Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Contents (Syllabus) for

Second Year B. Tech.
(Civil Engineering)
Sem - III to IV

AY 2020-21

Proposed Syllabus for S.Y.B.Tech (All branches)

Course: Probability and Statistics (5MA201)

Year: 2020-21

Module 1: Random Variable: (4)

Discrete random variable, Continuous random variable, probability mass function, cumulative distribution function, bivariate discrete random variable, joint probability distribution, joint distribution function of two dimensional discrete random variable.

Module 2: Probability Distribution: (4)

Gaussian distribution, Exponential distribution, Uniform distribution.

Module 3: Statistical Methods: (5)

Measure of Central tendency, Measure of dispersion, Range, Quartile deviation, Mean deviation, variance, Standard deviation, Coefficient of variance, moments, Symmetry, Skewness, Kurtosis, and Types of Kurtosis.

Module 4: Population and Sample: (3)

Introduction, Types of Characteristics: Attributes and variables, Collection and Organization of data, Population and sample, Methods of sampling.

Module 5: Exact Sampling Distribution: (4)

Chi- square distribution: definition and its properties, Student t- distribution: definition and its properties.

Module 6: Test of Hypothesis: (7)

Random samples, parameter, statistic, standard error of statistic, null and alternative hypothesis, critical region, level of significance, Types of error, large sample test, Small sample test.

References Book:

(1)Probability and Statistics for Engineers and Scientists by S.Ross.

Text books:

(1) Fundamental of Mathematical Statistics by Gupta and Kapoor.

(2) An Introduction to probability and statistics by Vijay Rohatgi.

Title of the Course: Fluid Mechanics (5CV202)	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses: Engineering Physics , Engineering Mechanics and Mathematics

Textbooks:

1. Bansal R.K., "A textbook of Fluid mechanics and hydraulic machines", Laxmi Publications (P) Ltd., New Delhi, 9th Edition, 2010.
2. Garde- Mirajgaonkar, "Engineering Fluid Mechanics", SCITECH Publication,1st Edition, 2010.
3. ModiP.M. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book HouseStandard Book House Since; 21St Edition , 2018.

References:

1. Kumar D.S., "Fluid Mechanics and Fluid Power Engineering", KatariaS K and Sons, 2th Edition, 2010.
2. Jain A.K., "Fluid Mechanics Including Hydraulic Machines", Khanna Publishers, New Delhi, 8th Edition, 2003.
3. Streeter, V.L. and Wylie E.B. "Fluid Mechanics", McGraw Hill, New York, 8th Edition,1985.

Course Objectives :

1. To provide the student fundamentals of fluid mechanics.
2. To provide the student necessary knowledge and concept in the field of fluid mechanics. The students shell be provided with necessary skills for flow and losses of water distribution pipe flow system.
3. To prepare the students for higher studies and research in the field of fluid mechanics.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	*explain* the fundamentals of fluid mechanics	1,2	remembering, understanding
CO2	*apply* the knowledge of fundamental of fluid mechanics to solve and analysis of fluid at rest and in motion	3,4	applying ,analyzing
CO3	*estimate* the different losses and flow in pipe flow system .	5	Evaluate

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:

Module 1: Fluid Properties and Statics	**Hrs.**
Scope and importance of Fluid Mechanics, Physical Properties: density, specific weight, specific volume, specific gravity, dynamic and kinematic viscosity, compressibility, surface tension and capillarity and Vapor pressure. The basic equation of hydrostatics,Pascal's law, Concept of pressure head, datum, absolute and gauge pressure, Measurement of pressure, Application of the basic equation of hydrostatics. Principle of floatation and Buoyancy, Equilibrium of floating bodies, Stability of floating bodies.	**5**
Module 2: Fluid Kinematics	**Hrs.**
Introduction of basic terms: Path line, streak line, stream line and stream tube, Velocity and acceleration of fluid particle. Types of flow: steady and unsteady, uniform and non-uniform, Laminar and Turbulent, one, two, three-dimensional flow, rotational and irrotaional flow. Flow net: Equation of stream line and equipotential line, methods of developing the flow net and its uses.	**3**
Module 3:Fluid Dynamics	**Hrs.**
Forces acting on fluid mass in motion, Euler's equation of the motion along a streamline, Bernoulli's equation: assumptions, applications and its limitations. Momentum equation and its application in fluid mechanics. Applications of Bernoulli's Equation**:** Analysis of the hydraulic coefficients for the discharge measuring devices: orifices, mouthpieces, venturimeter, pitot tube, notches and weirs. Analysis of losses in closed and open channel flow.	**6**
Module 4: Flow in Pipes	**Hrs.**
Laminar Flow: Reynolds's Experiment, laminar flow through fixed parallel plate ,Coutte's flow and Hazen Poiselle's equation for circular pipes. Turbulent Flow: Velocity distribution and shear stresses in turbulent flow, Nikuradse'sexperiments, Elementary concepts of turbulent flow in smooth and rough pipes. Losses in Pipes**:** Losses in Pipes: Darcy Weisbach equation and minor losses in flow through pipe, Concept of equivalent length of pipe and diameter of pipe. Analysis of losses in pipe for the pipes connected in series, parallel and Siphon. Solving the two reservoir problem, three-reservoir problem and Pipe Network analysis.	**5**
Module 5: Boundary Layer Theory	**Hrs.**
Concept of boundary layer, Development of boundary layer on a flat plate, different thickness. Drag and lift of submerged bodies, Hydro dynamically smooth and rough boundaries, Boundary layer	**3**

separation and its control.	
Module 6: Dimensional Analysis and model testing:	**Hrs.**
Dimensional analysis, Buckingham's theorem, Dimensionless numbers and their significance. Model similitude, Model laws, Theory and applications.	**4**
Moodle wise Outcomes: At end of each module students will be able to 1. Explain the properties of fluid, pressure measuring devices and computethe hydrostatic forces acting on different plane. 2. Explain fluid Kinematics and apply the knowledge forsolving problem ofthe pipe flow system. 3. Explain thefluid dynamics and applythe knowledge for solving the pipe flow system. 4. Explain the laminar and turbulent flow and apply the knowledge for solving the problem of water distribution pipe network system. 5. Explain the boundary layer formation theory and its applications. 6. Explain thedimensionless numbersand apply for model simulation.	
Tutorials: Problems on following topics will be covered in tutorial hours; 1. The properties of fluid, pressure measuring devices and computethe hydrostatic forces acting on different plane. 2. Fluid Kinematics and apply the knowledge for solving problem of the pipe flow system. 3. The fluid dynamics and apply the knowledge for solving the pipe flow system. 4. The laminar and turbulent flow and apply the knowledge for solving the problem of water distribution pipe network system. 5. The boundary layer formation theory and its applications. 6. The dimensionless numbers and apply for model simulation.	

Title of the Course: **Building Materials and Construction (5CV203)**	L	T	P	Cr
	3	-	-	3

Pre-Requisite Courses: Nil

Textbooks:

1. R. K. Rajput, "Engineering Materials", S. Chand Publications, New Delhi, 2014.
2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Building Construction" Laxmi Publications, 5th Edition, 2005.
3. Bindra and Arora, "Building Construction", Dhanpat Rai and Sons, 1997.

References:

1. P. C. Varghese, „Building Materials" PHI Learning, Eastern Economy Edition, 2nd Edition, 2015.
2. S. K. Duggal „Building Materials" New Age International, 3rd Edition, 2008,
3. Birdie and Ahuja, "Building Construction and Construction Materials", Dhanpat Rai and Sons, 4th Edition, 2012

Course Objectives : To impart to the class,

1. in-depth knowledge of the various construction materials and techniques in Building Construction.
2. the role played by various building components and their interactions for an integrated behavior of the building as a whole.
3. the representation of building components in terms of sketches and drawings.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	*Distinguish* the strengths and weaknesses of various building materials by assessing and comparing the quality parameters as per standards, and *interpret* their applications in building components in context to strength, durability and energy efficiency.	2, 3	Understand Apply
CO2	*Classify* the various components and their relationships in buildings of different structural systems and identify the materials and construction techniques to be adopted for different building components and systems to integrate design of cost-effective and energy efficient buildings.	2, 3, 4	Understand Apply Analyze
CO3	*Illustrate* the various building components in terms	3	Apply

CO-PO Mapping :

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

CO1: *is mapped to PO 2 (strongly) as the candidate will have to attain this outcome by understanding through literature search, the various civil engineering materials (historical devp., types based on*

manufacturing methods, origin, physical, chemical classification, the relevant testing methods as per

existing codal provisions and judge (hence strongly mapped) their applications in building components using fundamental principles of mathematics, natural sciences, and engineering sciences to decide the acceptance criteria, with a sense of economy and sustainability and hence mapped (lightly) to PO 7.

