



**NAGARJUNA**

**COLLEGE OF ENGINEERING & TECHNOLOGY**

*An Autonomous College under VTU*

## **DEPARTMENT OF CIVIL ENGINEERING**

### **VISION**

To transform the students as leaders in Civil Engineering to achieve professional excellence in the challenging future.

### **MISSION**

- M1:** To provide the Civil Engineering knowledge and skills for students through an excellent academic environment.
- M2:** Adopting innovative teaching techniques using modern engineering tools for designing, modeling and analyzing the societal and environmental problems.
- M3:** Developing Communication skill, leadership qualities through team work and skills for continuing education among the students.
- M4:** To inculcate moral, ethical and professional values among students to serve the society.
- M5:** Validate engineering knowledge through innovative research projects to enhance their employability and entrepreneurship skills.

## **III & IV Semesters**

### ***Scheme and Syllabus***

***With effect from Academic Year 2018-19***

**Third Semester B.E. - Scheme**

Sl. No.	Course Code	Course	Teaching Dept.	L-T-P-S (Hrs/week)	Total Credits	Marks
1	17CVM31	Engineering Mathematics-III (IC)	Mathematics	3-0-2-0	4	100
2	17CVT32	Building Materials and Concrete Technology	CE	3-0-0-0	3	100
3	17CVT33	Strength of Materials	CE	3-0-0-0	3	100
4	17CVT34	Surveying	CE	4-0-0-0	4	100
5	17CVI35	Engineering Geology (IC)	CE	3-0-2-0	4	100
6	17CVT36X	Foundation Elective-I	CE	3-0-0-0	3	100
7	17CVL37	Basic Material Testing Laboratory	CE	1-0-2-0	2	100
8	17CVL38	Surveying Practice-I	CE	1-0-2-0	2	100
9	17CVH39	Integrated Rural Development – Part 1	CE	0-2-0-0	1	100
Total				21-2-8-0	26	900

**Foundation Elective-I**

Sl. No.	Course Code	Course
1	17CVT361	Ecology and Environmental Impact Assessment
2	17CVT362	Rural Water Supply and Sanitation
3	17CVT363	Solid Waste Management

**Fourth Semester B.E. - Scheme**

Sl. No.	Course Code	Course	Teaching Dept.	L-T-P-S (Hrs/week)	Total Credits	Marks
1	17CVM41	Engineering Mathematics-IV (IC)	Mathematics	3-0-2-0	4	100
2	17CVT42	Fluid Mechanics	CE	4-0-0-0	4	100
3	17CVT43	Structural Analysis-I	CE	3-0-0-0	3	100
4	17CVI44	Building Planning and Drawing (IC)	CE	3-0-2-0	4	100
5	17CVT45X	Foundation Elective-II	CE	3-0-0-0	3	100
6	17CVT46X	Engineering Elective-III	CE	3-0-0-0	3	100
7	17CVL47	Concrete Laboratory	CE	1-0-2-0	2	100
8	17CVL48	Surveying Practice-II	CE	1-0-2-0	2	100
9	17CVH49	Integrated Rural Development – Part 2	CE	0-2-0-0	1	100
<b>Total</b>				<b>21-2-8-0</b>	<b>26</b>	<b>900</b>

**Foundation Elective-II**

Sl. No.	Course Code	Course
1	17CVT451	Elements of Construction Industry
2	17CVT452	Alternative Building Material And Technology
3	17CVT453	Advanced Concrete Technology
4	17CVT454	Online Certification Course, IIRS- ISRO certification. Equivalent to 36-40 hours approved by Department

**Engineering Elective-III**

Sl. No.	Course Code	Course
1	17CVT461	Renewable Energy Resources
2	17CVT462	Environmental Air Pollution
3	17CVT463	Remote Sensing and GIS
4	17CVT464	Smart Materials

IC – Integrated Course

L – Lecture

T-Tutorials

P-Practical

S – Self Study

## Engineering Mathematics-III (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVM31	3:0:2:0	4	CIE:50 SEE:50	3 Hours	BS

### Course Objectives:

The students will be able to :

- Develop the application of mathematical skills in solving the engineering problems using computers.
- Learn to use the partial differential equations in engineering applications.
- Use the transforms in the engineering problems.
- Find the approximated solutions to engineering problems numerically.

### Syllabus

#### Module - I

**Partial Differential Equations:** Formation of PDE –Eliminating the Arbitrary constants and arbitrary functions, solutions of non homogenous PDE by direct integration. Method of separation of variables. Applications to PDE –Derivation of one dimensional wave equation and solution by separation of variables-with specified boundary conditions. Derivation of one dimensional Heat equation and solution by separation of variables-with specified boundary conditions. **08 Hours**

#### Module - II

**Fourier Series:** Periodic functions, Dirchlet's conditions, Euler's Formulae-Fourier series of periodic functions of period  $2l$  and  $2\pi$ , Half range Fourier series , Practical harmonic analysis. **08 Hours**

#### Module - III

**Fourier –Transform and Calculus of Variations:** Infinite Fourier Transform, Fourier Sine and Cosine Transform. Variation of function and a functional. Extremal of a functional, variational problems, Euler's equation, Standard Variational problems including Geodesics, minimal surfaces of Revolution, hanging chain and Brachistochrone problems. **08 Hours**

#### Module - IV

**Numerical Methods:** Numerical solutions of Algebraic and transcendental equations-Regula False Method and Newton Raphson Method. Finite Differences-Forward, Backward and central differences, Newton's Forward, Newton's Backward and Sterling's interpolation formulae. Lagrange's Interpolation formula (without proof). Numerical Differentiation using Newton's Forward and Backward formulae. **08 Hours**

## Module - V

Introduction to SCILAB, and its family, Menus and toolbars, Types of windows and types of files, SCILAB Help system, Basic calculations in SCILAB, Basic variables, Functions-Elementary Mathematical, Builtin and User defined functions. Array operations, Matrix operations, Loops: for and while loops, condition statements- if-then and if-then-else statements, plotting of graphs, working with scripts and files.

**08 Hours**

### List of SCILAB Experiments

Sl. No.	Name of the Experiment
1	SCILAB Environment
2	Basic operations in SCILAB
3	Basic Matrix operations
4	SCILAB programming environment
5	Use of Functions
6	Plotting of 2D and 3D Curves
7	Polynomial Evaluation and Determination of Roots of a Polynomial
8	Statistics Using SCILAB
9	Differentiation and Integration using SCILAB
10	Numerical Methods using SCILAB

### Course Outcomes:

On completion of this course, the students are able to :

- Form a partial differential equations and their solutions.
- Expressing the given functions as infinite series of sine and cosine.
- Solve the functional and variation problems.
- Find approximated solutions by numerical methods.
- Use the SCILAB to solve the various types engineering problems.

### Text Books:

1. Dr. B.S. Grewal: "Higher Engineering Mathematics", (Chapters 10,17,18, 22, 23, 28- 30), Khanna Publishers, New Delhi, 42<sup>nd</sup> Edition, 2012, ISBN.: 9788174091956.
2. N.P. Bali and Dr. Manish Goyal: "A Text Book of Engineering Mathematics", (Chapters 10, 16, 17, 20, 22, 23), Laxmi Publications (P) Ltd., New Delhi, 9<sup>th</sup> Edition, 2014, ISBN: 9788131808320.
3. Rudrapratab: "Getting started with MATLAB", (Chapters 1-4), Oxford University Press, United Kingdom, Indian Edition, 2014 (reprinted).

**Reference Books:**

1. Erwin Kreyszig: “Advanced Engineering Mathematics”, (Chapters 11, 12, 19), Wiley Pvt. Ltd., India, New Delhi, 9<sup>th</sup> Edition, 2011, ISBN 13: 9788126531356.
2. B.V. Ramana: “Higher Engineering Mathematics”, (Chapters 17-21, 32), Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 2<sup>nd</sup> Reprint, 2007, ISBN 13: 978-0-07063417-0.
3. S.S. Sastry: “Introductory methods of numerical analysis”, (Chapters 2, 3, 6), PHI learning private, Delhi, 5<sup>th</sup> Edition, 2013, ISBN: 978-81-203-4592-8.
4. Stormy Attaway: “A practical introduction to programming and problem solving”, Elsevier, Boston, 2<sup>nd</sup> Edition.

**E-Resources:**

1. <http://bookboon.com/en/essential-engineering-mathematics-ebook>
2. <https://www.free-ebooks.net/ebook/essential-engineering-mathematics>
3. <https://www.scilab.org/resources/documentation/books>
4. <https://archive.org/details/AdvancedEngineeringMathematics10thEdition>
5. [https://mars.uta.edu/mae3183/simulation/introscilab\\_baudin.pdf](https://mars.uta.edu/mae3183/simulation/introscilab_baudin.pdf)



## Building Materials and Concrete Technology

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT32	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Achieve the basic knowledge of concrete.
- Understand the advances in construction materials.
- Learn the importance of materials used in concrete.
- Understand fresh concrete properties and admixtures.
- Utilise the codal provisions for concrete mix design.

### Syllabus

#### Module - I

**Masonry:** Definition of terms used in Masonry, Classification of Masonry.

**Stone Masonry:** Classification, joints.

**Brick Masonry:** Manufacture of Bricks, Standard properties of brick, Field test.

**Block Masonry:** Classification and properties.

**Foundation:** Importance and requirements of a good foundation, types of foundation, Preliminary investigation of soil, safe bearing capacity of soil, Introduction to spread, combined, strap, mat and pile foundations. **08 Hours**

#### Module - II

**Roofs:** Types of roofs and roofing materials, Flat roof (RCC), types of pitched roofs, Introduction to Form Work and Scaffolding.

**Plastering:** Purposes of plastering, Materials of Plastering, Methods of plastering, Defects in plastering.

**Painting:** Introduction to paintings and types of painting, Purpose of painting, defects in painting, application of paints to new and old surfaces. **08 Hours**

#### Module - III

**Cement:** Chemical composition, hydration of cement, types of cement, manufacture of OPC with flow charts. Bogue's compound, Tests on cement – field and Lab test, Quality of mixing water.

**Fine aggregate:** Grading of aggregates, sieve analysis, specific gravity, bulking, and moisture content, deleterious materials.

**Coarse aggregate:** Importance of size, shape and texture, grading of aggregates, sieve analysis, specific gravity, flakiness and elongation index, crushing, impact and abrasion tests, Structure of aggregate phase, structure of hydrated cement paste, structure - property relationship in hydrated cement paste. **08 Hours**

## Module - IV

**Concrete:** Ingredients, Manufacture of concrete.

**Workability:** Definition, factors affecting workability, measurement of workability by slump, compaction factor, vee-bee, flow tests. Segregation and bleeding, process of manufacture of concrete – batching. Mixing, transporting, placing, compaction, curing of concrete.

**Hardened concrete:** Test on Compression, tensile, Flexural.

**Admixtures:** Chemical and Mineral Admixtures.

**08 Hours**

## Module - V

**Shrinkage and creep:** Factors affecting Shrinkage, Drying and Plastic Shrinkage. Factors affecting creep, effects of creep.

**Durability:** Definition, Permeability, sulphate attack, Chloride attack, Carbonation freezing and Thawing, factors contributing to cracks in concrete.

**Mix design:** Concept of mix design, procedure of mix design as per IS 10262-2009, numerical examples of mix design.

**08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Recognise the materials used in construction.
- Describe the physical and mechanical properties of a variety of construction materials.
- Identify the functional components of a building.
- Describe the construction process of various components of a building.
- Explain the fundamental principles and procedures in preparing concrete.

### Text Books:

1. M.S. Shetty: “Concrete Technology”, (Chapters 1-3,6-9,11), Theory and Practice, S. Chand and Company, New Delhi, 7<sup>th</sup> Edition, ISBN-13: 9788121900034.
2. Neville A.M : “Properties of Concrete”, (Chapters 1,3-6,9,10,14), ELBS, London, 4<sup>th</sup> Edition, ISBN: 9780582230705.
3. S K Duggal: “Building materials”, (Chapters 2,3,6,10), New Age International Publishers, India, 4<sup>th</sup> Revised Edition, ISBN 10: 81224337900.



