs: Designand detailingof foldedplates withnumerical example

10 Hours

Module 5: FE approach: Finite Element Analysis of Thin Plate: Triangular Plate Bending Element, Rectangular Plate Bending Element, Finite Element Analysis of Thick Plate. Shell elements, four and eight noded shell element and finite elements formulation. **10 Hours**

Reference Books:

[1] Timoshenko and Krieger, “Theory of Plates and Shells”, McGraw-Hill International Book Company.

[2] P.C. Varghese, “Design of Reinforced Concrete Shells and Folded Plates, PHI.

[3] S. S. Bhavikatti, “Theory of Plates and Shells”, New Age International Publishers

[4] Robert D Cook et al, “Concepts and Applications of Finite Element Analysis”, 3rd Edition, John Wiley and Sons, New York

[5]Chandrashekara K, “Theory of Plates”, University Press

[6]Ugural A C, “Stress in Plates and shells”, McGraw-Hill International Books

22PCDL302 Internship in Industry or R&D organization (4-Weeks) 4

Course Learning Objectives: To provide the structure and framework for learning outside of the classroom during training experience. The objective of training is to illustrate how a student will DO something and should be specific, strong and clear to provide an understanding of his/her needs and course they are pursuing.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Experience of applying existing engineering knowledge in similar or new situations	**1,3**	**2**	
CO-2	Ability to identify when new engineering knowledge is required, and apply it	**1,3**	**2**	
CO-3	Ability to integrate existing and new technical knowledge for industrial application	**1,3**	**2**	
CO-4	Ability to demonstrate the impact of the internship on their learning and professional development	**1,3**	**2**	
C0-5	Understanding of lifelong learning processes through critical reflection of internship experiences.	**1,3**	**2**	

POs	PO-1	PO-2	PO-3
MappingLevel	3	2	3

Evaluation:

1. Final internal evaluation of Industrial training - To be conducted by the internal guide of the college (After the completion of internship). **(50 marks).**
2. Viva-Voce on Internship Report- To be conducted internally is the internship guide (from the college) and external guide under whose supervision the student has carried out the internship **(50 marks).**

22PCDL303 Project phase - I (0-0-6) 6

Contact Hours: 50

Course Learning Objectives:

The students are expected to learn carrying out literature surveys to locate the

state-of-the-art technology while formulating/defining the project problem in computer aided analysis and design of structures. The students are expected to select a topic from an emerging area relevant to analysis and design of structures and/or other relevant branches and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The same work is to be continued in the next phase in IV sem.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state-of-the-art technology in computer aided analysis and design of structures	**1,3**	**2**	
CO-2	Define/formulate the problem for the project work	**1,3**	**2**	
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to his/her project work	**1,3**	**2**	
CO-4	Summarize the work and write a project report and present.	**2**		

POs	PO-1	PO-2	PO-3
MappingLevel	3	2.25	3

Contents:

1) The students are expected to locate the state-of-the-art technology in computer aided analysis and design of structures through proper literature survey and select a topic from an emerging area relevant to structural engineering and/or other relevant branches and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase.

2) Know the current challenges in analysis and design of structures and try suggesting solutions.

Reference materials/books:

Engineering books.
International reputed Journals.

Manuals and data sheets.
Software packages.
Previous project reports.
Product information brochures.
Interaction with academia and industrial experts.
Internet

Project Phase-I Evaluation

Presentation on formulating/defining the project problem, literature survey, visits, data collection, preliminary design, analysis etc. Will be evaluated for 100 marks by a committee formed by DPGC.

22PCDE325 Design of Precast & Composite Structures (3-0-0) 3

Contact Hours: 39

Course Learning Objectives: In this course, topics on Concepts and components of precast construction**,** Precast Systems**,** design of composite floors and beam elements are dealt.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the concepts and techniques of precast construction.	**1**		
CO-2	Design precast elements suitable for project specific requirements.	**1,3**		
CO-3	Design precast systems to ensure integrity and safety of structures.	**1**		
CO-4	Design composite floors and beam elements.	**3**		

POs	PO-1	PO-2	PO-3
MappingLevel	**3**		**2**

Contents:

Module 1: Concepts and components of precast construction: Need and

types of precast construction, Modular coordination, basic module, planning and design modules, modular grid systems, National Building Code Specifications, Precast Elements- Hollow Core Slabs, TT, ST, Joists and Planks, Beams and Girders — R, L, I, IT, U shapes, Columns — Single Storey, Multi Storey (continuous), Wall Panels — Solid, Hollow core, Ribbed, Sandwich.

