Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Contents (Syllabus) for

Final Year B. Tech.
(Civil Engineering)
Sem - VII to VIII

AY 2020-21

Title of the Course:	L	T	P	Cr
Earthquake Engineering 3CV403	3	--	--	3

Desirable Courses : Nil

Textbooks:

1. A.K. Chopra, "*Dynamics of Structure: Theory & Application to Earthquake Engineering*", Pearson Education Lim., 4th Edition, 2014.
2. P. Agarwal and M. Shrikhande, "*Earthquake Resistant Design of Structures*", PHI publications, New Delhi, 3rd Edition,2006.
3. D. J. Dowrick, "*Earthquake Resistant Design for Engineers & Architects*", John Wiley & Sons,2nd Edition, 1987.

References:

1. David Key, "*Earthquake Design Practice for Buildings*", Thomas Telford Publication,London,2nd Edition,2006.
2. James M. Kelly, "*Earthquake Resistant Design with Rubber*", Springler-Verlag Publication, London, 2nd Edition, 2012.
3. Manual of "Earthquake Resistant Non engineering Construction", University of Roorkee ,2000.

Course Objectives:

1. To develop awareness about the earthquake engineering and its effects on Civil Engineering structures.
2. To impart the knowledge of dynamic response systems under earthquake loading.
3. To illustrate codal provisions for design of earthquake resistant structures.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	**Comprehend** engineering Seismology and different terminologies related to earthquake.	2	Understanding
CO2	**Compute** characteristics of earthquake and its effect on structures	3	Applying
CO3	**Find** response of structures subjected to earthquake loads for various building configuration.	4	Analyzing

CO-PO Mapping :

	a	**b**	**c**	**D**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	**2**											
CO2	**2**			**2**								
CO3	**3**		**3**	**3**								

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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Elements of seismology – terminology, structure of earth, causes of an earthquake, plate tectonic theory, seismic waves, magnitude and intensity, methods of measurement, energy released, seismograph, strong motion earthquakes, accelerando, prominent earthquakes of India	**6**
Module 2	**Hrs.**
Fundamentals of theory of vibration, Single-Degree of freedom Systems, Analytical models, Equations of motion free and forced vibrations of single degree of freedom systems, Response to harmonic loading, Resonance, Support motion, Transmissibility, Vibration isolation. SDOF systems subjected to periodic and impulsive loading, Fourier series loading, Sine wave pulse, rectangular pulse etc. Duhamel Integral	**8**
Module 3	**Hrs.**
Response Spectrum theory, Strong ground motion, Accelerometers, Peak parameters, Concept of earthquake response spectrum, Tripartite plot of response spectrum, Construction of design response spectrum	**5**
Module 4	**Hrs.**
Earthquake Resistant Design Philosophy, MCE and DBE planning aspects, symmetry, simplicity, regularity, Lateral load analysis, Provisions of IS: 1893 for buildings, Base shear, Application to Multi-storey buildings, Load combinations.	**5**
Module 5	
Concept of earthquake resistant design, Objectives, Ductility, Ductility reduction factors, Ductile detailing, Provisions of IS: 13920,	**7**
Module 6	**Hrs.**
Conceptual design, Building configuration eccentricity, Construction aspects and strengthening techniques of low cost and low rise buildings, Introduction to multi degree of freedom systems. Concepts of structural Control	**7**

Module wise Measurable Students Learning Outcomes :

1: Comprehend the concept of seismology.

2: Apply the concept of theory of vibration & SDOF system.

3: Demonstrate response spectrum analysis.

4: Find base shear as per IS:1893 of multistoried buildings.

5: Apply knowledge of ductility in earthquake resistant design of structures.

6: Devise various structural control techniques for earthquake resistance.

Title of the Course:	L	T	P	Cr
Design of concrete structures-II (3CV 404)	3	--	--	3

Desirable courses: Design of concrete structures I

Textbooks:

1. Sushil Kumar "*Treasure of R.C.C Design*", standard book house publication, 18th Edition, 2009.
2. A.K. Jain "*Reinforced Concrete Design (Limit State)"* Nem chand and brother's publishers, 1st Edition, 2012.
3. N.C. Sinha & S.K. Roy, "*Fundamentals of Reinforced Concrete*" S. Chand Publishing, 4th Edition, 2013.

References:

1. P.C. Varghese "*Limit State Design of Reinforced Concrete*", Prentice Hall of India, New Delhi, 2nd Edition, 2011.

2. T.Y. Lin "*Prestressed Concrete*", John Wiley & sons Inc. New York, 3rd Edition, 1981.

3. N. Krishna Raju "*Prestressed Concrete*", Tata Mcgraw Hill Education, 4th Edition, 2006.

Course Objectives:

To design of reinforced concrete structures and to impart concepts of prestressed concrete. The knowledge and skills acquired in the basic course design of concrete structures-I will be further enhanced through theory and series of numerical examples.

Course Learning Outcomes:

CO	**After the completion of the course, the student should be able to**	Bloom's Cognitive	
		Level	Descriptor
CO1	**Distinguish** concepts of reinforced and prestressed concrete.	4	Analyze
CO2	**Evaluate** various RCC and prestressed concrete sections.	5	Evaluate
CO3	**Design** of RCC and prestressed concrete structures.	6	Create

CO-PO Mapping:

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1	**3**										
CO2	**2**		**3**	**3**							
CO3	**3**		**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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Water tank - Design of circular and rectangular water tank resting on ground using approximate and IS Code method.	**7**
Module 2	**Hrs.**
Foundation - Design of combined footing (Slab type, slab beam type) and raft foundation.	**7**
Module 3	**Hrs.**
Retaining wall - Design of cantilever & counterfort retaining wall.	6
Module 4	**Hrs.**
Introduction to prestressed concrete, material used, systems and methods of Prestressing, basic concepts, Analysis by stress concept, strength concept, load balancing concept, Pre-& Post tensioned members, end anchorages Losses in Prestress, merits & demerits of prestressed concrete	**6**
Module 5	**Hrs.**
Analysis of rectangular and Symmetrical I sections, thrust line, cable profiles. Design of rectangular and Symmetrical I sections, kern distances & efficiency of section.	7
Module 6	**Hrs.**
Shear & diagonal tension, End block stresses, Design of end block by I.S. code method.	6

Module wise Measurable Students Learning Outcomes:

1: Design circular and rectangular water tank resting on ground using approximate and IS Code method.
2: Design combined footing and raft foundation.
3: Design of cantilever retaining wall.
4: Apply concept of prestressed concrete.
5: Analyse and design rectangular and I section of prestressed concrete.
6: Analyse and design end block of prestressed concrete and understand diagonal tension.

Title of the Course:	L	T	P	Cr
Engineering Economics and Valuation (3CV401)	3	0	0	3

Desirable Courses: Building materials and construction, Building planning and design; Civil Engineering Drawing, Engineering mathematics

Textbooks:

1. "Engineering Economy" Brajesh Kumar, Arshad Noor Siddiquee, Zahid A. KhanPublisher: Pearson India,1st Edition, 2012
2. "Civil Engineering Contracts &Estimates", B. S. Patil, Orient Langman Ltd., 1st Edition, 1981.
3. "Professional Practices (Estimating & Valuation)", Roshan Namavati., LBD Publishers, 4th Edition, 1984.

References:

1. "Valuation of Real Properties" Rangwala, Charotar Publishing House, 10th Edition : 2015
2. "Engineering Economy", Zahid A khan, New Delhi: Dorling Kindersley, 1st Edition, 2012

Course Objectives :

1. To provide a sound understanding of concepts and principles of engineering economy essential for economic feasibility studies relating to design and implementation of engineering projects.
2. To develop proficiency with methods for valuation of immovable properties.
3. To acquaint the students with use of excel for equivalence comparisons as well as computations for valuation.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	**Describe** elements of engineering economics as well as valuation	2	Understanding
CO2	**Appraise** the different alternatives for an engineering project.	4,5	Analyzing, Evaluating,
CO3	**Value** the different immovable properties.	5	Evaluating

CO-PO Mapping :

PO	**A**	**b**	**c**	**D**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1					**1**						
CO2				**2**	**2**						
CO3					**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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents

Module1:	**Hrs.**
Introduction to Engineering Economy Time value of money, Cash flow diagrams, Interest and inflation, Interest rate, Inflation rate, Discrete and continuous compounding.Necessity of financial appraisal of project alternatives, Project alternatives of equal and unequal lives, Tangible and intangible costs as well as benefits, Concept of economic viability, Cost – benefit analysis, Payback period, Return on capital.	**5**
Module2:	**Hrs.**
Economic Appraisal of Projects - I Interest formulae for discrete and continuous compounding, Nominal and Effective interest. Effect of inflation on interest rate, Uniform and Gradient series factors for PW and FW. Capital recovery factor, Concept of Equivalence comparison, Present worth method, Annual cost method, Selection of appropriate method for equivalence comparison.	**6**
Module3:	**Hrs.**
Economic Appraisal of Projects - II Discounting cash flow, Internal rate of return, Methods for determining IRR, IRR for economic viability. Comparison of project alternatives based on IRR. Replacement analysis, Economic life of the asset. Elements of cost, Break even analysis, Economicorder quantity.	**7**
Module 4:	**Hrs.**
Elements of Valuations Concept of value, price and cost, attributes of value, various types of values and essential characteristics of market value. Immovable properties: Freehold and leasehold properties, Different types of leases. Different types of rents, Depreciation, different methods, sinking fund, obsolescence Years Purchase, Single rate and dual rate, reversion value of land, Valuation tables, capitalized value	**6**

Module 5:	**Hrs.**
Valuation-I Purposes of valuation, factors affecting valuations, Various methods of valuation, Valuation tables, Physical method of valuation, Belting method, Rating valuation, Fundamental principles of rating valuation.	**6**
Module6	**Hrs.**
Valuation-II Rental Method: Gross rent, outgoings, net rent, capitalized value and total value of the property.Valuation Based on Profits: Gross profit, outgoings, net profit, and capitalized value and total value of the property.Development Method: Cost of development.	**8**
Module-wise Measurable Students Learning Outcomes : After the completion of the course the student should be able to: 1. describe elements of Engineering Economy 2. appraise project alternatives using Present worth and Annual cost method 3. justify project alternatives using IRR and justify EOQ and replacement of assets 4. describe elements of valuation of immovable properties 5. value immovable properties by physical methods 6. value immovable properties by methods based on rent, profit, development policy	

