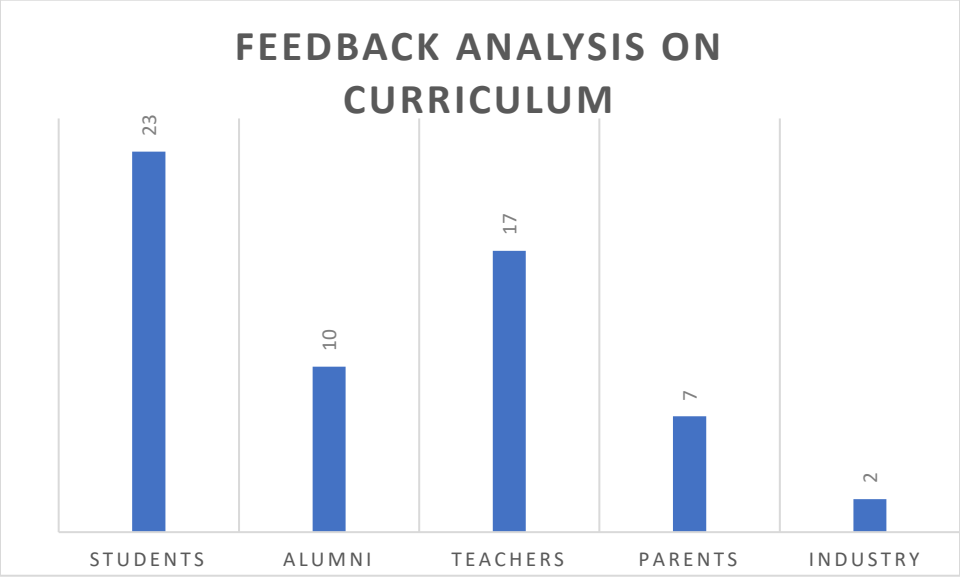
School of Engineering and Technology
Department of Civil Engineering
Feedback Analysis on Curriculum

Feedback was collected from the stake holders on the existing curriculum for Academic year 2021-22. The analysis of the feedback is shown below.

Feedback From	Total Responses	Excellent	Good	Satisfied
Students	23	13.00%	82.60%	4.40%
Alumni	10	20%	60%	20%
Teachers	17	27.50%	62.50%	
Parents	7	62.50%	37.50%	
Industry	2	50%	50%	



Summary of all the feedbacks analyzed

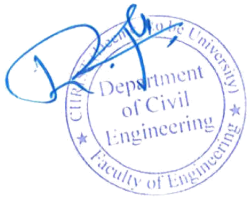
1. Suggestion by students was to include of civil engineering related softwares in curriculum.
2. Suggestion by alumni were 1. software in curriculum, 2. Mini projects.
3. Suggestion by teachers was to include more of skill-based courses.
4. Suggestion by Parents mode of teaching to be made offline.
5. Suggestion by Industry people to include elective courses relevant to the current trend in civil engineering.

Department of Civil Engineering

School of Engineering and Technology
Department of Civil Engineering
Action Taken on Feedback Analysis on Curriculum

The Curriculum Development Cell made the following changes in curriculum based on the feedback analysis.

1. In the courses CE333P, CE334P, CE431P, CE433P, CE531, CE532P, CE533, CE632P, MTCE131, MTCE132, MTCE231; relevant use of softwares were added.
2. New Elective courses offered in the elective basket.



Minutes of the Fourteenth Meeting of the Board of Studies in Civil Engineering held on 25 February 2022 at 9:30 am on the WebEx Platform/at the Panel Room, Block I, CHRIST (Deemed to be University), Bangalore Kengeri Campus

In the Chair:

Members Present
All members as per the attendance list were present

Leave of Absence
Nil

Declaration of Quorum and Calling the Meeting to Order
The Chairperson declared the validity of the quorum and called the Meeting to Order.

Matters on the Agenda

1. **To confirm the Minutes of the Thirteenth Meeting held on 13 February 2021**
   The minutes of the previous meeting of the Board of Studies in Civil Engineering as per Annexure A to the Notice was duly reviewed and approved by the Board.

   It was noted that there were no matters arising out of the Minutes.

2. **To consider and approve the new programmes**

   2.1 **The intake for the programme BTech in Civil (Construction Engineering and Management with specialization in AI and ML) was reduced from 30 to 0**
   2.2 New programme B. Tech in Civil Engineering and Honours in Construction Practices in Association with L&T Edutech
   2.3 To propose new apprenticeship-based engineering education in collaboration between CHRIST (Deemed to be University) and Mu Sigma Inc. from Second Year for B. Tech Civil Engineering students.

3. **To consider and approve the recommended changes in curriculum for the following Undergraduate Programmes**
   The Board reviewed the proposed changes in the curriculum for the following undergraduate programmes based on the feedback received from stakeholders such as Industry, Academic Peers, Professional Bodies, Alumni, and Students and as suggested by the Curriculum Development Cell.

   3.1 To consider and approve recommended Changes in curriculum of BTech Programme
   The Board of Studies reviewed and approved the proposed changes in curriculum as mentioned below.
   3.1. a Programme Outcome - (A list of the programme outcomes)

   3.1.b. Course Code Changes – CE652P, CE782, CE783, CE881.

   3.1.c. Course Title Changes - Old Title CE433P Materials, Testing & Evaluation New Title CE433P Construction Materials, Testing & Evaluation

   3.1.d. Course Outcome changes –

Department of Civil Engineering

CE134P (Course outcomes changed as syllabus was reamped and more than 20% syllabus changed)
CE331P (Course outcomes changed as the syllabus is now more oriented towards practicals)
CE332 (Course outcomes taxonomy changed from the past year experience)
CE333P(Course outcome CO1 changed as unit is changed)
CE432(Course outcomes changed as more than 20% syllabus changed)
CE433P(Course outcomes changed as more than 20% syllabus changed)
CE434P (Course outcomes taxonomy changed from the past year experience)
CE531(Course outcomes changed as more than 20% syllabus changed)
CE532P(CO4 changed)
CE631P(Course outcomes changed as more than 20% syllabus changed)

3.1.e. Semester Changes - CE652P moved from 7sem to 6sem

3.1.f. Credit Changes – CE331P L:T:P – 1:0:1 to L:T:P – 0:0:2 giving more significance to hands on experience

3.1.g. Marks Changes - "Not Applicable"

3.1.h. CIA Pattern Change - "Not Applicable"

3.1.i. ESE Pattern Change - "Not Applicable"

3.1.j. Changes in Course Type: Theory/Practical - "Not Applicable"

3.1.k. Changes in teaching methods/pedagogy - "Not Applicable"

4. To consider and approve the recommended changes in curriculum for the following Postgraduate programmes

The Board reviewed the proposed changes in the curriculum for the following postgraduate programmes based on the feedback received from stakeholders such Industry, Academic Peers, Professional Bodies, Alumni, and Students and as suggested by the Curriculum Development Cell.

4.1 To consider and approve recommended Changes in curriculum of M.Tech in Structural Engineering Programme
The Board of Studies reviewed and approved the proposed changes in curriculum as mentioned below.

4.1. a Programme Outcome – As per NBA Annexure B
4.1.b. Course Code Changes –
Structural Health Monitoring was **MTCE142B** changed to **MTCE242A**
Advanced Steel Design was **MTCE241A** changed to **MTCE141C**
Design of Advanced Concrete Structures was **MTCE242A** changed to **MTCE142B**
Theory of Structural Stability was **MTCE141C** changed to **MTCE241A**
4.1.c. Course Title Changes – MTCE231-Finite Element Method in Structural Engineering changed to Finite Element Analysis
4.1.d. Course Outcome changes
MTCE231 - CO 1 and CO2 have been clubbed as CO1 is considered redundant.
MTCE232 - CO 1 and CO2 have been clubbed as concepts of stress and strains are contiguous in learning.