4. Rangawala P C: “Engineering Materials (Material Science)”, (Chapters 3, 4, 8, 9), Charotar Publishing House, India, 33<sup>rd</sup> Edition, 2015, ISBN: 978-93-85039-04-1.

**Reference Books:**

1. Gambhir M.L : “Concrete Technology”, (Chapters 1-4,6,8,11,15), Dhanpat Rai and Sons, New Delhi, 4<sup>th</sup> Edition, ISBN: 978125906255.
2. P G Varghese: “A Textbook Building Materials”, (Chapters 1,3,19), PHI Learning Publication, 2<sup>nd</sup> Edition, 2015, ISBN: 81-203-2848-5. IS:10262-2009, Recommended guidelines for concrete Mix design.

**E-Resources:**

1. [www.atozcivilengineering.com](http://www.atozcivilengineering.com) › Education
2. [www.actemirates.ae](http://www.actemirates.ae)
3. [www.advconcrete.com/contact-us](http://www.advconcrete.com/contact-us)
4. [www.act-course.co.uk](http://www.act-course.co.uk)
5. [www.labour.gov.hk/eng/public/os/D/Constructionsite.pdf](http://www.labour.gov.hk/eng/public/os/D/Constructionsite.pdf)



## Strength of Materials

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT33	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FC

### Course Objectives :

The students will be able to :

- Study the behaviour of materials within elastic limit subjected to Flexure, Shear and Torsion.
- Analyze the buckling behaviour of columns.
- Understand the importance of deflection in beams.
- Analyze the complex stresses.

### Syllabus

#### Module - I

**Simple Stress and Strain:** Introduction, Stress, Strain, Hooke's law, Poisson's Ratio, Stress – Strain diagram for structural steel, Principle of superposition, Elastic constants, relationship among elastic constants. **08 Hours**

#### Module - II

**Bending Moment and Shear Force:** Introduction, Shear force, Bending moment, Relationship between loading, shear force and bending moment, SFD and BMD with salient values for simply supported beams, cantilever beams and overhanging beams considering point loads, UDL, UVL and Moment. **08 Hours**

#### Module - III

**Torsion of circular shafts:** Pure torsion, torsion equation of circular shafts, torsional rigidity and polar modulus, Power transmitted by shaft for solid and hollow circular shafts.

**Elastic stability of columns:** Short and long columns, Euler's theory on long columns, Effective length, slenderness ratio, radius of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine's formula. **08 Hours**

#### Module - IV

**Deflection of beams:** Definitions of slope, deflection, Elastic curve, derivation of differential equation for deflection, Sign convention, Slope and deflection for standard loading cases using Macaulay's method for beams subjected to point loads, UDL and moment.

**Compound stresses:** Introduction, Stress components on inclined planes, General two dimensional stress system, Principal planes and stresses, Mohr's circle of stresses and complimentary shear stress. **08 Hours**

## Module - V

**Bending Stress in Beams:** Introduction to Bending stress in beams, Assumptions in pure bending and derivation of Bending equation, Modulus of rupture, section modulus, Moment of resistance and Flexural rigidity.

**Shear Stress in Beams:** Expression for shear stress in beam, Shear stress diagram for rectangular, symmetrical 'I' and 'T' section. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Describe the fundamental concepts of stress and strain under elastic limits.
- Draw SFD and BMD for beams.
- Design shafts to transmit required power.
- Determine the buckling loads of long columns.
- Determine deflection in beams under different loading conditions.
- Analyze the major and minor principal stresses and their directions.
- Analyze the bending stress and shear stress in the beams.

### Text Books:

1. Dr. R K Bansal: "A Textbook of Strength of Materials", (Chapters 1-3,6,7,9,12), Laxmi Publisher, 5<sup>th</sup> Edition, 2012, ISBN: 978-8131808146.
2. S Ramamrutham and R Narayanan: "Strength of Materials", (Chapters 1,2,5,7,9), Dhanpat Rai Publishing Company, 14<sup>th</sup> Edition, 2011, ISBN:9788187433545.

### Reference Books:

1. S S Bhavikatti: "Strength of Materials", (Chapters 1,2,4,7,8,10), S.Chand (G/L) and Company Ltd., 4<sup>th</sup> Edition, 2013, ISBN: 978-9325971578.
2. Dr. B C Punmia, Dr. A K Jain: "Mechanics of Materials", (Chapters 1- 5,7,11,12), Fire Wall Media, 2002, ISBN: 9788170082156.

### E-Resources:

1. <http://elearning.vtu.ac.in/elcmys/P1/CV33/3/ReloadContentPreview.htm>
2. <http://elearning.vtu.ac.in/elcmys/P1/CV33/2/ReloadContentPreview.htm>
3. <http://elearning.vtu.ac.in/elcmys/17/e-Notes/10CV52/Unit2-GSS.pdf>
4. <http://elearning.vtu.ac.in/elcmys/17/e-Notes/10CV52/Unit2-GSS.pdf>



## Surveying

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT34	4:0:0:0	4	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Learn basics of surveying and exposed to different techniques of surveying.
- Understand the principles of Tacheometry, geodetic surveying and GPS.
- Identify the types of errors encountered in surveying.

### Syllabus

#### Module - I

**Introduction to Surveying:** Introduction to plane surveying, Chain and tape measurement, Meridians, Azimuths and bearings – Theodolites – Temporary and permanent adjustment – Horizontal and Vertical angle measurements – Electronic total station. **10 Hours**

#### Module - II

**Introduction to levelling:** Differential levelling, longitudinal and cross section levelling, refraction and curvature correction, reciprocal leveling - Tacheometry – Stadia tacheometry, tangential tacheometry and substance tacheometry- Contouring, methods of contouring. **10 Hours**

#### Module - III

**Areas, volumes and GPS:** Area, volume calculation of earth work - Introduction to Global positioning system – GPS surveying methods. **10 Hours**

#### Module - IV

**Curve Setting:** Definitions, designation of curve, elements of simple curve - settings of simple circular curve, compound and reverse curve- transition curve – Introduction to vertical curves. **10 Hours**

#### Module - V

**Introduction to geodetic surveying:** Triangulation surveying – base line measurement and correction, satellite station. Surveying adjustments – principle of least square and adjustment of triangulation network. **10 Hours**

**Course Outcomes:**

On completion of this course, the students are able to :

- Identify the basics involved in different types of surveying like tape, compass, levelling, and Theodolite (total station).
- Recognize the skills in performing measurement of distance, angles, levelling.
- Develop skills for estimating distance between given points, area of a given plot and earthwork involved in cuttings and fillings.
- Develop skill to carry out tacheometry, geodetic surveying wherever situation demands and curve setting.
- Apply error adjustment to the recorded reading to get an accurate surveying output.

**Text Books:**

1. Dr B C Punmia: “Surveying Volume I”, (Chapters 1-4,6,7,9,13,16,18,22), Lakshmi Publications Pvt. Ltd., 6<sup>th</sup> Edition, 2005, ISBN: 978-81-700-8853-0.
2. Dr B C Punmia: “Surveying Volume II”, (Chapters 1-4,6,7,15), Lakshmi Publications Pvt. Ltd., 6<sup>th</sup> Edition, 2005, ISBN: 978-81-700-8853-0.

**Reference Books:**

1. C Venkatramaiah: “ Text Book of Surveying”, (Chapters 1-5,7-10,11,12), Universities Press (India) Pvt. Ltd., 5<sup>th</sup> Edition, 1996, ISBN: 9788187433545.
2. S.K. Roy: “Fundamentals of Surveying”, (Chapters 1,3,19), Prentice-Hall Of India Pvt. Limited, 2004, 2<sup>nd</sup> Edition, ISBN: 81-20-312-60-0.

**E-Resources:**

1. [http://lib.uniten.edu.my/libsite/index.php?option=com\\_joomdandview=iteman dlayout=detailandtypeid=2andid=202andItemid=790](http://lib.uniten.edu.my/libsite/index.php?option=com_joomdandview=iteman dlayout=detailandtypeid=2andid=202andItemid=790)
2. <http://ascelibrary.org/journal/jsued2>
3. [www.survivorlibrary.com/engineers\\_surveying\\_instruments\\_1892.pdf](http://www.survivorlibrary.com/engineers_surveying_instruments_1892.pdf)



## Engineering Geology (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVI35	3:0:2:0	4	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Understand the principles of engineering Geology.
- Analyse Earth resources and their properties, Earth processes and natural hazards.
- Identify Earth's structures and their impact on engineering construction.

### Syllabus

#### Module - I

**Introduction:** Geology and its role in the field of civil engineering. Earth: Its internal structure and composition.

**Geodynamics:** Earthquakes- seismic waves, seismograph, causes, effects, seismic zones, shield areas and seismic resisting structures. Coastal zones, coastal landforms, continental shelf, continental rise, continental slope, abyssal plain, mid-oceanic ridges, trenches, tsunamis. Land slides: causes, effects and remedial measures.

**Mineralogy:** Description and identification of Rock forming minerals and Ores, based on physical and special properties Quartz and its varieties; Feldspar group Mica group, carbonate group, Hornblende, Olivine, Asbestos, Talc, Gypsum, Garnet, Corundum. Magnetite, Hematite, Limonite, Pyrite, Chalcopyrite, Pyrolusite, Psilomalane, Chromite, Galena, Bauxite.

**08 Hours**

#### Module - II

**Petrology:** Rocks as fundamental units and building materials of the earth crust and their engineering applications: As building stones, road metals and stones for decoration, pavement, cladding, roofing, flooring, concreting and foundation engineering.

**Igneous Rocks:** Origin, classification (chemical and textural), mode of occurrence; Identification and description of Granite, Syenite, Diorite, Gabbro, Dunite, Pegmatite, Porphyries, Dolerite, Rhyolite, Basalt and Pumice.

**Sedimentary Rocks:** Origin, classification, primary structures and description of Sandstones, Conglomerate, Breccia, Shale, Limestones and Laterite.

**Metamorphic Rocks:** Kinds of metamorphism, description of Gneiss, Quartzite, Marble, Slate, Phyllite and Schists.

**08 Hours**

**Module - III**

**Geomorphology:** Epigene and Hypgene geological agents; rock weathering and its types; Soil formation, types, erosion and remedial measures, Geological action of rivers with different drainage patterns; Geological action of wind. **08 Hours**

**Module - IV**

**Rock Mechanics And Engineering Geology:** Stress, strain and deformational effects on different rocks, Out crop, Dip, strike and escarpment, Clinometer-compass-Joints, faults, folds and unconformities their effects on civil engineering structures. Geotechnical investigations for civil engineering projects: Study of toposheets and geological maps, importance of lithological and structural features studies for the construction of Dams, Reservoirs, Tunnels, Bridges and Highways. **08 Hours**

**Module - V**

**Hydro-geology:** Hydrological cycle, distribution of ground water in the earth crust, properties of water bearing geological formation: Aquifers and their types, selection of sites for well locations and spacing of wells, geological, hydrological and geophysical (electrical resistivity) investigations for ground water exploration; artificial recharge of groundwater methods and rain water harvesting. Sea water intrusion and remedial. **08 Hours**

Lab Session	Topic for a session (3 hrs)	Tests/Assignments/Tutorials
1	Minerals and rocks differentiation, Classification of minerals in to different groups, Physical properties of minerals, Minerals identification- quartz group and its varieties.	Mineral identification Chart preparation
2	Minerals identification- rock forming minerals- feldspars, micas, pyroxenes, amphiboles, carbonates, sulphate groups, garnet group, kaoline and talc, olivine group, corundum, other silicates.	Record sheets
3	Minerals identification- ore minerals: iron ores, chromium ores, aluminum ore, mn ores, sulphide group	Minerals record Rocks identification Chart preparation

4	Rocks – textures and structures, classification into igneous, sedimentary and metamorphic; and subgroups, identification of individual rocks. Igneous rocks: granite, syenite, diorite, gabbro, dunite, porphyries, dolerite, pegmatite, basalt, rhyolite and pumice	Rocks and minerals Record preparation
5	Sedimentary rocks: sandstone, limestone, shale, breccia, conglomerate and laterite	Record sheets
6	Metamorphic rocks: gneiss, quartzite, marble, slate, phyllite, schists and charnockite	Record sheets Rock identification Record sheets- final
7	Maps – introduction, profiling, interpretation. Contour maps – simple, profile, interpretation	Maps and Record sheets
8	Geological maps- horizontal beds, profile and interpretations	Maps and Record sheets
9	Geological maps – inclined beds, fold, unconformity	Maps and Record sheets
10	Maps- faulted, and complicated	Maps and Record sheets
11	Preparation of drainage map using topographic sheet.	Choice practical
12	Evaluation by test (model lab test)	Mse (evaluation)
13	Dip and strike problems	Problems
14	Dip and strike problems	Problems
15	Bore hole problems	Problems

### Course Outcomes:

On completion of this course, the students are able to :

- Describe earth and its internal structure.
- Explain Earth processes and its effect on engineering construction.
- Identify and estimate natural resources.
- Recognize good building materials and their properties.