CO2: *are mapped only to PO 3 (strongly) as this outcome caters the candidate to exhibit his/her knowledge in understanding the expectations and role played by different components and their interrelationships. The skills in application of various material (from CO1) for such components in building system for its integrated behavior in context to strength, stability, durability (public health and safety) and energy efficiency (public health, environmental considerations) needs to be exhibited by the candidate and hence mapped lightly to PO7.*

CO3: *is moderately mapped to PO3 wherein the student needs to exhibit his/her skills in scaled engineering drawing, sketching various buildings components in terms of plan, elevation and sectional elevation, which caters to a better understanding and providing imagery evidences during planning and execution of works.*

All the course outcomes are moderately/lightly mapped to ***PSO1 and PSO2,*** *as the candidate's knowledge in quality assessment of materials and appropriate construction techniques to be adopted are basic needs for a design or field execution of any infrastructure project and also are generally expected topics to be queried on in competitive exams.*

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:

Module 1: Building Systems – Conceptualization	**Hrs.**
The need for buildings, Defining Sustainability for Building systems, Concept Matrix for Buildings, Expansion and Conversion, Structural systems; Load bearing, Framed, Prefabrication, Pre Engineered Construction, Loads on Building, Components in Buildings and their functions, General properties of materials and their role in Construction, Sustainability Concepts, Current Problems, Green building Technologies, Life cycle energy in buildings.	**5**
Module 2: Civil Engineering Materials	
Origin, Engineering properties and Applications of Stone, Brick, Lime and Cement, Mortar, Steel, Specifications as per IS codal provisions.	**7**

Module 3: Concrete	
Definition, History, Ingredients, Processes in concreting, Role and types of Formwork, Properties of fresh concrete and hardened concrete, Strength and Durability considerations, Role of admixtures and pozzolans, Special concretes and their applications, Concreting in Hot and Cold weather, Mix design concepts. Applications of PCC and RC.	**7**
Module 4: Foundations, Walls and Columns	
Foundations: Definition and Functions, Structural Requirements, Bearing Capacity of Soils, Materials used and their properties, Types of Shallow and Deep foundations, Conditions for their applications, Plinth and Plinth Beams. **Walls and Columns:** Structural and Functional requirements, Types of Units and Mortars and their properties, Factors affecting strength and stability of walls, Functions of wall in buildings, Construction joints in masonry, Types: Stone masonry, Brick masonry, Concrete Block masonry, Types of Bonds, Procedure for construction of walls, Strength and stability of walls, Function and types of columns.	**7**
Module 5: Openings in Buildings	
Physical and Functional roles of Openings, Materials Involved, Means of providing openings, Criteria for sizes of Openings, Functional types of Doors, Windows, and Ventilators. Openings vs. Internal Comfort, Role of Lintel and Chajja. Stair Cases- Characteristics, types, design criteria.	**7**
Module 6: Roofs and Floors	
Definitions, Accessible and Inaccessible roofs, Structural and functional requirements, Load considerations, Types of Sloped roofs, Types of Flat roof/floor, Roof covering materials, Types of RC slabs, Role of concrete and steel reinforcement, Formwork, Application of DPC, Joints in construction, Cost effective and Sustainable roofs.	**7**
Module Wise Outcomes At end of each module students will be able to **Module 1:** grasp the concepts of building as an integrated system addressing its strength, stability, aesthetic requirements and the need for sustainability. **Module 2:** Perceive the strength and weaknesses of different building materials by examining their engineering properties and choose appropriate materials for various components as per the strength and durability requirements of buildings. **Module 3**: Articulate various processes in concreting and types of concrete and examine the various properties of concrete for strength and durability considerations. **Module 4:** Distinguish various types of foundations and masonry walls and apply the relevant materials/technique in different situations. **Module 5:** Distinguish different types of individual components viz. Doors, Windows, and Staircases and suggest the suitability for a given situation. **Module 6:** Compare and contrast between roofs and floors, explain the materials involved in different types of roofs and interpret the relevant choice of materials and techniques in buildings.	

Title of the Course:	L	T	P	Cr
Engineering Geology (5CV204)	2	-	-	2

Pre-Requisite Courses: Nil

Textbooks:

1. K. M. Bangar.,"Principles of Engineering Geology", Standard Publishers Distributors 1705-B Nai Sarak, Delhi
2. N. Chenna Kesavulu, "Textbook of Engineering Geology",Macmillian India Ltd. 2/10 Ansari Road Daryanganj, New Delhi.
3. Parbin Singh, "Engineering and General Geology", S. K. Katariya and Sons, Delhi.,1984, 1st Edition.

References:

1. Subinoy Gangopadhy, "Engineering Geology", Oxford University Press, New Delhi, 2017, 5th Edition.
2. A. Holmes, "Principles of Physical Geology", ELBS Chapman and Hall, London.
3. Dr. D. V. Reddy "Engineering Geology for Civil Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1995, 1st Edition.

Course Objectives :

1. Introduce students the necessary knowledge and concepts in the field of geology and to develop the sense of Engineering Geology among civil engineering students.
2. Introduce the technique of recognizing, classifying and describing various geological event and phenomena.
3. Enable students to understand geological problem before undertaking any civil engineering Project.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	*Describe* the geological phenomena especially in the field of physical geology, mineralogy, petrology, structural Geology.	2	Understanding
CO2	*Describe* and *explain* the surface and subsurface methods of preliminary geological investigations.	2	Understanding
CO3	Use the knowledge of geology to *recognize* and *identify* geological phenomena and *apply* in civil engineering.	3	Applying

CO-PO Mapping :

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

Assessments : Teacher

Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:

Module 1: Introduction and Basic Seismology	**Hrs.**
Main and allied branches of Earth Sciences and their scope, Importance of Earth Science in Civil Engineering, Earthquakes, types, effects, epicenter, focus, isoseismal and coseismal lines, Seismograph and seismic waves, Intensity and Magnitude, Locating the epicenter and depth of focus of earthquake, Seismic belts of India and World.	**4**
Module 2: Physical Geology	**Hrs.**
Agents modifying Earth surface, weathering, types of weathering, Geological work of Wind, River and Glacier with respect to mode transport, processes of erosion, erosional features, deposition and depositional features. Ground Water- Origin of groundwater, Zones of groundwater, porosity and permeability, Aquifers and types of aquifers, Rocks as aquifuge, aquiclude, aquitard and aquifer, water table, groundwater exploration, occurrence of groundwater in Deccan trap region.	**5**
Module 3: Mineralogy & Petrology	**Hrs.**
Definition of a mineral, Common rock forming mineral groups, Ore minerals. Igneous Rocks- formation, classification, structures, textures and forms of igneous rocks, common igneous rocks and their civil engineering relevance. Sedimentary Rocks- formation, classification, structures, textures of sedimentary rocks, common secondary rocks and their civil engineering relevance. Metamorphic Rocks- Agents of metamorphism, Types of metamorphism, Products of metamorphism, Structures and textures of metamorphic rocks, Metamorphic aureole and facies, zones of metamorphism, common metamorphic rocks.	**5**
Module 4: Structural Geology	**Hrs.**
Outcrop, Dip, true dip and apparent dip, Strike, outlier and inlier, Folds- Parameters and types. Faults- Parameters and types, Joints- definition and types of joints, Unconformities- Definitions and types. Civil Engineering significance of geological structures.	**4**
Module 5: Geological Investigations	**Hrs.**
Introduction to Surface methods and subsurface methods of geological investigations. Core logging: Core drilling, advantages and limitations, core logging, core recovery, Rock Quality Designation, describing lithology, correlation and interpretations of core log data. Geophysical Methods- Electrical Resistivity Method, Seismic, Magnetic and Gravity methods with their principle, instrument and some common interpretations.	**5**
Module 6: Applications of Geology in Civil Engineering	**Hrs.**
Rocks as source of construction material, building stones etc., Geological considerations and investigation stages in selection of dam-site, Dams on various lithological conditions, some case	

histories. Geological conditions for Capacity, water tightness of the reservoir, siltation. Tunnels- purpose, effects of tunneling, over break, geological considerations for successful tunneling, some case histories. Geological considerations for roads and bridges.Landslides- types, causes and prevention.	**5**
Module wise Outcomes At end of each module students will be able to 1. Describe the scope of geology in civil engineering and also explain the phenomenon of Earthquake. 2. Perceive and describe work of the agents modifying the Earth's surface. 3. Explain various Rocks and Minerals. 4. Interpret the geological structures along with its civil engineering relevance. 5. Explain the methods of geological investigations with their specific applications. 6. Analyze the geological condition and apply the knowledge for associated civil engineering project.	