4.1.e. Semester Changes-
Structural Health Monitoring was in elective 2 shifted to elective 4
Advanced Steel Design was in elective 3 shifted to elective 1
Design of Advanced Concrete Structures was in elective 4 shifted to elective 2
Theory of stability of structures was in elective 1 shifted to elective 3

4.1.f. Credit Changes - "Not Applicable"
4.1.g. Marks Changes - "Not Applicable"
4.1.h. CIA Pattern Change - "Not Applicable"
4.1.i. ESE Pattern Change - "Not Applicable"
4.1.j. Changes in Course Type: Theory/Practical - "Not Applicable"
4.1.k. Changes in teaching methods/pedagogy - "Not Applicable"

5. To consider and approve the Generic Electives, Skill Enhancement, Non-Core Elective courses, Value Added courses offered to other departments

5.1 The new open elective courses "NCC1" and "NCC2" was proposed to be offered for the NCC cadets were reviewed and the board approved the same.

6. To review the Results of the ESE October 2021 for all the Undergraduate and Postgraduate programmes offered by the department.
6.1 To review the Results of the ESE October 2021 for the B.Tech Programme offered by the department
6.2 To review the Results of the ESE October 2021 for the M.Tech Programme offered by the department.

The Result Analysis of the End Semester Examinations for **B. Tech and M. Tech** was reviewed by the BOS. The Board also reviewed the statistics of the result analysis over the years from 2010 to October 2021 and appreciated the improvement in the results.

7. To review the existing status of externally funded research projects and suggest modes of increasing external research projects and consultancies
The Board reviewed the external research projects and consultancy during the academic year and made the following observations and suggestions:
a. To pursue towards NABL accreditation of Laboratory equipments.

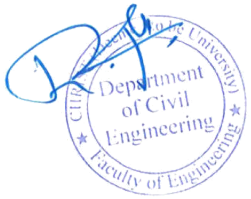
8. To review and suggest ways to enhance the quality and quantity of research and publications by students and faculty. (Capacity building) Annexure -VI
Considering the efforts of the faculty members to recognise the effort taken The Board reviewed the faculty and students publications during the academic year and suggested the following measures to enhance the quality and number of publications:
a. Latex training for students.
b. Encouraging faculties and students to publish in Scopus journals.
c. All M.tech students are advised to publish their project work in Scopus journals.

9. To consider any other matter with the permission of the Chair

- Institutional Development Plan / Strategic Plan 2018-23 were presented for the information of the members.
- The Statistics of the Ph.D. registration from 2012 to 2021 were presented for the information of the members.

- Memorandum of Understanding made between the department of civil engineering and Industries till date were presented for the information of the members.
- The Statistics of the placements of the department for the previous academic years were presented for the information of the members.
- The Statistics of the faculty/ student publications and the patent awarded were presented for the information of the members.
- The activities of the Centre for Social Action – Department of Civil Engineering were presented for the information of the members.
- The Chairperson adjourned the meeting thanking all the participants. The Chairperson particularly thanked Mr. Basant Kumar Bhatnagar, Dr. Balasubramanian, and Dr. M C Narasiman for their presence and valuable suggestions.

Dr. Iven Jose
Chairperson
Board of
Studies



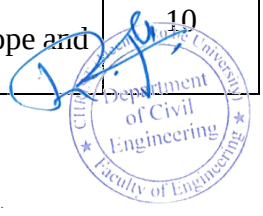
CE333P

Course Name: Introduction to Solid Mechanics					
Course Code: CE333P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3

Course objectives: The objective of this course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.

Prerequisites: Mathematics I, II, Physics, Basics of Civil Engineering and Engineering Mechanics

Units	**Teaching Hours**
Unit-1 Simple Stresses and Strains	
Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress –strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section –composite bars – Temperature stresses. Compound Stresses and Strains Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two-dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.	8
Unit-2 Bending moment and **Shear Force Diagrams**	
Simply Supported and Cantilever beams: Differential relationship between Load, Shear force and bending moment, Bending moment and Shear Force Diagrams, Determination of Maximum bending moment and shear force for a given loading (uniformly distributed load, Gradually Varying load and concentrated loads). Numerical problems to be solved analytically and using commercially available software.	8
Unit-3 Flexural Stresses-Theory of Simple Bending	
Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections. Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.	10
Unit-4 Slope and Deflection in statically determinate structures	
Slope and deflection- Relationship between moment, slope and deflection. Double integration method **Macaulay's method**: Concepts and Application of this method to determine slope and deflection in beams.	10



Unit-5 Torsion	
Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.	9

PRACTICALS

MATERIALS TESTING LABORATORY: LIST OF EXPERIMENTS

1. Tension test on Mild steel and HYSD bars.
2. Compression test of Mild Steel, Cast iron and Wood.
3. Torsion test on Mild Steel circular sections.
4. Bending Test on Wood Under two point loading.
5. Shear Test on Mild steel.
6. Impact test on Mild Steel (Charpy and Izod).
7. Hardness tests on ferrous and non-ferrous metals – Brinell's, Rockwell and Vicker's.
8. Determination of Poisson's Ratio and Bulk Modulus
9. Demonstration of Strain gauges and Strain indicators.

NOTE: All tests to be carried out as per relevant BIS Codes

Self-study: Nil

Site/Industrial Visits: Nil

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

CO1: Compute stresses and strain in axial members (L3) (PO1) (PO2)

CO2: Compute bending moment and shear force in beams (L3) (PO1, PO2)

CO3: Compute stresses in beams under symmetrical loading (L3) (PO1, PO2)

CO4: Compute deflection in beams under symmetrical loading (L3) (PO1, PO2)

CO5: Analyze torsion in hollow and solid circular shafts. (L3) (PO1)

Textbooks:

T1 Timoshenko, S. and Young, D. H., *"Elements of Strength of Materials*",5th ed DVNC, New York, USA, 2003

T2 Kazmi, S. M. A., "*Solid Mechanics*" TMH, Delhi, India, 2017

T3 Hibbeler, R. C. *Mechanics of Materials*. 6th ed. East Rutherford, NJ: Pearson Prentice Hall,2004

T4 R. Subramanian, *Strength of Materials* , Oxford University Press, New Delhi, 2016

Reference Books:

R1. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids.2nd ed. New York, NY: McGraw Hill, 1979

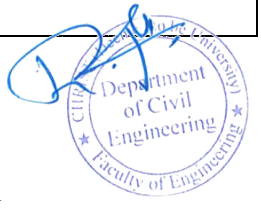
R2. Laboratory Manual of Testing Materials - William Kendrick Hall, 2006

R3. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.

Online Resources:

W1. https://nptel.ac.in/courses/105106049/

W2. https://nptel.ac.in/courses/105108072/2



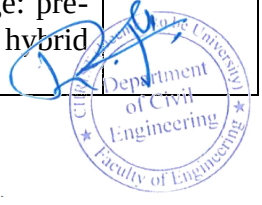
CE334P

Course Name: Surveying and Geomatics					
Course Code: CE334P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	**3**

Course objectives: In this course, the students will be taught to use the various conventional and modern survey instruments and analyse the data collected from survey equipment. They will also be introduced to advanced surveying and mapping techniques like Photogrammetry, Remote Sensing, GIS, and GPS.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Introduction to Surveying	
Basics of Surveying: Basics of Surveying: Introduction to Surveying, importance of surveying in civil engineering, Objective of Surveying, Principles of surveying, Classification of surveying, Introduction to Chain, Compass, Plane Table, Theodolite surveying , Levelling: Trigonometric and Spirit Levelling, Principles of levelling-profile levelling, contouring: Characteristics, methods, uses; Areas and volumes,	9
Unit-2 Modern methods of field measurements	
Total Station Surveying and GPS Surveying: Working principle of Total Station, Advantages and Applications, corrections in total station data, Surveying with Total Station, Field Procedure for total station survey, Errors in Total Station Survey; Global **Positioning Systems**- Segments, GPS measurements, errors and biases, surveying with hand held GPS, Projection systems and coordinate transformation	9
Unit-3 Photogrammetry	
Elementary Photogrammetry: Photogrammetry Surveying : Introduction, Types of Photogrammetry, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, flight planning; Stereoscopy: Determination of ground coordinates with parallax measurements. **Digital Photogrammetry:** Aero Triangulation, Bundle block adjustment, Ortho Mosaic generation, Drone Based Surveying for large scale stereoscopic Mapping, processing of Drone based data in open ware software's.	9
Unit-4 Remote Sensing	
Basics of Remote Sensing: Introduction–Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere (types of scattering and its effect on remote sensing images) and earth surface features, Typical reflectance curves of Water, Soil and Vegetation, remote sensing data acquisition: platforms and sensors; IRS satellite Constellation, Processing of Satellite Images: visual image interpretation keys, digital image: pre- and post-processing, classification techniques (Supervised, unsupervised and hybrid techniques), accuracy assessment of classified data	9