**Text Books:**

1. Parbin Singh: "Text of Engineering and General Geology", (Chapters 1-4,6,7,9,12-14,17-25), S. K. Kataria and Sons, New Delhi, 8<sup>th</sup> Revised Edition, 2012, ISBN: 9788188458516.
2. Chenna Kesavulu: "A text book of Engineering Geology", (Chapters 2-10,12-14, 17-19), Mac Millan India Ltd., 2<sup>nd</sup> Edition, 2009, ISBN:9780230638709.
3. G.B Mahapatra: "A text book of geology", (Chapters 1-3,5,6,11,12,14,20-23,25,26), CBS Publishers, 1<sup>st</sup> Edition, 1987, ISBN: 9788123900131.
4. Dimitri P. Krynine and William R. Judd: "Principles of Engineering Geology and Geotechnics", (Chapters 1,2), ISBN : 9788123906034.

**Reference Books:**

1. M. P. Billings : "Structural Geology", (Chapters 3-5), Prentice Hall of India Pvt. Ltd., New Delhi, 3<sup>rd</sup> Edition, ISBN: 9780203894538.
2. Tony Waltham: "Foundations of Engineering Geology", (Chapters 1-5), CRC Uni-versities Press, 3<sup>rd</sup> Edition, ISBN: 9780415469609.

**E-Resources:**

1. <http://elearning.vtu.ac.in/elcmys/18/enotes/06CV834/Unit1and2-SKP.pdf>
2. <http://elearning.vtu.ac.in/elcmys/P5/enotes/CV/S3-HSR.pdf>
3. <http://elearning.vtu.ac.in/elcmys/P6/enotes/EE61/Unit1-8.pdf>
4. <http://www.srividyaaengg.ac.in/elearn1/coursematerial/Civil/103331.pdf>
5. <http://www.slideshare.net/gauravhtandon1/engineering-geology-unit-i>
6. [http://www.dphu.org/uploads/attachements/books/books\\_2752\\_0.pdf](http://www.dphu.org/uploads/attachements/books/books_2752_0.pdf)
7. <http://nptel.ac.in/courses/105105106/>



## Ecology and Environmental Impact Assessment

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT361	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FE

### Course Objectives:

The students will be able to :

- Differentiate ecological factors influencing environment.
- Understand the framework of Impact Assessment and various developing projects.
- Assess the Impact prediction on various features like air and water.
- Identify the public Interest in Environmental decision making.
- Differentiate salient Features of various project activity.

### Syllabus

#### Module - I

**Ecology:** Development and evolution of ecosystems – Principles and concepts, Classification of Ecosystems, Structure and Function of Ecosystems, Energy flow in Ecosystems, Ecological Niche and succession, Bio-geo-chemical cycles, Ecological Pyramids.

**Aquatic and Terrestrial Ecosystems:** Diversity and dominance Indices, Ecosystem Models.

**Lake Ecosystem:** Trophic levels, nutrient loading, nutrient enrichment, Leibig's Law, control of eutrophication.

**08 Hours**

#### Module - II

**Environmental Impact Assessment:** Definition, Objectives, Development Activity and Ecological Factors EIA. Types – Rapid and Comprehensive EIA, EIS, FONSI. Step-by-step procedure for conducting EIA and Limitations of EIA, Prevention of Significant Deterioration (PSD) Programme. Carrying capacity concept.

**08 Hours**

#### Module - III

**Frame work of Impact assessment:** Scope and contents of EIA, methodologies and techniques of EIA. Frame work of Impact Assessment. Development Projects-Environmental Setting, Objectives and Scope, Contents of EIA.

**Prediction and Assessment:** Assessment and Prediction of Impacts on Attributes Air, Water, Noise, Land Ecology, Soil, Cultural and Socio-economic Environment. EIA guidelines for Development Projects, Rapid and Comprehensive EIA.

**08 Hours**

### Module - IV

**Guidelines for Development:** EIA guidelines for Development Projects, Rapid and Comprehensive EIA. Public Participation in Environmental Decision making. Practical Considerations in preparing Environmental Impact Assessment and Statements. Salient Features of the Project Activity-Environmental Parameter Activity Relationships- Matrices. **08 Hours**

### Module - V

**EIA On Projects:** EIA for Water resource developmental projects, Highway projects: Nuclear-Power plant projects, Mining project (Coal, Iron ore), Thermal Power Plant, Infrastructure Construction Activities. Case studies with present scenario. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Identify various ecological components influencing environment.
- Distinguish different methodologies, outlook of Impact assessment and development of many projects.
- Predict the impact of many components on environment.
- Assess the Public Interest in Environmental Decisions.
- Examine important features of different project activities.

### Text Books:

1. Jain R.K., L.V. Urban: "Environmental Impact Analysis", (Chapters 1-3), Nostrand Reinhold Co., ISBN: 9780071370080.
2. Anjaneyalu. Y, Valli Manickam: "Environment Impact Assessment," (Chapters 1-5,6-9,11), CRC Press, 2011, ISBN: 9780415665568.

### Reference Books:

1. Guidelines for EIA of developmental Projects Ministry of Environment and Forests, GOI.
2. Larry W. Canter: "Environment Impact Assessment", McGrawHill Publication.
3. Kormondy: "Concepts of Ecology", Prentice Hall Publication, New Jersey.
4. Odum: "Fundamentals of Ecology", Adisson Co.

### E-Resources:

1. [https://en.wikipedia.org/wiki/Environmental\\_impact\\_assessment](https://en.wikipedia.org/wiki/Environmental_impact_assessment)
2. <https://scholar.google.co.in/scholar>.
3. <https://www.epa.gov/international-cooperation/technical-review-guidelines-environmental-impact-assessments-tourism>.
4. <https://www.nptel.ac.in/courses/120108004>

## Rural Water Supply and Sanitation

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT362	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FE

### Course Objectives:

The students will be able to :

- Understand the water sources, drinking water quality standards and water borne diseases.
- Learn Water treatment methods and measures to control the contamination of water.
- Understand the usage of pumps.
- Distinguish the collection and disposal systems.
- Study the principles of rural sanitation and rain water harvesting.

### Syllabus

#### Module - I

**Rural Water Supply:** Introduction: Need for a protected water supply, Investigation and selection of water sources, water borne diseases, Protection of well waters, drinking water quality standards. **08 Hours**

#### Module - II

**Types of Pumps:** Supply systems viz., BWS, MWS, PWS, water treatment methods- disinfection, deflouridation, hardness and iron removal, ground water contamination and removal. **08 Hours**

#### Module - III

**Rural Sanitation:** Conservancy, public latrine, concept of eco-sanitation, trenching and composing methods, two pit latrines, aqua privy, W.C, septic tank, soak pit.

**Drainage Systems:** Storm water and sullage disposal, rain water harvesting and uses. **08 Hours**

#### Module - IV

**Communicable diseases:** Terminology, Classifications, Methods of communication, general methods of Control Refuse Collection and disposal: Garbage, ash, rubbish, collection methods, transportation and disposal-salvaging, dumping, controlled tipping, incineration and composting, dung disposal-digester, biogas plant. **08 Hours**

#### Module - V

**Milk Sanitation:** Essentials, Test for milk quality, pasteurization, quality control, cattle borne diseases, planning for a cow shed.

**Insect Control:** House fly and mosquito-life cycle, diseases, transmission and control measures.

**08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Identify and select water supply systems in rural areas.
- Distinguish between urban and rural water supply systems.
- Categorize the different types of water borne and communicable diseases and apply the principles of rain water harvesting.
- Explain overall management of rural water supply and other components like milk sanitation.
- Examine overall management of solid waste collection, disposal and other components like composting of waste to energy.

### Text Books:

1. S. K Garg: "Water Supply Engineering," (Chapters 1-3), Khanna Publishers, Delhi, 26<sup>th</sup> Edition, 2012, ISBN: 978-8174091208.
2. E.William: "Steel, Water Supply and Sewerage", (Chapters 4,5), McGraw-Hill Publishers, Delhi, 28<sup>th</sup> Edition, 2011, ISBN: 978-0471523772.

### References Books:

1. K.Park: "Preventive and Social medicine", (Chapters 4,5), Bhanot Publishers, Jabalpur (M.P ,India), 2<sup>3rd</sup> Edition, 2015, ISBN: 978-9382219057.
2. Joseph. A. Solveto: "Environmental Engineering and Sanitation", (Chapters1-3), Wiley-Interscience Publishers, New Delhi, 4<sup>th</sup> Edition, 2012, ISBN: 978-0471523772.

### E-Resources:

1. <http://nptel.ac.in/courses/105105048/>
2. <http://nptel.ac.in/courses/105104102/>



## Solid Waste Management

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT363	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FE

### Course Objectives:

The students will be able to :

- Characterize the waste, apply the knowledge of laws for municipal solid waste management and disposal of biomedical wastes and plastic wastes.
- Apply the knowledge of mathematics, science, engineering for effective solid wastes collection systems, waste collection route optimization and processing of solid waste.
- Understand composting systems, maintenance and operation of aerobic and anaerobic composting processes for effective organic waste recycling.
- Know construction and operations of landfill facilities, energy recovery systems and management of leachate systems.

### Syllabus

#### Module - I

Definition of solid wastes, Land Pollution-scope and importance of solid waste management, functional elements of solid waste management.

**Sources:** Classification and characteristics of solid wastes, Municipal Solid Waste, Commercial and Industrial. Method of quantification. Biomedical Waste Handling Rules and Recycled Plastic usage Rules. **08 Hours**

#### Module - II

**Collection of solid waste:** Systems of collection of solid wastes, transfer stations-bailing and compacting, collection equipments, garbage chutes, route optimization techniques and numerical problems on route optimization.

**Incineration:** Incineration process- 3T's, factors affecting incineration process, incinerators-types, prevention of air pollution, pyrolysis, design criteria for incineration. **08 Hours**

#### Module - III

**Composting:** Composting, factors affecting composting process, aerobic and anaerobic composting, Indore and Bangalore method of composting, mechanical composting process, vermi-composting. **08 Hours**

#### Module - IV

**Landfills:** Sanitary land filling –Different types, trench method, area method, ramp method and pit method. Factors considered for a landfill site selection, Prevention of site pollution. Cell design, leachate collection systems, control of gas movement and gas recovery systems. Geo-synthetic fabrics in sanitary landfills. **08 Hours**

## Module - V

**Disposal Methods:** Open dumping-selection of site, ocean disposal, feeding to hogs, incineration, pyrolysis, composting, sanitary land filling, merits and demerits, plastic waste, Biomedical waste and its impact on Human health. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Explain Components of solid waste management and the laws governing it.
- Describe the solid waste collection systems, route optimization techniques and processing of solid wastes.
- Design, operation and maintenance of landfills and composting units.
- Discuss the importance and techniques of all major and minor methods of disposal considering plastic and biomedical waste.