Title of the Course:	L	T	P	Cr
Construction Project Management 3CV402	3	1	0	4

Desirable Courses: Estimating and costing

Textbooks:

- Kumar NeerajZha, "*Construction Project Management*", Pearson India Education, 1st edition,(2011)
- Saleh Mubarak, " Construction Project Scheduling and Control", Wiley, 2nd edition (2010)

References:

1. Chitkara K K, *"Construction Project Management : Planning, Scheduling and Controlling"*, Tata McGraw - Hill Education, 2nd edition, 2010
2. P K Joy, *"Handbook of Construction Management",*Macmillan India Limited,2nd edition(2000*)*
3. Barrie D.S. & Paulson B C, "*Professional Construction Management*", McGraw Hill

Course Objectives :

As technological integration and construction complexity increase, so does construction lead time. To stay competitive companies have sought to shorten the construction times of new infrastructure by managing construction development efforts effectively by using different project management tools. In this course, three important aspects of construction project management are taught:the theory, methods and quantitative tools used to effectively plan, organize, and control construction projects;efficient management methods revealed through practice and research;hands-on, practical project management knowledge from on-site situations(learnt form mini-project run in the same semester along with this theory course).

To achieve this, we will use a basic project management framework in which the project life-cycle is broken into organizing, planning, monitoring, controlling and learning from old and current construction projects. By the end of the term you will be able to adapt and apply the framework to effectively manage a construction project in an Architecture/Engineering/Construction (A/E/C) organization.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	**Organize** and **Plan** for various dimensions of construction projects such	3	**Applying**
CO2	**Demonstrate** knowledge in monitoring and controlling construction projects with respect to various dimensions such as time, cost, quality , safety and scope.	3	**Applying**
CO3	**Apply** standards of professional and ethical responsibility to determine an appropriate course of action	3	**Applying**

CO-PO Mapping :

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1			3								1	1	1	
CO2			3										2	2
CO3							3				2		2	

Assessments :

Teacher Assessment:

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

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

Course Contents: (Arrange Contents logically/process-wise/Conceptually/Theory followed by application)

Module 1: Introduction to construction project management	**Hrs.**
• Evolution of Scientific Management, Concepts and functions of Management • Construction project: unique features, types, phases, role in economic development, role of stakeholders, regulatory requirements. • Construction project management and its relevance • Construction project organization: structure, traits of project manager, project coordinator, • Ethical Conduct for Engineers	**7**
Module 2: Construction project planning and scheduling	**Hrs.**
• Stages of project planning • Process of development of plans and schedules: work break-down structure, activity lists, assessment of work content, estimating durations, sequence of activities. • Planning techniques: Bar charts, Networks • Formulation and analysis of CPM networks(AOA , AON and precedence networks) • Formulation and analysis of PERT networks. • Introduction to line of balance technique, Simulation. • Resource Scheduling- resource constraintsand conflicts, resource aggregation, allocation, smoothening and leveling, calendaring networks.	**12**

Module 3: Construction materials management and cost management-	**Hrs.**
• Construction materials management: • Materials flow system, role of materials management and its linkage with other functional areas, vendor networking,buyer-seller relationships, EOQ model, material codification andclassification, concept of logistics and supply chain management, role of ERP inmaterials management Construction costs management- • cost classification, cost codes, • time cost trade-off in construction projects, compression and decompression • cost planning, cost budgeting, • value management in construction,	**06**
Module 4: ProjectMonitoring & control	**Hrs.**
• Measuring progress, periodic progress reports • Updating of plans. • Cost control,Earned value analysis • Introduction to Management Information System • Common causes of time and cost overruns and corrective measures.	**05**
Module 5: Construction Quality and Safety management	**Hrs.**
• Quality assurance & control: • use of manuals and checklists for quality control • Introduction to TQM, quality audit, cost of quality, ISO standards *x* Safety and health on project sites: • accidents causes and effects, costs of accidents, occupational health problems in construction, • Safety and health management system • Health and safety act regulations	**06**
Module 6: Risk Management	**Hrs.**
• Risk in Construction : Identification, Classification, Mitigation, • Basics of Decision Analysis, Decision Tree, Sources of risk in construction Scope Changes and Claims, Disputes and Project closure	**04**
Module wise Outcomes At end of each module students will be able to	
Tutorial: Tutorial hour is used for **1.** Define Construction project: unique features, types, phases, role in economic development, role of stakeholders, regulatory requirements. **2.** Process of development of plans and schedules: work break-down structure **3.** Formulation and analysis of CPM networks(AOA , AON and precedence networks) Formulation and analysis of PERT networks **4.** Numerical on EOQ model **5.** Introduction to TQM, quality audit, cost of quality	

Professional Core (Lab) Courses

Title of the Course:	L	T	P	Cr
Mini Project Concrete structures design and drawing lab (3CV454)	--	--	4	2

Pre-Requisite Courses: Design of Concrete structures I & II

Textbooks:

4. N.C. Sinha & S.K. Roy, "*Fundamentals of Reinforced Concrete*" S. Chand Publishing, 5th Edition, 2010.
5. B. C. Punmia, Jain and Jain, "Comprehensive *Design of R.C. Structures*", Standard Book House, New Delhi, 8th Edition, 1998.
6. Dr. V. L. Shah and Dr. S.R. Karve, "*Limit State Theory and Design*", Pune Vidyarthi griha Publication, 7th Edition, 2015.

References:

1. P. Dayaratnram, "*Limit State Analysis and Design*", Wheeler Publishing company, Delhi, 5th Edition, 1996.
2. Sinha, "*RCC Analysis and Design Vol. I and II*", S. Chand and Co. New Delhi,3rd Edition, 2014.

3. P.C. Varghese "*Limit State Design of Reinforced Concrete*", Prentice Hall of India, New Delhi, 1st Edition,1999.

Course Objectives:

To demonstrate design of residential buildings, water tanks with staging, retaining wall and combined footing. To impart training of various analysis, design and drawing professional software for civil engineering structures using relevant IS codes.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	**Analyse** real life civil engineering RCC structures	4	Analyzing
CO2	**Appraise** various structural designs and drawings.	5	Evaluating
CO3	**Create** structural detailing and drawings.	6	Creating

CO-PO Mapping:

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1		**3**						**3**			
CO2		**2**	**3**					**2**			
CO3		**2**	**2**					**2**			

Assessments:

Teacher Assessment:

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weights each.

Assessment	Marks
ISE	50
ESE	50

ISE is based on experimental work/performance in laboratory/assignment/declared test/etc.

ESE: Assessment is based on performance and oral.

Course Contents:

LIST OF DESIGNS

The lab work shall consist of detailed design &drawing of the following R. C. structures by Limit State method unless specified.

1. Residential G+2 storey building
2. Any two from following
   a) Circular water tank resting on ground with rigid base. (by working stress method)
   b) Retaining wall (cantilever or counter fort type)
   c) Combined footing/ raft foundation/ pile foundation.

Note:

- Computer analysis of any one frame for project No.1 shall be performed for Dead Load, Live Load & Earthquake Loads using relevant application software.
- Drawings prepared shall indicate ductility details as per the provision in IS: 13920.

Title of the Course:	L	T	P	Cr
Mini Project Construction Project Management (3CV452)	0	0	2	1

Desirable Courses: Quantity Surveying & Valuation

Textbooks:

1. Kumar Neeraj Zha, "*Construction Project Management*", Pearson India Education, 1st edition,(2011)
2. Saleh Mubarak, " Construction Project Scheduling and Control", Wiley, 2nd edition (2010)
3. S. Seetharaman, "*Construction Engineering & Management*", Umesh Publications Delhi, 4th edition,(2008)

References:

1. Chitkara K K, *"Construction Project Management : Planning, Scheduling and Controlling"*, Tata McGraw - Hill Education, 2nd edition, 2010
2. Sonia Atchison, Brian Kennemer," *Using Microsoft Project 2010*", Pearson, 2011
3. Paul E Harris ,"*Planning and Control Using Primavera® P6 Version 7: For All Industries*", Eastwood Harris Pty Limited, 2013

Course Objectives: *This course is designed to develop amongst students the necessary analytical & managerial skills to systematically analyze the scope of work on construction sites and evaluate the relation between time and money during the planning phase of construction projects to achieve better productivity. The mini project work will expose the students to understand the practical complexities involved during the planning and execution of various phases/activities of construction projects and learn the various tools and techniques to manage the resources namely time, money, material, equipment & labour, thereby facilitating to become productive managers.*

Course Learning Outcomes: After completion of this course a student will be able to,

CO	Course Outcomes	Bloom's Cognitive	
		level	Descriptor
CO1	comprehend scope of selected construction project and develop WBS	2	Understanding
CO2	schedule selected project using precedence network technique based contemporary scheduling software.	6	Creating
CO3	demonstrate conceptual level Quality management and safety management Programme for the same project	3	Applying

CO-PO Mapping:

POs	**A**	**b**	**c**	**d**	**E**	**f**	**G**	**h**	**i**	**j**	**k**
CO1			**2**								
CO2			**1**	**3**							
CO3			**2**		**1**						

Teacher Assessment:

- Teacher's Assessment based on – Laboratory performance, assignments, Tests, Report containing experiments, Orals (50%)
- External examination: Performance and/or Oral (50%)

Course Contents:

Small student groups formed will need to undertake following stages in this course; -

1. Identify a small construction project and collect its documents defining scope (BOQ, drawings etc.)
2. Prepare the Work breakdown structure to evolve at least 100 distinct activities (appropriate software may be used)
3. Schedule the project using contemporary software taking into consideration following:-
    - Activity list generated from WBS
    - Construction methodology decision for each activity
    - Important Resource allocations
    - Precedence relations (Both technical and resource constrained)
    - Time duration allotment (based upon resources, work content)
    - Working calendar
4. Demonstrate quality management plan and safety management plan for the same project at preliminary level.