8 Hours

Module 2: Design of precast elements: Design Examples - Wall Panels, Hollow core slabs, Columns with corbels

8 Hours

Module 3: Precast Systems: Large panels, frames, Slab-column systems with walls, mixed. Connections in precast structures — Classification, Design considerations, Details- wall panel connection, column splices, Foundation connection, Beam, Slab. Handling and assemblage considerations, Structural integrity and avoidance of progressive collapse.

8 Hours

Module 4: Composite Floors: Structural Elements, Profiled Sheeting with concrete topping, Design method, Bending and Shear Resistance of Composite Slabs, Serviceability Criteria, Analysis for Internal forces and Moments, Design Steps

8 Hours

Module 5: CompositeBeams: Elasticbehavior — No and Full interaction, Shear connectors, Load bearing Mechanism, Ultimate Load behavior of Composite beams, Stresses and deflection in service and vibration, BasicDesign Considerations, Design Example of Simply Supported and Continuous Composite beams. **7 Hours**

Reference Books:

[1] Hass A.M. — Precast Concrete — Design and applications Applied Science, 1983.

[2] David Sheppard — “Plant cast, Precast and Prestressed concrete — McGraw Hill; 1989

[3] NBC(2005)-(Part I to Part VII) BIS Publications, New Delhi,

[4]R.P.Johnson: Composite Structure of Steel and Concrete (Volume 1), Blackwell Scientific Publication(Second Edition), U.K., 1994.

[5] IS: 11384-1985, Code of Practice for Composite Construction inStructural Steel and Concrete.

22PCDE326	**Advanced Design of Prestressed Concrete Structures**	**(4-0-0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs): Concept of shear and torsion in PSC. To study different types of composite beam and its behavior in flexural and shear. To discuss the precast bridge girders, segmental constructions and external prestressing.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Design and Analyze Anchorage Zone stress in post-tensioned members	**1**		**3**
CO-2	Design and Analyze Shear and torsional resistance	**1**		**3**
CO-3	Design and Analyze Composite Beams	**1**		**3**
CO-4	Illustrate and evaluate Tension members and compression members Slab and grid floors	**1**		**3**
CO-5	Design and Analyze Precast elements, Railway sleepers	**1**		**3**

POs	PO-1	PO-2	PO-3
Mapping Level	3		1

Contents:

Module 1: Anchorage Zone stress in post-tensioned members-Introduction to PSC, stress distribution in end block, investigations on anchorage zone stress, Magnel and Guyon's methods, comparative analysis, anchorage zone reinforcement. **10 Hours**

Module 2: Shear and torsional resistance- Shear and principal stresses, ultimate shear resistance, design of shear reinforcement, torsion, design of reinforcement for torsion. **11 Hours**

Module 3: Composite Beams-Introduction, types of composite beams, analysis for stress, differential shrinkage, serviceability limit state, design for flexural and shear strength. **10 Hours**

Module 4: Tension members and compression members-Introduction, ties, Columns, Short columns, long columns, biaxially loaded columns, prestressed concrete piles**.**

Slab and grid floors- Types of floor slabs, design of one way, two way and flat slabs.Distribution of prestressed tendons, analysis and design of grid floors.

11 Hours

Module 5: Precast Elements: Introduction, prestressed concrete poles, manufacturing techniques, shapes and cross-sectional properties, design loads, design principles**.**

Railway sleepers: classification and manufacturing techniques, design loads, analysis, and design principles. Precast bridge girders and segmental constructions, external prestressing. **10 Hours**

Reference Books:

[1] Lin.T.Y and H.Burns, “Design of prestressed concrete structures”-John Wiley and sons,1982.

[2] N.Krishnaraju, “Prestressed concrete”- Tata McGraw-Hill,3rd edition,1995.

[3]P.Dayaratnam, “Prestressed concrete structures”-Oxford and IBH, 5th edition, 1991.

[4]G.S.Pandit and S.P.Gupta, “Prestressed concrete structures”-CBS Publishers, 1993.

[5]Guyon, “Prestressed concrete structures”, Contractors Record books,1963.

[6] IS 1343:1980.