### Text Books:

1. Howard S.Peavy et.al: “Environmental Engineering”, (Chapters 10-13), Mc-Graw-Hill Book Company, New York, 2012, ISBN: 978-0071002318.
2. George Tchobanoglous et.al.: “Integrated Solid Waste Management”, (Chapters 1-5), Mc-Graw-Hill Inc., New York, 2013, ISBN: 9780070632370.

### Reference Books:

1. K Sasikumar: “Solid Waste management”, (Chapters 1-4), PHI Learning Pvt. Limited, New Delhi, 1<sup>3th</sup> Edition, ISBN: 9788120338692.
2. S.K Garg: “Environmental Engineering (Vol II)”, (Chapters 9-12), Khanna Publishers, New Delhi, 2009, ISBN: 9788174092304.



## Basic Material Testing Laboratory

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVL37	1:0:2:0	2	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Apply the knowledge of Mathematics and Engineering in calculating the mechanical properties like tensile strength, compressive strength, bending strength, shear strength and hardness of metallic and non-metallic construction materials and test on bricks and tiles.

### Syllabus

1. Tests on Fine aggregates – Specific gravity, Sieve analysis and Bulking.
2. Tests on Coarse aggregates – Specific gravity and Sieve analysis.
3. Tension test on Mild steel bars.
4. Compression test on Cast iron.
5. Torsion test on Mild Steel circular sections.
6. Bending test on Wood Under two point loading.
7. Shear Test on Mild steel.
8. Impact test on Mild Steel (Charpy and Izod).
9. Hardness tests on ferrous and non-ferrous metals – Brinell's, Rockwell and Vicker's.
10. Test on Bricks and Tiles.

### Course Outcomes:

On completion of this course, the students are able to :

- Interpret basic knowledge of mathematics, science and engineering in finding the strength in tension, compression, shear and torsion.
- Identify and solve engineering problems of structural elements subjected to flexure.
- Decide the techniques, skills, and modern engineering tools necessary for engineering applications.

### Text Books:

1. Dr. B.C Punmia: "Mechanics of Materials Volume-I", (Chapters 1-3,7), Lakshmi Publications, 1<sup>st</sup> Edition, 2014, ISBN: 978-81-318-0646-3.
2. F. P. Beer and E. R. Johnston: "Vector Mechanics for Engineers – Volume I- Statics", (Chapters 1-5,7,9), Tata McGraw Hill, 9<sup>th</sup> Edition, 2011, ISBN: 0-07-058828-7.



**Reference Books:**

1. P. G. Varghese: "A Textbook Building Materials", (Chapters 1,3,19), PHI Learning Publication, 2<sup>nd</sup> Edition, 2015, ISBN: 81-203-2848-5.
2. Neville A. M and Brooks J. J: "Concrete Technology", (Chapters 1,2), ELBS Edition, London, 2<sup>nd</sup> Edition, 2010, ISBN: 978-81-317-0536-0.
3. M.G. Shah, C.M. Kale and S.Y. Patki: "Building Drawing", (Chapter 1), Tata McGraw Hill Education Pvt. Ltd., New Delhi, 5<sup>th</sup> Edition, 2012, ISBN: 0-07-463876-9.

**E-Resources:**

1. [www.eng.mu.edu/CEEN162-Lab1-S09-Sieve-SpecificGravity.pdf](http://www.eng.mu.edu/CEEN162-Lab1-S09-Sieve-SpecificGravity.pdf)
2. [www.reviewmylife.co.uk/blog/compression-of-cast-iron-experiment](http://www.reviewmylife.co.uk/blog/compression-of-cast-iron-experiment)
3. [www.madinpoly.com/pdf/1/CE-Material%20Testing%20Lab.pdf](http://www.madinpoly.com/pdf/1/CE-Material%20Testing%20Lab.pdf)
4. [www.santarosa.edu/~yataiia/E45/Bend%20Test%20of%20wood.pdf](http://www.santarosa.edu/~yataiia/E45/Bend%20Test%20of%20wood.pdf)



## Surveying Practice-I

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVL38	1:0:2:0	2	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Impart the practical knowledge and usage of different surveying instruments. Adopt different methods surveying.

### Syllabus

#### Exercise– 1

- To measure distance between two points using direct ranging.
- To set out perpendiculars at various points on given line using cross staff, optical square and tape.

#### Exercise – 2

Setting out of rectangle, hexagon using tape/chain and other accessories.

#### Exercise – 3

To set out rectangles, pentagon, hexagon, using tape /chain and compass.

#### Exercise – 4

To determine the distance between two inaccessible points using compass.

#### Exercise –5

To determine difference in elevation between two points using fly leveling technique and to conduct fly back leveling. Booking of levels using both HI and Rise and Fall methods.

#### Exercise – 6

To determine difference in elevation between two points using reciprocal leveling and to determine the collimation error.

#### Exercise – 7

To conduct profile leveling for water supply /sewage line and to draw the longitudinal section to determine the depth of cut and depth of filling for a given formation level.

### Demonstration

Minor instruments – Clinometer, Ceylon ghat tracer, Hand level, Box sextant, Planimeter and Pantagraph.

## Course Outcome

On completion of this course, the students are able to :

- Explain principles involved in different instruments used in surveying.
- Apply the concept of basic mathematics and its application in surveying.
- Develop skill to measure vertical distances using dumpy level.
- Determine ground profile by different methods of levelling.

## Text Books:

1. Dr B C Punmia: "Surveying Volume I", (Chapters 1-4,6,7,9-13,16,18,22), Lakshmi Publications Pvt. Ltd., 6<sup>th</sup> Edition, 2005, ISBN: 978-81-700-8853-0.
2. Dr B C Punmia: "Surveying Volume II", (Chapters 1-4,6,7,15), Lakshmi Publications, Pvt. Ltd., 6<sup>th</sup> Edition, 2005, ISBN: 978-81-700-8853-0.

## Reference Books:

1. C Venkatramaiah: "Text Book of Surveying", (Chapters 1-5,7-12), Universities Press (India) Pvt. Ltd., 5<sup>th</sup> Edition, 1996, ISBN: 978-81-700-8853-0.
2. S.K. Roy: "Fundamentals of Surveying", (Chapters 1,3,19), Prentice-Hall of India Pvt. Limited, 2004, 2<sup>nd</sup> Edition, ISBN: 81-20-312-60-0.

## E-Resources:

1. [http://lib.uniten.edu.my/libsite/index.php?option=com\\_joomdandview=itemandlayout=detailandtypeid=2andid=202andItemid=790](http://lib.uniten.edu.my/libsite/index.php?option=com_joomdandview=itemandlayout=detailandtypeid=2andid=202andItemid=790)
2. <http://ascelibrary.org/journal/jsued2>
3. [www.survivorlibrary.com/engineers\\_surveying\\_instruments\\_1892.pdf](http://www.survivorlibrary.com/engineers_surveying_instruments_1892.pdf)



## Integrated Rural Development – Part 1

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVH39	0:2:0:0	1	CIE:50 SEE:50	2 Hours	HSS

### Course Objectives:

This course will enable students to:

- Gain an awareness of the existing challenges in rural areas of India
- Develop the ability to communicate and interact with rural sections of our society
- Use and apply their academic knowledge to facilitate rural development and uplift via targeted initiatives and activities.

### Syllabus

#### Module - I

**Introduction:** Introduction to the course and its objectives; overview of typical challenges faced in villages; importance of integrating villages in mainstream society; relevance of course to nation building; division of students into groups; allotment of villages to student groups; assignment of mentors to student groups. **03 Hours**

#### Module - II

**Project Definition:** Visit of student groups to respective villages with assigned mentors; interacting with villagers and ice-breaking activities; identifying possible project topics with the help of mentor and supervisor; student group discussion to finalize the project definition; review of project definition with mentor and supervisor. **06 Hours**

#### Module - III

**Project Conceptualization and Planning:** Creation of plan to realize the project; review of plan with mentor and supervisor; assigning action items to students within the group; planning for needed logistics and infrastructure. **06 Hours**

#### Module - IV

**Project Realization:** Execution of the project plan (for example by conducting workshops); aggregation of project deliverables like survey reports, collected data, interviews, and questionnaires; recording of impact of the project on the village; periodical review of the project execution status as well as the project deliverables (like aggregated data and survey reports) with mentor and supervisor. **10 Hours**

## Module - V

**Project Reporting:** Creation of project report by the student groups detailing the motivation for the project, the approach, the work packages along with student assignments, the execution of the project, impact of the project, and lessons learned by the students during the project; creation of a slide-set to present the project report during the final exam; review by mentor and supervisor. **03 Hours**

### Course Outcomes:

On completion of this course, students will be able to:

- Develop the ability to interact and communicate with different sections of society, thus improving their communication skills.
- Understand the existing problems and needs of a village, thus developing an awareness of the challenges facing rural India.
- Conceptualize, plan, and realize measures to address these problems, thus improving their practical problem-solving and leadership skills.
- Make an impact to rural section of society, thus building their self-confidence.

### Text Books:

1. Bhagawan Sri Sathya Sai Baba: “Service to Village is Service to God”, Sri Sathya Sai Publications.

### Reference Books:

1. Bhagawan Sri Sathya Sai Baba: “Man Management: A Value-Based Management Perspective”, Sri Sathya Sai Publications.
2. Lt. Gen. M.L.Chibber: “Sai Baba’s Mahavakya on Leadership : Book for Youth, Parents and Teachers.”

### E-Resources:

1. <http://rural.nic.in/netrural/rural/index.aspx>
2. [www.annapoorna.org.in](http://www.annapoorna.org.in)



## Engineering Mathematics-IV (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVM41	3:0:2:0	4	CIE:50 SEE:50	3 Hours	BS

### Course Objectives:

This course will enable students to :

- Find differentiation, integration and solutions of differential equations using numerical methods.
- Develop the application of mathematical skills in solving statistics and probability problems using computers.
- Analyse of complex variable functions, Introduction of Statistical Software's.

### Syllabus

#### Module - I

**Numerical Methods-I:** Numerical Integration-Trapezoidal rule, Simpson's 1/3rd and 3/8th rule. Numerical solutions of ordinary differential equations of first order and first degree- Picard's method, Taylor's Series method, Modified Euler's Method, Runge-Kutta Method of 4th order and Milne's Predictor Corrector Method. **08 Hours**

#### Module - II

**Numerical Methods-II:** Numerical solutions of simultaneous first order ordinary differential equations: Picard's method and Runge- Kutta method of fourth order. Numerical solutions of second order ordinary differential equations: Picard's method and Runge-Kutta method of fourth order. Numerical solutions of partial differential equations:-One dimensional heat equation. one dimensional wave equation.

**08 Hours**

#### Module - III

**Complex variables:** Functions of a complex variable, derivative of complex functions. Analytic functions: Cauchy's-Riemann equations in Cartesian and polar forms (No problems by using limits), Harmonic functions, construction of analytic functions by using Milne-Thomson method. Cauchy Theorem, Cauchy's integral formula problems.

**08 Hours**

#### Module - IV

**Probability and Statistics:** Probability distributions: Poisson distribution, Poisson distribution is the limiting case of binomial distribution. Constants of Poisson distribution (no proof), Continuous random variable, Continuous probability distribution, Normal distribution ( no proof)-problems.

**Sampling and Inference:** Sampling distribution, testing of hypothesis, level of significance, confidence limits. Test of significance of large samples, sampling of variables, central limit theorem, confidence limits for unknown means, students t-distribution.

**08 Hours**

**Module - V**

Introduction to R, Basic Data types, vector operations, matrix construction, lists, data frames, Elementary statistics with R-Qualitative and Quantitative data, Numerical measures, probability distribution, interval estimation and simple linear regression.