Unit-5 Geographic Information Systems (GIS)	
Fundamentals of GIS: Definitions: components of a GIS The four M's concept – Domain expertise for GIS, GIS objectives — Topology – Data structures –Database management –Errors in GIS **Vector and Raster Data Analysis Techniques**: Vector data models, Raster Data Models, GIS modelling, Spatial data analysis techniques, Integration of GPS, drone and Remote Sensing Data in GIS environment, GIS software packages (openware and commercial) thematic Map Generation.	9
PRACTICALS	
List of Experiments:	**Practical Hours**
1. To determine difference in elevation between two points using fly levelling, Profile of water supply line /highway alignment (CO1)	2
2. To determine difference in elevation between two points using fly levelling, Profile of water supply line /highway alignment (CO1)	2
3. Set out simple circular curves in the field by angular and linear methods.	2
4. Traversing with Total station (CO2)	2
5. Stakeouts with Total Station (CO2)	2
6. Demonstration of Flying a Drone (CO3)	2
7. Preparation of Stereo Model (CO3)	2
8. Generate Digital Surface model (DSM), Digital Terrain Model (DTM) and Contour map from drone images using openware software (CO3)	2
9. Geo referencing of Toposheet and satellite image (CO5)	2
10. Visual Image Interpretation of satellite image (CO4)	2
11. Land Use Land Cover (LULC) map preparation from satellite Images in QGIS (CO4)	2
12. Thematic map Generation in QGIS (CO5)	2
Self-study: Plane table surveying, Interpolation of contours.	
Site/Industrial Visits: Nil	
Course outcomes: **CO1** Understand the concepts of conventional survey methods and principles. { L3}{PO1, PO5, PO9, }{PSO3} **CO2** Classify the modern survey instruments and operate total station for surveying and levelling { L5}{ PO1, PO5, PO9,}{PSO3} **CO3** Analyse the Drone images using photogrammetric concepts {L5}{ PO1, PO5}{PSO3} **CO4** Analyse the passive remote sensing images visually and digitally {L5}{ PO1, PO5} {PSO3} **CO5** Perform overlay analysis using GIS concepts to prepare thematic maps {L5}{PO1, PO5,}{PSO3}	

Textbooks:

T1 B.C. Punmia., Surveying, Vol-1and II, 16th edition, New Delhi,Laxmi Publications, 2018.(UNIT 1)

T2 M. A. Reddy, Text Book of Remote Sensing and Geographical Information Systems, 4thEdition, Hyderabad, BS Publications, 2013. (UNIT 4 and UNIT 5)

T3 B.C. Punmia, "Advanced Surveying", Laxmi Publications, New Delhi, 2018 (UNIT 2, 3, 4)

T4 Remote Sensing and Image Interpretation – Lillesand, John Wiley and Sons, 2014(UNIT 4)

T5 Reddy. M. A, "Text Book of Remote Sensing and Geographical Information Systems", BS Publications, Hyderabad, Fourth Edition, 2013. (UNIT 4 and UNIT 5)

T6 P.R Wolf and B.A. Dewitt Elementary Photogrammetry, 4th edition, TMH publishing, 2014 (UNIT 3)

Reference Books:

R1. S. Kumar, Basics of Remote Sensing sand GIS, New Delhi, Laxmi Publications, 2016.(UNIT 4 AND UNIT 5)

R2. T.P Kanitkar and S.V Kulkarni, Surveying Levelling, Part I and II, Pune, Vidhyarthi Gruha Prakashana, 2006.(UNIT 1)

R3. Alak De, Plane Surveying, 1St edition, New Delhi, S. Chand and Company Ltd, 2000.

R4. Arora S.K, Surveying, Vol-I and II, Standard Book House, Delhi, 2010. (UNIT 1 and UNIT 2)

R5. Arther Bannister, Dr Stanley Raymond and Dr.Raymond Baker, Surveying, India, Pearson Education, 1998. (UNIT 1)

R6. N.Basak, Surveying, India, Tata McGraw-Hill Education Pvt. Ltd, 2001. (UNIT 1)

R7. A.M.Chandra, Plane surveying, 3rd edition, New Delhi, New Age International Ltd, 2015.(UNIT 1)

R8. S.K.Ro., Fundamentals of Surveying, 2nd Edition, India, Prentice Hall of India, 2011.

R9. C.Venkataramiah, "Textbook of Surveying", 2nd edition, New Delhi, Orient Blackswan, 2011.(UNIT 1 and UNIT 2)

Online Resources:

W1. http://www.gisresources.com/

W2. https://onlinecourses.nptel.ac.in/noc17_ce09

W3. https://nptel.ac.in/courses/105107122/1

W4. www.surveyofindia.gov.in/

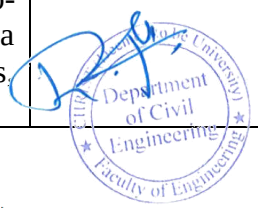
CE431P

Course Name: - Hydraulic Engineering					
Course Code: CE431P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3

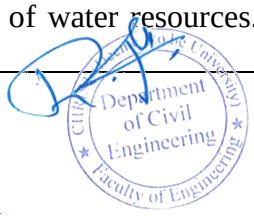
Course objectives: To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering

Prerequisites: Introduction to Fluid Mechanics

Units	**Teaching Hours**
Unit-1 Laminar and Turbulent Flow	
Laminar Flow- Laminar flow through circular pipes, annulus and parallel plates. Stoke's law, **Turbulent Flow**- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.	**9**
Unit-2 Boundary Layer Theory	
Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum and energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.	**6**
Unit-3 Open Channel Flow	
Introduction Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. **Uniform Flow** Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient, Most economical section of channel, Computation of Uniform flow, Normal depth. Computation of economical section and bed roughness analytically as well as by using software **Non-Uniform Flow** Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. . Hydraulic Jump-Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump.	**10**



Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile	
Unit-4 Hydraulic Machines	
Hydraulic Machines: Introduction to hydraulic machines, Classification of turbines, impulse and reaction turbines. Design features, efficiency of turbines, operating and main characteristic curves Hydraulic Pumps: Introduction, Classification of pumps: centrifugal and reciprocating pumps, pumps in series and parallel, efficiency of the pumps, characteristic curves	**12**
Unit-5 **Computational Fluid Dynamics**	
Basic Equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web-based modelling in water resources engineering.	**8**
PRACTICALS	
Laboratory Components: List of Experiments 1. Calibration of V-notch 2. Calibration of rectangular or Trapezoidal notch. 3. Calibration of Ogee weir 4. Calibration of Broad crested weir. 5. Calibration of Venturi flume. 6. Calibration of Venturi meter. 7. Determination of Darcy's friction factor for a straight pipe. 8. Determination of minor loss constants (Bend, Sudden contraction, sudden expansion). 9. Determination of vane coefficient for flat and hemispherical vanes. 10. Determination of hydraulic coefficient of a vertical orifice. 11. Performance tests on a single stage or multistage centrifugal pump (constant speed). 12. Performance tests on a Pelton wheel. 13. Performance tests on Francis 14. Performance tests on Kaplan turbine.	
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Differentiate laminar and turbulent flow (L2, L3) (PO1, PO2), (PSO3) CO2 Explain the concept of boundary layer theory (L2, L3) (PO1, PO2), (PSO3) CO3 Determine most economical channel section and Analyse Hydraulic jump (L3, L4) (PO1, PO2), (PSO3) CO4 Analyse Characteristics of hydraulic machines for efficiency (L4) (PO1, PO2),(PSO3) CO5 Explain the importance of computational fluid dynamics in modeling of water resources. (L2) (PO1, PO2), (PSO3)	



CO6 Calibrate flow measuring devices and hydraulic machines. (L5) (PO1, PO2, PO9, PO10), (PSO3)

Textbooks:

T1 R. K. Bansal, Fluid Mechanics and Hydraulic Machines, New Delhi, Lakshmi Publications Revised Ninth Edition, 2018. (Unit 2, 4)

T2 A.K. Jain, Fluid Mechanics, New Delhi, Khanna Publishers. 2016 edition.