22PCDE327 Design of Substructures (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): To know design parameters of substructures and their RCC design. Design of piles and special foundations.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain and Illustrate Design parameters for substructures	**1**		**3**
CO-2	Design of different types of foundations	**1**		**3**
CO-3	Design and Illustrate Pile foundations	**1**		**3**

CO-4	Explain and Illustrate Special foundations	**1**		**3**
CO-5	Explain and Illustrate Elements of soil dynamics and design of machine foundations	**1**		**3**

POs	PO-1	PO-2	PO-3
MappingLevel	**3**		**1**

Contents:

Module 1: Design parameters for substructures: Factors influencing selection of depth of foundation, subgrade reaction, Winkler hypothesis and beams on elastic foundation, soil line method, foundations on expansive soils, geotechnical failure of foundations during earthquake-earthquake resistant design of shallow foundations, liquefaction and remedial measures. **8 Hours**

Module 2: RCC Design: Spread footings, Combined footings and Rafts; Unsymmetrical Footing **8 Hours**

Module 3: Pile foundations: Classification of pile foundation and general consideration of design, ultimate load capacity of piles, pile settlement, analysis of single pile and pile group, laterally loaded piles and ultimate lateral resistance, uplift resistance of piles and under reamed pile, pile load tests, design examples **8 Hours**

Module 4: Special Foundations: Foundation for transmission line towers-necessary information, forces on tower foundation, general design criteria, choice and type of foundations, design procedure and design problems. Earth retaining structure. **8 Hours**

Module 5: Elements of soil dynamics and design of machine foundations:IS 2974: Part I to IV machine foundation system, block foundation, frame foundation, design criteria, tuning foundation, DOF of rigid block foundation, linear elastic spring, elastic half space analog, parameter influencing dynamic soil parameter, soil mass participation, vibration isolation system. **7 Hours**

Reference Books:

[1] Swamy Saran, “Analysis and Design of Substructures”, 5th edition, Oxford and IBH Publishing co., Pvt, Ltd, New Delhi,1996.

[2] Swami Saran (1999), “Soil Dynamics and Machine Foundations”, Galgotia publications pvt Ltd, New Delhi.

[3]Dr.B.C.Punmia, “Soil Mechanics and Foundation Engineering”.Laxmi

Publications,113, Golden House, Darya Ganj, New Delhi - 110002, India
[4] Varghese P.C., “Foundation engineering”, Prentice hall of India, New Delhi
[5] Das B.M., “Principles of foundation Engineering”, Thomson Brooks/ Cole Publishing Company, Singapore

22PCDE328 Design of Structural Systems In Bridges (3-0-0) 3

Contact Hours:39

Course Learning Objectives (CLOs): This course constitutes a transition from general building systems topics to specific applications within the context of structural engineering. It provides the foundation for advanced design and bridge analysis and integrates the finite element approach.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Use the basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.	**1**		**3**
CO-2	Assess the load flow mechanism and loads on bridges.	**1**		**3**
CO-3	Design of Elevated bridge.	**1**		**3**
CO-4	Design of underpass bridge	**1**		**3**
CO-5	Apply finite element method for Bridge element	**1**		**3**

POs	PO-1	PO-2	PO-3
MappingLevel	3		1

Contents:

Module 1: Introduction to bridge engineering: Proportioning, Bridge geometry, Conceptual design of various structural forms. Foundations with or without piles; abutments, retaining wallsand wing walls; columns and cap beams; bearings, loads on bridges. **8 Hours**

Module 2: Design of slab and cross girder of a T beam bridge: Analysis and design of Slab using Pigeauds Method, Analysis and design of Cross Girder.
8 Hours

Module 3: Design of longitudinal, cantilever and cross girder of a T beam bridge: Analysis and design of Main Girder using Courbon's Method for different loading. **8 Hours**

Module 4: Design of slab culvert: Analysis and design of reinforced concrete slab culvert under different loadings – IRC Class, IRC Class A.
8 Hours

Module 5: Design of Box culvert: Analysis and design of reinforced concrete box culvert under different loading conditions – with and without water pressure from inside. **7 Hours**

Reference Books:

[1] Krishna Raju N "Design of Bridges," Oxford, IBH Publications New Delhi.
[2] JohnsonVictor, "Essential of Bridge Engineering," Oxford, IBH Publications, New Delhi
[3]Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008.
[4] IRC112 - 2011 Code of Practice for Concrete Road Bridges and Railway Board Codes
[5] Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", Prentice Hall of India
[6] Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.
[7] IITK-RDSO GUIDELINES ON SEISMIC DESIGN OF RAILWAY BRIDGES-Provisions withCommentary and Explanatory Examples, 2010