**08 Hours**

<b>List of R-Lab Experiments</b>	
<b>Sl. No.</b>	<b>Name of the Experiment</b>
1	Introduction to R Software and basic commands
2	Demonstration and operations of Vectors
3	Operations of Matrices
4	Demonstration of Lists
5	Demonstration of Data Frames
6	Qualitative Data Analysis
7	Quantitative Data Analysis
8	Numerical Measures of Data
9	Probability Distribution
10	Linear Regressions

**Course Outcomes:**

On completion of this course, the students are able to :

- Determine the Differentiation, Integration using numerical methods.
- Solve Differential equations using numerical methods.
- Find the differentiation and integrals of complex functions.
- Find the probability using different distributions and analysis by using samplings.
- Use the statistical software's.

**Text Books:**

1. Dr. B.S. Grewal: "Higher Engineering Mathematics", (Chapters 20,26,27,30,32,33), Khanna Publishers, New Delhi, 42<sup>nd</sup> Edition, 2012, ISBN: 9788174091956.
2. N.P. Bali and Dr. Manish Goyal, "A Text Book of Engineering Mathematics", (Chapters : 19,21,22,24,25), Laxmi Publications (P) Ltd., New Delhi, 9<sup>th</sup> Edition, 2014, ISBN: 9788131808320.
3. W.N.Venables, D.M.Smith: "An introduction to R".

**Reference Books:**

1. Erwin Kreyszig: “Advanced Engineering Mathematics”, (Chapters 13, 14,19,21,24,25), Wiley Pvt. Ltd., India, New Delhi, 9<sup>th</sup> Edition, 2011, ISBN 13: 9788126531356.
2. B.V. Ramana: “Higher Engineering Mathematics”, (Chapters 22,23,27-29,32,33), Tata McGraw – Hill Publishing Company Limited, New Delhi, 2<sup>nd</sup> Reprint, 2007, ISBN 13: 978-0-07063417-0.
3. S.S.Sastry: “Introductory methods of numerical analysis”, (Chapters 6,8,9), PHI Learning Private Ltd., Delhi, 5<sup>th</sup> Edition, 2013, ISBN: 978-81-203-4592-8.
5. John Verzani: “Using R for introductory Statistics”, Champan and Hall/ CRC, New York, Washington D.C., ISBN: 978-1-59327-384-2.

**E-Resources:**

1. <http://www.zums.ac.ir/ebooks/mathematics/essential-engineering-mathematic>.ic.
2. <https://archive.org/details/AdvancedEngineeringMathematics10thEdition>
3. <https://www.r-project.org/>





## Fluid Mechanics

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT42	4:0:0:0	4	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Understand the basic concepts of fluid mechanics, its classification and their applications in engineering.
- Acquire the knowledge to solve the problems related to fluid-statics and fluid-dynamics.
- Differentiate types of flow through pipes, losses and flow measurements.
- Understand the concept of uniform and non uniform flow in open channels.
- Explain the working principle, efficiency and performance of centrifugal pumps and Hydraulic turbines.

### Syllabus

#### Module - I

##### Fluid Properties and Fluid Pressure:

**Basic properties of fluid:** Introduction, Definition of Fluid, properties of fluid with units: Mass density, Specific weight, Specific gravity, Specific volume, Viscosity, Surface tension. Newton's law of viscosity (theory and problems).

**Pressure and its Measurement:** Definition of pressure, Pressure at a point, Pascal's law. Types of pressure. Vapour pressure. Measurement of pressure using simple, differential manometers (theory and problems). **10 Hours**

#### Module - II

**Hydrostatic Pressure on Surfaces:** Introduction, Definitions Total pressure and Centre of pressure, equations for hydrostatic force and depth of centre of pressure for Vertical and inclined submerged plane -Problems.

**Kinematics and Dynamics of Fluid Flow:** Introductions, methods of describing fluid motion, definitions of types of fluid flow, streamline, path line. Three dimensional continuity equation in Cartesian Coordinates (derivation and problems). Bernoulli's equation using Euler's equation of motion with assumptions and limitations (Problems). **10 Hours**

#### Module - III

**Pipe Flow:** Introduction, Major and minor losses in pipe flow, Darcy-Weisbach equation for head loss due to friction in a pipe. Pipes in series, pipes in parallel -problems. ( Theory and Problems).

**Discharge Measurements:** Introduction, Venturimeter, Orificemeter, Triangular notch, Rectangular notch, Cipolletti notch, Ogee weir and Broad crested weir, Small orifices- Problems. **10 Hours**

### Module - IV

#### Open Channels Flow:

**Uniform Flow:** Introduction, Geometric properties of Rectangular, Trapezoidal and Circular channels. Chezy's equation, Manning's equation-problems. Most economical open channels for rectangular, trapezoidal - problems.

**Non- Uniform Flow:** Introduction to Non-Uniform flow, Specific energy, Specific energy diagram, Conditions for Critical flow- Theory and problems. Hydraulic jump in a Horizontal Rectangular Channel- Theory and problems. **10 Hours**

### Module - V

**Centrifugal Pumps:** Introduction, Classification, Priming, methods of priming. Heads and Efficiencies. Equation for work done, minimum starting speed. Multistage Centrifugal Pumps (Pumps in Series and Pumps in parallel). Characteristic Curves for a Single stage Centrifugal Pumps- problems.

**Turbines:** Introduction, Classification of Turbines. Layout of hydroelectric Power plant

**Pelton wheel:** Components and working principle. Maximum power, Efficiency, working proportions- problems.

**Francis Turbines:** Components and working principle. Draft Tube: Types, Efficiency of Draft tube and problems. **10 Hours**

#### Course Outcomes:

On completion of this course, the students are able to :

- Describe the scope and importance of Fluid Mechanics. Learn types of fluid and properties of fluids, viscosity and its application. Analyze problems related to fluid pressure measurements.
- Identify the various forces acting on a fluid motion and the relation between pressure and velocity in a flow. Use principles of mathematics to represent kinematic concepts related to fluid flow.
- Analyse the flow mechanism in pipes along with various losses and their estimation with simple design of pipes.
- Distinguish between the concept of flow in open channels for uniform flow and Non-uniform Flow and concept of economical flow.
- Identify the pump required for different purposes and classify the turbines and explain design criteria.

**Text Books:**

1. R. K. Bansal: "Text Book on Fluid mechanics and Hydraulic Machines", (Chapters 1-8), Laxmi Publications, 9<sup>th</sup> Edition, 2015, ISBN: 9788131808153.
2. R.K.Rajput: "A Textbook of Fluid mechanics and Hydraulic Machines", (Chapters 1-3,5,6,8,9,12,16), S.Chand and Co., New Delhi, 2006, ISBN: 9788121916677.
3. P.N.Modi, S.N.Seth: "Hydraulics and Fluid Mechanics", (Chapters 1-3, 6,8-11,14-16), Standard Book House, New Delhi, 20<sup>th</sup> Edition, 2015, ISBN: 978-81-89401-26-9.

**Reference Books:**

1. Madan Mohan Das: "Fluid Mechanics and Turbo machines", (Chapters 1-3, 5-10,18,19), PHI Learning Pvt. Limited, New Delhi, 2009, ISBN: 97881203-3523-3.
2. N. Narayana Pillai: "Principles of Fluid Mechanics and Fluid Machines", (Chapters 1-3,9,10,15-17), Universities Press (India), Hyderabad, 2009, ISBN: 978-8173716751.

**E-Resources:**

1. <http://nptel.ac.in/courses/105101082/>
2. <http://elearning.vtu.ac.in/10CV35.html>
3. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=112106185>



## Structural Analysis-I

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT43	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Understand the concept of different structural systems.
- Learn the analysis of arches and cables.
- Analyze the trusses and beams by different methods.

### Syllabus

#### Module - I

**Introduction:** Forms of structures, Conditions of equilibrium, Degree of freedom, one, two and three dimensional structural systems, Determinate and indeterminate structures, Degree of Indeterminacy.

**Analysis of trusses:** Method of joints and Method of sections. **08 Hours**

#### Module - II

**Arches and Cables:** Three hinged parabolic arches - Determination of Radial shear, normal thrust and bending moment. Two hinged parabolic arches, Analysis of cables under point load and UDL. **08 Hours**

#### Module - III

**Deflection:** Moment area method and Conjugate beam method applied for beams. **08 Hours**

#### Module - IV

**Deflection:** Strain energy method applied to beams and trusses. **08 Hours**

#### Module - V

**Analysis of beams:** Fixed beams, Clapeyron's theorem of three moments for continuous beams with different end conditions. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Identify different structural systems.
- Analyze the trusses by different methods.
- Determine forces and moments in arches and cables under different loading conditions.
- Compute the deflection of structural elements by different methods.
- Determine support moments for beams under different support conditions.

**Text Books:**

1. S S Bhavikatti: "Structural Analysis - Vol. I", (Chapters 1,7,8,12), Vikas Publishing House, 4<sup>th</sup> Edition, 2009, ISBN: 9788125927907.
2. S Ramamrutham and R Narayan: "Theory of Structures", (Chapters 1,4,6,9), Dhanpat Rai Publishing Company Private Limited, New Delhi, 9<sup>th</sup> Edition, 2014, ISBN: 978-9384378103.

**Reference Books:**

1. V. N Vazirani: "Analysis Of Structures Vol. 1: Analysis, Design And Details Of Structures", (Chapters 1,6,9), International Student Edition, Mcgraw Hill Book Co., New York, 2008, ISBN: 978-8174091406.
2. Reddy C. S: "Basic Structural Analysis", (Chapters 1,6,8), Tata McGraw Hill, New Delhi, 3<sup>rd</sup> Edition, 2010, ISBN: 9780070702769.

**E-Resources:**

1. <http://elearning.vtu.ac.in/elcmys/13/enotes/eceem/gr.pdf>
2. [http://elearning.vtu.ac.in/elcmys/e-con/stru\\_ana/ch5/html/0004.htm](http://elearning.vtu.ac.in/elcmys/e-con/stru_ana/ch5/html/0004.htm)
3. [http://elearning.vtu.ac.in/elcmys/p2/cv42/Chapters\\_05/html/0004.htm](http://elearning.vtu.ac.in/elcmys/p2/cv42/Chapters_05/html/0004.htm)
4. <http://elearning.vtu.ac.in/elcmys/struana.html>



## Building Planning and Drawing (IC)

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVI44	3:0:2:0	4	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Understand the principles of planning and bylaws.
- Draw plan, elevation and section of residential buildings.
- Study the functional planning of Public Health Centre, School Building, College canteen etc.
- Prepare detailed working drawing for doors, windows, footing, steel truss, staircase etc.
- Understand building services for a residential building.

### Syllabus

#### Module - I

**Masonry:** Classification of Masonry, Definition of terms used in Masonry, introduction to classification and qualities of bricks, Bonds in Brick work - English Bond, Flemish Bond, Reinforced, Brick Masonry, Common building stones. **08 Hours**

#### Module - II

**Stairs, Doors and Windows:** Definition of technical terms, Requirements of ground stair, Types of Stairs, Geometrical design of RCC Dog legged and open well stairs. Location of doors and windows, Definition of technical terms, Types of Doors, Types of windows, Varieties of materials for doors and windows and their properties. **08 Hours**

#### Module - III

**Functional Design of Building:** Design of Residential, Public and Industrial, positioning of various components of buildings, orientation of buildings, building standards, bye laws, set back distances and calculation of carpet area, plinth area and floor area ratio. **08 Hours**

#### Module - IV

Development of plan, elevation, section and schedule of openings from the given line diagram of buildings using Auto CAD.

- |                            |                             |
|----------------------------|-----------------------------|
| i) Single storied building | iv) Primary school building |
| ii) Two storey building    | v) Primary health centre.   |
| iii) Office building       | <b>08 Hours</b>             |

## Module - V

For a given single line diagram, preparation of water supply, sanitary and electrical layouts. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Illustrate the knowledge of bonds in brick masonry.
- Recognize principles of planning using bylaws for buildings.
- Develop plan for Public Health Centre, School Building, College canteen.
- Draw plan, elevation and section for various residential buildings.
- Illustrate the knowledge of electrical, water supply and sanitary services for residential buildings.