Title of the Course:	L	T	P	Cr
Project-I (3CV491)	0	0	8	4

Pre-Requisite Courses: --------

Textbooks: based upon broader area selected for the project

References:

1. R.C. Kothari, "*Research Methodology*", New Age Publications, 2nd Edition
2. 2. Technical books based upon broader area selected for the project

Course Objectives :

This course intends to make group of students to identify a specific problem for their next semester major project and design methodology to address the problem. It also focuses on skills such as teamwork, leadership, interaction skills, and presentation skills.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	identify a specific problem for the current need of the society and collect information related to the same through detailed review of literature.	IV	**Analyzing**
CO2	formulate problem statement and Design solution methodology	VI	**Creating**
CO3	present work progress.	VI	**Creating**

CO-PO Mapping :

PO	**a**	**b**	**C**	**D**	**E**	**f**	**g**	**h**	**i**	**j**	**k**
CO1				**2**		**2**					**2**
CO2		**2**		**2**							
CO3						**2**				**3**	

Assessments :

Teacher Assessment:

ISE: Teacher's Assessment based on – Laboratory performance, assignments, Tests, Project Report, Orals (50%)

ESE: External examination, Performance, Oral (50%).

Assessment	**Marks**
ISE	50
ESE	50

Course Contents:

- The student groups collectively are made to work on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest.
- They can select any topic which is relevant to the area of Civil Engineering. (may be theoretical or case studies)
- At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work.

Professional Elective (Theory) Courses

Title of the Course: Professional Elective-I **Advanced Structural Analysis (3AM411)**	L	T	P	Cr
	3	0	0	3

Desirable Courses: Solid Mechanics, Structural Mechanics I, Structural Mechanics II

Textbooks:

1. V.N. Vazarani and M.M. Ratwani, *"Analysis of Structures"* Khanna Publishers, 8th Edition, 1983.
2. C. S. Reddy, "Basic Structural Analysis", Tata McGraw hill, 7th Edition, 1981.
3. S. B. Junnarkar, *"Mechanics of Structures Vol. I"*, Chartor House pulications. 31st Edition, 2014.

References:

1. S. Timoshenko *"Strength of Materials Vol-II,"* East Van Nostrand, 3rd Edition, 1955.
2. N. Krishna Raju & D. R. Gururaja*, "Advanced Mechanics of Solids and Structures"*-, Naraosa Publishing House, New Delhi, 1997

Course Objectives:

The objective of this course is to apply advanced structural analysis techniques to various civil engineering structures based on courses structural mechanics I & II through theory and series of numerical examples. The course serves as a prerequisite for the advanced design of reinforced concrete structures.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	**Demonstrate** advanced techniques of structural analysis to various types of structures.	3	Applying
CO2	**Analyse** special type of structures in civil engineering.	4	Analyzing
CO3	**Evaluate** external and internal forces in structures for design of structures.	5	Evaluating

CO-PO Mapping:

	a	**b**	**c**	**d**	**E**	**f**	**g**	**h**	**i**	**j**	**k**
CO1			**2**	**2**							
CO2			**2**	**3**							
CO3			**3**	**3**							

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

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Influence Lines: Muller Breslau principle, qualitative and quantitative Influence line diagrams for reactions, Shear force and bending moment's for propped cantilever, fixed beam and continuous beams. Practical applications of influence lines.	**7**
Module 2	**Hrs.**
Beams Curved in Plan: Analysis of statically determinate and indeterminate beams curved in plan subjected to loads normal to plane of beam using strain energy method. Bending moments and twisting moment diagrams**.**	**7**
Module 3	**Hrs.**
Fixed Arches: Types of arches, Elastic Center Method, Analysis of parabolic and circular / semicircular fixed arches. Normal Thrust, Radial Shear and Bending Moment at any section of an arch**.**	**7**
Module 4	**Hrs.**
Approximate Methods: Portal and Cantilever methods for analysis of building frames subjected to lateral loads. Axial force, Shear force and bending moment diagrams**.**	**6**
Module 5	**Hrs.**
Secondary Stresses: Causes of secondary stresses, Change in angles, deflection angles and Analysis of Secondary Stresses in Plane Frames, Analysis of pin jointed space frames by tension coefficient method**.**	**6**
Module 6	**Hrs.**
Beams on Elastic Foundations: Assumptions, Types of beams on elastic foundation, Analysis of beams on elastic foundation subjected to various loads and boundary conditions, deflection curve, pressure distribution, shear force and bending moment diagrams**.**	**6**

Module wise Measurable Students Learning Outcomes: An ability to,

1. Construct ILD for indeterminate structures.
2. Analyze beams curved in plan.
3. Analyze parabolic & circular fixed arches.
4. Construct SFD & BMD of building frames subjected to lateral loads.
5. Find secondary stresses in plane frame.
6. Analyze beams on elastic foundation.

Title of the Course: Professional Elective-I Computer Applications in Structural Engineering (3AM412)	L	T	P	Cr
	3	0	0	3

Desirable Courses: Analysis and Design of Concrete and Steel Structures

Textbooks:

1. M.K.Jain, S.R.K.Iyengar & R.K.Jain " Numerical Methods for Scientific and Engineering Computation ", 4th ed. 2004
2. Pundit & Gupta "Structural Analysis", Tata MC Graw Hill Book company

1. 3. Devdas Menon,S. Pillai , Reinforced Concrete Design - The MC Graw Hill company Third Ed– 2009 4. N. Subramanian, "Design of Steel Structures", (Oxford Higher Education)-2008

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, 3rd Edition, 1990, ELBS

3. A.K.Chopra, "Structural Dynamics for Earthquake Engineering", 4th Edition, 2008,Pearson Pubilications

Course Objectives:

1. To provide knowledge of numerical approach and significance of analysis by computers.

2. To provide 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 computers.

4. To deliver know-how of typical software application techniques applicable to engineering problems.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	**Apply** program development skill for Matrix operations, Numerical methods to analysis and design structures.	3	Applying
CO2	**Analyze** and develop sequential procedure and algorithm/program for analysis and design of civil engineering structures.	4	Analyzing
CO3	**Design** civil engineering structures using commercial software on computers and create design reports.	6	Creating

CO-PO Mapping:

	a	b	c	d	e	F	g	h	i	j	k
CO1	**3**			3							
CO2	**2**			**2**							
CO3			**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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 ALGORITHM DEVELOPMENT & PROGRAMMING LANGUAGES	**Hrs.**
Basics of computer hardware and 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®or SCILAB.	**8**
Module 2 MATRIX **METHODS AND PROGRAMMING**	**Hrs.**
Matrix operations: product, inverse etc., Simultaneous linear equations, Programming techniques of above methods.	**6**
Module 3 NUMERICAL METHODS AND PROGRAMMING	**Hrs.**
Numerical Integration methods, Regression Analysis tools and curve fitting, Numerical Method in structural dynamics/earthquake engineering. Algorithm/Programming techniques of above methods.	**6**
Module 4 COMPUTER AIDED STRUCTURAL ANALYSIS	**Hrs.**
Stiffness method: - Analysis of Trusses, Analysis of Continuous Beams by Finite Element method.	**8**
Module 5 COMPUTER AIDED STRUCTURAL DESIGN	**Hrs.**
Design of Steel Truss members by IS-800, Design of Beam sections in RCC, Design of One way slab by IS-456. Algorithm/programming development for each structural design type.	**6**
Module 6 COMMERCIAL SOFTWARE APPLICATIONS	**Hrs.**
Application in commercial software STAAD® or ETABS® Analysis of TRUSS, Analysis of	**6**

2D frame and Essentials of RCC building Design.	

Module wise Measurable Students Learning Outcomes:

1. Apply fundamentals of Algorithm and programming.

2. Carry out matrix operations by programming.

3. Implement numerical methods by programming

4. Analyze 2D structural problems by Finite Element Method.

5. Design simple RCC and STEEL members by latest BIS-codes

6. Generate structural applications in Finite Element software.

Title of the Course: Professional Elective-I Maintenance and Rehabilitation of Structures (3CV411)	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

Textbooks:

01. P.K. Guha, "Maintenance and Repairs of Buildings", New Central book Agencies Publications, 5th Edition, 2015,
02. Nayak B. S., "Maintenance Engineering For Civil Engineers" Khanna Publication, 2nd Edition, 2011
03. Hutchin B. D., "Maintenance and Repairs of Buildings", Newnes Butterworth Publications, 6th edition, 1975

References:

01. Shrikhande and Agrwal, "Earthquake resistant Design of Structures", 1st edition, PHI Learning Pvt. Ltd., 2006
02. S. K. Duggal, "Earthquake Resistant Design of Structures" 3ed Edition, Oxford University Press, 2007

Course Objectives :

4. The Degree holder enables to inspect and identifies the damages of civil engineering structures.
5. To make conversant with the techniques for Retrofitting and strengthening of structures.
6. Prepare the estimate of maintenance, rehabilitation and strengthening of structure.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Distinguish between different types of causes of damage and decide the appropriate technique of repair according to failure.	II	**Understanding**
CO2	Identify causes of failure of masonry building & R.C.C. building its retrofitting**.**	II & III	**Understanding & Applying**
CO3	Compute strength and age of building, maintenance of life lines and prepare estimates & tenders for structure damage due to hazards.	II & III	**Understanding , Applying& Evaluate**

CO-PO Mapping :

PO	**a**	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**I**	**j**	**k**
CO1			**1**		**1**						
CO2			**2**	**2**	**2**						
CO3			**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
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ISE 1 and ISE 2 are based on assignment/declared test/oral/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:

Chapter No.	Title/Details (Topic Subtopic)	Allocated Hrs.
Module No1	**Introduction** 1.1 Necessity, operation, maintenance & repairs of structures 1.2 Classification of maintenance, 1.3 Rehabilitation (restoration), strengthening, retrofitting. 1.4 Methodical approach to repairs, inspection-annual, emergency, special, repairs- minor, special and renovation.	04
	Causes & detection of damages: 2.1 Causes of damages, damages due to earthquakes, fire hazards, flood, hazards, dilapidation, 2.2 List of basic equipments for investigation.	04
	Materials for repairs: 3.1 Epoxy resin, epoxy mortar, gypsum cement mortar, quick setting, cement mortar, 3.2 Shot-creating 3.3 Mechanical anchors.	02

Module No 2	**Masonry walls:** 4.1 Damp walls, causes effects, remedies, eradication of efflorescence 4.2 cracks in walls, remedial & preventive measures bond between old & new brick work, reinforced brickwork.	03
	Repairs to foundation: 5.1 Remedies, types & processes of settlement, foundation sinking 5.2 Examination of existing foundation, strengthening of foundation.	03
	Water proofing: 6.1 Leaking Basements & roofs	02
Module No 3	**Concept of repairs & strengthening of RCC structures:** 7.1 Concept of repairs of RCC structures 7.2 Physical examination of common defects, 7.3 Structural repairs & strengthening repairs by new developments.	02
	Damage due to fire: 8.1 Fire resistance, effects of temp. of RCC, 8.2 Repairs to RCC structures damaged due to fire	04
	Advanced Damage detection techniques: 9.1 Advanced damage detection techniques, non-destructive testing.	04
Module No 4	**Strengthening methods**: 10.1 Cantilevers, beams, slabs, walls, columns, foundation	08
	Evaluation of strength, economic & age of building: 11.1 Determination of approx. age of a building. 11.2 Determination of strength of structural member of old building. 11.3 Finding cost in use of a existing building.	02
	Maintenance of life lines: 12.1 Maintenance of electric supply, water supply leaking pipe joints and sewerage systems, closed drains, sewers. 12.2 Maintenance of roads, road berms, side drain maintenance of bridges, culverts causeways	04
	Estimates and tendering: 13.1 Estimates of annual repairs, special repairs and maintenance work.	02

	13.2 Preparation of tender	
Outcomes as regards to improvement in Communication Skills The Degree holder enable to inspects and identify the damages of civil engineering structures, find root cause, use the appropriate construction material and technique for repair and prepare the estimate and tender for maintenance and rehabilitation of structure.		
Computer Usage / Lab Tool Concrete testing and computer laboratory		

<table>
<tr><td colspan="2">Title of the Course: Professional Elective-I

Advanced Water and Wastewater Treatment (3CV 412)</td><td>L-3</td><td>T-1</td><td>P-0</td><td>Cr-3</td></tr>
<tr><td>Desirable Courses:</td><td colspan="5">Water Supply and Treatment Technology

Waste Management and Pollution Control</td></tr>
<tr><td>Textbook:</td><td colspan="5">1. Peavy H, S, Rowe D, R, and Tchobanoglous G, “Environmental Engineering”, McGraw-Hill Book Company, International edition 1985.
2. Metcalf and Eddy “Wastewater Engineering Treatment and Reuse”, Tata McGraw Hill Publication, 6th Reprint. 2003.
3. Hammer M, J and Hammer M, J, “Water and Wastewater Technology”, PHI learning private limited, 6th Edition, 2008.

Davis, M, L, and Cornwell, D, A, “Introduction to Environmental Engineering”, Tata McGraw Hill Publishing Company, Special Indian Edition, 2010.</td></tr>
<tr><td>References:</td><td colspan="5">1. Droste, Ronald L “Theory and Practice of Water and Wastewater Treatment”, John Wiley & Sons Publication, 1st Edition, 1997.
2. Weber W, J, “Physico-Chemical Processes of Water quality control”, Wiley-Interscience, 1994.
3. Renolds T, D, and Richards, P. A, “Unit operations and processes in Environmental Engineering”, PWS Publishing Company, 2nd Edition, 1996.
4. Sincero A, P and Sincero G, A, “Environmental Engineering A Design approach”, PHI learning private limited, 2004.
5. Nazaroff W, W, and Alvarwz-Cohen, “Environmental Engineering Science”, John Wiley & Sons Publication, 2011.
6. Quasim, S. R., Motley E, M and Zhu G, “Water works engineering”, PHI learning private limited, 2000.
7. Quasim, S. R., “Wastewater Treatment Plants Planning, Design and Operation”, CRC Press, 2nd Edition, 2010.
8. "Manual on Water Supply and Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 1999.
9. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 1993.</td></tr>
<tr><td>Course Objectives :</td><td colspan="5">1. To provide students the necessary knowledge and concepts of advancements/emerging techniques of treatment in physical, chemical and biological treatment processes.
2. To impart students with the skill of design and operation of water and wastewater treatment plants based on latest technology.
3. To provide students prerequisite knowledge necessary for higher studies and research in the field of water and wastewater treatment.
4. To encourage students for undertaking further studies in the field of environmental engineering.</td></tr>
<tr><td>Course Learning Outcomes:</td><td colspan="5"><table><tr><td>CO</td><td>After the completion of the course the student should be able to</td><td colspan="2">Bloom’s Cognitive</td></tr><tr><td></td><td></td><td>level</td><td>Descriptor</td></tr></table></td></tr>
</table>

	CO1	**Explain and Apply** the concepts of unit operations and processes for advanced treatment of water and wastewater.	2, 3	Understanding Applying
	CO2	**Analyze** and **evaluate** the advanced treatment systems used in water and wastewater.	4,5	Analyzing Evaluating
	CO3	**Design** the advanced treatment facilities for water and wastewater.	6	Creating

CO-PO Mapping

	a	**b**	**c**	**d**	**e**	**F**	**g**	**h**	**i**	**j**	**k**
CO1				3							
CO2				**3**							
CO3			3		2						

Assessments

Teacher's in-semester assessment (10%): 10 marks based on performance in Quiz/Home assignments/Mini Projects/Test/any other.

Two semester examinations SE I and SE II (20% each): Each examination is of one hour duration and will be assessed for 20 marks on the syllabus covered between i) start of the term and SE I (approximately 33% of total syllabus), and ii) SE I and SE II (approximately 33% of total syllabus excluding syllabus for SE I).

End Semester Examination (50%) : Two hours duration and will be assessed for 50 marks and would be on entire syllabus with weightage 20% each for the syllabus of SE I and SE II and 60% on the syllabus covered after SE II.

Course Contents:

1 Fundamentals **5**

Need for Advanced water and wastewater Treatment

Reactors and Reaction Kinetics: Types of Reactions and Reaction Kinetics Types of reactors and Principles of Reactor Design

Principles of aeration, Gas-liquid mass transfer, two film theory

2 Physical **5**

Ion Exchange: Process, Ion exchange resins, exchange capacity, ion exchange chemistry and reactions, Applications for hardness and TDS removal, Design of ion exchange units

3 Membrane Processes **8**

Membrane Filtration: Terminology, Process classification, Membrane

configurations, Membrane operation for micro filtration, Ultra filtration and Reverse osmosis, Membrane fouling and its control, Application of Membranes.

Electro dialysis: Theory, Area and power requirement, Disposal of

Concentrate waste streams.

4 Adsorption **6**

	Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors. **5 Biological Treatment** **8** Physical, Chemical and Biological processes for Nitrogen and phosphorous removal, Removal of heavy metals. Anaerobic sludge blanket processes, Design considerations for up flow Anaerobic Sludge Blanket process. Design of high rate clarifier Disinfection with ozone: chemistry, modeling, estimation of ozone dosage. UV disinfection: system components, modeling, Estimation of UV dose. **6 Constructed wetland** **8** Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Free water surface and subsurface constructed wetlands, Floating and emergent plants, Combination systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems. **Tutorial** One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment surprise test etc. The teacher may add any of other academic activity to evaluate student for his/her in semester performance.
Module wise Measurable Students Learning Outcomes	1. An ability to understand principles of reaction kinetics and gas transfer. 2. An ability to apply ion exchange system. 3. An ability to apply and design membrane processes. 4. An ability to use adsorption in water and wastewater treatment. 5. An ability to analyze and design biological nitrogen removal system. 6. An ability to understand constructed wetlands and its design.
Outcomes as regards to improvement in Communication Skills	Development of the skill of presentation and interactive responses with audience.
Computer Usage / Lab Tool	Use of spreadsheet in design

Laboratory Experiences:	-
Independent Learning Experiences:	Independent learning through visits to treatment systems of water and wastewater.

Open Electives Courses

Title of the Course: Open Elective –III Structural Health Monitoring (3OE401)	L	T	P	Cr
	3	0	0	3

Desirable Courses:

Textbooks:

1. Daniel Balageas, Claus - Peter FritzenamI Alfredo Guemes, Structural Health monitoring, Published by ISTE Ltd., U.K. 2006.
2. Guide Book on Non-destructive Testing of Concrete Structures, Training course series No.17, International Atomic Energy Agency,Vienna, 2002.

References:

1. Hand book on "Repair and Rehabilitation of RCC Buildings ", Published by Director General, CPWD, Govt. of India, 2002.
2. Hand Book on Seismic Retrofitting of Buildings, Published by CPWD & Indian Building Congress in Association with IIT, Madras, Narosa Publishing House, 2008.

Course Objectives :

1: Structural Sustainability

Structural Health Monitoring examines the use of low-cost, long term monitoring systems to keep civil infrastructure under constant surveillance, ensuring structural integrity. Moreover, the tools and skills the students will learn in this class can be implemented to develop sustainable maintenance and rehabilitation schemes and programs.

