University of Mumbai

Program Structure B.E. Civil Engineering. (Rev. 2016)

S. E. Civil Engineering (Semester-III)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEC301	Applied Mathematics-III	4	-	1	4	-	1	5
CEC302	Surveying-I	4	2	-	4	1	-	5
CEC303	Strength of Materials	4	2	-	4	1	-	5
CEC304	Engineering Geology	3	2	-	3	1	-	4
CEC305	Fluid Mechanics-1	3	2	-	3	1	-	4
Total		18	8	1	18	4	1	23

Course Code	Course Name	Examination Scheme							
		Theory					TW	Oral &Practical	Total
		Internal Assessment			End Sem.	Exam Duration			
		Test1	Test2	Avg.					
CEC301	Applied Mathematics-III	20	20	20	80	3	25	-	125
CEC302	Surveying-I	20	20	20	80	3	25	25	150
CEC303	Strength of Materials	20	20	20	80	3	25	25	150
CEC304	Engineering Geology	20	20	20	80	3	25	25	150
CEC305	Fluid Mechanics-1	20	20	20	80	3	25	25	150
Total									725

	Semester III	
Subject Code	**Subject Name**	**Credits**
CE-C 301	**Applied Mathematics-III**	**5**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**-**	**01**	**04**	**-**	**01**	**05**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**-**	**-**	**125**

Rationale

The course is aimed to develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering and technology.

Objectives

- To provide students with a sound foundation in the mathematical fundamentals necessary to formulate, solve and analyze engineering problems.
- To make the students understand the basic principles of Laplace Transform, Fourier series, Complex Variables and solving partial differential equations.

Details Syllabus			
Module	**Sub-Modules/ Contents**		**Periods**
I	**1. Laplace Transform**		**12**
	1.1	Function of bounded variation, Laplace Transform of standard functions such as 1, t^n, e^{at}, $\sin at$, $\cos at$, $\sinh at$, $\cosh at$	
	1.2	Linearity property of Laplace Transform, First Shifting property, Second Shifting property, Change of Scale property of L.T. (without proof) $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)du\right\}, L\left\{\frac{d^n f(t)}{dt^n}\right\}$ Laplace Transform of Periodic functions	

	1.3	Inverse Laplace Transform: Linearity property, use of theorems to find inverse Laplace Transform, Partial fractions method and convolution theorem (without proof).	
	1.4	Applications to solve initial and boundary value problems involving ordinary Differential equations with one dependent variable.	
II	**2. Complex variables**		**08**
	2.1	Functions of complex variable, Analytic function, necessary and sufficient conditions for to be analytic (without proof), Cauchy-Riemann equations in polar coordinates.	
	2.2	Milne-Thomson method to determine analytic function when it's real or imaginary or its combination is given. Harmonic function, orthogonal trajectories.	
	2.3	Mapping: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations such as Rotation and magnification, inversion and reflection, translation.	
III	**3. Complex Integration**		**08**
	3.1	Line integral of a function of a complex variable, Cauchy's theorem for analytic functions (without proof) Cauchy's integral formula (without proof) Singularities and poles:	
	3.2	Taylor's and Laurent's series development (without proof)	
	3.3	Residue at isolated singularity and its evaluation.	
	3.4	Residue theorem, application to evaluate real integral of type $\int_0^{2\pi} f(\cos\theta, \sin\theta)\, d\theta, \quad \& \quad \int_{-\infty}^{\infty} f(x)\, dx$	
IV	**4. Fourier Series**		**10**
	4.1	Orthogonal and orthonormal functions, Expressions of a function in a series of orthogonal functions. Dirichlet's conditions. Fourier series of periodic function with period $2\pi \ \& \ 2l$.	
	4.2	Dirichlet's theorem (only statement), even and odd functions, Half range sine and cosine series, Parsvel's identities (without proof)	
	4.3	Complex form of Fourier series.	
V	**5. Partial Differential Equations**		**09**
	5.1	Numerical Solution of Partial differential equations using Bender-Schmidt Explicit Method, Implicit method (Crank- Nicolson method).	
	5.2	Partial differential equations governing transverse vibrations of an elastic string its solution using Fourier series.	
	5.3	Heat equation, steady-state configuration for heat flow.	
	5.4	Two and Three dimensional Laplace equations.	