### Text Books:

1. Shah M.H and Kale C.M: “Building Drawing”, (Chapters 1,2), Tata McGraw Hill Publishing Co. Ltd., New Delhi, 5<sup>th</sup> Edition, 2011, ISBN : 9780071077873.
2. Rangawala P C: “Engineering Materials (Material Science)”, (Chapters 3,4,8,9), Charotar Publishing House, India, 33<sup>rd</sup> Edition, 2015, ISBN: 978-93-85039-04-1.
3. P. G. Varghese: “A Textbook Building Materials”, (Chapters 1,3,19), PHI Learning Publication, 2<sup>nd</sup> Edition, 2015, ISBN: 81-203-2848-5.

### Reference Books:

1. Gurucharan Singh: “Building Construction”, (Chapters 1-4), Standard Publishers and distributors, New Delhi, 1st Edition, ISBN: 9788180140051.
2. National Building Code, BIS, New Delhi.

### E-Resources:

1. [http://bbmp.gov.in/documents/10180/504904/Zoning\\_Regulations\\_RMP2015f.pdf/0a916060-b198-4903-b7cd-d18db7096ebdhttp://moud.gov.in/model-building bye laws bbmp.](http://bbmp.gov.in/documents/10180/504904/Zoning_Regulations_RMP2015f.pdf/0a916060-b198-4903-b7cd-d18db7096ebdhttp://moud.gov.in/model-building%20by%20laws%20bbmp)
2. <https://www.jntubook.com/building-planning-drawing-textbook-free-download>
3. <http://www.avlib.in/ebook/title/building-drawing-by-shah-and-kale.html>
4. <http://pdfsu.com/book.php?q=Two%20Storey%20Autocad%20Building%20Drawing%20-%20clumagz.info>



## Elements of Construction Industry

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT451	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FE

### Course Objectives:

The students will be able to :

- Learn overview of Civil Engineering professional ethics.
- Understand the properties of common building materials.
- Understand the basic structural components and its application.
- Acquire knowledge of planning, execution, importance of the drawing.
- Understand the basics of total station, excavation for structures, formwork and concreting methods.

### Syllabus

#### Module - I

Overview of civil engineering, attributes of good civil engineer and professional ethics. **08 Hours**

#### Module - II

Building Materials (Aluminium/ Glass/ Timber/ Concrete/ Steel/ Stone/ Brick). **08 Hours**

#### Module - III

Basic Structural Components and Its Application ( Foundation / Column / Beam/ Slab/ Cables/ Arches/ Retaining Wall/ Corbels). **08 Hours**

#### Module - IV

PMC - Planning and Execution, Importance of the Drawing (Types of Drawing / Scale / Plan / Sections / Elevations / Blown Up Details / Notes / Fabrication Drawing / BBS). **08 Hours**

#### Module - V

Construction Technology (Formwork / Production of Concrete / Excavation).  
Surveying (Total Stations). **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Explain overview of Civil Engineering professional ethics.
- Understand significance of common building materials.



- Describe basic structural components and its application.
- Understand the basics of planning and execution, importance of the building drawing.
- Utilize basics of construction technology and total station surveying.

**Text Books:**

1. Rao M.N. and Rao H.V.N : “Air Pollution”, (Chapters 1-6), Tata-McGraw-Hill Publishing Company Ltd., New Delhi, India, 2011, ISBN 13: 978-0074518717.
2. Anjaneyulu Y: “Air Pollution and control Technologies”, (Chapters 2-5), Allied Publishers, Delhi, 2012, ISBN-13: 9788177641844.
3. Rao C.S: “Environmental Pollution Control Engineering”, (Chapters 2-6), New-age International Publishers, New Delhi, 2<sup>nd</sup> Edition, 2013, ISBN-13: 978-8122418354.

**References Books:**

1. Gilbert M Masters: “Introduction To Environmental Engineering and Science”, (Chapters 1-4), Pearson Education, 3<sup>rd</sup> Edition, 2007, ISBN-13: 978-0131481930.
2. Mahajan.S.P: “Pollution Control in Process Industries”, (Chapters 1-5), Tata Mc-Graw Hill Publishing Co., New Delhi, 2010, ISBN-13: 978-0074517727.

**E-Resources:**

1. <http://nptel.ac.in/courses/105102089/>
2. <http://nptel.ac.in/courses/105104099/>
3. [nptel.ac.in/courses/103107084/module1/lecture1/lecture1.pdf](http://nptel.ac.in/courses/103107084/module1/lecture1/lecture1.pdf)



## Alternative Building Material and Technology

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT452	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FE

### Course Objectives:

The students will be able to :

- Understand the concept of energy, environmental and cost effectiveness in buildings.
- Identify alternate materials and technology applied in construction.
- Understand the strength concepts in masonry structures.
- Recognize equipments required for manufacture of alternate building materials.

### Syllabus

#### Module - I

**Introduction:** Energy in building materials, Environmental issues concerned to building materials, Global warming and construction industry, Environmental friendly and cost effective building technologies, Requirements for building of different climatic regions, Traditional building methods and vernacular architecture.

**08 Hours**

#### Module - II

**Alternative Building Materials:** Characteristics of building blocks for walls, Stones and Laterite blocks, Bricks and hollow clay blocks, Concrete blocks, Stabilized blocks: Mud Blocks, Steam Cured Blocks, Fal-G Blocks and Stone Masonry Block.

**08 Hours**

#### Module - III

**Alternative Building Technologies:** Alternative for wall construction, Ferrocement and ferroconcrete building components, Composite beam panel roofs, Masonry vaults and domes, Alternative roofing systems, Filler slabs.

**08 Hours**

#### Module - IV

**Structural Masonry:** Compressive strength of masonry elements, Factors affecting compressive strength, Strength of units, prisms / wallettes and walls, Effect of brick work bond on strength, Bond strength of masonry : Flexure and shear, Elastic properties of masonry materials and masonry.

**08 Hours**

#### Module - V

**Equipment for Production of Alternative Materials:** Machines for manufacture of concrete, Equipments for production of stabilized blocks, Moulds and methods of production of precast elements.

**08 Hours**

**Course Outcomes:**

On completion of this course, the students are able to :

- Identify material properties (physical, structural) for most common and advanced building materials.
- Explain typical and potential applications of alternative building materials.
- Discuss relationship between material properties and structural form.
- Identify crucial problem areas in manufacture and applications of building materials.
- Evaluate the importance of experimental verification of material properties.

**Text Books:**

1. Alternative building methodologies for Engineers and architects, lecture notes edited: K.S. Jagadish and B.V. Venkatarama Reddy, (Chapters 1-12) Indian Institute of Science, Bangalore, published by Garland Science, Edition: 4<sup>th</sup> Edition, ISBN: 978-81-224-2037-1.
2. Arnold W. Hendry: "Structural Masonry", (Chapters 1-5), Palgrave Macmillan, 2<sup>nd</sup> Edition, ISBN: 9780333733097.

**Reference Books:**

1. Relevant IS Codes.
2. Alternative building materials and technologies.
3. Proceedings of workshop on Alternative building material and technology, 19<sup>th</sup> to 20<sup>th</sup> December 2003 @ BVB College of Engineering. and Tech., Hubli.

**E-Resources:**

1. <http://elearning.vtu.ac.in>
2. [www.hebel.arch.ethz.ch/alternative-building-materials](http://www.hebel.arch.ethz.ch/alternative-building-materials)
3. [https://en.wikipedia.org/wiki/Alternative\\_natural\\_materials](https://en.wikipedia.org/wiki/Alternative_natural_materials)



## Advanced Concrete Technology

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT453	3:0:0:0	3	CIE:50 SEE:50	3 Hours	FE

### Course Objectives:

The students will be able to :

- Understand the fundamentals of concrete structure at micro and macro levels.
- Visualize properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.
- Learn the various types of concrete and applications of different types of cement and concrete.

### Syllabus

#### Module - I

**Chemical Admixtures and Mineral Admixture:** Introduction, Mechanism of chemical admixture, Plasticizers and Super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, new generation Super Plasticiser, Fly ash, Silica fume, GGBS, and their effect on concrete property in fresh state and hardened state.

**08 Hours**

#### Module - II

**Mix Design:** Factors affecting mix design, design of concrete mix by BIS method using IS10262 and current American (ACI) methods. Provisions in revised IS10262-2004.

**08 Hours**

#### Module - III

**Durability of Concrete:** Introduction, Permeability of concrete, chemical attack, acid attack, efflorescence, Corrosion in concrete. Thermal conductivity, thermal diffusivity, specific heat. Alkali Aggregate Reaction, IS456-2000 requirement for durability, RMC Concrete - manufacture, transporting, placing, precautions, Methods of concreting- Pumping, under water concreting, shotcrete, High volume fly ash concrete concept, properties, typical mix.

**08 Hours**

#### Module - IV

**Self Compacting and Fiber Reinforced Concrete:** Introduction, materials, tests, properties, application and Typical mix, Fibers types and properties, Behavior of FRC in compression, tension including pre-cracking stage and post-cracking stages, behavior in flexure and shear, Ferro cement - materials, techniques of manufacture, properties and application.

**08 Hours**

## Module - V

**Light Weight Concrete and Test on Hardened Concrete:** Materials properties and types. Typical light weight concrete mix, High density concrete and high performance concrete-materials, properties and applications, typical mix, Effect of end condition of specimen, capping, H/D ratio, rate of loading, moisture condition. Compression, tension and flexure tests. Tests on composition of hardened concrete-cement content, original w/c ratio. NDT tests concepts-Rebound hammer, pulse velocity methods. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Recognize suitable admixtures to be used in different types of concrete.
- Design different grades of concrete.
- Discuss the importance of durability of concrete.
- Explain the basic knowledge of new emerging concretes.

### Text Books:

1. Neville, A.M: "Properties Of Concrete", (Chapters 5,10,12,14), Longman Ltd., London, 5<sup>th</sup> Edition, ISBN: 978-81-317-9107-3.
2. M.S. Shetty: "Concrete Technology, M.S. Shetty", (Chapters 5, 9, 11,12), S. Chand, 2005, ISBN: 8121900034, 9788121900034.

### Reference Books:

1. M L Gambhir: "Concrete Technology", (Chapters 5,6,10,14,15,16), The McGraw-Hill Companies, 3<sup>rd</sup> Edition, ISBN: 9780070583740.
2. John Newman: "Advanced Concrete Technology Processes", (Chapters 4,6,7), Ban Seng Choo, London, 1<sup>st</sup> Edition, ISBN: 9780750651035.

### E-Resources:

1. [www.atozcivilengineering.com](http://www.atozcivilengineering.com) › Education
2. [www.actemirates.ae](http://www.actemirates.ae)
3. [www.advconcrete.com/contact-us](http://www.advconcrete.com/contact-us)
4. [www.act-course.co.uk](http://www.act-course.co.uk)
5. [www.labour.gov.hk/eng/public/os/D/Constructionsite.pdf](http://www.labour.gov.hk/eng/public/os/D/Constructionsite.pdf)



## Renewable Energy Resources

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT461	3:0:0:0	3	CIE:50 SEE:50	3 Hours	EE

### Course Objectives:

The students will be able to :

- Provide detailed information of the present energy scenario and the available Renewable Energy Resources.
- Get a detailed insight knowledge in basics of solar radiation geometry and various measurement techniques.
- Understand the solar energy through solar thermal devices, PV conversion and their performance analysis.
- Gain the conceptual knowledge about the various energy conversion methods such as Wind, Tidal, OTEC and Geothermal.
- Understand the basics of energy from biomass, hydrogen energy and their impact on environment and sustainability.

### Syllabus

#### Module - I

**Introduction:** Energy source, India's production and reserves of commercial energy sources, need for non-conventional energy sources.

**Solar Radiation:** Extra-Terrestrial radiation, spectral distribution of extraterrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data.

**Measurement of Solar Radiation:** Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working. **09 Hours**

#### Module - II

**Solar Radiation Geometry:** Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation), local apparent time. Apparent motion of sun, day length, numerical examples.