2: Structural Resiliency

Structural Health Monitoring covers the concepts of rapid after disaster assessment of civil infrastructure. The tools and skills incorporated within the curriculum of this class provide quantitative means to assess the structural integrity loss a system undergoes after natural disasters and other hazardous events.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	**Demonstrate** the knowledge of SHM for various components of structures.	3	**Apply**
CO2	**Evaluate** various techniques for SHM of structures.	5	**Evaluate**
CO3	**Design** various SHM techniques for various structures.	6	**Create**

CO-PO Mapping:

PO	**a**	**b**	**c**	**d**	**E**	**f**	**g**	**h**	**i**	**J**
CO1			**3**	**3**				**2**		
CO2			**2**	**2**				**2**		
CO3			**2**	**2**				**1**		

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	**Hrs.**
Introduction to Structural Health Monitoring (SHM) : Definition & motivation for SHM, SHM - a way for smart materials and structures, SHM and bio mimetic - analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and Active SHM, NDE, SHM and NDECS, basic components of SHM, materials for sensor design	**7**
Module 2	**Hrs.**
Application of SHM in Civil Engineering: Introduction to capacitive methods, capacitive probe for cover concrete, SHM of a bridge, applications for external post tensioned cables, monitoring historical buildings.	**7**
Module 3	**Hrs.**
Non Destructive Testing of Concrete Structures: Introduction to NDT - Situations and contexts, where NDT is needed, classification ofNDT procedures, visual Inspection, half-Cell electrical potential methods, Schmidt Rebound Hammer Test, resistivity measurement, electromagnetic methods, radiographic Testing, ultrasonic testing, Infra Red thermography, ground penetrating radar, radio isotope gauges, other methods.	**7**
Module 4	**Hrs.**
Condition Survey & NDE of Concrete Structure: Definition and objective of Condition survey, stages of condition survey (Preliminary, Planning, Inspection and Testing stages), possible defects in concrete structures, quality control of concrete structures - Definition and need, Quality control applications in concrete structures, NDT as an option for Non-Destructive Evaluation (NDE) of Concrete structures, case studies of a few NDT procedures on concrete structures	**6**
Module 5	**Hrs.**

Rehabilitation and Retrofitting of Concrete Structure : Repair rehabilitation & retrofitting of structures, damage assessment of concrete structures, Materials and methods for repairs and rehabilitation, modeling of repaired composite structure, structural analysis and design - Importance ofre-analysis, execution of rehabilitation strategy, Case studies	**7**
Module 6	**Hrs.**
Damage Detection of Composite Structures: Introduction to composites and their applications in structural Industry. Learning from failures. Various kinds of damage detection techniques. Repair **&** rehabilitation & retrofitting of composite structures, damage assessment of composites structures, Case studies.	**6**
Module wise Measurable Students Learning Outcomes: 1. Demonstrate concepts of Structural Health Monitoring (SHM). 2. Apply SHM to Civil Engineering structures. 3. Carry out non-destructive testing of concrete Structures. 4. Judge condition of existing concrete structures by NDT survey. 5. Devise rehabilitation and retrofitting strategies for concrete Structures. 6. Evaluate damage of composite structures.	

Title of the Course: Open Elective-III Finite Element Method (1OE402)	L	T	P	Cr
	3	--	--	3

Desirable Courses: Nil

Textbooks:

1. P.N.Seshu "Finite Element Analysis", PHI learning private Lim. Delhi,2013.
2. J. N. Reddy. *"An Introduction to the Finite Element Method"* McGraw Hill, 3rd Edition, New York, ,3rd edition, 2006.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha,Robert J. Witt,"*Concepts and Applications of Finite Element Analysis",*2003

References:

1. Klaus-Jurgen Bathe, "*Finite Element Procedures in Engineering Analysis",1982*
2. T. R. Chandrupatla and A.D. Belegundu, *"Introduction to Finite Element in Engineering",* Prentice Hall of India Private Limited, 3rd Edition,2002.
3. Zienkiewicz.O.C. & Taylor.R.L., *"The Finite Element Method- Vol I &Vol II* Tata McGraw-Hill Publishing Company Limited, 6th Edition,2005.
4. C. S. Desai & J. F. Abel *"Introduction to Finite Element Method",* AEP,1st Edition, 1972.

Course Objectives :

1. To impart knowledge of element stiffness matrix formulation for 1D,2D and 3D elements
2. To demonstrate applications of finite element method in structural engineering in a wide perspective.
3. To provide knowledge of finite element method to model and solve continuum structures by using FEM based softwares.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Organize** finite element methodology by developing element stiffness matrix.	4	Analyzing
CO2	**Evaluate** nodal degrees of freedom and stress resultants.	5	Evaluating
CO3	**Devise** finite element model for solutions of various field problems.	6	Creating

CO-PO Mapping :

	a	b	c	d	e	F	g	h	i	j	k
CO1			**3**	**3**							
CO2			**2**	**2**				**2**			
CO3			**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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Basic concept of finite element analysis, Discretization, nodes, element incidences, formulation of element stiffness matrices for spring, bar and plane truss elements. Solutions for unknown nodal displacements; Applications of method to spring, bar and plane truss problems	**8**
Module 2	**Hrs.**
Formulation of element stiffness matrices for beam and plane portal frame element by direct method; Transformation of matrix from local to global system; Numbering of nodes; minimization of band width; force displacement relations; Solution for displacement unknowns; Applications of method to plane truss; Continuous beams and plane portal frames.	**6**
Module 3	**Hrs.**
Elementary theory of Elasticity: Stress strain relation; Strain displacement, relations; plane stress and plane strain problems; Compatibility conditions; differential equations of equilibrium; equations for two dimensional and three dimensional problems.	**6**
Module 4	**Hrs.**
Principle of minimum potential energy; variational method; continuum problems; Two dimensional Elements; use of displacement functions; Pascal's triangle; triangular and rectangular elements; Formulation of element stiffness matrix. Convergence requirements – Selection of the order of polynomial, conforming and non-conforming elements, Effect of element aspect ratio, finite representation of infinite bodies.	**6**
Module 5	**Hrs.**
Shape function in Cartesian and natural co-ordinate system, Lagrange's interpolation formulae, concept of iso-parametric element, relation between Cartesian and natural	**7**

coordinate system, Jacobian matrix, one and two dimensional Iso-parametric elements.	
Module 6	**Hrs.**
Introduction to three-dimensional problem, various three-dimensional elements, Axisymmetric problems, formulation of stiffness matrix of three dimensional and axisymmetric elements.	**6**

Module wise Measurable Students Learning Outcomes:

1. Comprehend basic concept of F.E.M. and formulation of [k] for spring, bar and truss element with their applications.
2. Develop element stiffness matrix for beam and frame element and solve the problems of continuous beams and portal frames.
3. Analyze plane stress/strain problems by using theory of elasticity.
4. Demonstrate the concept of displacement function and its convergence requirements.
5. Develop shape functions in Cartesian and natural coordinate system and apply concept of isoparametric elements.
6. Solve three dimensional and axisymmetric problems by using finite element method.

Title of the Course: Open Elective-III	L	T	P	Cr
Concrete Engineering & Technology (1OE416)	3	0	0	3

Desirable Courses: --------

Textbooks:

1. Neville A. M. and Brooks J. J., "Concrete Technology", Pearson Education Limited, 1987
2. Shetty M. S., "Concrete Technology", S. Chand & Company Ltd. New Delhi, 7th Edition, 2013.
3. Gambhir M. L, "Concrete Technology", McGraw Hill Professional 5th Edition, 2013.

References:

2. Mehta P. K. and Paulo J. M. M, "Concrete – Microstructure, Properties and Material", McGraw Hill Professional 3rd Edition, 2009.
3. Neville A. M.., "Properties of Concrete", Prentice Hall, 5th edition, 2012
4. Santhakumar A. R., "Concrete Technology", Oxford University press, 1st Edition, 2007

Course Objectives :

1. To give exposure of necessary knowledge and concepts in the field of Concrete Technology from the point of practical applications.
2. To provide the student, knowledge of physical, Mechanical, long term properties of concrete and develop skills to design concrete mix.
3. To make students well acquainted with durability issues of concrete and their remedial measure.
4. To expose the students for new developments in the field of concrete technology.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	apply the knowledge cement, concrete and admixtures to fulfill the requirement of construction industries.	III	**Applying**
CO2	demonstrate and analyze fresh properties, mechanical properties and durability of concrete.	II & IV	**Understating & Analyzing**
CO3	design a concrete mix according to construction industry stipulation.	V	**Evaluating**

CO-PO Mapping :

PO	**A**	**B**	**c**	**D**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1			**2**								
CO2			**2**								
CO3			**3**	**3**				**2**	**1**		

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.

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

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Course Contents:

Module 1: Cement	**Hrs.**
Clinkering reactions, Hydration Reactions & Chemistry of Cement paste, Setting of Cements, Heat of Hydration, Calculation of Products and Porosity, Microstructure of HCP.	**7**
Module 2: Admixtures in Concrete	**Hrs.**
Specification, Functions, and Classification - Mineral and Chemical. a) Chemical Admixtures: Plasticizers, Super-plasticizer, Accelerators, Retarders, Air entraining agents: Working principles, Compatibility of Admixtures and IS Specifications -(9103 and 456), b) Mineral Admixtures: Fly ash, Silica Fume, Slag, GGBS, Rice husk ash. c) Pozzolanic Reactivity of Mineral admixtures	**8**
Module 3: Fresh Properties of Concrete	**Hrs.**
Factors affecting workability, measurement of workability, cohesion and segregation, bleeding, Steam curing of concrete, Setting of concrete, Rheology of concrete	**4**
Module 4: Concrete Mix Design:	**Hrs.**
Factors to be considered, Statistical quality control, Mix design for compressive strength by IS: 10262 (2009) method, ACI method and British method. Concept of Particle Packing density	**7**
Module 5: Engineering properties of concrete:	**Hrs.**
• Compressive strength and parameters affecting it. • Tensile strength - direct and indirect; Modulus of elasticity and Poisson's ratio. • Stress strain response of concrete. • Creep and relaxation - parameters affecting; Shrinkage of concrete - types and significance. • Parameters affecting shrinkage; measurement of creep and shrinkage**.** • **Introduction to Non-destructive analysis of concrete**	**7**
Module 6: Durability of Concrete	**Hrs.**
Permeability and Pore Structure, Ionic Diffusion, Chemical Attack (Sulphate, Chloride, acids, corrosion, leaching), Physical Attack (freeze-thaw, scaling, abrasion, Carbonation), Corrosion	**7**

of reinforcement, Deteriorations by fire and Chemical reactions. Alkali-Aggregate Reaction	
Moodle wise Outcomes At end of each module students will be able to 1. Understand and apply the knowledge of cement Chemistry and hydration reaction. 2. Demonstrate and use the various admixtures according to site prerequisites. 3. Analyze the fresh properties of concrete 4. Design a concrete mix satisfying the construction industry requirement. 5. Appraise hardened properties of concrete. 6. Understand and Evaluate parameters affecting durability of concrete.	