Title of the Course: **Engineering Surveying (5CV205)**	L	T	P	Cr
	3	-	-	3

Pre-Requisite Courses: Nil

Textbooks:

1. B. C. Punmia and Jain, "Surveying", Vol. 1, 2 & 3, Laxmi Publications, 17th edition, 2015, New Delhi.
2. N. N. Basak, "Surveying and Levelling", Tata Mcgraw Hill Education Pvt. Ltd, 2nd Edition, 2017, New Delhi.
3. K. R. Arora "Surveying", Vol. 1 & 2, Standard Book House, 16th edition, 2018, Kota.

References:

1. Duggal S. K, "Surveying", Tata Mcgraw Hill Education Pvt Ltd, 4th edition, 2017, Delhi.
2. Bannister and Raymond, "Surveying", ELBS, Longman Group Ltd., England.
3. R. E. Davis, F. Foote and J. Kelly, "Surveying; Theory and Practice", McGraw Hill Book Company, New York.

Course Objectives :

1. To impart basic principles of conventional surveying through class instructions.
2. To develop a basic understanding of computations made in topographic mapping, and land Surveys.
3. To develop an ability to analyze land profiles in logical manner and will be able to apply well understood principles in planning and design of engineering structures on the Earth's surface.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	***Apply*** their knowledge to evaluate alternate surveying techniques suitable for scope of the project and site situation.	3	Applying
CO2	***Identify*** Surveying equipment, work in team, collect and ***analyze*** the topographical data with due consideration to systematic errors, random errors and blunders.	4	Analyzing
CO3	***Perceive*** modern surveying equipment and techniques	2	Understanding

CO-PO Mapping :

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Module 1: Introduction to Land Survey Systems	**Hrs.**
A. Study of conventional land survey systems, Brief review of basic Concepts, objective based classification of Surveying, Phases of surveying in Civil engineering fields. B. Types of measurements and range of instrumentation, Traversing & Trilateration C. Precision in Survey measurements, probable errors in measurements, Reliability of measurements, Probability in measurements	**6**
Module 2: Measurement of Horizontal and Vertical Distances; Angles and Directions	**Hrs.**
A. Methods and equipment for horizontal distance measurement, errors and corrections B. Methods and equipment for vertical distance measurement, errors and corrections C. Constructions, adjustments & uses of major and minor conventional angle measuring equipment, Methods for angle and direction measurement, errors and corrections	**6**
Module 3: Conventional Surveying Methodologies	**Hrs.**
A. Chain & Compass Survey B. Leveling & Contouring; Essentiality of Precise Leveling C. Theodolite Traversing ; Trigonometric leveling D. Tachometric Survey E. Plane Table Survey	**7**
Module 4: EDM Instrumentation	**Hrs.**
Basics of EDM, Types of EDM, Electromagnetic spectrum, wavelength regions and their applications, solar radiation, radiation laws , advantages and disadvantages, advances in technology, Fundamental parameters for calculation, correction factors and constants; Setting up, leveling, initial general settings, back sighting, station codes, overview of system functions and applications; and data retrieval and processing,	**8**
Module 5: Project Surveying	**Hrs.**
Detailed surveys, Horizontal Control, Vertical Control, Methods for Location, Survey for Route, Bridge, Dam, Reservoir and Tunnel	**7**
Module 6: Modern Techniques of Surveying and Mapping	**Hrs.**
Modern techniques and procedures for Aerial, Remote Sensing, GIS, GPS, LIDAR, 3D Scanner, Data interpretation and analysis, Elements of visual interpretation, and digital image processing	**6**

Module-wise Outcomes: At end of each module students will be able to **Module 1:** Describe surveying fundamentals for topographic mapping. They will also be able to recognize nature of errors and need of control on error. **Module 2:** Identify equipment for linear and angular measurements for topographic mapping. **Module 3:** Apply conventional surveying method based on scope of the project **Module 4:** Handle Total Station for topographic survey **Module 5:** Plan & execute survey for major engineering projects like Route, Bridge, Dam, Reservoir and Tunnel **Module 6:** Describe modern surveying techniques for mapping	

Title of the Course:	L	T	P	Cr
Solid Mechanics (5CV206)	2	1	--	3

Pre-Requisite Courses: Engineering Mechanics

Textbooks:

1. Hibbeler R. C., "Mechanics of Materials", Pearson Education, 10th Edition, 2016.
2. Popov E. B., "Mechanics of Materials", Pearson Education, 2nd Edition, 2015.
3. Gere and Timoshenko, "Mechanics of Materials", CBS publishers, 2nd Edition, 2004.

References:

1. Beer and Johnston, "Mechanics of Material", Tata McGraw Hill publication, 7th Edition, 2014.
2. Andrew Pytel and Jaan Kiusalaas, "Mechanics of Materials", Cengage Learning, USA, 2nd Edition, 2011.
3. Timoshenko. S. & Young. D. H, "Strength of Material", McGraw Hill Book Company Publication, 4th Edition, 2006.

Course Objectives :

1. To impart the basic concepts of stress and strain in elastic body.
2. To illustrate internal effects and deformations caused by the various applied loads.
3. To provide the knowledge of stability analysis, shear and bending stress distribution for the analysis and design aspects of structural engineering.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	**Explain** state of stress-strain and internal forces in elastic bodies.	2	Understanding
CO2	**Solve** problems on structures to find internal forces.	3	Applying
CO3	**Analyze** different stresses in structural members.	4	Analyzing

CO-PO Mapping :

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

Assessments : Teacher

Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30

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ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:

Module 1: S**tresses and strains**	**Hrs.**
Mechanical properties of Materials -Elasticity, Plasticity and Creep ,Linear, lateral, shear and volumetric strains, Stresses, Elastic constants, Poisson's ratio and their relationship, Material constitutive law, St. Venant's Principle. Stress-strain curves for Brittle and Ductile materials, Allowable Stresses and factor of safety, Uni-axial and multi-axial loading.	5
Module 2: Composite sections under axial loading	**Hrs.**
Stresses, strains and deformations in homogenous and composite bars and thermal effects, Axial force diagram, Equilibrium and Compatibility Equations, Strain energy due to gradually and suddenly applied axial loads and impact load, Modulus of Resilience.	4
Module 3: Principal Stresses and Planes	**Hrs.**
State of stress on planes, Normal and Shear stresses on any oblique plane, principal planes and principal stresses, Mohr's Circle Method, Principal stresses in beams, stress trajectory. Various theories of elastic failures.	5
Module 4: Shear and bending of beams	**Hrs.**
Concept of shear force and bending moment, Relation between SF, BM and intensity of loading, Plotting S.F.D. and B.M.D. for determinate simple and compound beams under various types of loads and supports. Bending and shear stresses: Euler's beam theory, Moment of resistance of cross section, Bending and shear stress distribution across symmetrical and unsymmetrical cross sections.	6
Module 5: Torsion of Circular Shafts	**Hrs.**
Theory of torsion, solid and hollow circular shafts, transmission of power through circular shafts. Shaft subjected to bending and torsion, equivalent shear, equivalent bending, effect of end thrust.	5
Module 6: Stability Analysis	**Hrs.**
Short column, Slenderness ratio, Euler's theory, Critical loads, Rankine's, Jordon's formula and Secant formula. Column subjected to combined axial load and bending moment, core of a section, Stability of chimneys, dams and retaining walls.	4
Module wise Outcomes At end of each module students will be able to 1. Determine the elastic stresses and strains using principles of elasticity.	

2. Examine stresses and strains in various composite sections under axial loading. 3. Analyze the principal stresses and strains to study theories of elastic failures. 4. Construct shear force and bending moment diagrams and shear and bending stress distribution across the cross-sections. 5. Analyze shear stresses due to torsion of circular shaft and effect of combined bending and torsion. 6. Estimate buckling load of columns using Euler's and Rankine's theory and to apply the concept to check the stability of chimneys, dams and retaining walls.	

Tutorial

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.