**Radiation Flux on a Tilted Surface:** Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations), numerical examples.

**Solar Thermal Conversion:** Collection and storage, thermal collection devices, liquid flat plate collectors, solar air heaters concentrating collectors (cylindrical, parabolic, paraboloid) (Quantitative analysis). **09 Hours**

### Module - III

**Performance Analysis of Liquid Flat Plate Collectors:** General description, collector geometry, selective surface (qualitative discussion) basic energy-balance equation, stagnation temperature, transmissivity of the cover system, transmissivity – absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss coefficient, problems (all correlations to be provided). Temperature distribution between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow factor, mean plate temperature, instantaneous efficiency (all expressions to be provided). Effect of various parameters on the collector performance; collector orientation, selective surface, fluid inlet temperature, number covers dust. **09 Hours**

### Module - IV

**Photovoltaic Conversion:** Description, principle of working and characteristics, applications.

**Wind Energy:** Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind, machines and their characteristics, horizontal and vertical axis wind mills.

**Tidal Power:** Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.

**Ocean Thermal Energy Conversion:** Principle of working, Rankine cycle.

**Geothermal Energy Conversion:** Principle of working, types of geothermal station with schematic diagram. **08 Hours**

### Module - V

**Energy from Bio Mass:** Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with bio-gas production, application of bio-gas, application of bio-gas in engines, advantages.

**Hydrogen Energy:** Properties of Hydrogen with respected to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production bio-chemical production. **07 Hours**

### Course Outcomes:

Upon the completion of the course, the students will be able to,

- Explain the present energy scenario and the available Renewable Energy Resources.
- Describe the basics of solar radiation geometry and various measurement techniques.

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- Analyze the knowledge gained in tapping the solar energy through solar thermal devices, pv conversion and their performance analysis.
- Demonstrate the various energy conversion methods such as Wind, Tidal, OTEC and Geothermal.
- Apply knowledge of Biomass and Hydrogen energy and their impact on environment and sustainability.

### Text Books:

1. G D Rai: "Non-Conventional Energy Sources", (Chapters 1-3,6-9,11), Khanna Publishers, 5<sup>th</sup> Edition, 2011, ISBN-13: 9788174090737.
2. John Twidell and Tony Weir: "Renewable Energy Resources", (Chapters 2,5,6,7,9-14), Routledge Publisher, 3<sup>rd</sup> Edition, 2015, ISBN-13: 978041558437.
3. N K Bansal, "Non-Conventional Energy Resources", (Chapters 1-3,9,10,12,13), Vikas Publishing, 2014, 1<sup>st</sup> Edition, ISBN-13: 978935978577

### Reference Books:

1. B H Khan: "Non-Conventional Energy Resources", (Chapters 4-10), Tata McGraw-Hill Pub., 2<sup>nd</sup> Edition, 2006, ISBN - 13: 9780070142763.
2. S P Sukhatme, J K Nayak: "Solar Energy", (Chapters 3,4), Tata McGraw-Hill Pub., 3<sup>rd</sup> Edition, 2008, ISBN-13: 9780070260641.





## Environmental Air Pollution

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT462	3:0:0:0	3	CIE:50 SEE:50	3 Hours	EE

### Course Objectives:

This course will enable students to :

- Understand the fundamentals of air pollution with a background on historical perspective on air pollution and current air quality policies and standards.
- Acquire knowledge on major air pollutants, their sources and their effects (environmental, economic and health) and how emissions are estimated from road traffic and industrial sources.
- Identify the dispersion of air pollutants in the atmosphere and their emission control methods.
- Analyze and present the air quality models.
- Understand the principles of different air quality monitoring equipments.

### Syllabus

#### Module - I

**Introduction:** Definition – Classification and Characterization of Air Pollutants, Emission Sources, Behaviour and Fate of air pollutants, Chemical Reactions in the Atmosphere, Photo-chemical Smog, Coal-induced Smog.

**Effects of Air Pollution:** On Human Health, Animals, Plants and Materials – Major Environmental Air Pollution Episodes – London Smog, Los Angeles Smog and Bhopal Gas Tragedy. **08 Hours**

#### Module - II

**Meteorology:** Introduction – Meteorological Variables, Primary and Secondary Lapse Rate, Inversions, Stability Conditions, Windrose, General Characteristics of Stack Plumes, Meteorological Models. Factors to be considered in Industrial Plant Location and Planning, Noise pollution sources, measurement units, effects and control. **08 Hours**

#### Module - III

**Sampling, Analysis and Control:** Sampling and Measurement of Gaseous and Particulate matter, Stack Sampling, Analysis of Air Pollutants, Smoke and Smoke Measurement.

**Air Pollution Control Methods:** Particulate, Emission Control, Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers, Selection of a Particulate Collecting Equipment. **08 Hours**

### Module - IV

Control of Gaseous Emissions, Adsorption by Liquids, Adsorption by Solids, Combustion Odours and their control.

**Air Pollution due to Automobiles:** Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect Methods of control. **08 Hours**

### Module - V

**Burning Environmental Issues:** Acid Rain, Global Warming, Ozone Depletion in Stratosphere, Indoor Air Pollution.

**Environmental Legislation:** Environmental Policy, Environmental Acts, Water, Air and Noise Pollution Standards. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Examine emission standards for industrial and other sources.
- Identify air pollution concentrations as a function of emission, meteorology, topography and the built environment.
- Discuss impact of air pollution on health of humans, animals, plants and materials.
- Identify different equipments for air quality monitoring and control.
- Distinguish between global and local effects of air pollution.
- Recognize legal aspects of air pollution.

### Text Books:

1. Rao M.N. and Rao H.V.N : "Air Pollution", (Chapters 1-6), Tata-McGraw-Hill Publishing Company Ltd., New Delhi, India, 2011, ISBN 13: 978-0074518717.
2. Anjaneyulu Y: "Air Pollution and control Technologies", (Chapters 2-5), Allied Publishers, Delhi, 2012, ISBN-13: 9788177641844.
3. Rao C.S: "Environmental Pollution Control Engineering", (Chapters 2-6), Newage International Publishers, New Delhi, 2<sup>nd</sup> Edition, 2013, ISBN-13: 978-8122418354.

### References Books:

1. Gilbert M Masters: "Introduction To Environmental Engineering and Science", (Chapters 1-4), Pearson Education, 3<sup>rd</sup> Edition, 2007, ISBN-13: 978-0131481930.
2. Mahajan.S.P: "Pollution Control in Process Industries", (Chapters 1-5), Tata McGraw Hill Publishing Co., New Delhi, 2010, ISBN-13: 978-0074517727.

### E-Resources:

1. <http://nptel.ac.in/courses/105102089/>
2. <http://nptel.ac.in/courses/105104099/>
3. [nptel.ac.in/courses/103107084/module1/lecture1/lecture1.pdf](http://nptel.ac.in/courses/103107084/module1/lecture1/lecture1.pdf)



## Remote Sensing and GIS

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT463	3:0:0:0	3	CIE:50 SEE:50	3 Hours	EE

### Course Objectives:

The students will be able to :

- Understand the principles of Remote sensing and GIS.
- Analyze Remote sensing and GIS advantages in mapping.
- Identify the application of Remote sensing and GIS in the field of Civil engineering.

### Syllabus

#### Module - I

**Principles of Remote Sensing:** Introduction to remote sensing, Remote sensing system. Electromagnetic spectrum, Black body Atmospheric windows, Spectral characteristics of earth's surface, Range of sensing system. Active remote sensing. Passive Microwave Remote Sensing: Basics–physics of RADAR waves, spectral characteristics of RADAR waves, microwave radiometers, passive microwave scanners and sensors. **08 Hours**

#### Module - II

**Platforms, Sensors and Data Products:** Ground aircraft, space aircraft platforms-photographic sensors, scanners, radiometers, Radar and Mission planning. Data types and format, Scale and Legend. Introduction, platforms- Indian satellite IRS and Land sat specifications, Sensors-active and passive, MSS, AVHRR, LISS, TM, PAN, WIFS, microwave sensors, sensor resolutions (spatial, spectral, radiometric and temporal) Basic elements in Image interpretation. **08 Hours**

#### Module - III

**Geographic Information System:** Introduction, history of GIS, comparisons with CAD, Necessity of GIS, components of GIS, GIS Architecture-data input, data manipulation, data output, Operation-processes and capabilities, different types of GIS, GIS data-spatial and non spatial, data models with advantages and disadvantages. **08 Hours**

#### Module - IV

**Hyper-spectral Remote Sensing:** Hyper-spectral Imaging: Hyper spectral concepts, data collection systems, calibration techniques, data processing techniques; preprocessing, N dimensional scatter-plots, Special angle mapping, Spectral mixture analysis, Spectral Matching, Classification techniques, airborne and space-borne hyper-spectral sensors, applications. High-resolution hyper-spectral satellite systems: Sensors, orbit characteristics, description of satellite systems, data processing aspects, applications. **08 Hours**

## Module - V

Civil Engineering Applications of RS and GIS, Re-modelling of water Distribution systems using GIS, Ground water Vulnerability Modelling using GIS, Urban Development Planning using RS and GIS, Environmental Solid Waste and Degradation Assessment using RS and GIS, RS and GIS site selection for Dams, Bridges, Reservoirs. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Describe Remote sensing technology.
- Interpret GIS Maps.
- Explain about the remote sensing systems.
- Discuss application of RS and GIS for Civil engineering.

### Text books:

1. Lilles and T.M and R.W. Kiefer: "Remote sensing and image interpretation", (Chapters 1-8), 4<sup>th</sup> Edition, John Wiley and Sons, 2000, ISBN: 9780470052457.
2. Jensen J.R: "Introductory digital image processing, a remote sensing perspective", (Chapters 1-4), 2<sup>nd</sup> Edition Prentice Hall, 1996, ISBN: 9780132058407.
3. Richards J.A., and X. Jia: "Remote sensing digital image analysis: an introduction", (Chapters 1-3), 3<sup>rd</sup> Edition, Springer, 2006, ISBN: 9783540297116.
4. Mikhail E., J. Bethel, and J.C. McGlone: "Introduction to modern photogrammetry", (Chapters 5-9), Wiley, 2001, ISBN: 9780471309246.

### Reference Books:

1. Ravi P Gupta: "Remote sensing Geology", (Chapters 1-8), Springer Verlag, New York, ISBN: 9783662052839
2. Mather P.M.: "Computer processing of remotely-sensed images, an introduction", ISBN: 9781119956419.

### E-Resources:

1. <http://www.set.ait.ac.th/page.php?fol=rsgis&page=rsgis>
2. [http://geology.wlu.edu/harbor/geol260/lecture\\_notes/notes.html](http://geology.wlu.edu/harbor/geol260/lecture_notes/notes.html)
3. <http://www.rejinpaul.com/2014/10/vtu-civil-notes-vtu-civil-engineering-1st-2nd-3rd-4th-5th-6th-7th-8th-semester-lecture-notes-download-load.html>
4. <http://www.rejinpaul.com/2013/12/civil-2nd-4th-6th-8th-semester-notes-anna-university-civil-notes.html>

## Smart Materials

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVT464	3:0:0:0	3	CIE:50 SEE:50	3 Hours	EE

### Course Objectives:

The students will be able to :

- Understand the characteristics of composites and smart materials in the product design process.
- Know the types of sensing and actuation devices.
- Gain the knowledge of optics and electromagnetic technology.
- Study the importance of different control systems.
- Realize and understand the principles of vibration and modal analysis.

### Syllabus

#### Module - I

**Introduction:** Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics.

**Control Design:** Design of shape memory alloys, Types of MR fluids, Characteristics and application, principles of MR fluid valve designs, Magnetic circuit design, MR Dampers, Design issues. **09 Hours**

#### Module - II

**Sensing And Actuation:** Principles of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility with conventional and advanced materials, signal processing, principles and characterization. **08 Hours**

#### Module - III

**Structures:** Principles of drag and turbulence control through smart skins, applications in environment such as aerospace and transportation vehicles, manufacturing, repair and maintainability aspects.