Title of the course: Open Elective III: Computational Methods and Optimization Techniques (1OE417)	**L- 3**	**T-0**	**P-0**	**Cr-3**

Desirable course: Engineering Mathematics(I, II and III)

Textbook:

1. Chapra S.C. and Canale R.P., *"Numerical Methods for Engineers",* Tata McGraw Hill Publications, 4th Edition, 2002.
2. Hamdy A. Taha, *"Operation Research",* Pearson Education, 7th Edition, 2004.

References:

1. Balguruswamy, E. *"Numerical Methods",* Tata McGraw-Hill Publishing Co. Ltd., 2nd Edition, 2009.
2. Gerald. C.F. and Wheatly. P.O., Addison Wesley, *"Applied Numerical Analysis",* 5th Edition, 1994.
3. Babu Ram *"Numerical Methods",* Pearson, 1st Edition, 2010.
4. Jain M.K., Iyengar S. R., Jain R. K., *"Numerical Methods",* New Age International (P) limited, 5th Edition, 2007.
5. Ravindran, A. , Phillips, D. T and Solberg, J. J. , Operations Research: Principles and Practice , John Willey and Sons, 2nd Edition, 2009.

Course Objectives:

This course is designed to enable students to acquire knowledge of computational methods so that they can apply the same for applications in engineering. It also inculcates application level knowledge of optimization techniques dealing with linear programming problem.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	demonstrate knowledge of elements of computational methods and optimization techniques	2	Understanding
CO2	solve linear and nonlinear equations, ODEs and PDEs with computational methods	3	Applying
CO3	optimize linear programming problems	3	Applying

Assessments

Two components of In Semester Evaluation (ISE-1 & ISE-2) with 10% weight each, One Mid Semester Examination (MSE) with 30% weight and one End Semester Examination (ESE) with 50% weight.

Course Contents:

1. Introduction to optimization, OR Models, Phases of OR study, classical theory of optimization, Unconstrained and constrained optimization. …….(4)

2. Linear programming, Revision of graphical method and properties of linear system of equations, canonical form, Simplex method, Big M Method, duality, sensitivity analysis, Application of Linear Programming in engineering…..(8)

3. Transportation model, Initial feasible solution by various methods namely NW corner rule, least cost rule and Vogel's approximation methods, Optimization by stepping stone method and MODI method, Assignment model, Hungarian method. …….(8)

4.Introduction to Computational Methods, Significance of Computational Methods, Accuracy &Precision, Error, Round-off Error, Truncation Error, Total Error, Relative Error, Percentage Error, Significance of Error Computation in Numerical Methods, Pre specified Error, Error Propagation, and Importance of Modern Computers in Numerical Methods, Revision of Computational methods for solution of linear and transdental equations, Interpolation and regression…….(4)

5. Numerical Differentiation and integration, Numerical Quadrature, general formula, Cote's formula, Trapezoidal Rule, Simpson's Rule, Difference Equations, Solutions of Ordinary Differential Equations, Initial value and boundary value problems, Runge-Kutta Method, Solutions of B.V. Problems by Finite Difference methods…….(6)

6. Classification of Partial Differential Equations, Formation of difference equations, Solution of Laplace's and Poisson's equations, Solution by Liebmann's Method, Solution of parabolic equations, Bender- Schmidt method, Crank-Nichloson method, Solution of hyperbolic equations……(8)

Mandatory Life Skill Courses

Put the syllabi of each mandatory life skill courses (mandated by AICTE) after this page

Minor Specialization Courses

Put the syllabi of each course offered by this department for minor specialization at this semester

after this page

(This is Only for UG programs. NOT Necessary for PG Programs)

Honors Specialization Courses

Put the syllabi of each course offered by this department for Honors specialization at this semester after this page

(This is Only for UG programs. NOT Necessary for PG Programs)

Value Added
Professional Courses

Put the syllabi of each value added professional course offered by this department at this semester

after this page

EVEN Semester

Professional Core (Theory) Courses

Professional Core (Lab) Courses

Title of the Course:	L	T	P	Cr
Project-II (3CV492)	0	0	16	8

Desirable Courses: --------

Textbooks: based upon broader area selected for the project

References:

1. R.C. Kothari, "*Research Methodology*", New Age Publications, 2nd Edition
2. 2. Technical books based upon broader area selected for the project

Course Objectives :

This sequel course after Project-I course in the earlier semester is designed to make students solve the identified problem based on the formulated methodology. Thereby students will also develop skills to analyze and discuss the test results, make conclusions & present report. Students are also permitted to execute major part of their project work at the premises of identified industry.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	execute solution methodology stated in pre-project course through data collection surveys/ experimentation / professional assignment etc.	VI	**Creating**
CO2	analyze & interpret the results obtained.	IV	**Analyzing**
CO3	conclude project work and present the same	VI	**Creating**

CO-PO Mapping :

PO	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**I**	**j**	**k**
CO1		**2**	**2**	**2**		**3**	**2**	**2**		**2**	**2**
CO2			**2**	**2**		**2**					**2**
CO3			**2**	**2**		**2**				**3**	

Assessments :

Teacher Assessment:

ISE: Teacher's Assessment based on – Laboratory performance, assignments, Tests, Project Report, Orals (50%)

ESE: External examination, Performance, Oral (50%).

Assessment	**Marks**
ISE	50
ESE	50

Course Contents:

○ The student group should continue the pre-project work on the selected topic as per the formulated methodology under the same supervisor. Students are also permitted to execute major part of their project work at the premises of identified industry. ○ At the end of the semester, after completing the work to the satisfaction of the supervisor and/or review committee, a detailed report should be prepared and submitted to the head of the department. ○ The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.	

Title of the Course: Field Studies (3CV493)	L	T	P	Cr
	-	1	0	1

Desirable Courses: Civil Engineering Courses

Textbooks: - Same as recommended under specific course curriculum

References: Technical reports, Magazines & Journals pertaining to Civil Engineering

Course Objectives: To acquire communication, cognitive and professional skills to demonstrate the acquisition and retention of understandings of concepts learnt through theoretical and lab courses pertaining to the program.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Study field practices in Civil Engineering.	4	Analyzing
CO2	Demonstrate knowledge acquired to identify improper practices and suggest appropriate measures.	3	Applying
CO3	Convince the concerned through effective interaction.	5	Evaluating

CO-PO Mapping :

PO	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**K**
CO1			3	2			3	2			
CO2	2				2				2		
CO3						3				3	

Assessments: ISE: Teacher's Assessment based on mentors gradation and final report and presentation (100%)

Assessment	**Marks**
ISE	100

Course Contents/ Areas of field studies:

The students should identify an appropriate area in Civil Engineering wherein they are exposed to constructionwork/design/monitoring/analysis/planning/estimation/survey/investigations/scheduling/testing. They will apply to respective authority through proper channel, obtain the permission from the due authority and undergo field training to achieve course learning outcomes.

Period of Activity: It is typically spread between 3rd and 7th semester in vacations. The student has to devote 270-300 man-hours (@ 45 days) distributed over the three semester vacations since completion of second year of B. Tech. program. Out of the total man-hours minimum 120 hours (@ 20 days) could be spent in a single vacation broadly defined as follows-

SY B.Tech.- Sem I – FS Part I: Site selection, Surveying methodologies, Soil/ Geological investigations, Structural systems, Planning principles, Building materials, and Construction practices.

TY B.Tech.- Sem I – FS Part II: Learn professional customs and practices being applied for water treatments or structural designs

TY B.Tech. Sem II – FS Part III: Learn professional customs and practices being applied for any one of Waste management facility, Road/ railway works, Real Estate developers, architect or structural consultancy.

The student may work with any Govt./ Non Govt/ or research organization pertaining to their interest.

Reporting and Submission requirement:

At each of the semester commencement student will submit a report to respective mentor based on training one has undergone for gradation. The report should be supported by certificate from appropriate authority, actual photographs, video's and day wise field notes. The field notes may consist of communication records, log of activities, work specifications, analysis of material, labor, and cost requirements, billing

1. Regular reporting to mentor.
2. Certificate from company/organization/firm stating attendance, satisfactory completion of work assigned.
3. Log book and photographs
4. Feedback by employer
5. Report consisting of Introduction, Study/Work carried out, Observations, and Outcomes.

Professional Elective (Theory) Courses

Title of the Course: – Professional Elective-II **Design of Concrete Bridges 3AM405**	L	T	P	Cr
	3	0	0	3

Desirable Courses: Design of Concrete structures I & Design of Concrete structures II

Textbooks:

1. Dr. V.K. Raina, *"Concrete Bridge Practice",* Tata McGraw Hill, 2nd Edition, 1991.
2. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, *"Reinforced Concrete Structures – Vol II",*Laxmi Publications,10th Edition,2014.

References:

1. Dr. Johnsan Victor, *"Essential of Bridge Engineering",* Oxford & IBH Publishing Co., Pvt. Ltd.,6 th Edition,2007.
2. R. E. Rowe, *"Concrete Bridge Design"* John Wiley & Sons, 1963, C.R. Books Limited,1st Edition,1962.
3. Jagadesh T. R. & Jayram M.A., *"Design of Bridge Structure",* Prentice Hall of India Pvt. Ltd., 2nd Edition, 2009.