Title of the Course: **Fluid Mechanics Laboratory (5CV252)**	L	T	P	Cr
	0	0	2	1

Pre-Requisite Courses:

Engineering Physics , Fluid Mechanics

Textbooks:

1. RangarajuK.G., "Flow in Open Channels", Tata McGraw Hill Publication Co. Ltd., New Delhi,1st Edition,1993.
2. Aswa G.L., "Experimental Fluid Mechanics", Vol. I & II, Nem Chand & Bros., Roorkee,1st Edition,1983.
3. Likhi, S.K., "Hydraulics: Laboratory Manual", New Age International Publishers, 1stEdition, 1995.

References:

1. Modi P.M. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, 9th Edition,2013.
2. Subramanya K.,"Theory and Applications of Fluid Mechanics" Tata McGraw Hill Publishing Co., Ltd., 7thEdition2000.
3. VenTe Chow,"Open channel Hydraulics", Tata McGraw Hill Publishing, 1st Edition,2000.

Course Objectives :

1. To provide students hands-on practice for measurement of viscosity, pressure and discharge by using measuring devices.
2. To develop the skill required for applying knowledge to analysis of flow in pipe.
3. To develop the skill required for applying knowledge to estimate the losses in pipe flow.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	***Determine a viscosity*** of oil and metacentric height of ship model, ***measure*** the pressure using measuring devices ofthe pipe flow.	2	Understanding
CO2	***develop*** the flow pattern by using electrical analogy method	3	Applying
CO3	***Demonstratethe*** different type of flow through Reynolds number, discharge and losses in pipe flow.	4	Analyzing

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

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

Lab Assessments :

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments	**Hrs.**
1. Determination of viscosity of oil by using Redwood viscometer	**2**
2. Determination of metacentric height of ship model	**2**
3. Measurement of pressure by using pressure measuring devices	**2**
4. Development of Flow net by using electrical analogy method	**2**
5. Verification of Bernoulli's theorem for the energy equation	**2**
6. Verification of momentum equation by using impact of jet on circular disc	**2**
7. Measurement of discharge by using sharp edged circular orifice and Venturimeter	**2**
8. Study of different types of flow by using Reynoldsexperiment	**2**
9. Measurement and calculation of minor losses are due to entrance, exit, expansion of flow, contraction of flow, elbow, bent and valve	**2**
10. Measurement of Loss of head forthe pipeflow by using differential U-tube manometer	**2**

Title of the Course: **Building Materials and Construction Laboratory (5CV253)**	L	T	P	Cr
	-	-	2	1

Pre-Requisite Courses: Exposure to theory course in Building Materials and Construction

Textbooks:

1. M L Gambhir; Neha Jamwal, Building and Construction Materials: Testing and Quality Control, Tata McGraw-Hill Education, 2014
2. Mantri Institute"s „The A to Z of Practical Building Construction and its Management" Mantri Institute of Devp. and Research. Pune, Published by Satya Prakashan, 2011

References:

1. Shetty M. S., "Concrete Technology", S. Chand & Company Ltd. New Delhi, 7th Edition, 2013.
2. IS 3495, IS 1077, IS 2386, IS 383, Bureau of Indian Standards, New Delhi.
3. Material Testing-lab-manual.pdf: http://site.iugaza.edu.ps/mymousa/files/Material_-Testing-lab-manual.pdf

Course Objectives :

1. To involve students in hands on laboratory activities to evaluate the properties of basic construction materials.
2. To engage students in visits to ongoing construction sites to appreciate/relate the classroom learning"s and also get an exposure to new developments in the construction industry.
3. To update students about the perennial changing costs and quality of building materials through market surveys.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Evaluate and compare the quality parameters, the strengths and weaknesses of basic building materials by demonstration of experiments to justify acceptance or rejection for application.	5	Evaluate
CO2	Perceive by physical observation the complexities and skills involved in actual construction process so that they can demonstrate the various building components in terms of building drawings and can apply in similar situations in future.	3	Apply
CO3	Differentiate and compare the quality of various building materials of different brands and reproduce unit cost through market surveys.	2	Understand

CO-PO Mapping :

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

CO1: *is mapped to PO's 4, 5 and 1 as the candidate will have to attain this outcome by demonstration of experiments on certain materials using specific tools/equipments (hence strongly mapped to PO5)and evaluate specific characteristic/property by applying simple mathematics (lightly mapped to PO1) and engineering principles (moderately mapped to PO4) to decide the acceptance criteria as per in IS codes.*

CO2 and CO3*: are mapped only to PO 4 (moderately) as these outcomes caters the candidate to exhibit his sensitivity in observing the materials/equipments/tools used, skills of executing the work, quality checks to be performed etc. for various activities during field visits on construction sites or market surveys for study of materials, which may not be always unique method and can change due to various constraints on other sites.*

All the course outcomes are mapped to PSO1 moderately as most of the construction materials are needed in any of the civil engg. infrastructure development and quality assessment thereby is a prime issue and are mapped lightly to PSO2 as MCQs may generally be asked on such topics in competitive exams.

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments	**Hrs.**
1. **Quality Assessment of Masonry units**	**2 Hrs in 2nd week**
Students will explore the various building units utilized for masonry works and conduct experiments on various properties viz. size, density, water absorption, IRA, and compressive strength as per the IS codal Provisions and submit a report.	
2. **Analysis of Aggregates**	**2 Hrs in 3rd week**
Students will collect samples of fine/coarse aggregates and conduct experiments on various properties viz. sieve analysis, fineness modulus, bulking of sand and represent the results graphically and submit a report.	
3. **Visit to Foundation Site**	**2 Hrs in 5th week**
Students will visit a building site where the building foundation work is in progress. They are expected to observe the foundation type, construction details, Plinth details and submit site photographs and draw neat sketches. The report should also contain notes on various other types of foundations and their applications.	
4. **Market Survey**	**2 Hrs in 7th week**
Students will visit material supplier agencies for physical observation of materials and get the details of source of procurement, storage methods, application, price in the market, of at least 25 items related to Building construction and submit a report within one week after the visit.	
5. **Visit to Masonry Construction Site**	

Students will visit a building site with masonry work in progress. They are required to observe the method of wall construction, proportion and mixing of mortar, placing of bricks, joint thickness, Checking verticality using plumb and water level. They should note the rate of wall construction and the	**2 Hrs in 9th week**
bricks required for unit volume and submit a report along with the images /photographs of sites visited Within one week after the visit.	
6. **Visit to Study Water Supply and Drainage System in a Building**	**2 Hrs in 10th week**
Students will visit a site to observe the facilities namely UGWT, OHWT, water supply system, Provisions of traps, septic tank and soak pit and sketch the various accessories in a report to be submitted in a week.	
7. Study of Staircases	**2 Hrs in 11th week**
Students will visit and study at least five types of staircases within/outside the campus and report the functional details viz. floor to floor height, riser, tread, waist slab dimensions with appropriate sketch and photographs	
8. Observations on Concreting /Plastering/Flooring Tiles	**2 Hrs in 12th week**
Students will visit a site during ongoing plastering, pointing or painting works and gather information About the type of external and internal paints. They are also expected to visit a paint store/shop and gather information about various shades and prices of different paints.	

Title of the Course:	L	T	P	Cr
Engineering Geology Laboratory (5CV254)	-	-	2	1

Pre-Requisite Courses:

Textbooks:

1. K. M. Bangar.,"Principles of Engineering Geology", Standard Publishers Distributors 1705-B Nai Sarak, Delhi
2. N. Chenna Kesavulu, "Textbook of Engineering Geology", Macmillian India Ltd. 2/10 Ansari Road Daryanganj, New Delhi.
3. Parbin Singh, "Engineering and General Geology", S. K. Katariya and Sons, Delhi, 1984, 1st Edition.

References:

1. M. S. Krishnan, "Geology of India and Burma", CBS Publishers & Distributors
2. A. Holmes, "Principles of Physical Geology", ELBS Chapman and Hall, London.
3. Dr. D. V. Reddy "Engineering Geology for Civil Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1995, 1st Edition.