VI	**6. Principal Planes and Stresses**		**05**
	6.1	Correlation-Karl Pearson's coefficient of correlation- problems. Spearman's Rank correlation problems, Regression analysis- lines of regression (without proof) –problems	
	6.2	Curve Fitting: Curve fitting by the method of least squares- fitting of the curves of the form, $y = ax + b$, $y = ax^2 + bx + c$ and $y = ae^{bx}$.	
		Total	**52**

Contribution to Outcomes

- To use Laplace transform to solve ordinary differential equations.
- To apply concepts of complex variables and complex integration in the field of civil engineering.
- To analyze civil engineering problems applying concepts of Fourier series.
- To understand the Partial differential equations and apply the concept in their actual engineering subjects.
- To understand curve fitting and concept of correlation and regression.

Theory examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 is compulsory and based on entire syllabus.
4. Remaining questions will be mixed in nature (e.g. Suppose Q.2 has part (a) from module 02 then part (b) will be from any module other than module 02).
5. Weightage of marks should be proportional to number of hours assigned to each module. Questions out of remaining five questions.

Internal Assessment:

Class Test 1 for 20 marks in first 40% syllabus and class test 2 for 20 marks in next 40% syllabus. Test duration is one hour.

Term Work Examination:

Assignments (02) on entire syllabus 05 marks
Class Tutorials on entire syllabus (08) 15 marks
Attendance (Theory and Tutorial) 05 marks
Total: 25 marks

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University rules for practical.
2. Students must be encouraged to write assignments in tutorial class only. Each student has to complete at least 8 class tutorials on entire syllabus.

Recommended Books:

1. Elements of Applied mathematics, P N & J N Wartikar, Pune Vidyarthi Gruha Prakashan
2. Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication

3. Advanced Engineering Mathematics, E Kreyszig, Wiley Eastern Limited
4. Fundamentals of mathematical Statistics by S.C. Gupta and Kapoor

Reference Books:

1. Complex Variables: Churchill, Mc-Graw Hill
2. B.V. Ramana: "Higher Engineering M athematics" Tata McGraw-Hill, 2006.
3. Numerical Methods: Kandasamy

Semester III		
Subject Code	**Subject Name**	**Credits**
CE-C 302	**Surveying-I**	**5**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**02**	**-**	**04**	**01**	**-**	**05**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**25**	**-**	**150**

Rationale

Surveying is a core subject for civil engineers. It is the first step towards all civil engineering projects. A good surveyor is an asset to the company, organization or establishment. All the civil engineering projects such as buildings, transportation systems including roads, bridges, railways, airports along with dams and water/ sewage treatment plants start with surveying as the basic operations. Hence, the knowledge of surveying is very essential to all the civil engineering professionals. In this subject, the students get acquainted with the basic methods and instruments that are used in surveying and it helps them to produce plans and sections. It is also useful in setting out civil engineering structures on construction sites.

Objectives

On completion of the course, learners will be able to:

- Select appropriate methods of surveying based on accuracy and precision required, availability of resources, economics and duration of project.
- Appreciate the superiority and leverage of using modern methods in surveying over conventional ones.
- The successful completion of the course shall equip the learners to undertake the course of Surveying-II.

Details Syllabus			
Module	**Sub-Modules/ Contents**		**Periods**
`I	**Introduction**		**8**
	1.1	Definition, principles, objectives, classification, technical terms, uses and necessity of surveying. Units of measurement, surveying measurement and errors, type of errors and their corrections (including numericals), corrections for wrong scales, accuracy and precision, stages of survey operations	
	1.2	Chaining, Ranging and offsetting: Definitions, Principles, Types, Instruments required, methods, obstacles (including numericals), sources of errors, conventional signs and symbols.	
	1.3	Electronic Distance Measurement: Working Principles, types, applications in surveying	
II	**Measurement of Directions and Angles**		**10**
	2.1	Basic definitions, meridians, bearings, magnetic and true bearings, compasses, prismatic and surveyor's, temporary adjustments, declination, dip, local attraction	
	2.2	Types of traverse, procedures, control establishments, Conversion of WCB into RB and vice-versa, Traverse Survey and Computations of interior angles of a closed Traverse. Adjustment of closing error, correction for local attraction.	
III	**Levelling & its application**		**12**
	3.1	Introduction to levelling, basic terms and definitions, types of instruments, construction and use of dumpy level, auto level, digital level and laser level in construction industry, principle axes of dumpy level, temporary and permanent adjustments	
	3.2	Booking and reduction of levels, plane of collimation (HI) and rise-fall methods, computation of missing data, distance to the visible horizon, corrections due to curvature and refraction, reciprocal levelling, Numerical problems	
	3.3	Differential levelling, profile levelling, fly levelling, check levelling, precise levelling, sources of errors, difficulties in levelling work, corrections and precautions in levelling work.	
IV	**Plane Tabling& Contouring**		**4**
	4.1	**Plane Table Surveying:** Definition, principles, accessories required for plane table surveying, merits and demerits, temporary adjustments, Different	