Course Objectives:

1. To provide knowledge of loads and analysis for different types of bridges.
2. To impart knowledge for design of different types of RC bridges including bearings with relevant codes.
3. To provide knowledge for construction, inspection and maintenance of bridges.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	**Demonstrate** types of bridges**,** their components and selection of bridge site.	3	Applying
CO2	**Analyze** various types of bridges with appropriate loads and methods.	4	Analyzing
CO3	**Design** bridges and bearings along with reinforcement details.	5	Evaluating

CO-PO Mapping:

	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1			**3**								
CO2	**3**		**2**	**2**							
CO3	**2**		**2**	**1**							

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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Components of bridge, Importance of bridges, various types of bridges, Selection of bride site and type of bridge and economic span length, super structure – philosophy, geometric alignment, drainage, road curb.	**7**
Module 2	**Hrs.**
Design loads for bridges, IRC loading, Design of R. C. deck slab, beam and slab, T beam, Pigeaud's theory, Courbon's theory, balanced cantilever bridge.	**8**
Module 3	**Hrs.**
Design of Box culvert, Composite Bridge – Reinforced concrete slab on steel plate girder, Stiffeners, Shear connectors, Connections.	**8**
Module 4	**Hrs.**
Construction & maintenance, Short & long span concrete bridge, Form work and False work, Construction management, inspection, maintenance, innovative construction techniques, Lessons from bride failures.	**7**
Module 5	**Hrs.**
Design of sub – structure - abutments, Piers, approach slab, Pile and Well foundation, Pneumatic caissons.	**8**
Module 6	**Hrs.**
Bearing and expansion joints – forces on bearings – Types of bearings, design of unreinforced& reinforced elastomeric bearings, expansion joints	**7**

Module wise Measurable Students Learning Outcomes:

1. Apply IRC loads for the analysis of road bridges.
2. Design slab culverts, T beam bridge with different theories
3. Analyze and Design of box culverts bridges and composite bridges.
4. Demonstrate knowledge of Construction, Inspection and maintenance of RC bridges.
5. Analyze and design bridge substructure.
6. Design bearings & expansion joint.

Title of the Course: Professional Elective-II	L	T	P	Cr
	3	0	0	3

Advanced Structural Design (3AM406)

Desirable Courses: Design of Concrete structures I & Design of Concrete structures II

Textbooks:

1. N. Krishna Raju and R. N. Pranesh, *"Reinforced concrete design"* New Age International Publishers, New Delhi, 3rd Edition, 2016.
2. A.K. Jain, "Reinforced Concrete Limit State Design", Nem Chand and Brothers Publishers, 7th Edition, 2012.
3. B.C. Punmia, A.K. Jain and A.K. Jain "Limit State Design of Reinforced Concrete" Laxmi Publications, New Delhi, 1st Edition, 2007.

References:

1. P.C. Varghese, "*Limit State Design of Reinforced Concrete*", Prentice Hall of India, New Delhi, 2nd Edition, 2006.
2. N.C. Sinha & S.K. Roy, "*Fundamentals of Reinforced Concrete*" S. Chand Publishing,1st Edition, 2013.
3. "*Handbook of Reinforced Concrete",* SP-34 (1987).

Course Objectives:

To impart the knowledge for design of special structures such as elevated storage reservoirs, deep foundations, circular slab, grid floors etc.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Demonstrate** advanced techniques of structural design to various types of civil engineering structures.	3	Applying
CO2	**Analyse** special type of structures in civil engineering.	4	Analyzing
CO3	**Design** special type of structures in civil engineering.	6	Creating

CO-PO Mapping:

	a	b	c	d	e	f	g	h	i	j	k
CO1			3								
CO2	2		2	3							
CO3			1	3							

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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Design of elevated water reservoirs rectangular RCC water tank with staging, Using Provisions of IS 3370.	**6**
Module 2	**Hrs.**
Design of elevated water reservoirs Circular Flat Bottom - top dome with staging.	**6**
Module 3	**Hrs.**
Yield line theory of slabs, Virtual work Method of analysis, Equilibrium Method, Analysis of rectangular and circular slabs with various Boundary conditions.	**6**
Module 4	**Hrs.**
Analysis and Design by limit state method, with redistribution of moments and without redistribution of moments, by using elastic envelop method, problems of fixed beam, propped cantilever, and two span continuous beams.	**6**
Module 5	**Hrs.**
Analysis and Design of raft foundations. Analysis and design of Deep foundations: pile foundations, pile cap.	**6**
Module 6	**Hrs.**
Analysis & design of circular slabs, grid floors.	**6**

Module wise Measurable Students Learning Outcomes:

1) Design elevated water tank with staging
2) Design elevated circular flat bottom water tank with staging
3) Analyze rectangular & circular slab with various Boundary conditions by yield line theory.
4) Design two span continuous beams with & without redistribution of moments.
5) Analyze & design raft & pile foundation.
6) Analyze & design circular & grid slabs.

Title of the Course: Professional Elective-II	L	T	P	Cr
Construction Practices (3CV407)	3	0	0	3

Desirable Courses:

Textbooks:

1. Kumar Neeraj Zha, *"Construction Project Management",* Pearson India Education, 1st edition,(2011)
2. Apte & Phadke. *"Construction Technique & Machinery"*, Nirali Prakashan
3. Mahesh Varma, "Construction Equipment", Metropolitan Book Company

References:

4. Albert Edward Wynn, "Design and construction of formwork for concrete structures", Concrete publications, 1926
5. Robert Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Robert Schmitt, "*Construction planning, equipment, and methods*", McGraw-Hill, 8th edition, 2010
6. Sharma S.C. "*Construction Equipment and Management*", Khanna Publishers New Delhi, 1988.

Course Objectives :

This course attempts to connect students with the availability of numerous traditional and contemporary construction techniques and equipment. Although it is impossible to deliver all techniques and equipment knowledge; students are expected to identify need of market survey and ability to acquire basic professional knowledge about the same.

Course Learning Outcomes: After completion of this course a student will be able to,

CO	Course Outcomes	Bloom's Cognitive	
		level	Descriptor
CO1	select and justify choice of construction equipment for earthwork and batching plant	5	Evaluating
CO2	describe construction techniques for piling, diaphragm Walls, Prefabricated and steel construction	2	Understanding
CO3	demonstrate knowledge of traditional and contemporary formwork practices.	3	Applying

CO-PO Mapping :

POs	a	b	c	d	e	f	g	h	i	j	k
CO1			**3**					**1**			
CO2			**1**					**1**			
CO3			**2**					**2**			

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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Construction Equipment **11**

- **Introduction** –Conceptual planning of new project, site access and services, mechanical v/s manual construction
- **Earth moving Equipment**- Tractors, Bulldozers, Scrappers, Power shovel, Hoes, Simple numerical problems based on cycle time and production rates.
- Drag line, Clamshell, Trenchers, Compactors-types and performance, operating efficiencies, lifting capacities

Module 2: Drilling & Blasting **7**

- Excavation in hard rock: Rippers, jack hammers, drills, compressors and pneumatic equipment. ,Blasting explosives, detonators, fuses.

Module 3: Formwork **4**

- Material for formwork, special types of formwork, introduction to design of formwork
- Slip formwork techniques

Module 4: Batching Plants **7**

- RMC plant, layout and production capacity.
- Asphalt mixing and batching plant (Hot mix plant), Sensor Paver for rigid roads,
- Aggregate crushing plants.

Module 5: Construction Techniques **8**

- Diaphragm Walls: Purpose and Construction methods ,
- Introduction to trenchless technology
- Prefabricated construction: Planning for pre-casting, selection of equipment for fabrication, transport and erection, quality measures, safety measures during erection.
- Steel Construction : Planning for field operations, selection of equipment and erection tools

Module 6: Pile Construction 3

- Pile driving equipment- Types, pile driving hammers, single acting and double acting, differential acting hammers, hydraulic and diesel hammers, vibratory drivers.

Title of the Course: Professional Elective-II Title of the Course: **Design of Unreinforced Masonry Structures (3CV408)** For Civil Engg- UG students and M.Tech (Structural Engg.) Sem-II	L	T	P	Cr
	3	1	0	3

Desirable Courses:

1. Building Materials and Construction

2. Strength of Materials

Textbooks:

4. Structural Masonry, K. S. Jagadish, I. K. International Publishing House, New Delhi, 2015.
5. Brick and Brick Reinforced Structures, P. Dayaratnam, Oxford and IBH publishing House,

References:

1. Structural Masonry, A. W. Hendry, Macmillan Press Ltd, 1998, London.
2. Structural Design of Masonry, Andrew Orton, Longman, 1992 second edition
3. Structural Masonry, Sven Sahlin, Prentice Hall, 1971.
4. Alternative Building Materials and Technologies, K. S. Jagadish, B. V. Venkatrama Reddy, K. S. Nanjunda Rao, New Age International.
5. Structural Masonry designer's Manual, Curtin, Shaw and Beck, BSP Professional Books, Second edition 6. IS 1905, Indian standard code of practice for structural use of unreinforced masonry, BIS, New Delhi.