Course Objectives :

1. Introduce students the properties of Minerals and Rocks and enable them to identify them.
2. Introduce them technique of drawing the cross sections from given geological outcrop maps of various types, solving structural geology problems.
3. Enable students to understand geological problem with the help of subsurface investigation data.
4. Introduce students the stratigraphic formations of India with more emphasis on Maharashtra with the geological maps.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	*Identify* and *describe* the given mineral and rock specimen.	2	Understanding
CO2	*Construct* cross section from given geological outcrop map and *solve* any structural geology problem and *interpret* the same for civil engineering decision making	3	Applying
CO3	*Summarize* the core logging from the recovered core data and *Interpret* the subsurface conditions by correlating the same.	3	Applying

CO-PO Mapping :

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

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments	Hrs.
1. Identification and description of megascopic properties of minerals.	2
2. Describing the minerals' specimen from Silica, Feldspar, Olivine, Pyroxene, Amphibole and Mica group of minerals.	2
3. Describe the minerals' specimen from Garnet, Carbonate, Sulphate, Zeolite, Other silicates and Ore mineral groups	2
4. Petrographic identification of Igneous Rock Specimen.	2
5. Petrographic identification of Metamorphic Rock Specimen.	2
6. Petrographic identification of Sedimentary Rock Specimen.	2
7. Geological Outcrop Map with Horizontal Series	2
8. Geological Outcrop Map with Inclined Series	2
9. Geological Outcrop Map with Two series and one Unconformity	2
10. Geological Outcrop Map with Dykes and Sill.	2
11. Geological Outcrop Map with Vertical Fault.	2
12. Structural Geology-Dip and Strike Problems.	2
13. Core logging from available core sample data, preparation of report, interpretation and correlation.	2

Title of the Course:	L	T	P	Cr
Surveying Laboratory (5CV255)	-	-	2	1

Pre-Requisite Courses: Engineering Surveying

Textbooks:

1. B. C. Punmia and Jain "Surveying", Vol.1, 2 & 3, Laxmi Publications, 17th edition, 2015, New Delhi.
2. N. N. Basak, "Surveying and Levelling", Tata Mcgraw Hill Education Pvt Ltd, 2nd edition , 2017, New Delhi.
3. K. R. Arora "Surveying", Vol.1 & 2, Standard Book House, 16th edition, 2018, Kota.

References:

1. Duggal S. K, "*Surveying"*, Tata Mcgraw Hill Education Pvt Ltd, 4th edition, 2017, Delhi.
2. Bannister and Raymond, "*Surveying"*, ELBS, Longman Group Ltd., England.
3. R.E. Davis, F. Foote and J. Kelly, "*Surveying; Theory and Practice"*, McGraw Hill Book Company, New York.

Course Objectives :

1. To study basic surveying techniques through field exercises.
2. To develop and retain a basic understanding of site selection, locational survey, horizontal and vertical control establishment in the field with computations made in land Surveys.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	***Implement*** appropriate surveying methodology	3	Applying
CO2	***Study*** topographic feature	4	Analyzing
CO3	***Verify*** suitability of site condition for major engineering project	5	Evaluating

CO-PO Mapping :

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

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:	
List of Experiments	**Hrs.**
Part I: Field Exercises (inside the campus) 1. Chain & Compass Traversing	2
2. Plane Table Survey	4
3. Leveling a. Study of Dumpy, Auto, and tilting level b. Leveling exercises	4
4. Theodolite & Trigonometric leveling a. Angle measurement and traversing by theodolite b. Study of micro optic theodolite c. Line out of Structures.	8
5. Tachometry a. Determination of constants of Tachometer b. Stadia tachometry for length, gradient, and area determination	4
Part II: Field Projects (outside the campus) 6. Road Surveying (Alignment, Earthwork calculations etc.) 7. Block and Radial Contouring (Interpolation calculations, Drawings etc.)	6

Title of the Course: Environmental Science (5IC201)	L	T	P	Cr
	2	-	-	0

Textbooks:

1. Mrinalini Pande, "Disaster Management", Wiley Publications New Delhi, First edition, 2014
2. N.K Uberoi, "Environmental Studies", Excel Books Publications New Delhi, first edition, 2005.
3. R.Rajagopalan, "Environmental Studies from crisis to cure" Oxford university press, second edition, 2011

References:

1. William. Cunningham and Barbara Woodworth Saigo, "Environmental Science: A Global Concern", WCB/McGraw Hill publication, 5th Edition, 1999.
2. Peter. H. Raven, Linda. R. Berg, George. B. Johnson, "Environment", McGraw Hill publication, 2nd -Edition, 1998.
3. Catherine Allan & George H. Stanley (Editors), "Adaptive Environmental Management", Springer Publications. 2009.

Course Objectives :

1. Infuse an understanding of the various environmental concepts on scientific basis in the functional area of Engineering and technology.
2. Provide a foundation to critically assess the approaches to pollution control, environmental and resource management, sustainable development, cleaner technologies, Environmental Legislation based on an understanding of the fundamental, environmental dimensions.
3. Inculcate the modern concept of green industry and the impact of excess human population, globalization, and climate change on the environment.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Describe key concepts of Environmental science and their relationship to engineering.	II	Understanding
CO2	Explain ethical and legal responsibility of an engineer and his role in effective implementation of sustainable activities through EIA and EMS in the corporate sector.	II	Understanding
CO3	Predict impact of contemporary issues (Population Explosion, Climate change, Environmental pollution) on the environment.	II	Understanding

CO-PO Mapping :

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:

Module 1: Environment, Ecology and Biodiversity	**Hrs.**
Introduction: Natural and Built Environment, Environmental education: definition, scope, objectives and importance, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere and Biosphere. Ecology : Introduction, Types (terrestrial and aquatic ecosystems) , Structure and function, Trophic levels, Food chains, food webs, Ecological pyramids, Ecological succession, Biogeochemical cycles. Biological Diversity: Introduction, Value of biodiversity: consumptive use, Threats to biodiversity, Conservation of biodiversity.	**07**
Module 2: Human Population, Energy and Natural Resources	**Hrs.**
Human Population Growth and Environment: Population Dynamics, Age structures, Energy Scenario: Future projections of Energy Demand, Utilization of various Energy Sources, Conventional Energy Sources and Non- Conventional Energy Sources, Urban problems related to energy. Natural Resources: Food, Water, Forest, Geological, Equitable Use of Resources for Sustainable life style. Case studies.	**05**
Module 3: Climate Change, Environmental Quality and Pollution Control	**Hrs.**
Climate change: Global warming, Ozone depletion, Acid Rain. Environmental Impact: Impact of Modern agriculture on the Environment, Impact of Mining on the Environment, Impact of Large dams on the Environment, Environmental pollution: Air, Water, Soil, Noise, Marine, classification of pollutants, their causes, effects and control measures. Case studies.	**05**
Module 4: Solid, Hazardous Waste and Disaster Management	**Hrs.**
Solid and Hazardous waste management: Introduction, categories, causes, effects and management of municipal solid waste, Hazardous waste Disaster Management: Introduction, types of disasters, Disaster mitigation. Case studies.	**04**

Module 5: Social Issues, Environmental Management and Legislation	**Hrs.**
Environmental ethics: Introduction, Ethical responsibility, issues and possible solutions. Environmental Management**:** Introduction to Environmental Impact Assessment, Environmental Management System: ISO 14001Standard, Environmental Auditing, National and International Environmental protection Agencies pertaining to Environmental Protection. Environmental Legislation: Environmental protection act 1986, Water (prevention and control of pollution) Act 1974, Air (prevention and control of pollution) Act 1981, Wild life Protection Act 1972 and Forest Conservation Act 1980. Municipal Solid Wastes (Management and Handling) Rules, 2000.	**04**
Module 6: Cleaner technology	**Hrs.**
Restoration Ecology, Role of Information Technology in Environment science, Green buildings, Green products, Consumerism and Waste Products, Minimization of Hazardous Products, Reuse of Waste, By-products, Rainwater Harvesting, Translocation of trees. Some Success Stories. Case studies	**03**
Module wise Outcomes At end of each module students will be able to **Module 1:** Determine an in-depth understanding of the interdisciplinary relationship of cultural, ethical, and social aspects of local/global environmental issues. Understand how interactions between organisms and their environments drive the dynamics of individuals, populations, communities, and ecosystems. **Module 2:** Describe the impact of human population on the environment, and the utilization of natural resources for sustainable life style. **Module 3:** Explain the issues like Climate change, Global warming, Global Warming Potential, Ozone depletion, Ozone depletion Potential, Impact of Modern agriculture on the Environment, Impact of Mining on the Environment, Impact of Large dams on the Environment, Bio magnification, Eutrophication and apply learned information to postulated environmental scenarios to predict potential outcomes. **Module 4:** Identify and define different disasters and their mitigation in addition to solid and hazardous waste management. **Module 5:** Sense the legislation governing environmental research and the environment. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. **Module 6:** Describe strategies, technologies, and methods for assessment and sustainable management of environmental systems and for the remediation or restoration of degraded environments.	