		methods of plane table surveying, Errors in plane table surveying, Use of telescopic alidade	
	4.2	**Contouring**: definitions, contour interval, equivalent, uses and characteristics of contour lines, direct and indirect methods of contouring. Grade contour: definition and use.	
V	**Area & Volume**		**4**
	5.1	Area of an irregular figure by trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various coordinate methods. Planimeter: types including digital planimeter, area of zero circle, uses of planimeter.	
	5.2	Computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plans	
VI	**Theodolite Traversing**		**10**
	6.1	Various parts and axis of transit, technical terms, temporary and permanent adjustments of a transit, horizontal and vertical angles, methods of repetition and reiteration.	
	6.2	Different methods of running a theodolite traverse, Latitudes and departures, rectangular coordinates, traverse adjustments by Bowditch's, transit and modified transit rules, Gales Traverse Table, Numerical Problems	
	6.3	Use of theodolite for various works such as prolongation of a straight line, setting out an angle, bearing measurements. Omitted measurements, Problems in using theodolite traversing, errors in theodolite traversing; Trigonometrical Levelling: Problems on one plane and two plane methods,	
VII	**Tacheometric surveying**		**6**
	7.1	Principle, purpose, uses, advantages and suitability of tacheometry, different methods of tacheometry, stadia formula, Stadia diagram and tables. Subtense bar method	
	7.2	Application in plane table and curve setting.	
	7.3	Radial Contouring	

Contribution to Outcomes

On completion of the course, the learners will be able to:

- Apply principles of surveying and levelling for civil engineering works
- Measure vertical and horizontal plane, linear and angular dimensions to arrive at solutions to basic surveying problems.
- Record the data in field book and hence process it
- Perform various practicals and hence projects using different surveying instruments.

- Apply geometric principles for computing data and drawing plans and sections
- Analyze the obtained spatial data and compute areas and volumes.
- Represent3D data on plane surfaces(2D) as contours

Theory examination:

1. The question paper will comprise of six questions; each carrying 20 marks.
2. The first question will be compulsory and will have short questions having weightage of 4-5marks covering the entire syllabus.
3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. The students will have to attempt any three questions out of remaining five questions.
5. Total four questions need to be solved.

Oral Examination:

The oral examination shall be based on the entire syllabus and the term work. It will include a practical exam (10 marks) before proceeding for viva (15 marks)

List of Practicals:

1. Computing area of polygon by chaining, ranging and offsetting and verify distances by EDM
2. Measuring bearing of closed traverse using Prismatic/Surveyor's compass and computing included angle.
3. Simple and differential levelling using dumpy level
4. Transferring R.L from benchmark to new point by auto level/digital level with at least three change points and performing check levelling
5. Measurement of horizontal angle by Repetition and Reiteration Method using Vernier Transit theodolite.
6. To find the constants of a tachometer and to verify filed distances.
7. To find R.L and distances by tachometric surveying.
8. To find height of inaccessible tower using one plane and two plane methods using Vernier Transit theodolite.
9. Plane table surveying by various methods with at least four stations.
10. Determination of areas of irregular figures by conventional/digital planimeter

Term work:

It shall consist of the following:

Field book submission on afore-mentioned practical conducted on and off the field.

The account of practical performed with aim, apparatus, observations, calculations, results and inferences

The assignments shall comprise of the minimum 20 problems covering the entire syllabus divided properly module wise.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of laboratory and field work by the student, appropriate completion of the assignments.

10 marks shall be reserved for practical, 10 marks for assignments and 5 marks shall be reserved for attendance during lecture and practical hours.