T3 V. T. Chow, Open Channel Hydraulics, McGraw-Hill Publishing Company, , New Delhi, 1993, Most of the syllabus is covering. (Unit 3)

T4 M. Hanif Chaudhry, Open-Channel Flow, Springer, USA, 2nd edition, 2008 , Most of the syllabus is covering (Unit 3)

T5 P.N. Modi and S.M. Seth, Fluid Mechanics and Hydraulics, New Delhi, Standard Book House.21st edition, 2017. (Unit 1, 2, 4)

T6 J.D. Anderson, Computational Fluid Dynamics, Springer,USA, 2nd edition, 2008 , Details of the course. (Unit 5)

T7 James. F. Cruise, Vijay P. Singh, Mohsan M. Sherif, "Elementary Hydraulics", (1st Edition, 2008) Thomson Learning. (Unit 5)

T8 K. Subramanya, "Theory and Applications of Fluid Mechanics", 2014, Tata McGraw Hill.

Reference Books:

R1 H. Chanson, The Hydraulics of Open Channel Flow, Elsevier , Numerical application on open channel flow

R2 K. Subramanya, Flow in Open Channel, Tata McGraw Hill , Good examples on problems in open channel flow

R3 K. A Hoffmann, Computational Fluid Dynamics, Engineering Education System, 2000 , Details of the course

R4 SS Rattan, "Fluid Mechanics and Hydraulic Machines", 2014, Khanna Publishing House

R5 CSP Ojha, R Berndtsson and P.N. Chandramouli, "Fluid Mechanics and Machinery," 2016, Oxford Universiy

R6 Raghunath. H.M., "Fluid Mechanics and Machinery", 2014, CBS Publishers

R7 Arora.K.R., "Hydraulics and Fluid Mechanics", 2000, Standard Book house, NewDelhi

R8 Gupta. S.C., "Fluid Mechanics and Hydraulic Machines", 2016, Pearson Education, India

R9 Jain, A.K., "Fluid Mechanics", 2012, Khanna Publishers, New Delhi.

R10 John F. Douglas et al., "Fluid Mechanics",3rd edition, 2008, Pearson Education, India.

R11 Rao. B. C. S, "Fluid Mechanics and Machinery", 2010, Tata McGraw-Hill Education Pvt. Ltd.

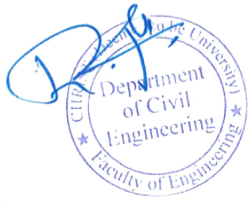
R12 Subramanya K., "1000 Solved Problems in Fluid Mechanics: Includes Hydraulic Machines", 2014, Tata Mc Graw-Hill Education Pvt. Ltd

Online Resources:

https://nptel.ac.in/courses/105103096/

https://nptel.ac.in/courses/105/106/105106114/

https://nptel.ac.in/courses/105103021/



CE433P

Course Name: - Materials, Testing and Evaluation					
Course Code: CE433P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3

Course objectives: Course deals with an experimental determination and evaluation of mechanical characteristics and advanced behaviour of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behaviour of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, as well as practical application of mechanical characteristics.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Introduction to Engineering Materials	
Stones, bricks, aggregates, timber, glass, plastics, ceramics and refractories, bitumen, asphalt, Cements, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete)	9
Unit-2 Building Components- Masonry and Concrete	
Classification of Foundations, Introduction to Different type of foundation, Masonry footings, isolated footings. Combined and strap RCC footings, Raft footing, and Pile foundations. MASONRY: Definition of terms used in masonry, Bonds in Brickwork, English Bond, Flemish Bond, Reinforced brickwork, Joints in Stone Masonry, Rubble Masonry, Coursed Rubble Masonry, Uncoursed rubble masonry, Random rubble masonry, Ashlar Masonry, Masonry design requirements as per IS 1905. FLOORS AND ROOFS: Types of flooring, Granolithic, Mosaic, Ceramic, Marble, Polished Granite, Industrial flooring, Flat Roof (R.C.C.), Sloped roof (R.C.C and Tile roof), Lean to roof, Wooden truss (King post and queen post trusses), steel trusses, Weather proof course for RCC Roof. STAIRS, PLASTERING AND PAINTING: Purpose of Plastering, Materials of plastering, Lime mortar, Cement Mortar, Methods of plastering, Stucco plastering, Lath plastering, Purpose of Painting, Types of Paints, Application of paints to new and old surfaces, Distemper, Plastic emulsion, Enamel, Powder coated painting to walls and iron and steel surfaces, Polishing of wood surface	10
Unit-3 Stairs, Doors and Windows	
Types (Classifications) and Technical terms in stairs, Requirements of a good stair. Geometric Design of RCC Dog Legged and open well stairs. (Plan and sectional elevation of stairs), Doors, Types, Panelled doors, Glazed doors, Flush doors, Collapsible and rolling shutters, Louvered doors, Revolving, sliding and swing doors, Windows, Types, Panelled, Glazed, Bat window, Dormer window, Louvered and corner window and Ventilators. [Inclusion drawing of dog legged stair case and open well stair case using Auto CAD.]	9

Unit-4 Introduction to Cost Effective Construction	
Necessity, Advantages, Pre-fabrication techniques, Pre cast doors and windows (Pre cast frames and shutters), Alternative Building Materials, Hollow concrete blocks, Stabilized mud blocks, Micro concrete tiles, Precast roofing elements, Miscellaneous topics: Form Work, Form work Details, RCC columns, Beams, Floors, Slip forming, Damp proof construction CONCRETE MIX DESIGN: Basic principles of concrete mix design, methods of mix design, ACI and IS method of concrete mix design	7
Unit-5 Material Testing and Standard Evaluation Procedures	
Introduction to Material Testing: What is the "Material Engineering"?; Mechanical behaviour and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundaments and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics **Standard Testing and Evaluation Procedures:** Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep HARDENED CONCRETE: Factors affecting strength, w/c ratio, gel/space ratio, maturity concept, Effect of aggregate properties, relation between compressive strength, and tensile strength, bond strength, modulus of rupture, Accelerated curing, aggregate-cement bond strength, Elasticity- Relation between modulus of elasticity, Poisson ratio, Shrinkage, Creep and Durability concepts. Factors contributing to cracks in concrete-plastic shrinkage, settlement cracks construction joints. Thermal expansion, transition zone, structural design deficiencies, Testing of hardened concrete-compressive strength, split tensile strength, Flexural strength, factors influencing strength test results.	10
PRACTICALS	
Lab Component: List of Experiments 1. Gradation of coarse and fine aggregates 2. Different corresponding tests and need/application of these tests in design and quality 3. control 4. Tensile Strength of materials and concrete composites 5. Compressive strength test on aggregates 6. Tension I - Elastic Behaviour of metals and materials 7. Tension II - Failure of Common Materials 8. Direct Shear - Frictional Behaviour 9. Concrete I - Early Age Properties 10. Concrete II - Compression and Indirect Tension 11. Compression – Directionality 12. Soil Classification 13. Consolidation and Strength Tests 14. Tension III - Heat Treatment	

15. Torsion test
16. Hardness tests (Brinell's and Rockwell)
17. Tests on closely coiled and open coiled springs
18. Theories of Failure and Corroboration with Experiments
19. Tests on unmodified bitumen and modified binders with polymers
20. Bituminous Mix Design and Tests on bituminous mixes - Marshall method
21. Concrete Mix Design as per BIS

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes: - Upon the completion of this course the student will be able to:

CO1 Understand the properties civil engineering materials (L2, PO1, PO2)

CO2 Understand and Choose the components and functions of buildings made up of masonry and concrete (L3, PO1, PO2)

CO3 Understand the types of doors, windows and staircases made up of various materials (L2, PO1,PO2)

CO4 Understand and Distinguish the prefabrication and precast techniques in construction (L4, PO1,PO2)

CO5 Understand and Apply the test procedures for material testing and analyse the properties of materials using standard methods and evaluation procedures(L3, PO1, PO2)

Textbooks:

T1 T1. S.K.Duggal , "Building Materials" Fifth Edition, New Age International (P) Limited, Publishers [Unit 1 and Unit 2]

T2 T2 Medan Mehta, Walter Scarborough, Diane Armpriest "Building Construction : Principles, Materials and Systems" , Pearson [Unit 3 and Unit 4]

T3 T3 H.E. Davis, G.E. Troxell, George F.W. Hauck, "Testing Of Engineering Materials" Fourth Edition McGraw Hill, New Delhi, 2010 [Unit 5]

T4 T4 Khanna and Justo, "Highway Materials and Pavement", Nemchand and Bros, Roorkee, 2000 [Unit 1]

Reference Books:

R1. Chudley, R., Greeno, "Building Construction Handbook", 6th ed., Butterworth-Heinemann, 2006

R2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, "Highway Materials and Pavement Testing", Nem Chandand Bros, Fifth Edition

R3. Various related updated and recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications

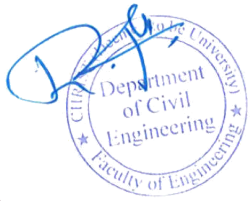
R4. Kyriakos Komvopoulos, "Mechanical Testing of Engineering Materials", Cognella,2011

R5. E.N. Dowling, "Mechanical Behaviour of Materials", Prentice Hall International Edition, 1993

R6. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards, (post 2000)

Online Resources:

NIL



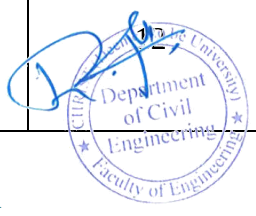
CE531

Course Name: - Structural Engineering					
Course Code: CE531					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	1	0	**CIA Marks**	50
Contact Hrs./Sem.	45	15	0	**ESE Marks**	50
Credits.	3	1	0	**Exam Hours**	3

Course objectives: This course aims at providing students with the necessary background on principles of structural engineering and design. Students will be exposed to the theories and concepts of reinforced concrete design, steel design, and the design of prestressed concrete structures at the elementary level.

Prerequisites: Engineering Mechanics**,** Mechanics of Solids

Units	**Teaching Hours**
Unit-1 Introduction Structural Engineering	
Definition of structure, history of structural engineering, requirements of structural analysis, steps involved in structural engineering, Forms of structures, one-two- and three-dimensional structural systems, the role of an architect, structural engineer, architectural plan, structural framing plan, building services. The first principle of the design process.	12
Unit-2 Introduction to national building code and loading standards	
Static Load: Dead Load, Super Imposed Dead Load, and Live Load Dynamic load: Earthquake Load and Wind Load. Pressure loads: Active and Passive earth pressure and Hydrostatic Load. Self-Straining Loads: Temperature stresses, creek, and shrinkage loads. Provisions for structural design in national building codes.	12
Unit-3- Structural Design Criteria – Design of Reinforced Concrete Elements	
Concept of reinforced concrete, stress-strain characteristics, stress block parameters, the concept of singly reinforced sections. Introduction to design of reinforced RC elements using IS 456:2000. Design of singly and doubly reinforced beam sections, design of one-way and two-way slabs, Design of axially loaded columns. [Analysis and Design of RCC frames using commercially available software]	12
Unit-4 - Structural Design Criteria - Design of Steel Structures	
Advantages and drawbacks of steel constructions, Steel sections, Introduction to steel design, IS 800:2007, Types of connections, bolted connections, advantages, disadvantages, welded connections, advantages, disadvantages. Numerical problems on bolted and welded connections.	12
Unit-5 - Structural Design Criteria – Prestressed Concrete Structures	
Basic Principles of Prestressing: Fundamentals, Load balancing concept, Stress concept, the centre of Thrust. Pre-tensioning and post-tensioning systems, tensioning methods, and end anchorages. Analysis of Sections for Flexure: Stresses in concrete due to pre-stress and loads, stresses in steel due to loads, Cable profiles.	12



Losses of Pre-Stress: Various losses encountered in pre-tensioning and post-tensioning methods.	
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Identify the various structural systems. [L2], {PO2, PO3} CO2 Calculate various types of loads acting on a structure. [L4], {PO2, PO3} CO3 Design reinforced concrete elements such as beams, slabs, and columns. [L5], {PO2, PO3, PO5, PO6} CO4 Design bolted and welded connections for steel sections. [L5], {PO2, PO3, PO6} CO5 Calculate stresses and losses in prestressed concrete sections. [L4], {PO2, PO3, PO6}	
Textbooks: T1 Daniel L Schodek & Martin Bechthold "*Structures*", 7th Edition, Pearson Publications. **(Unit 1)** T2 Punmia BC, Jain AK, "*Theory of Structures*", 12th edition, Laxmi Publications. **(Unit 1 & 2)** T3 Unnikrishnan Pillai and Devadas Menon, "*Reinforced Concrete Design*", 4th Edition, Tata McGraw Hill publications. **(Unit 3)** T4 Varghese P C, "*Limit State Design of Reinforced Concrete*", 2nd Edition, PHI Learning publications. **(Unit 3)** T5 Subramanian N, "*Design of Steel Structures*", 3rd Edition, Oxford University Press. **(Unit 4)** T1 T6 Krishna Raju N, "*Prestressed Concrete*", 6th Edition, McGraw Hill publications. **(Unit 5)**	
Reference Books: R1 Hibbeler R C, "*Structural Analysis*", 9th Edition, Pearson Publications. **(Unit 1 & Unit 2)** R2 Park and Paulay, "*Reinforced Concrete Structures*", 1st Edition, Wiley Publications. **(Unit 3)** R3 Duggal S K, "*Limit State Design of Steel Structures*", 3rd Edition, McGraw Hill Publications. **(Unit 4)** R4 Edward G N, "*Prestressed Concrete: A Fundamental Approach*", 3rd Edition, Pearson Publication. (**(Unit 5)**) IS 875: 1987 (Part 1), "Code of Practice for Design Loads - Dead Loads" IS 875: 1987 (Part 2), "Code of Practice for Design Loads - Live Loads" IS 1893: 2016 (Part 1), "Criteria for Earthquake Resistant Design" IS 456: 2000, "Plain and reinforced concrete – Code of practice." IS 800: 2007, "General Construction in Steel - Code of Practice." R1.IS 1343: 2012, "Prestressed Concrete – Code of Practice"	
Online Resources:NIL	

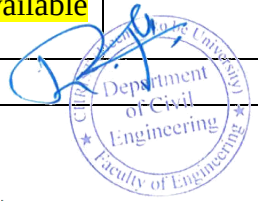
CE532P

Course Name: - Geotechnical Engineering					
Course Code: CE532P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3

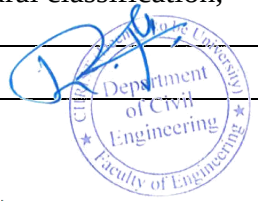
Course objectives: The objective of this subject is to study and understand the basic concepts of Soil mechanics and Properties, behavior of soil and their significance under Compaction, Consolidation and Shear strength.