Title of the Course: Applied Mathematics (5MA202)	L	T	P	Cr
	2	-	-	2

Pre-Requisite Courses: Engineering Mathematics I and Engineering Mathematics II

Textbooks:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Eastern Limited Publication, 1978, 1st Edition.
2. P. N. and J. N. Wartikar, "A Text Book of Applied Mathematics, Vol I and II", Vidyarthi Griha Prakashan, Pune, 2006.
3. B .S. Grewal, "Higher Engineering Maths", Khanna Publication, 2005, 39th Edition

References:

1. Wylie C.R., "Advanced Engineering Mathematics", Tata McGraw Hill Publication, 1999, 8th Edition.
2. H. K. Dass, "Advanced Engineering Mathematics", S. Chand & Company Ltd., 1988, 1st Edition

Course Objectives :

1. To develop mathematical skills and enhance thinking power of students.
2. To introduce fundamental concepts of mathematics and their applications in engineering fields

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom"s Cognitive	
		Level	Descriptor
CO1	Explain mathematical concepts in engineering field.	2	Understanding
CO2	Use mathematical and computational methods to solve the problems in science and engineering field.	3	Applying

CO-PO Mapping :

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

Assessments : Teacher

Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Module 1: Fourier Series	**Hrs.**
Periodic functions, Dirichlet‟s conditions, Definition, Determination of Fourier coefficients (Euler's formulae), Expansion of functions, Even and odd functions, Change of interval and functions having arbitrary period, Half range Fourier sine and cosine series.	**6**
Module 2: Linear Differential Equations With Constant Coefficients	**Hrs.**
Definition, Complete solution, The operator D, Auxiliary equation , Rules for finding the Complementary function, Inverse operator, Rules for finding the particular integrals , Homogeneous linear differential equations.	**6**
Module 3: Matrices And Its Applications	**Hrs.**
Transpose Adjoin, General properties, Rank, Determinant, Transformation Matrices Rotation Translation, mirror scaling, Homogeneous co-ordinate system.	**4**
Module 4: Partial Differential Equations And Its Application	**Hrs.**
Four Standard forms of Partial differential equations, Application to one dimensional heat equation.	**4**
Module 5: Vector Differentiation	**Hrs.**
Concept of vector field, Directional derivatives, Gradient of vector field, Tangent line to the curve. Velocity, Acceleration, Divergent and curl of vector field, Conservative vector field.	**4**
Module 6: Vector Integration	**Hrs.**
Line integrals, Surface and volume integral, Green's theorem in plane, Gauss Divergence Theorem, Stoke‟s Theorem.	**4**
Module wise Outcomes At end of each module students will be able to 1. Module 1: Solve the problems of Fourier series, expansion of function in Fourier series. 2. Module 2: Solve examples in linear differential equations with constant coefficients. 3. Module 3: Solve examples in transformation of matrices as translation, rotation, scaling etc. 4. Module 4: Solve partial differential equations and application to heat equation. 5. Module 5: Solve examples and understand the problems of fluid mechanic by using vector calculus and the problems of conservation of mass. 6. Module 6: Solve and understand the problems of surface integral, line integral, volume integral and understand concept of Greens theorem , Stokes „s theorem.	

Title of the Course: **Hydraulics and Hydraulics Machinery (5CV221)**	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses: Fluid Mechanics

Textbooks:

1. RangarajuK.G., "Flow in Open Channels", Tata McGraw Hill Publication Co. Ltd.,New Delhi, 1st Edition, 1993.
2. Modi P.M. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, 9th Edition, 2013.
3. VenTe Chow, "Open channel Hydraulics", Tata McGraw Hill Publishing, 1st Edition, 2000.

References:

1. SubramanyaK. , "Flow in Open Channels" Tata McGraw-Hill Education, 7th Edition, 2009
2. Chanson "The Hydraulics of Open Channel Flow an Introduction", Wiley, 1st Edition, 2004.
3. A.K. Jain, "Fluid Mechanics", Khanna Publishers, 11th Edition,2013 .

Course Objectives :

1. To provide studentknowledgeon basic concepts of open channel flow.
2. To develop students skillsand applythe knowledge foranalysis of hydraulic jumps, uniform and gradually-varying flows.
3. To providestudent the knowledge of centrifugal pump and Pelton wheel turbine for its selection.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	*explain and distinguish* basic concept of open channel flow	1,2	*Remembering, Understanding*
CO2	*apply and analyze* the basic equations of open channel flow for surface profiles and energy dissipation system.	3,4	*Applying, Analyzing*
CO3	*analyze* the performance and working of pump and turbine	5	creating

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last

three modules) covered after MSE.	
Course Contents:	
Module 1: Introduction to open channel Flow	**Hrs.**
Scope and importance ,Types of open channel, Types of flows in open channel,Geometric elements, Velocity distribution, Energy and momentum equationapplied to open channel flow, Measurement of velocity and discharge	**7**
Module 2: Uniform Flow	**Hrs.**
Uniform flow, Uniform flow characteristics, prismatic channel, Chazy's and Manning's Formulae, Manning's roughness coefficient, Uniform flowcomputations, Normal depth, Conveyance, Section factor, Hydraulic exponent,Hydraulically most efficient sections.	**7**
Module 3: Specific Energy and Specific Force	**Hrs.**
Energy -Depth relationship in open channel flow, Specificenergy - definition and diagram, Critical flow, Sub-critical and supercriticalflow, Specific force -definition and diagram, Unit discharge anddischarge diagram.	**6**
Module 4: Gradually Varied flow	**Hrs.**
Definition and types of non-uniform flow, Gradually Varied Flow (GVF) andRapidly Varied Flow (RVF), Basic assumptions of GVF; Governing DifferentialEquation of GVF- Alternative forms; Classification of channel bed-slopes; Zonesof GVF profiles; Various GVF profiles, their general characteristics and examplesof their occurrence; Control section., Gradually varied flow computations.	**8**
Module 5: Rapidly varied flow	**Hrs.**
Phenomenon of Hydraulic jump; Location and examples of occurrence ofhydraulic jump; Assumptions in the theory of hydraulic jump; Application ofmomentum equation to hydraulic jump in rectangular channel; Conjugate depthsand relation between conjugate depths.Various terms related to hydraulic jump; Classification of hydraulic jump;Practical uses of hydraulic jump.Energy dissipation in hydraulic jump; graphical method of determination ofenergy dissipation.	**6**
Module 6: Pump and Turbine	**Hrs.**
Pelton wheel turbine: type, working and principle of Pelton wheel turbine. Centrifugal pump: type, component parts and working of pump.	**6**
Module wise Outcome: At end of each module students will be able to 1. Explain thecharacteristics open channel flow andapply the knowledge for the analysis of the velocity distribution in open channel flow. 2. Explain the hydraulically most efficient sections of openchannel flowand apply the knowledge for the analysis of different type of channel sections. 3. Explain the specific Energy and Specific Force curve; apply the knowledge for the analysis of hydraulic jump. 4. Explain thegradually varied flow and apply the knowledge for theanalysis of water surface profiles developed due to construction of the hydraulics structures. 5. Explain the hydraulic jump and apply the knowledge for the analysis of energydissipating devices. 6. Explaintheworking of the Pelton wheel turbine and centrifugal pump and apply the knowledge for the analysis of performance and its selection.	

Title of the Course:	L	T	P	Cr
Building Planning and Design (5CV222)	2	0	0	2

Pre-Requisite Courses: Exposure to Building Materials and Construction

Textbooks:

1. Kumarswamy and Kameshwar Rao., "Building Planning and Design," Charotar Publications, 8th Edition, 2010
2. V. B. Sikka, Civil Engineering Drawing, S. K. Kataria and Sons, 7th Edition, 2015

References:

1. Pierce S Rowland, Planning: The Architect's Handbook „E. & OE", Iliffe Books Ltd. London, 1963, 8th Edition.
2. John Hancock Callender, Joseph De Chiara, "Time Saver Standards for Building Types", McGraw- Hill, New York, 1983.
3. National Building Code of India 2016 (NBC 2016) Volume 1 and 2, Bureau of Indian Standards, New Delhi, 2016.