Recommended Study Materials

(A) Recommended Books:

1. Surveying and Levelling: Vol-I and II: Kanetkar and Kulkarni, Pune VidyarthiGriha, Pune.
2. Surveying and Levelling: N N Basak, Tata McGraw Hill, New Delhi.
3. Surveying: R. Agor, Khanna Publishers.
4. Surveying: Vol-I: Dr K.R. Arora, Standard Book House.
5. Surveying and Levelling (2nd Edition): R. Subramanian; Oxford Higher Education.
6. Surveying and levelling (Vol.-I): Dr. B.C. Punmia, Laxmi Publications.
7. Surveying and Levelling (Vol.-I): S. K. Duggal, Tata Mc-Graw Hill
8. Textbook of Surveying, By C Venkatramaiah, University Press, Hyderabad, Latest Edition

(B) Web Materials:

1. http://nptel.ac.in/courses/105107122/

Semester III		
Subject Code	**Subject Name**	**Credits**
CE-C 303	**Strength of Materials**	**4**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**02**	**-**	**04**	**01**	**-**	**05**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**-**	**25**	**150**

Rationale

There are different types of structures made up of different materials such as concrete, steel, metals and timber. They are subjected to various types of loading/ forces such as axial, shear, bending and torsion. This subject equips the students to analyze the internal behavior of material of the structural members under different types of loading. The knowledge gained in this subject is helpful to study other subjects like Structural Analysis and Structural Design.

Objectives

- To study the engineering properties of the materials and solids and analyze the same to evaluate the stress-strain behavior.
- To analyze the internal forces for the statistically determinate and compound beams having internal hinges with different types of loading.
- To understand the concept and behavior of flexural members (beams) in flexure and shear, solid circular shaft for torsion, thin shells for internal stresses.
- To introduce the concept of strain energy for axial, flexure, shear and torsion.
- To study the behavior of axially loaded columns and struts using different theories available for the analysis with various end conditions.

	Detailed Syllabus		
Module	**Sub-Modules/ Contents**		**Periods**
I	**1. Simple Stresses and Strains**		**08**
	1.1	Stresses, Strains, Modulus of elasticity (E), Modulus of rigidity (G), Bulk Modulus (K), Yield Stresses, Ultimate Stress, Factor of safety, shear stress, Poisson's ratio.	

	1.2	Relationship between E, G and K, bars of varying sections, deformation due to self- weight, composite sections, temperature stress.	
II	**2. Shear Force and Bending Moment in Beams**		**06**
	2.1	Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading.	
	2.2	Relationship between rate of loading, shear force and bending moment.	
III	**3. Theory of Simple Bending**		**07**
	3.1	Moment of inertia, transfer theorem, polar moment of inertia	
	3.2	Flexure formula for straight beam, simple problems involving application of flexure formula, section modulus, moment of resistance, flitched beams.	
IV	**4. Strain Energy**		**03**
	Strain energy due to axial force, stresses in axial member and simple beams under impact loading.		
V	**5. Shear Stresses in Beams**		**06**
	Distribution of shear stress across plane sections commonly used for structural purposes.		
VI	**6. Theory of Simple Torsion**		**06**
	6.1	Torsion in circular shafts-solid and hallow, stresses in shaft when transmitting power	
	6.2	Concept of equivalent torsional and bending moment	
VII	**7. Direct and Bending Stresses**		**05**
	Application to member's subjected to eccentric loads, core of section, problems on chimneys, retaining walls, dams, etc. involving lateral loads.		
VIII	**8. Columns and Struts**		**04**
	Members subjected to axial loading, concept of buckling, Effective length, Euler's formula for columns and struts with different support conditions, Limitation of Euler's formula, Rankine's formula, Problems based on Euler's and Rankine's formulae.		
IX	**9. Principal Planes and Stresses**		**04**
	General equation for transformation of stress, principal planes and principal stresses, maximum shear stress, stress determination using Mohr's circle.		
X	**10. Thin Cylindrical and Spherical Shells**		**03**
	Thin Cylindrical and spherical shells under internal pressure.		
		Total	**52**

Contribution to Outcomes

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

- Understand and determine the engineering properties for metals and non-metals.

- Understand the concepts of shear force, bending moment, axial force for statically determinate beams and compound beams having internal hinges; and subsequently, its application to draw the shear force, bending moment and axial force diagrams.
- Analyze the flexural members for its structural behavior under the effect of flexure (bending), shear and torsion either independently or in combination thereof.
- Study the behavior of the structural member under the action of axial load, bending and twisting moment.
- Study the deformation behavior of axially loaded columns having different end conditions and further, evaluate the strength of such columns.

The successful completion of the course will equip the students for undertaking the courses dealing with the analysis and design of determinate and indeterminate structures.

Theory examination:

6. The question paper will comprise of **six** questions; each carrying 20 marks.
7. The **first** question will be **compulsory** and will have short questions having weightage of 4-5 marks covering the entire syllabus.
8. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
9. There can be an **internal** choice in various questions/ sub-questions in order to accommodate the questions on all the topics/ sub-topics.
10. The students will have to attempt **any three** questions out of remaining five questions.
11. Total **four** questions need to be solved.