Course Objectives: The course is designed for Final year B.Tech. (VII Sem) & Ist Year M.Tech. students to

1. Introduce the rational theoretical basis for prediction of structural masonry.

2. Understand and apply the structural design of axial and laterally loaded masonry walls.

3. Educate and carry out applied research on structural masonry based on modern and proven structural theories.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Perceive the properties of various building units/mortar and within the available alternatives make qualitative judgment with appropriate choices for structural masonry.	5	Evaluate
CO2	Analyze, design and estimate the strength of masonry under vertical and lateral loading conditions.	4, 6	Analyze, Create
CO3	Apply the concepts of reinforced and contained masonry and impart ductility and earthquake resistance to masonry buildings.	3	Apply

CO-PO Mapping :

PO	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**
CO1		**3**								
CO2			**3**							
CO3				**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	**Hrs.**
Introduction on Masonry Materials History of Masonry, Masonry units, materials and types, Characteristics of bricks in India, stones, Hourdi block, concrete blocks, stabilized mud blocks, FAL G blocks, Factors affecting properties of masonry units, Classification and properties of Mortars, Testing procedures as per IS codes, Energy considerations..	**6**
Module 2	**Hrs.**
Behaviour of Masonry under Compression Factors influencing masonry compressive strength, Effects of bed materials, unit height, hollow block units, type of bond, wall types, direction of loading, workmanship factors, workmanship and construction details, Deformation properties of masonry under compression, compression failure theories.	**6**
Module 3	**Hrs.**
Masonry in tension, shear and biaxial stress Interfacial bond strength, tensile bond strength, flexural bond strength, strength of masonry in shear, Failure modes, Masonry under biaxial stress, Shear modulus of masonry.	**6**
Module 4	**Hrs.**
Design Analysis of unreinforced Masonry Structural adequacy of masonry walls, types of walls, Design considerations, Lateral support and stability, Stiffening walls, Effective height, length and thickness considerations, Structural design as per codal provisions, Computations of permissible stresses, Application of reduction factors, Assessment of eccentricity.	**6**
Module 5	**Hrs.**
Practical Applications and Case studies Codes of practice, Planning, detailing and construction techniques, Joints with slabs, Joints with roof	**6**

structure, Reinforcement, Expansion joints, Tolerances, Case studies.	
Module 6	**Hrs.**
Reinforced masonry for seismic resistance Seismicity and buildings, Design philosophy, Performance and vulnerability of masonry structures, Typical failure at Bhuj and Latur earthquakes, Structural configuration, BIS codal provisions, Concept of confined masonry, Minimum wall density, Construction Guidelines, New Research trends in contained Masonry.	**6**
Module wise Measurable Students Learning Outcomes: After the completion of the course the student should be able to **Module1:** collect, experiment and compare the characteristics of various building units/blocks/mortar individually and arrive at an appropriate choice in masonry applications. **Module 2:** relate and review the effects of different combinations of masonry units and mortars and its unified behavior in masonry. **Module 3:** experiment and evaluate the various failure theories in masonry. **Module 4:** synthesize and design masonry walls for a given static axial loading condition. **Module 5:**Apply construction techniques by designing masonry walls for a combination of given static axial and lateral loading condition. **Module 6:** Comprehend the behavior of masonry structures in earthquake prone regions and recall the basics of mechanics of materials in making masonry structures resistant to dynamic loads.	
Limitations: The course being an elective will cater to a maximum of 25 students (15 from final year UG students of Civil Engg. and 10 PG students from Structural Engg.)	

Title of the Course: Professional Elective-II Town and Country Planning (3CV409)	L	T	P	Cr
	3	0	0	3

Desirable Courses: Quantity Surveying & Valuation, Water supply and Treatment Technology, Waste Management & Pollution control, Transportation Engineering-I, Building planning and Design

Textbooks:

1. G.K. Hiraskar,"*Fundamentals Of Town Planning*", DhanpatRai Publication (p) Ltd., New Delhi,17th Edition (English)2012
2. S. C. Rangawala "*Town Planning*", Charotar Publications, Pune ,27th : 2014
3. Biswas Hiranmay "Principles Of Town Planning And Architecture", VAYU Education of India, 2012 edition

References:

1. MRTP Act 1966
2. Land Acquisition Act
3. Economic development in Third world: Todaro Michael, OrientLongman Publication, New- delhi
4. Planning legislation by Koperdekar and Diwan.
5. UDPFI guidelines, ministry of urban affairs and employment, Govt. & India.

Course Objectives :

This course is designed to be offered as elective to interested students who wish to consider town and country planning as their probable career option. It focuses on relevant practices in preparation of RP, DP, TPS etc. It also includes relevant legislations knowledge required for a modern town planner.

Course Learning Outcomes: After completion of this course a student will be able to,

CO	Course Outcomes	Bloom's Cognitive	
		level	Descriptor
CO1	comprehend general principles of town planning	2	Understanding
CO2	explain elements of regional plan(RP) and development plan(DP)	2	Understanding
CO3	describe important provisions of different town planning legislations and town planning schemes	2	Understanding

CO-PO Mapping :

POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
CO1			**1**								
CO2			**2**								
CO3							**2**				

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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

1	Introduction - Objective of town planning, principles, stages in town development, brief history - growth of towns and theories of developments (ribbon, sector zone, concentric, multiple zone etc.) - Institutional arrangements in Maharashtra (CIDCO, MMRDA, MHADA, SRA, TPVD etc.)	**7**
2	Regional Plan (R.P) - Need , Regional Delimitation, Surveys , Analysis and Projections - Necessary Steps for process of Regional Planning - Relation with the state Plan and surroundings	**5**
3	Development Plan (D.P) - Surveys, types, duration etc., - Analysis and Projections,- Demographic Projections - Goals and objectives, Public Participation, Implementation and Financial Aspects. - Delineation, Relation with R.P., - Content of DP and Planning norms - Modifications, purchase notice, Legal and Administrative process to start D.P.	**6**
4	Town Planning Scheme - Concept of T.P.S, Legal Provision, Relation with D.P.	**6**

	- Original Plot, final Plot, Semi-final Plot - Incremental Contribution (Betterment charge), Rational for charging Incremental Contribution - Function of Arbitrator, Advance Possession, Amenities, Partially beneficial, Cost of Scheme	
5	Acts and Rules - Municipal Act - MR and TP Act 1966 - LA Act. 1894, and LARA 2013 - SEZ - DCR	**8**
6	Special Townships - Special Township Policy - Land requirement , procedures for locational clearance, salient feature - Responsibilities of developer - Hill station Policy	**7**

Title of the Course: Professional Elective-II Remote Sensing and GIS (3CV410)	L	T	P	Cr
	3	0	0	3

Desirable Courses:

Textbooks:

1. Panda B C 2002 : "Principals of Remote Sensing", Viva Books Private Limited.

2.Shahab Fazal,"Remote Sensing Basics", Kalyani Publishers Ludhiyana3. George Joseph, 2003: "Fundamentals of Remote Sensing", Universities Press

4. M. Anji Reddy 2002: "Remote Sensing & Geographical Information System" , BS Publications, Hyderabad.

5. Banerjee, R. K. and Banerjee, B : " Remote Sensing Techniques for Regional Development",

Chandler Publishing Company

6. A.N. Patel, Surendra Singh, "Remote Sensing Principles and Applications", Scientific Publishers, Jodhpur

7.Gupta Ravi P., "Remote Sensing Geology" Springer; 2nd ed. 2003 edition

References:

1. John R. Jensen 2003: "Remote Sensing & Digital Image Processing", Department of

Geography University of South Carolina Columbia

2. Lillesand Thomas M. & Kiefer Ralph 1999 : "Remote Sensing and Image Interpretation" ,

John Villey

3. Campbell John B. 1996 : "Introduction to Remote Sensing", Taylor & Francis

Course Objectives :

1. Introduce students the necessary knowledge and concepts in the field of RS and GIS and their civil engineering significance. To develop the sense of Applications of Spatial technology among civil engineering students.
2. Introduce the technique of interpreting, classifying and applying various RS and GIS data in Civil Engineering decision making
3. Enable students in decision making to manage the Civil Engineering related spatial problems before preparing and implementing any civil engineering action plans.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive

		Level	Descriptor
CO1	Identify and describe the fundamentals of Remote Sensing and photogrammetry.	II	Understanding
CO2	Demonstrate, Classify, Interpret spatial data to extract maximum information	III	Applying
CO3	To investigate, manipulate and generate spatial database useful to formulate or forecast the future civil engineering activities/events.	VI	Creating

CO-PO Mapping :

PO	**a**	**b**	**C**	**d**	**e**	**f**	**G**	**h**	**i**	**j**	**k**
CO1	**2**										**2**
CO2				**1**				**2**		**2**	**2**
CO3			**1**	**2**	**1**	**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 with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**Hrs.**
Definition, History of Remote sensing, Remote sensing process, interaction of EMR with atmosphere, interaction of EMR with ground objects data transmission and reception GRS, RS platforms, EMR and spectrum, atmospheric windows.	**7**
Module 2	**Hrs.**
Early history of aerial photography, simple camera, aerial camera, types of aerial photographs , taking vertical aerial photograph and flight planning , scale determination, image parallax, parallax measurement, relief displacement of vertical features, stereoscopy .	**7**
Module 3	**Hrs.**
Introduction of ISRO, NASA, NRSC, IIRS and SAC. Earth observation sensors and platforms, India and foreign remote sensing satellites and sensors, sensor applications.	**7**
Module 4	**Hrs.**
Types of remote sensing, types of satellite, digital image, spatial resolution, spectral resolution ,	**7**

radiometric resolution and temporal resolution, visual image interpretation ,image interpretation keys ,spectral signature, spectral reflectance curves, hyperspectral data and its applications.	
Module 5	**Hrs.**
Digital image processing , pre-processing and post-processing, image registration ,image enhancement, image transformation, digital image classification, supervised and unsupervised classification.	**7**
Module 6	**Hrs.**
Geographical information system, definition, spatial and non-spatial data, data inputs, data storage, data transformation, data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, thematic layers and layer combinations. introduction to GPS applications of RS and GIS in civil Engineering.	**7**
Module wise Measurable Students Learning Outcomes: After the completion of the course the student should be able to: 7. Remember and understand history of RS and knowledge of RS process. 8. Understand and apply the knowledge of photogrammetry. 9. Understand and apply the knowledge of various platforms and sensors. 10. Analyze, evaluate and interpret satellite imageries/data. 11. Analyze and apply knowledge of satellite image processing. 12. Create thematic layers by understanding and applying knowledge of RS and GIS.	

Open Electives Courses

Mandatory Life Skill Courses

Put the syllabi of each mandatory life skill courses (mandated by AICTE) after this page

Minor Specialization Courses

Put the syllabi of each course offered by this department for minor specialization at this semester

after this page

(This is Only for UG programs. NOT Necessary for PG Programs)

Honors Specialization Courses

Put the syllabi of each course offered by this department for Honors specialization at this semester after this page

(This is Only for UG programs. NOT Necessary for PG Programs)

Value Added
Professional Courses

Put the syllabi of each value added professional course offered by this department at this semester

after this page

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