Course Objectives : To make the class knowledgeable by sharing

1. Concepts in Building Planning and functional design.
2. Integration of aesthetical concepts and influence of climate in building design.
3. The art of expressing buildings in terms of drawings.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	*Perceive* the requirements of residential/public building in terms of structural, functional aspects and *apply* the principles of planning, bye Laws/regulations during planning process of buildings.	2, 3	Understand Apply
CO2	*Practice* the planning ideologies in buildings, in relevance to building services, climatology, acoustics and fire resistance.	3	Apply
CO3	*Design* buildings by composing functional and aesthetical aspects and *Illustrate* building graphically in terms of engineering drawings.	3, 6	Apply Create

CO-PO Mapping :

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

CO1: is mapped to PO 2 (strongly) as the candidate will have to attain this outcome by identifying and understanding the specific requirements, analyzing as per the clients requirements and applying his/her planning knowledge in formulating the building design.

CO2: is mapped only to PO 3 (strongly) as this outcome caters the candidate to exhibit his/her knowledge

in integrated application of various services like water supply and sewage disposal, comfort to inhabitants within the building envelope (health and environment), sound quality in special buildings (society and culture) and fire resistance in tall buildings (safety) leading to sustainable development (PO7).

CO3: is strongly mapped to PO3 wherein the student needs to exhibit his/her skills in expressing the building design as scaled drawing in terms of plan, elevation and sectional elevation, which caters to a better understanding and providing imagery evidences during planning and execution of works.

The outcomes CO1 and CO2 are lightly mapped to PSO1 and PSO2 as these outcomes are majorly handled by Architects than civil engineers, however as entrepreneurs candidate"s knowledge in these outcomes would be desirable. CO3 is mapped moderately to PSO1 as every civil engineer is expected to understand the language of drawings.

Assessments :

TeacherAssessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

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

Module 1: Site, Building and Building Drawings	**Hrs.**
Categories of buildings as per NBC, Types of Residential buildings, Site selection, Factors influencing selection of site, guidelines for planning and drawing of buildings, Positions of Various building components, types of drawings and relevant scales.	**4**
Module 2: Principles of Building Planning	**Hrs.**
Conceptual understanding of Aspect, prospect, Privacy, Furniture, Roominess, Grouping, Circulation, Sanitation, Lighting, Ventilation, Flexibility, Elegance, Sanitation, Economy and Their interrelationship in the integrated planning of buildings.	**5**
Module 3: Building Bye laws	**Hrs.**
Objectives, Minimum plot size, Building frontage, open spaces, exemption to open spaces, standard dimensions in buildings, Provision for light & ventilation, Means for access, Drainage & sanitation, FSI, Fungible FSI, Saleable areas, Transfer of development rights, RERA.	**5**
Module 4: Planning of Building Services and Finishes	**Hrs.**
Requirements in different types of buildings, Integrated approach to planning in aspects like	**5**
, building services viz. Plumbing for water supply and sanitation, Electrification, landscape. Types of Finishes for Wall, Floor, Roof, Ceilings. Types of Paints and theirnApplications, Defects in finishes.	
Module 5: Climatology and Building Aesthetics **design**	**Hrs.**
Elements of climate, Climatic zones, Comfort indices, Direction and its characteristics, orientation of buildings, factors affecting orientation, Orientation criteria in various zones, Natural and Artificial means of achieving comfort.	**5**

Module 6: Acoustics and Fire resistance in buildings	**Hrs.**
Applications, Sound ratings, conditions of good acoustics, Sound behavior in enclosures, Common acoustical defects, Echo & reverberation, acoustical design of auditoriums. Fire safety & role of designer, causes, fire loads & occupancies, Fire resistance of common building materials, general fire safety recommendations, Fire escapes, Alarms & extinguishing Equipment.	**5**
Module wise Outcomes At end of each module students will be able to **Module 1:** to compare and list the various categories and types of buildings, their merits and demerits, types of drawings to be given for a particular building assignment. **Module 2:** to recognize the various factors affecting the functional planning of the building and the necessity of an integrated approach required during planning buildings in context to balance the structural and functional requirements. **Module 3:** to apply the bye laws, regulations during planning phases to satisfy the regulatory authorities. **Module 4:** to integrate building services detailing and aesthetical considerations during planning. **Module 5:** to differentiate and design buildings adopting passive and active design concepts in context to climate and thermal comfort. **Module 6:** to identify and apply the techniques for achieving acoustical and fire resisting Measures in buildings.	

Title of the Course: Water Resource Engineering (5CV223)	L	T	P	Cr
	2	1	0	3

Pre-Requisite Courses:

Textbooks:

1. S.K. Garg, "Water resources Engg. Vol. I, Hydrology & water resources Engg.", Khanna publisher, Delhi,15th edition (2010)
2. M.J. Deodhar, " Elementary Engineering Hydrology", Pearson Education, 1st Edition(2009)
3. S.K. Garg, "Water resources Engg. Vol. II, Irrigation Engineering & hydraulic Structures",Khanna publisher, Delhi,24th edition (2011)

References:

1. H.M. Raghunath,"Hydrology: principles, analysis, design", New Ace International (P) Limited, Publishers, 2nd edition.
2. B. C. Punmia, PandeBrijBasiLal, Arun Kumar Jain, Ashok Kumar Jain, "Irrigation and Water Power Engineering",Laxmi Publications, 16th edition(2009).
3. Asawa G.L., "Irrigation and Water Resources Engineering", New Age International Publishers,1st edition (2005).

Course Objectives :

1. To impart basic knowledge of fundamental concepts of Engineering Hydrology.
2. To impart fundamentals of Irrigation Engineering and watershed management and their relevance to sustainability.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	**Explain** basic concepts of hydrologic cycle, aquifers, irrigation systems, watershed management.	2	Understanding
CO2	**Describe** prevailing irrigation water management practices, types of minor irrigation, government laws and water policy.	2	Understanding
CO3	**Analyze** precipitation data and **solve** problems related to hydrograph, aquifers, irrigation, water requirement and crop yield.	3 4	Applying Analyzing
CO4	**Design** canal structures and rainwater harvesting system.	6	Creating

CO-PO Mapping :

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1													2
CO2	1													2
CO3			3										2	2
CO4			3										2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:

Module 1: Engineering Hydrology : Introduction	**05 Hrs.**
Hydrological cycle and application of hydrology. Precipitation: Types of Precipitation, measurement, analysis of Precipitation data, mass rainfall curves, intensity-duration curves, and concept of depth area duration analysis, frequency analysis. Evaporation, transpiration, evapotranspiration and infiltration.	
Module 2: Runoff	**05 Hrs.**
Rainfall-runoff relationships, Flow Duration Curve, Flow-mass Curve applications, Hydrograph analysis: Factors affecting runoff, Unit hydrograph theory and applications. Stream flow measurement. Floods Estimation and control, flood frequency analysis, Introduction to flood routing.	
Module 3: Ground water hydrology	**05 Hrs.**
Occurrence, Aquifers, hydraulic conductivity, transmissivity, Aquifer yield. Well irrigation: Well hydraulics, Tube wells- Types, Methods for drilling, Well Development. Open wells- Classification, Yield, Advantages and Disadvantages of well irrigation Ground water recharge methods and its efficiency.	
Module 4:Water Requirement and Reservoir Planning	**05 Hrs.**
Water requirement of crops, Soil Water-Plant Relationship, Methods of Field Water Application,Effects of excess water for irrigation, cropping pattern, Irrigation Water management and distribution, warabandi, rotational application, Introduction to prevalent Government laws and water policy. Irrigation: Necessity, Survey and data collection for irrigation project, Reservoir planning and sediment controlTypes of Irrigation Schemes, performance assessment of irrigation scheme	
Module 5: Canal Irrigation	**05 Hrs.**
Canal and Canal structures, Canal lining, Diversion head works- Weir and Barrages, Cross-Drainage works- Aqueduct, Siphon aqueduct, Super passage, Canal siphon, Canal Maintenance, Canal revenue assessment methods, canal water losses and its preventive measures.	
Module 6: Minor irrigation & Watershed Management	**05 Hrs.**
Minor Irrigation- Check dam, Nala bund,Bandhara Irrigation- Construction and Working, Advantages and Disadvantages, Layout and components, Percolation tank- Need, Selection of site, Construction, Lift irrigation schemes- Layout, Components and functions. Watershed management, Water Scarcity scenario, Soil conservation measures, Methods and	

design of Rainwater harvesting systems, effective utilization of water for various purposes.	
Module wise Outcomes: At end of each module students will be able to 1. **Explain** basic concepts of hydrologic cycle and analysis of precipitation data 2. **Describe** rainfall-runoff relationships, flood estimation and control, flood routing and **solve** problems related to hydrograph. 3. **Explain** basic concepts of groundwater hydrology and **solve** problems related to aquifer. 4. **Discuss** irrigation systems, watershed management, and **calculate** water requirement and crop yield. 5. **Design** canal structures, diversion head works and cross-drainage works. 6. **Explain** basic concepts of Watershed Management, Minor Irrigation Schemes and **design** of Rainwater Harvesting Systems.	
Tutorials: Problems on following topics will be covered in tutorial hours; 1. Analysis of Precipitation data 2. Hydrograph analysis 3. Aquifer yield 4. Soil Water-Plant Relationship, Water requirement of crops, 5. Canal, Cross-Drainage works 6. Design of Rainwater harvesting systems	

Title of the Course:	L	T	P	Cr
Structural Analysis (5CV224)	2	1	--	3

Pre-Requisite Courses: Solid Mechanics.