Oral Examination:

The oral examination shall be based on the entire syllabus and the report of the experiments/ practicals conducted by the students including assignments.

List of Practicals:

1. Tension test on mild steel bars (stress-strain behavior, Young's modulus determination)
2. Tests on Tor Steel (Tension, bend and re-bend)
3. Transverse Test on cast iron.
4. Shear Test on mild steel, cast iron, and brass.
5. Torsion Test on mild steel and cast iron bar.
6. Brinell Hardness test (any three metal specimen)
7. Rockwell Hardness test on mild steel.
8. Izod / Charpy impact test (any three metal specimen)

Term Work:

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each modules/ sub-modules contents thereof further.

Distribution of Term-work Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on experiments assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Report of the Experiments: 10 Marks
- Assignments: 10 Marks
- Attendance: 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80%: 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Recommended Books:

1. Strength of Materials: *S. Ramamrutham*, Dhanpatrai Publishers.
2. Strength of Materials: *R.K. Rajput*, S. Chand Publications.
3. Mechanics of Materials: Vol-I: *S.B. Junnarkar and H.J. Shah*, Charotar Publications.
4. Strength of Materials: *Subramanian*, Oxford University Press
5. Strength of Materials: *S.S. Rattan*, Tata Mc-Graw Hill, New Delhi
6. Strength of Materials (Mechanics of Materials): *R.S. Lehri and A.S. Lehri*, S.K. Kataria Publishers, New Delhi
7. Strength of Materials: *Dr. V.L. Shah*, Structures Publications, Pune

Reference Books:

8. Mechanics of Materials: *James, M. and Barry J.*; Cengage Learning.
9. Mechanics of Materials: *Andrew Pytel and Jaan Kiusalaas*, Cengage Learning.
10. Mechanics of Materials: *Timoshenko and Gere*, Tata McGraw Hill, New Delhi.
11. Mechanics of Materials: *James M. Gere*, Books/Cole.
12. Strength of Materials: *G.H. Ryder*, Mc-Millan.
13. Mechanics of Materials: *E.P. Popov*, Prentice Hall India (PHI) Pvt. Ltd.
14. Mechanics of Materials: *Pytel and Singer*, Mc-Graw Hill, New Delhi.
15. Strength of Materials: *William A. Nash and Nillanjan Mallick*, Mc-Graw Hill Book Co. (Schaum's Outline Series)

Semester III		
Subject Code	**Subject Name**	**Credits**
CE-C 304	**Engineering Geology**	**4**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**02**	**-**	**03**	**01**	**-**	**04**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**-**	**25**	**150**

Rationale

Geology is the study of earth, the minerals and rocks of which it is made. The study of the structures presents in the rocks and the effects of the natural forces acting upon them is essential to understand by civil engineers because all work performed by them involves earth and its features. The study helps to understand the causes and prevention of many geological activities like earthquakes, landslides and volcano. For a civil engineering project like dams, bridges, buildings etc. to be successful the engineers must understand the foundation rock and their structures, it also helps them to examine rocks for important metals, oil, natural gas and ground water.

Objective

- To acquire basic knowledge of Geology and to understand its significance in various civil engineering projects.
- To study of 'Theory of Plate Tectonics' which helps to explain much of the global-scale geology including the formation of mountains, oceans, different landforms and the occurrence and distribution of earthquakes, volcanoes, landslides etc.
- To study minerals and rocks in detail in order to understand their origin, texture, structure and classification which is helpful to comment on suitability of rock type for any civil engineering project
- To study structural geology in order to understand deformational structures like fold, fault, joint, etc. and the forces responsible for their formation.
- To study 'Principles of Stratigraphy' and geological history of Deccan Volcanic Province with its economic importance.

- To study methods of surface and subsurface investigation, advantages and disadvantages caused due to geological conditions during the construction of dam and tunnel.
- To study ground water zones, factors controlling water bearing capacity of rocks, geological work of ground water and techniques of recharge of groundwater.