22PCDE329	Composite and Smart materials	(4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):A great deal of fundamental and developmental research has been made to bring composite materials in various applications such as automobile, space, medical, automotive, building construction, etc. The advent of composite materials has introduced a new dimension in application of energetic, smart and reactive materials. The objective of this course is to know the processing and application of composite and smart materials.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Identify and understand the basic properties and manufacturing process along with their application for different types of composites.	**3**	**1**	
CO-2	Compose and Analyze Laminated Composites	**3**	**1**	
CO-3	Failure theories of composites and Analyze Cross-ply and Angle-ply Laminates	**3**	**1**	
CO-4	Familiarize with different classes of ceramic and polymeric smart materials; development of actuators and sensors and their integration into a smart structure	**3**	**1**	
CO-5	Generate controllable force and response of a system. Monitor the response of the system.	**3**	**1**	

POs	PO-1	PO-2	PO-3
Mapping Level	2		3

Contents:

Module1: Introduction to Composite materials Classifications and applicationsof fibers, volume fraction and load distribution among constituents, minimum & critical volume fraction, compliance & stiffness matrices, coupling

11 Hours

Module2: Anisotropic elasticity Unidirectional and anisotropic lamina, thermo-mechanical properties, micro- mechanical analysis,classical composite lamination theory,Cross and angle—ply laminates,symmetric,antisymmetric, and general symmetric laminates, mechanical coupling, and laminate stacking

11 Hours

Module3: Analysis of simple laminated structural elements Ply-stress and strain, lamina failure theories-first Ply failure, environmental effects, manufacturing of composites. **10 Hours**

Module4:Smart materials Introduction, Types of smart structures, actuators & sensors, embedded & surface mounted, piezoelectric coefficients, phase transition, piezoelectric constitutive relation

10 Hours

Module5: Beam modeling with strain actuator, bending extension relation

10 Hours

Reference Books:

[1]Robart M Jones,"Mechanics of Composite Materials",McGraw Hill Publishing Co.

[2]Bhagwan D Aggarwal, and Lawrence J Brutman,"Analysis and Performance of Fiber Composites",John Willy and Sons.

[3]MadhujitMukhopadhyay, "Mechanics of Composite Materials and Structures",Universities Press(2004)

[4] Lecture notes on "SmartStructures", by Inderjith Chopra, Department of Aerospace Engg., University of Maryland.

IV Semester

22PCDL401	Project phase - II	(0-0-22)18

Contact Hours: 200

Course Learning Objectives (CLOs):

The students are expected to find out solutions individually in computer aided analysis and design of structures. They are expected to carry out the intensive literature survey to locate the state-of-the-art technology in structural engineering. They must learn to formulate/define/locate real time problems for the project work. They will also learn to design, develop, analyze, test, interpret the results, fabricate, simulate, write code, and convert reports into papers for publication in journals to add value to the existing literature. They are also expected to acquire the skills of summarizing the work and writing a project report and present the same.

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state-of-the-art technology in structural engineering.	**1,3,2**		
CO-2	Define/formulate/locate real time problem for the project work	**1,3**		
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code, prepare papers etc.	**1,3**		
CO-4	Summarize the work and write a project report and present the same	**2**		

POs	PO-1	PO-2	PO-3
Mapping Level	3	3	3

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous semesters and relevant value-added information.

Contents:

1) The students are expected to locate the state-of-the-art technology in his domain of structural engineering and select a topic from an emerging area relevant to computer aided analysis and design and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase.

2) Structure related analysis and design challenges and providing feasible solutions.

Reference materials/books:

1. Engineering books.
2. International reputed Journals.
3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet etc.

Project Phase-II Evaluation

- Presentation on detailed design, implementation, validation, demonstration and report will be evaluated by an internal guide for 100 marks.
- Final viva voce will be conducted by two examiners (Internal and an external member nominated by DPGC) for 100 marks.

BOS recommended ONLINE course

Sl. No	ONLINE course	Course Offered by
1	Reliability-Based Structural Design	Swayam-NPTEL
2	Plates and Shells	Swayam-NPTEL
3	Advanced Reinforced Concrete Design	Swayam-NPTEL
4	Dynamics Of Structures	Swayam-NPTEL
5	Finite Element Method And Computational Structural Dynamics	Swayam-NPTEL
6	Advanced Design Of Steel Structures	Swayam-NPTEL
7	LaTex/Pytorch	Spoken Tutorial IIT Mumbai
8	Scilab	Spoken Tutorial IIT Mumbai
9	Python/Tensor flow	Spoken Tutorial IIT Mumbai
10	ETABS & SAFE : Advanced Course For RCC and Steel Structures	Udemy
11	STAAD PRO & RCDC Complete Building Design & Detailing Course	Udemy