Prerequisites: Basics of civil engineering, engineering Mechanics, Strength of Materials, Fluid Mechanics

Units	**Teaching Hours**
Unit-1	
Chapter 1: Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. **Chapter 2: *Plasticity Characteristics of Soil*** - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow and toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Classification of soils using commercially available softwares.	07
Unit-2	
Chapter 1: Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets. ***Chapter 2: Effective Stress Principle*** - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition. Solving permeability problems analytically and using commercially available softwares.	06
Unit-3	



Chapter 1: Compaction of Soil-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control. ***Chapter 2: Consolidation of Soil*** - Introduction, comparison between compaction and consolidation, initial, primary and secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation. Calculation of Compaction and Consolidation characteristics analytically and using softwares	09
Unit-4	
Chapter 1: Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, ***Chapter 2: types of shear tests***- Direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test. Solving problems on shear strength using commercially available software.	08
Unit-5	
Chapter 1: Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. ***Chapter 2: Soil Exploration***- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods. Solving problems on stability of slopes and preparing borelogs using software.	07
PRACTICALS	
Lab Experiments: 1. Field Density using Core Cutter method. 2. Field Density using Sand replacement method. 3. Natural moisture content using Oven Drying method. 4. Field identification of Fine-Grained soils. 5. Specific gravity of Soils. 6. Grain size distribution by Sieve Analysis. 7. Grain size distribution by Hydrometer Analysis. 8. Consistency limits by Liquid limit 9. Consistency limits by Plastic limit 11. Permeability test using Constant-head test method. 12. Permeability test using Falling-head method. 13. Compaction test: Standard Proctor test. 14. Direct Shear Test 15. Unconfined Compression Strength Test.	
Self-study: Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system.	
Site/Industrial Visits: NIL	



Course Outcomes: - Upon the completion of this course the student will be able to:

CO1 Understand the different types of soil based on their formation mechanism, various phase diagrams and behavior of soils based on their moisture contents. Investing the index properties practically.(L2, PO1, P05, PO9, PO10. PSO2)

CO2 Determine the permeability of soils through various laboratory and field tests and Plot various stress distribution diagrams along the depth of the soil mass (L3, PO1, PO2, PO5, PO9, PSO2)

CO3 Determine the compactive effort required to obtain necessary degree of compaction in-situ and evaluate ground settlements against time with consolidation. (L3, PO1, PO5, PO9, PO10, PSO2)

CO4 Evaluate the stiffness of soil using shear strength parameters in various conditions and investigate practically. (L5, PO1, PO2, PO5, PSO1)

CO5 Evaluate factor of safety of infinite slopes based on different ground conditions and specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground. (L5, PO1, PO2, PO5, PO9, PO10, PSO1)

Textbooks:

T1 K.R Arora, "Soil Mechanics and Foundations Engineering", 9th edition, UBS Publishers and Distributors, New Delhi, 2014.[Unit 1,2,3]

T2 V.N.S. Murthy, "Soil Mechanics and Foundation Engineering", 4th Edition, UBS Publishers and Distributors, New Delhi, 2009. [Unit1, 4]

T3 B.C. Punmia, "Soil Mechanics and Foundation Engineering", 16th Edition Laxmi Publications Co, New Delhi,2015. [Unit 1, 4, 5]

Reference Books:

R1. Karl Terzaghi, Soil Mechanics and Engineering Practices, 3rd edition, Wiley and Sons publishers and distributes, 2017

R2. Alam Singh and G. R. Chowdhary, "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi, 1994.

R3. J. E. Bowles, "Foundation Analysis and Design", 5th Edition, McGraw Hill Pub. Co. New York, 1996.

R4. Braja M. Das, "Principles of Geotechnical Engineering", 5th Edition, Thomson Business Information India Pvt. Ltd., India, 2002.

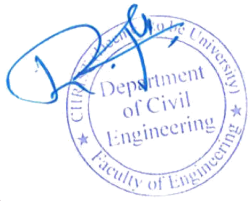
R5. Craig R. F, "Soil Mechanics", Van Nostrand Reinhold Co. Ltd, 1987.

R6. Gopal Ranjan and A.S.R. Rao, "Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi, 2000.

Online Resources:

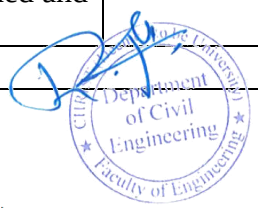
W1. http://nptel.ac.in/courses/105103097/

W2. https://www.geoengineer.org/online-library/soil-mechanics



CE533

Course Name: - Hydrology and Water Resources Engineering					
Course Code: CE533					
	L	**T**	**P**	**Category**	**PCC**
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: The objective of this subject is to study the basics and importance of Hydrology and Water Resources					
Prerequisites: Fluid Mechanics, Hydraulics and Hydraulic Machines.					
Units					**Teaching Hours**
Unit-1 Introduction to Hydrology and Water Resources Engineering					
INTRODUCTION: Definition of hydrology. Importance of hydrology. Global water availability. India's water availability. Practical applications of hydrology. Hydrologic cycle (Horton's qualitative and engineering representations). **WATER RESOURCES**: Introduction. Water wealth. River basins and their potential. Importance of water resources projects in India. Water resources development in Karnataka. **PRECIPITATION:** Definition. Forms and types of precipitation. Measurement of rainfall using Symon's and Syphon type of rain gauges. Optimum number of rain gauge stations. Consistency of rainfall data (double mass curve method). Computation of mean rainfall (arithmetic average, Thiessen's polygon and Isohyetal methods). Estimation of missing rainfall data (Arithmetic average, normal ratio and regression methods). Presentation of precipitation data (moving average curve, mass curve, rainfall hyetographs, intensity – duration - frequency curves).					9
Unit-2 Losses from Precipitation					
Losses from Precipitation: Introduction. Evaporation: Definition, Process, factors affecting, measurement using IS Class A Pan. Estimation using empirical formulae. Infiltration: Definition, factors affecting infiltration capacity, measurement (double ring infiltrometer). Harton's infiltration equation, infiltration indices **Runoff**: Definition. Concept of catchment. Water budget equation. Components. Factors affecting. Rainfall - runoff relationship using simple regression analysis. Evapotranspiration: AET, PET, Factors affecting evapotranspiration, Measurement of evapotranspiration, Pennman's equation and Blaney Criddle's formula and problems. Verification of losses analytically and by using commercially available software					9
Unit-3 Hydrographs and Ground Water Hydrology					
Hydrographs: Definition. Components of Hydrograph. Unit hydrograph and its derivation from simple storm hydrographs. Base flow separation. S–curve and its uses **Ground Water Hydrology and Well Hydraulics:** Scope and importance of ground water hydrology. Aquifer parameters. Steady radial flow into wells in unconfined and confined aquifers. Types of wells, Methods of construction.					9
Unit-4 Stream Flow Measurement and Reservoir Sedimentation					



Stream Flow Measurement: Introduction. Measurement of stage. Measurement of discharge by Area–Velocity method and slope area method. Simple stage discharge relation. Measurement of streamflow by using commercially available software **Reservoir Sedimentation**: Introduction. Process of erosion. Factors affecting erosion. Sediment yield. Reservoir Sediment control. Determination of Sediment Yield at a reservoir site	9
Unit-5 Flood Routing and Rainwater Harvesting	
Flood Routing and Hydrological Statistics – Introduction to hydrological flood routing, reservoir and channel routing methods, flood frequency studies and forecasting, analysis of extreme events **Rainwater Harvesting**: Introduction. Small scale and small tank harvesting. Urban rain water harvesting. Methods of ground water recharge	9
Self-study: NIL	
Site/Industrial Visits: NIL	
Course Outcomes: - Upon the completion of this course the student will be able to: **CO1** Explain the components of hydrological cycle and Analyse the precipitation data. (L2) (PO1, PO2) **CO2** Estimate evaporation, infiltration, evapo-transportation and runoff (L3) (PO1, PO2, PO4) **CO3** Develop and interpret hydrographs and estimate yield of aquifers (L5) (PO1, PO2, PO4) **CO4** Explain the stream flow measurement techniques, reservoir sedimentation process, Analyse the stream flow data sets and determine sediment yield in reservoirs. (L2, L4) (PO1, PO2) **CO5** Analyse inflow and outflow hydrographs using flood routing and compare rain water harvesting methods (L4, L5) (PO1, PO2, PO4)	
Textbooks: **T1** T1 Subramanya K, "Engineering Hydrology", Tata McGraw Hill, New Delhi (Unit 1, 2, 3) **T2** T2 Jayarami Reddy, "A Textbook of Hydrology", Lakshmi Publications, New Delhi (Unit 1, 2, 4) **T3** T3 Raghunath. H.M., "Hydrology", Wiley Eastern Publication, New Delhi (Unit 4, 5)	
Reference Books: **R1.** Mays, "Ground Resources Engineering", 2016, Wiley India Pvt. Ltd **R2.** Das and Saikia, Hydrology, PHI learning Private Limited, 2014. **R3.** S.K.Garg, Hydrology and Water Resources Engineering, 22nd edition, Khanna Publishers, New Delhi, 2014. (***Unit 3, 4, 5***) **R4.** Linsley, Kohler and Paulhus, Applied Hydrology, Wiley Eastern Publication, New Delhi, 2000. **R5.** Patra. K. C., Hydrology and water Resources Engineering, 2nd edition, Narosa publishing House, New Delhi, 2015. (***Unit 4, 5***) **R6.** Sharma R.K., and Sharma, Hydrology and Water Resources Engineering, Oxford and IBH, New Delhi **R7.** Todd, Ground Water Hydrology, 3rd edition, Wiley Eastern Publication, New Delhi, 2005. **R8.** Ven Te Chow, Handbook of Hydrology, McGraw Hill publishers, 2010. **R9.** Viessman, Jr. and Lewis, Introduction to Hydrology, 5th edition, PHI learning Private Limited, 2011.	
Online Resources: https://nptel.ac.in/content/syllabus_pdf/105107129.pdf http://www.nptelvideos.in/2012/11/advanced-hydrology.html	