Detailed Syllabus			
Module	**Sub-Modules/Contents**		**Periods**
I	**1. Introduction**		**3**
	1.1	Branches of geology useful to civil engineering, Importance of geological studies in various civil engineering Projects.	
	1.2	Internal structure of the Earth and use of seismic waves in understanding the interior of the earth, Theory of Plate Tectonics.	
II	**2. General and Physical Geology**		**6**
	2.1	Agents modifying the earth's surface, study of weathering and its significance in engineering properties of rocks like strength, water tightness and durability etc.	
	2.2	Brief study of geological action of river, wind, glacier, ground water and the related land forms created by them.	
	2.3	Volcano- Central type and fissure type, products of volcano and volcanic land forms.	
	2.4	Earthquake - Earthquake waves, construction and working of seismograph, Earthquake zones of India, elastic rebound theory Preventive measures for structures constructed in Earthquake prone areas.	
III	**3. Mineralogy**		**1**
	Identification of minerals with the help of physical properties, rock forming minerals, megascopic identification of primary and secondary minerals, study of common ore minerals.		
IV	**4.Petrology** Study of igneous, sedimentary and metamorphic rocks, distinguishing properties among these three rocks to identify them in fields.		**6**
	4.1	Igneous Petrology - Mode of formation, Texture and structure, Classifications, study of commonly occurring igneous rocks and their engineering application.	
	4.2	Sedimentary Petrology - Mode of formation, Textures, characteristics of shallow water deposits like lamination, bedding, current bedding etc., residual deposits, chemically and organically formed deposits, classification, study of commonly occurring sedimentary rocks and their engineering application.	

	4.3	Metamorphic Petrology - Mode of formation, agents and types of metamorphism, metamorphic minerals, rock cleavage, structures and textures of metamorphic rocks, classification and study of commonly occurring metamorphic rocks and their engineering application.	
V	**5. Structural Geology**		**4**
	5.1	Structural elements of rocks, dip, strike, outcrop patterns, outliers and inliers, study of joints, unconformities and their engineering consideration. Faults and folds, their classification and importance in engineering operations.	
	5.2	Determination of thickness of the strata with the help of given data.	
VI	**6. Stratigraphy and Indian Geology**		**2**
	General principles of Stratigraphy, geological time scale, Physiographic divisions of India and their characteristics. Stratigraphy of Deccan Volcanic Province		
VII	**7. Geological Investigation**		**3**
	7.1	Preliminary Geological Investigation and their importance to achieve safety and economy of the projects like dams and tunnels, methods of surface and subsurface investigations, Excavations-Trial pit, trenches etc.	
	7.2	Core Drilling - Geological logging, Inclined Drill holes. Electrical Resistivity method, Seismic method and their applications	
VIII	**8. Geology of dam and reservoir site:**		**3**
	8.1	Strengths, stability, water tightness of the foundation rocks and its physical characters against geological structures at dam sites, favourable and unfavourable geological conditions for locating dam sites.	
	8.2	Precautions over the unfavourable geological structures like faults, dykes, joints, unfavourable dips on dam sites and giving treatments, structural and erosional valleys.	
IX	**9. Tunnelling**		**4**
	9.1	Importance of geological considerations while choosing tunnel sites and alignments of the tunnel, safe and unsafe geological and structural conditions, Difficulties during tunnelling and methods to overcome the difficulties. Methods of tunnelling in soft soil and hard rock.	
X	**10. Ground water**		**3**
	10.1	Sources, zones, water table, unconfined and Perched water tables. Factors controlling water bearing capacity of rocks, Pervious and Impervious rocks, Cone of depression and its use in Civil engineering. Artesian well (flowing and non-flowing)	
	10.2	Springs seepage sites and geological structures. Different types of rocks as source of ground water	

XI	**11. Recharge of ground water**	**3**
	Methods of artificial recharge of ground water, geology of percolation tank.	
XII	**12. Land slides**	
	Types, causes and preventive measures for landslides, Landslides in Deccan region	
XIII	**13. Building stones**	
	Requirements of good building stones and its geological factors, controlling properties, consideration of common rocks as building stones, study of different building stones from various formations of Indian Peninsula.	**1**

Contribution to Outcomes

On completion of the course, the students shall be able to:

- Understand the significance of geological studies for safe, stable and economic design of any civil engineering structure.
- Demonstrate the knowledge of geology to explain major geological processes such as formation of mountain, ocean and the occurrence and distribution of earthquakes and volcanoes.
  Identify various types of minerals and rocks to use them as construction material, exploration of groundwater and to investigate suitability of the site for any civil engineering project.
- Explain various geological structures like folds, faults, joints, unconformity, their origin and distribution which are very essential in the design and construction of dams, tunnels and any other major civil engineering project.
- Understand the causes and prevention of natural hazard like earthquake, landslide, volcano etc. will help student to meet the specific needs with suitable considerations for public health and safety.
- Prepare effective reports mentioning advantages and disadvantages caused due to geological condition and can evaluate any site for civil engineering project.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have short questions having weightage of 4-5 marks covering the entire syllabus
3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be attempted.