**Optics And Electromagnetic:** Principles of optical fiber technology, characteristics of active and adaptive optical system and components, design and manufacturing principles. **09 Hours**

#### Module - IV

**Controls:** Principles of structural acoustic control, distributed, analog and digital feedback controls, Dimensional implications for structural control. **08 Hours**

## Module - V

**Principles of Vibration And Modal Analysis :** PZT Actuators, MEMS, Magnetic shape Memory Alloys, Characteristics and Applications.

**Information Processing:** Neural Network, Data Processing, Data Visualisation and Reliability – Principles and Application domains. **08 Hours**

### Course Outcomes:

On completion of this course, the students are able to :

- Explain the characteristics of composites and smart materials in the product design process.
- Identify various types of sensing and actuation devices.
- Analyze the optics and design structures using smart materials.
- Demonstrate the working principles of different control systems.
- Describe the principles of vibration and modal analysis.

### Text Books:

1. A V Srinivasan, D Michael Mcfarland: “Smart Structures: Analysis and De-sign”, (Chapters 2-5,7,8), Cambridge University Press, 1<sup>st</sup> Edition, 2001, ISBN-13: 9780521659772.
2. M V Gandhi, B S Thomson: “Smart Materials and Structures”, (Chapters 13-75), Chapman and Hall Pub., 1<sup>st</sup> Edition, 1992, ISBN-13: 9780412370106.

### Reference Books:

1. Eric Udd: “Fiber Optic Sensors: An introduction for Engineers and Scientists”, (Chapters 1-16), John Wiley and Sons Pub., 2<sup>nd</sup> Edition, 2011, ISBN-13: 9780470126844.
2. G P Gibss: “Adaptive Structres”, John Wiles and Sons, New York, 1998.
3. Banks HT, RC Smith, Y Wang, Massow S A: “Smart Materials and Structures”, Paris, 1996..



## Concrete Laboratory

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVL47	1:0:2:0	2	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Impart the basic knowledge of Concrete and its components.
- Link theory and practice about the usage of concrete effectively.
- Analyze data using experiments and to apply.
- Understand the basic construction material testing equipments.
- Solve problems on concrete mix design.

### Syllabus

#### Tests on Cement

1. Standard consistency.
2. Initial and Final setting time of cement.
3. Compressive strength of cement.
4. Fineness of cement.
5. Specific gravity of cement.
6. Soundness of cement.

#### Tests on Fresh Concrete

1. Workability of Concrete by Slump cone method.
2. Workability of Concrete by Compaction factor method.
3. Workability of Concrete by Vee-Bee Consistometer.

#### Tests on Hardened Concrete

1. Compressive strength of Concrete.
2. Split tensile strength of Concrete.
3. Flexural strength of Concrete.

#### Tests on Aggregates

1. Bulk density of sand.
2. Fineness Modulus of Coarse and Fine aggregates.
3. Water absorption of Coarse and Fine aggregates.
4. Specific gravity of Coarse and Fine aggregates.

## Concrete Mix Design

1. Concrete Mix Design as per IS:10262-2009.

### Bricks

1. Water absorption test on Bricks.
2. Compressive strength of Bricks.
3. Bonds in Brick Masonry.

### Course Outcomes:

On completion of this course, the students are able to :

- Identify the relevant physical properties pertaining to the construction materials.
- Identify the suitability of materials for the construction works.
- Recommend the relevant IS testing procedure to be carried out to ascertain the quality of building materials.
- Design a concrete mix as per IS:10262-2009.
- Recognize the construction technique to be followed in brick and stone masonry.

### Text Books:

1. Dr. M.L. Gambhir: "Concrete Manual", Dhanpat Rai and Sons, Delhi, 4<sup>th</sup> Edition, ISBN: 1234567144619.
2. TTTI Chandigarh: "Concrete Lab Manual", Indian Society of Technical Education, 6<sup>th</sup> Edition, ISBN -13: 9788122407570.
3. M.S.Shetty: "Concrete Technology, Theory and Practice", 23<sup>rd</sup> Edition, S. Chand and Company, ISBN 10: 8121900034 / ISBN 13: 9788121900034.

### E-Resources:

1. <http://elearning.vtu.ac.in>
2. [www.sginstitute.in/Downloads/Civil.../Manual\\_ConcreteTech](http://www.sginstitute.in/Downloads/Civil.../Manual_ConcreteTech)
3. [https://www.nbu.edu.sa/...Labs-Manual/02-%20CRT\\_Lab\\_safety\\_Manual](https://www.nbu.edu.sa/...Labs-Manual/02-%20CRT_Lab_safety_Manual)
4. <https://www.concrete.org/certification/certificationprograms.aspx>





## Surveying Practice-II

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVL48	1:0:2:0	2	CIE:50 SEE:50	3 Hours	FC

### Course Objectives:

The students will be able to :

- Impart the knowledge on theodolite.
- Set different curves using various methods in field.
- Use the total station and its applications in various fields of surveying.
- Utilize the basic concepts of GPS and its applications.

### Syllabus

#### Exercise – 1

Measurement of horizontal angles with method of repetition and reiteration using theodolite, Measurement of vertical angles using theodolite.

#### Exercise – 2

To set out simple curves using linear methods – perpendicular offsets from long chord and offsets from chords produced.

#### Exercise – 3

To set out simple curves using Rankine's deflection angles method.

#### Exercise – 4

To set out compound curve with angular methods with using theodolite only.

#### Exercise – 5

Exposure to use of total Station.

#### Exercise – 6

Traversing by total station.

#### Exercise – 7

Longitudinal sections, Cross section and Block levelling by total station.

#### Exercise – 8

Usages of relevant software for preparation of the contour drawings.

#### Exercise – 9

Co-ordinates and distance measurement with GPS.

**Course Outcomes:**

On completion of this course, the students are able to :

- Recognize the importance of theodolite in the field of surveying.
- Construct the simple curves using different linear methods.
- Illustrate the Concepts and Principles in setting out simple and compound curves.
- Illustrate the use of Total Station in the different fields of surveying.
- Compute the co-ordinates and to measure distances using GPS.

**Text Books:**

1. Dr B C Punmia: “Surveying Volume I”, (Chapters 1-4,6,7,9-13,16,18,22), Lakshmi Publications, Pvt. Ltd., 6<sup>th</sup> Edition, 2005, ISBN: 978-81-700-8853-0.
2. Dr B C Punmia: “Surveying Volume II”, (Chapters 1-4,6,7,15), Lakshmi Publications Pvt, Ltd., 6<sup>th</sup> Edition, 2005, ISBN: 978-81-700-8853-0.

**Reference Books:**

1. C Venkatramaiah: “Text Book of Surveying”, (Chapters 1-5,7-12), Universities Press (India) Pvt. Ltd., 5<sup>th</sup> Edition, 1996.
2. S.K. Roy: “Fundamentals of Surveying”, (Chapters 1,3,19), Prentice-Hall of India Pvt. Limited, 2004, 2<sup>nd</sup> Edition, ISBN: 81-20-312-60-0.

**E-Resources:**

1. [http://lib.uniten.edu.my/libsite/index.php?option=com\\_joomdandview=itemandlayout=detailandtypeid=2andid=202andItemid=790](http://lib.uniten.edu.my/libsite/index.php?option=com_joomdandview=itemandlayout=detailandtypeid=2andid=202andItemid=790)
2. <http://ascelibrary.org/journal/jsued2>
3. [www.survivorlibrary.com/engineers\\_surveying\\_instruments\\_1892.pdf](http://www.survivorlibrary.com/engineers_surveying_instruments_1892.pdf)



## Integrated Rural Development – Part 2

Course Code	L:T:P:S	Credits	Exam marks	Exam Duration	Course Type
17CVH49	0:2:0:0	1	CIE:50 SEE:50	2 Hours	HSS

### Course Objectives:

This course is an extension of the Integrated Rural Development course which was introduced in Semester 3. This course will extend the previous semester's work and will enable the students to:

- Continue working on the problems and challenges identified in the village.
- Apply their academic knowledge, talents, and abilities to come up with innovative and practical solutions to the challenges in the village.
- Foster a sense of entrepreneurship towards addressing the problems in the village.

### Syllabus

#### Module - I

**Overview:** Overview of the course; summary of the experiences from previous semester with assigned mentors and supervisors; discussion of the challenges faced in the village identified previously. **03 Hours**

#### Module - II

**Project Backlog Revision:** Revisiting the challenges already identified in the previous semester and identifying possible project topics with the help of mentor and supervisor (this can be either continuation of the previous semester's project with a larger scope or a new project); student group discussion to finalize the new project definition; review of project definition with mentor and supervisor. **06 Hours**

#### Module - III

**Project Plan Finalization:** Modification of the previous semester's project plan to accommodate the new objectives; review of new proposal and plan with mentor and supervisor to finalize plan of work; distribution of work and needed resources and logistics within the group. **06 Hours**

#### Module - IV

**Project Execution:** Execution of the project as per the plan; conducting surveys to evaluate the impact of the project execution; collection of project deliverables; periodical review of the project execution status and collected artifacts (like aggregated data and survey reports) with mentor and supervisor. **10 Hours**

## Module - V

**Project Presentation:** Creation of a final project report and a high-quality project presentation; both the project report and presentation should clearly articulate the motivation, how the project was conceptualized and executed, impact of the project, future directions in the project, and lessons learned by the students during the project; final review and evaluation by mentor and supervisor. **03 Hours**

### Course Outcomes:

On completion of this course, students will be able to:

- Further develop their social and communication skills by interacting with residents of the village and within their team.
- Conceptualize long term solution to challenges in villages, thus developing a sense of entrepreneurship.
- Make an impact to rural sections of society, thus building their self-confidence.

### Text Books:

1. Bhagawan Sri Sathya Sai Baba: "Service to Village is Service to God", Sri Sathya Sai Publications.

### Reference Books:

1. Bhagawan Sri Sathya Sai Baba: "Man Management: A Value-Based Management Perspective", Sri Sathya Sai Publications.
2. Lt. Gen. M.L.Chibber: "Sai Baba's Mahavakya on Leadership : Book for Youth, Parents and Teachers."

### E-Resources:

1. <http://rural.nic.in/netrural/rural/index.aspx>
2. [www.annapoorna.org.in](http://www.annapoorna.org.in)



## Program Educational Objectives (PEOs)

Civil engineering graduates are expected to fulfill the following PEOs after few years of their graduation.

PEO1	Graduates in Civil Engineering will apply the technical knowledge for sustainable societal growth.
PEO2	Graduates of civil Engineering will demonstrate designing, modeling and analyzing skills.
PEO3	Graduates in Civil Engineering will demonstrate good communication skills, dynamic leadership qualities with concern for environmental protection
PEO4	Civil Engineering graduates will be capable of pursuing higher studies, take up research and development work blended with ethics and human values.
PEO5	Civil engineering graduates will have the ability to become entrepreneurs thereby switching over from responsive engineering to creative engineering.

## Program Outcomes (POs)

PO1	<b>Engineering Knowledge:</b> Apply knowledge of mathematics and science, Engineering fundamentals and Civil Engineering principles to the solution of complex problems in Civil Engineering.
PO2	<b>Problem Analysis:</b> Identify, Formulate, review research literature and analyze complex Civil Engineering problems and reaching substantiated conclusions using first principles of mathematics and engineering sciences.
PO3	<b>Design/ Development of solutions:</b> Design solutions for complex Civil Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal and environmental considerations.
PO4	<b>Conduct Investigations of Complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions related to Civil Engineering problems

PO5	<b>Modern Tool Usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering tools such as CAD, FEM, GIS, etc. including prediction and modeling to complex Civil Engineering activities with an understanding of the limitations.
PO6	<b>The Engineer and Society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Civil Engineering practice.
PO7	<b>Environment and Sustainability:</b> Understand the impact of the professional Civil Engineering solutions in societal and environmental contexts and demonstrate the knowledge and the need for sustainable development.
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the Civil Engineering practice.
PO9	<b>Individual and Team Work:</b> Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
PO10	<b>Communication:</b> Communicate effectively on complex Civil Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	<b>Project Management and Finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage Civil Engineering projects and in multidisciplinary environments.
PO12	<b>Life-Long Learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.