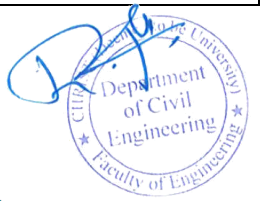
Course Name: - Highway Engineering					
Course Code: CE632P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3

Course objectives: The objective of this subject is to build a Strong, Stable and Deep concept in Highway Engineering, and also to have a clear picture in the details of Design, Construction and Maintenance of Highway structures coming under this field.

Prerequisites: Surveying, Strength of Materials and Soil Mechanics.

Units	**Teaching Hours**
Unit-1 Principles of Transportation Engineering and Highway Development and Planning	
Principles of Transportation Engineering: Importance of Transportation. Different modes of transportation, characteristics and comparison of different modes. Jayakar committee recommendations and implementation. **Highway Development and Planning**: Road Types and classification, road patterns. Planning surveys, Master plan – saturation system of road planning, phasing road development programme Road Development in India, 1st, 2nd and 3rd 20-year road development plan and problems only on 3rd 20-year road plan. Present scenario of road development in India (NHDP and PMGSY) and in Karnataka (KSHIP and KRDCL) –problems on best alignment among alternate proposals and phasing, Road Development Plan Vision 2021. Introduction to Transportation Planning, Travel demand modeling, Data collection, Trip generation, Trip distribution, Modal split and traffic assignment.	12
Unit-2 Highway Alignment Surveys and Geometric Design	
Highway Alignment and Surveys: Ideal alignment, factors affecting alignment, Engineering Surveys For New And Realignment Projects. **Highway Geometric Design-1:** Importance, Factors controlling the design of geometric elements, highway cross section elements – pavement surface characteristics, camber, width of carriageway, shoulder width, formation width, right of way, typical cross section of roads. **Highway Geometric Design-2:** Sight distance, Types and importance - Design of horizontal and vertical alignment – Numerical problems on above (No derivation of formulae). (Use of Commercial software for highway geometric design problems as per the Indian standards)	10
Unit-3 Pavement Materials and Design	
Pavement Materials: Properties and requirements of subgrade soils, HRB and IS soil classification. Determination of CBR and Modulus of subgrade reaction of soil. Properties and requirements of road aggregates, Bitumen – Tar – Emulsion – Cutback, just mention the types of tests on aggregates, bitumen and cut back for evaluating the required properties. Numerical problems on above. **Pavement Design:** Types of pavements – Design factors, Determination of ESWL by equal stress criteria and problems. IRC method of flexible pavement design based on	8

CSA method using IRC: 37 – 2001. Stresses in rigid pavement and design of rigid pavement as per IRC: 58 –2011 excluding design of joints.	
Unit-4 Pavement Construction and Highway Drainage System	
Pavement Construction: Specifications, construction steps and quality control tests for earthwork in cutting, filling and preparation of subgrade, Granular sub base course, Granular base / sub-base courses such as WBM, WMM, CRM, bituminous binder course (BM and DBM), common types of bituminous surfacing courses such as surface dressing, premixed carpet (PMC) and bituminous concrete and Rigid pavement (DLC and PQC). **Highway Drainage System**: Surface and Sub-subsurface drainage system for road pavements, types, functions and basic design principles.	8
Unit-5 Highway Economics and Financing and Pavement Maintenance	
Highway Economics and Financing: Highway user benefits – VOC using charts only – Highway costs – Economic analysis by annual cost method and benefit cost ratio method, NPV and IRR methods. Numerical problems on above. Highway financing – BOT, BOOT and Annuity concepts **Pavement Maintenance:** Pavement failures, Types, Causes and remedies. Maintenance of highways. Principles of pavement evaluation – functional and structural evaluation	7
PRACTICALS	
Highway Materials Laboratory **Aggregates:** Crushing, abrasion, impact and Shape tests (Flaky, Elongation, Angularity number) Specific gravity and water absorption. **Bituminous Materials and Mixes:** Specific Gravity, Penetration, Ductility, Softening point, Flash and fire point, Viscosity, Marshall Stability test. Demonstration: Benkelmen Beam deflection and bitumen extractor	
Self-study: Open Roads, Civil Design Software for Road Networks.	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Understand the importance of transportation for growth of country, compute trip generation and application of gravity model for trip distribution (L2, L3) CO2 Analyse and design geometric features of the highway (L2, L4, L6) CO3 Testing of pavement materials and design of pavement mix proportion as per Indian standards (L2, L4, L6) CO4 Understand the pavement construction as per Indian standards and highway drainage system (L2) CO5 Understand highway economic, financing, and maintenance (L2) (L3)	
Textbooks: T1 Kadiyali, L.R., "Highway Engineering, Khanna Publishers", New Delhi. T2 Khanna, S.K. and Justo, C.E.G., 'Highway Engineering", Nem Chand and Bros, Roorkee (2003). T3 Subramanyam, K.P., "Transportation Engineering–I", Scitech Publications, Chennai.	



Reference Books:

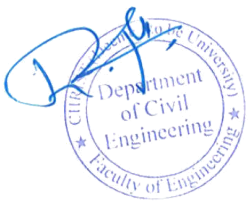
R1 "IRC:37-2012 Tentative guidelines for the design of flexible pavements.
R2 Bindra, SP; "A Course on Highway Engineering" New Delhi, Dhanpat Rai andSons
R3 Chakroborty and Das, "Principles of Transportation Engineering", PHI learning Private Limited
R4 Duggal AK, "Maintenance of Highway – a Reader", TTTI, Sector 26, Chandigarh
R5 Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering", Delhi, New Age Publishers (P) Ltd
R6 Khanna S. K., and Justo CEG, "Highway Material Testing Laboratory Manual", Nem Chand and Bros. Roorkee.
R7 Mannering, "Principals of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd
R8 MORT and H, IRC, "Specifications for Roads and Bridges", New Delhi (2001).
R9 Partha Chakra Borthy, "Principles of Transportation Engineering", Prentice-Hall
R10 Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill Education Pvt. Ltd.
R11 Rao, GV' Transportation Engineering
R12 Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" Delhi, S Chand and Co
R13 Sharma, RC; and Sharma, SK; "Principles and Practice of Highway Engineering", New Delhi, Asia Publishing House
R14 Vaswani, NK, "Highway Engineering" Roorkee Publishing House.
R15 Yoder. E.J., "Principals of pavement Design", John Wiley and Sons", New Delhi'
R16 Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall

Online Resources: https://nptel.ac.in/courses/105101087/

MTCE131

Course Name: Advanced Structural Analysis					
Course Code: MTCE131					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	**3**
Course objectives: The objective of this course to Analyse the structures using stiffness method and approximate methods.					
Prerequisites: Structural Analysis-I and Structural Analysis-II					

Units	**Teaching Hours**
Unit-1 Matrix Flexibility Method	
Introduction: Structural Engineering, steps involved in structural engineering. Concepts of stiffness and flexibility. **FLEXIBILITY METHOD:** Force-transformation matrix – Development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6 x 6 flexibility matrix). Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method (having not more than 3 coordinates – 3 x 3 flexibility matrix) Effects of temperature change and lack of fit. Related numerical problems by flexibility method. Numerical problems to be solved analytically and using commercially available software.	9
Unit-2 Matrix Stiffness Method	
Stiffness method: Displacement-transformation matrix – Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6 x 6 stiffness matrix). Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (having not more than 3 coordinates – 3 x 3 stiffness matrix) Effects of temperature change and lack of fit. Related numerical problems by flexibility and stiffness method. Numerical problems to be solved analytically and using commercially available software.	9
Unit-3 Curved Beams	
Curved beams: Introduction to curved beams andassumptions, WINKLER BACH equations, Limitation, Radius of neutral surface of rectangular, triangular sections, Trapezoidal and circular sections, Stress distribution on open curved members, hooks. Stress distribution in closed rings, Deformations of open, thin curved members, problems on thin curved members, Deformations of closed thin curved members such as rings, problems on closed rings	9
Unit-4 Beams on Elastic Foundation	



Beams on elastic foundations: Differential equation of elastic line, interpretation of constants of integration, infinite beam with concentrated load, infinite beam with moment UDL, infinite beam problems, semi-infinite beams with concentrated load and moment, semi-infinite beam with fixed and hinged conditions, problems on semi-infinite beams, finite beams with symmetrical load, problems on symmetrical load, finite beams with unsymmetrical load, problems on unsymmetrical load.	10
Unit-5 Tension Coefficient Method	
Tension coefficient method: introduction to tension coefficient method. Application of TCM to 2D frames, Application of TCM to 3D frames, problems on 3D frames.	8
Self-study: Nil	
Site/Industrial Visits : Nil	
Course outcomes: At the end of the course, students will be able to **CO1** Analyze the skeletal structures using flexibility method **CO2** Analyze the skeletal structures using stiffness methods **CO3** Analyse curved beam **CO4** Analyse beam on elastic foundation **CO5** Analyse space frame by tension coefficient method	
Reference Books: R1. Matrix Analysis of Framed Structures, Weaver and Gere. R2. The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co. R3. Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication. R4. The Finite Element Method, Desai and Able, CBS Publication.	
Online Resources: W1. https://nptel.ac.in/courses/122102004/5 W2. https://nptel.ac.in/downloads/105101085	

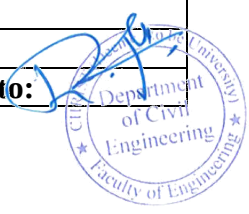
Course Name: Structural Dynamics					
Course Code: MTCE 132					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives:

- To understand the basic terminologies of dynamics like simple harmonic motion, natural frequency, time period, degrees of freedom, damping and the difference between statics and dynamics.
- To derive the equation of motion and understand the behaviour of SDOF and MDOF systems subjected to free vibration and forced vibration.
- To understand the behaviour of structures when subjected to dynamic forces like earthquake and wind.

Prerequisites: Engineering Mechanics, Engineering Mathematics

Units	**Teaching Hours**
Unit-1 Introduction to structural dynamics:	
Difference between statics and dynamics, basic terminologies, degrees of freedom, mathematical model, simple harmonic motion, equation of motion of SDOF system subjected to free vibration.	9
Unit-2 Single degree of freedom system	
free vibration: Solution for equation of motion of SDOF system subjected to free vibration, un-damped and damped systems, logarithmic decrement and numerical problems. Numerical problems to be solved analytically and using commercially available software.	9
Unit-3 Single degree of freedom system – forced vibration	
Equation of motion and solution to SDOF system subjected to forced vibration, resonance, dynamic load factor, half power band width, transmissibility ratio, response to impulsive loading, Duhamel's Integral.	9
Unit-4 Multi degree of freedom system	
Shear building model, equation of motion and solution to MDOF system subjected to free vibration, Eigen value and Eigen vectors, Mode shapes, Normalization of modes, response of MDOF systems subjected to forced vibration, approximate methods of analysis and response of continuous systems.	9
Unit-5 Dynamic problems in civil engineering:	
Effect of seismic loading, effects of wind loading, moving loads and vibration caused by traffic, blast loads, foundations for industrial machinery and Base isolation techniques.	9
Self-study: Applications and dynamic problems in civil engineering.	
Site/Industrial Visits : Nil	
Course outcomes: Upon completion of this course the student will be able to:	



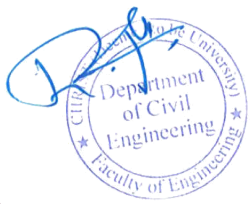
CO1: Understand basics of structural dynamics (L2)
CO2: Compute the natural frequency and other dynamic parameters of SDOF system (L2, L3)
CO3: Analyse single degree of system subjected to forced vibration (L4)
CO4: Compute the natural frequency and other dynamic parameters of MDOF system-L2 and L3
CO5: Interpret the behavior of structures subjected to dynamic loading - L4

Reference Books:

R1. Chopra A.K "Dynamics of Structures Theory and Applications to Earthquake Engineering", 5th Edition, Pearson, 2017.
R2. Paz Mario "Structural Dynamics Theory and Computation ", Springer, 5th Edition, 2006
R3. Clough R. W. and Penzien J "Dynamics of Structures", McGraw Hill Education, 3rd Edition, 2003.
R4. Damodarasamy. S.R and Kavitha. S, "Basics of Structural Dynamics and Aseismic Design" PHI Learning private limited, 2012.

Online Resources:

W1. Structural Dynamics http://nptel.ac.in/courses/105101006/



MTCE231

Course Name: Finite Element Analysis					
Course Code: MTCE231					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	**3**

Course objectives: The objective of this course is to familiarize students to study the finite element method and to know the importance in analysis of structures.

Prerequisites: Mathematics, Solid Mechanics

Units	**Teaching Hours**
Unit-1 Introduction	
History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.	9
Unit-2 Method of Weighted Residuals	
Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.	9
Unit-3 Analysis of FEM Elements	
Finite elements used for one, two- and three-dimensional problems	9
Unit-4 Application to Solid Mechanics:	
Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations	9
Unit-5 Computer Implementation	
Computer Implementation of FEM procedure, Pre- Processing, Solution, Post-Processing, Use of Commercial FEA Software.	9

Self-study: Triangular Elements, Rectangular Elements, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature

Site/Industrial Visits: Nil

Course outcomes:

CO1: Identify the various basic theory behind the Finite element analysis(L3)
CO2: Apply weighted residual method of shape functions to analyze truss and beam elements.(L3)
CO3: Formulate force-displacements relations for 1-D, 2-D and 3-D elements(L5)
CO4: Analyze the continuum problems using finite element analysis.(L4)
CO5: Analyze and interpret solutions of engineering problems with different loading and boundary conditions using FE Software's. (L5)

Reference Books:

R1. Seshu P., "Finite Element Analysis", Prentice-Hall of India,2005
R2. Cook R. D., "Concepts and Applications of Finite Element Analysis", Wiley J., New York, 1995.

R3. Hutton David, “Fundamentals of Finite Element Analysis”, Mc-Graw Hill, 2004.
R4. Buchanan G.R., “Finite Element Analysis”, McGraw Hill Publications, New York, 1995.
R5. Zienkiewicz O.C. and Taylor R.L. “Finite Element Method, Vol. I, II and III”, Elsevier, 2000. R6. Belegundu A.D., Chandrupatla, T.R., “Finite Element Methods in Engineering”, Prentice Hall India, 1991.

Online Resources:

W1. https://nptel.ac.in/courses/112104116/ W2. https://nptel.ac.in/courses/105105041/