Oral Examination:

Oral examination will be based on the entire syllabus and a neatly written report for the practical along with a report of the site visit.

List of Practicals:

1. Study of physical properties of the minerals.

2. Identification of minerals- Quartz and its varieties, Orthoclase, Plagioclase, Muscovite, Biotite, Hornblende, Asbestos, Augite, Olivine, Tourmaline, Garnet, Actinolite, Calcite, Dolomite, Gypsum, Beryl, Bauxite, Graphite, Galena, Pyrite. Hematite, Magnetite, Chromite, Corundum, Talc, Fluorite, Kyanite.
3. Identification of rocks: ***Igneous rocks-*** Granite and its varieties, Syenite, Diorite, Gabbro, Pegmatite. Porphyry, Dolerite, Rhyolite, Pumice, Trachyte, Basalt and its varieties, Volcanic Breccia, Volcanic tuffs.
   Sedimentary Rocks- Conglomerate, Breccia, Sandstone and its varieties, Shales, Limestones, Laterites.
   Metamorphic Rocks- Mica Schists, Hornblende Schists, Slate, Phyllite, Granite Gneiss, Augen gneiss, Marbles and Quartzite.
4. Study of Geological maps (At least 5).
5. Study of core samples, RQD, Core logging.
6. At least two engineering problems based on field data collected during site investigation.

Term Work:

The term work shall consist of the:

1. Report of the practical conducted in terms of the study of the physical properties of the minerals, identification of minerals and rocks.
2. Report of the Geological maps
3. Report of the two problems based on field data.
4. At least *six* assignments covering entire syllabus

Site Visit:

There shall be a visit to get the geological information according to the various contents mentioned in the syllabus. The students shall prepare a detail report along with the summarized findings. The report will form a part of the term work.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and depending upon the quality of the term work. The final certification and acceptance of term work ensures the satisfactory performance of laboratory work.

Recommended Books:

1. Text book of Engineering Geology: *Dr. R. B. Gupte*, Pune Vidyarthi Griha Prakashan, Pune.
2. Text book of Engineering Geology: *P. K. Mukerjee*, Asia.
3. Text book of Engineering and General Geology: *Parbin Singh*, Carson Publication.
4. Text book of Engineering Geology: *N. Chenna, Kesavulu*, Mc-Millan.
5. Principles of Engineering Geology: *K. M. Banger*.

Reference Books:

1. Principles of Physical Geology: Arthur Homes, Thomas Nelson Publications, London.
2. Earth Revealed, Physical Geology: David McGeeary and Charles C. Plummer
1. Principles of Geomorphology: *William D. Thornbury*, John Wiley Publications, New York.
2. Geology for Civil Engineering: A. *C. McLean, C.D. Gribble, George Allen & Unwin* London.
3. Engineering Geology: A Parthsarathy, V. Panchapakesan, R Nagarajan, Wiley India 2013.

Semester III		
Subject Code	**Subject Name**	**Credits**
CE-C 305	**Fluid Mechanics-I**	**4**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**02**	**-**	**03**	**01**	**-**	**04**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**-**	**25**	**150**

Rationale

The concept of fluid mechanics in civil engineering is essential to understand the processes and science of fluids. The course deals with the basic concepts and principles in hydrostatics, hydro kinematics and hydrodynamics with their applications in fluid flow problems.

Course Objectives

Students are introduced to:

- Properties of fluids and basic concepts applicable to fluid mechanics and its relevance in civil engineering.
- Fundamentals of hydrostatics viz. Pascal's law, hydrostatic law and determination of hydrostatic pressure and centre of pressure of surfaces.
- Principle of buoyancy and its application
- The concept of fluid kinematics and ideal fluid flow.
- Concepts of control volume, control surface and dynamics of fluid flow.
- Various flow measuring devices and their applications

Detailed Syllabus		
Module	**Sub-Module / Contents**	**Periods**
I	**1. Properties of Fluids** Mass density, weight density, specific gravity, specific volume, viscosity, compressibility and elasticity, surface tension, capillarity, vapour pressure, types of fluids, basic concepts applicable to fluid mechanics	03

II	**2. Fluid Statics**	10
	2.1 **Pressure measurement**: Pascal's law, hydrostatic law, pressure variation in fluids at rest. Absolute, atmospheric, gauge pressure, measurement of pressure using manometers	
	2.2 **Hydrostatic force on surfaces:** Total pressure and centre of pressure, total pressure on horizontal plane surface, vertical plane surface, Inclined plane surface, centre of pressure for vertical plane surface and for inclined plane surface, practical applications of total pressure and centre of pressure on dams, gates, and tanks.	
	2.3 **Buoyancy and flotation:** Archimedes principle, Metacentre, metacentric height, Stability of floating and submerged bodies, determination of metacentric height, metacentric height for floating bodies containing liquid, Time period of Transverse oscillations of floating bodies.	
III	3. **Liquids in Relative equilibrium**	03
	Fluid mass subjected to uniform linear acceleration, liquid containers subjected to constant horizontal acceleration and vertical acceleration, fluid containers subjected to constant rotation with axis vertical and horizontal.	
	4. Fluid Kinematics	05
	Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and acceleration of fluid particles, velocity potential and stream function, streamline, streak line, path line, equipotential lines and flow net, uses of flow net, rotational and irrotational motions, circulation and vorticity.	
IV	**5. Introduction to Ideal flow.**	02
	Introduction to ideal fluid flow, uniform flow, source and Sink, free vortex flow, superimposed flow, doublet, Flow past a half body, flow past a Rankine oval body and flow past a cylinder	
V	**6. Fluid dynamics**	07
	Control volume and control surface, Forces acting on fluid in motion, Navier Stokes Equation, Euler's Equation of motion, Integration of Euler's equations of motion, Bernoulli's Theorem and its derivation, Bernoulli's equation for compressible fluid and real fluid, practical applications of Bernoulli's Equation - Venturimeter, Orifice meter, nozzle meter, pitot tube, rotameter	
VI	**7. Flow measurement**	09
	7.1 **Orifices and Mouthpieces:** Classification of orifices, flow through orifices, determination of hydraulic coefficients, flow through large rectangular orifice, flow through fully submerged and partially submerged orifice, time of emptying a tank through an orifice at its bottom. Classification of Mouthpieces, Flow through	

	external cylindrical mouthpiece, convergent-divergent mouthpiece, Borda's mouthpieces.	
	7.2 **Notches and Weirs:** Classification of notches and weirs, discharge over a rectangular, triangular, trapezoidal notch/weir, velocity of approach, stepped notch, Cipolleti weir, broad crested weir, ogee weir, discharge over a submerged weir, ventilation of weirs.	

Contribution to Outcomes

On completion of this course the student will be able to:

- Define various properties of fluids, state and explain different types of laws and principles of fluid mechanics.
- Interpret different forms of pressure measurement and Calculate Hydrostatic Force and its Location for a given geometry and orientation of plane surface.
- Compute force of buoyancy on a partially or fully submerged body and Analyse the stability of a floating body.
- Distinguish velocity potential function and stream function and solve for velocity and acceleration of a fluid at a given location in a fluid flow.
- Derive Euler's Equation of motion and Deduce Bernoulli's equation.
- Measure velocity and rate of flow using various devices.

Theory examination:

1. The question paper will comprise of six questions; each carrying 20 marks.
2. The first question will be compulsory and will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
5. The students will have to attempt any three questions out of remaining five questions.
6. Total four questions need to be attempted.

List of Experiments (Any six):

1. Determination of metacentric height.
2. Verification of Bernoulli's theorem.
3. Determination of coefficient of discharge through Venturimeter.
4. Determination of coefficient of discharge through Orifice meter.
5. Determination of coefficient of discharge through Nozzle meter.
7. Determination of coefficient of discharge through Notches (Rectangular and Triangular notch).

8. Determination of coefficient of discharge over weirs (Broad Crested weir and Ogee weir).
9. Determination of hydraulic coefficients of orifice.
10. Determination of coefficient of discharge through mouthpiece.

Term Work:

The term work shall comprise of the neatly written report based on the afore-mentioned experiments and assignments. The assignments shall comprise of the minimum 20 problems covering the entire syllabus divided properly module wise.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of laboratory work by the student, appropriate completion of the assignments.

Recommended Books:

1. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
3. Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
4. Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
5. Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
6. Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons 6. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

Reference Books:

1. Fluid Mechanics: Frank M. White, Tata Mc-Graw Hill International Edition.
2. Fluid Mechanics: Streeter White Bedford, Tata Mc-Graw International Edition.
3. Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Franzini, E.J. Finnemore, Tata Mc-Graw Hill, New Delhi.
4. Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGE Learning India (Pvt.) Ltd.
5. Introduction to Fluid Mechanics: Edward J. Shaughnessy, Jr, Ira M. Katz, James P. Schaffer. Oxford Higher Education.