Textbooks:

1. Devdas Menon, "Structural Analysis", Alpha Science Intl, Ltd., 2nd Edition, 2008.
2. Pandit & Gupta, "Structural Analysis - Matrix Approach", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 4th Edition, 2004.
3. Bhavikatti S. S., "Matrix Methods of Structural Analysis", I. K. International Publishing house Pvt. Ltd., 1st Edition, 2003.

References:

1. Hibbeler R. C., "Mechanics of Materials", Pearson Education, 10th Edition, 2016.
2. Weaver and Gere J. M., "Matrix Analysis of Framed Structures", CBS Publications and Distributors, 2nd Edition, 2004.
3. Wang C. K., "Indeterminate Structural Analysis", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1st Edition, 1983.

Course Objectives :

1. To illustrate concept of static and kinematic indeterminacy of structures.
2. To provide the knowledge of various methods to evaluate deformations of various structures.
3. To impart the knowledge for analyzing determinate and indeterminate structures by using various methods.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	**Perceive** behavior of statically determinate and Indeterminate structures.	2	Understanding
CO2	**Apply** various techniques of structural mechanics to Solve determinate and indeterminate structures.	3	Applying
CO3	**Analyze field** structures using various approaches in Structural mechanics.	4	Analyzing

CO-PO Mapping :

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

Assessments : Teacher

Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:

Module 1 Slope and Deflections of beams	**Hrs.**
Types of structures, Equilibrium and compatibility conditions, determinate and indeterminate structures, Static and kinematic degree of indeterminacy. Deflection of Beams: Computation of Slope and Deflections in Beams- Macaulay's method – Moment area method - Conjugate beam method.	**5**
Module 2 Energy Principles	**Hrs.**
Strain energy due to axial force, shear force, bending moment and torque. Strain energy and complimentary energy, Castigliano's Strain Energy theorems. Unit load method. Computation of deflections in determinate structures such as beams, bends, arches, trusses Betti's and Maxwell's reciprocal theorems.	**5**
Module 3 Strain Energy Method	**Hrs.**
Analysis of indeterminate structures such as two hinged portal frames, Two hinged arches and indeterminate trusses, Effect of lack of fit, Temperature stresses.	5
Module 4 Influence Line Diagrams	**Hrs.**
Muller-Breslau's principle and its application to statically determinate simple and compound beams. Influence line diagrams for support reaction, shear force and bending moment, ILD for member forces in statically determinate trusses.	**4**
Module 5 Slope Deflection Method	**Hrs.**
Slope deflection equations, Sinking of supports, Application to beams and frames with and without sway, concept of Symmetry and anti-symmetry.	5
Module 6 Moment Distribution Method	**Hrs.**
Relative and absolute stiffness, Distribution factors, Sinking of supports, Applications to beams, frames with and without sway.	5

Module wise Measurable Students Learning Outcomes:

After the completion of the course the student should be able to:

1. Determine static and kinematic indeterminacy and apply various methods to find displacements of beams under various types of loads.
2. Solve determinate structures by applying energy principles.
3. Analyze indeterminate structures by using concept of strain energy method.
4. Construct influence line diagrams for various determinate structures such as beams, trusses etc.
5. Analyze statically indeterminate structures by using slope deflection method.
6. Analyze statically indeterminate structures by using moment distribution method.

Tutorial

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.

Title of the Course: **Concrete Technology (5CV225)**	L	T	P	Cr
	2	-	-	2

Desirable Courses: Building Materials and Construction.

Textbooks:

1. Gambhir, M. L., "Concrete Technology", Tata Mc Graw Hill Publishers, 2012.
2. Nevelli, A.M., "Properties of Concrete", Prentice Hall Publishers, 5th Edition, 2012.
3. Shetty, M. S., "Concrete Technology", S. Chand and Company Ltd, New Delhi, 2014.

References:

1. Indian codes- IS: 456-2000, IS: 2250-1981, IS: 516-1959, IS: 5816 -1999, IS: 4031(Part 6) - 1988.
2. Bhavikatti .S.S "Concrete Technology",I.K. International Pvt.Ltd. Kindle Edition 1st Edition 2015
3. Santhakumar, A. R. "Concrete Technology", Oxford University Press, second edition, 2018.

Course Objectives:

1. To provide knowledge of quality assessment of concrete through laboratory and field tests.
2. To impart the knowledge of concrete mix design.
3. To illustrate various types of special concretes and its field applications.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** the functional role of ingredients and admixtures in conventional and special concrete.	IV	Analyzing
CO2	**Discuss** various properties of fresh and hardened concrete.	V	Understanding
CO3	**Design** concrete mix for various grades of concrete.	VI	Creating

CO-PO Mapping :

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

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

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

Course Contents:	
Module 1: Concrete Ingredients and Admixtures	**5 Hrs.**
Concrete ingredients- chemical composition of cement, cement manufacturing process, test on cement, types of cement, role and properties of aggregate, alkali-aggregate reaction, bulking of aggregate, artificial and manufactured sand, role of chemical admixtures - accelerator, retarder, water reducing elements, plasticizer and super-plasticizer, functions and dosage.	
Module 2: Properties and Testing of Concrete	**5 Hrs.**
A) **Concrete preparation process –** methods of mixing and transportation, placing, methods of compaction, curing, RMC plant. B) **Properties for fresh concrete** - Factors influence workability, workability test on fresh concrete by slump cone, compaction factor and vee bee consistometer test. Segregation and bleeding. C) **Properties for hardened concrete** - Strength test on harden concrete like compressive strength test, flexure test and split tension test. Factors affecting strength – water cement ratio, gel space ratio, aggregate cement ratio, properties of ingredients, effect of age, maturity, aggregate cement-paste inter-face, various finishes of concrete. Introduction to aspects of elasticity, shrinkage and creep.	
Module 3: Additions to Concrete	**5 Hrs.**
Review of types, covering pulverised fuel ash, ground granulated blast furnace slag and silica fume; origins and manufacture; chemical composition; physical characteristics; chemical and physical processes of hydration and interaction; effects on properties of concretes, mortars and grouts; methods of test; applications; mixer blends and blended cements.	
Module 4: Mix Design	**5 Hrs.**
Principles of mix proportioning, factors governing selection of mix, variability of test results, acceptance criteria, various IS code provisions. Concrete Mix design: Different methods of mix design – factors affecting mix design – mix design exercise using IS method, ACI method, Road note – 4 method and DOE method. RMC plant.	
Module 5: Special Concrete	**5 Hrs.**
Ingredients, mix proportioning, mechanical properties, applications of following concrete- High strength concrete, high performance concrete, no-fines concrete, fiber reinforced concrete, Ferro cement, self-compacting concrete, light weight concrete, mass concrete, polymer concrete, and pre-cast concrete etc.	
Module 6: Durability and Permeability of Concrete	**5 Hrs.**
Volume change of concrete, freezing and thawing, chemical actions- sulphates attack, carbonation, chloride attack. Alkali – aggregate reaction, sulphate attack, chloride and acid attack. Effect of sea water, special coating for water proofing, concrete for hot liquids. Test on concrete permeability. Concrete in extreme hot and cold condition, under water construction. Concrete in road pavements, concrete dams. Green concrete- ingredients, manufacturing process, applications and durability aspects.	
Module wise Outcomes At end of each module students will be able to: 1. Explain functional role of ingredients and admixtures in concrete. 2. Explain properties of fresh and harden concrete. 3. Explain functional role of additive ingredients on properties of normal concrete. 4. Design concrete mix for normal concrete. 5. Discuss different types of special concrete, its properties and applications.	

6.	Discuss durability of concrete, manufacturing of sustainable concrete, properties of concrete for road pavements and dams.	

Title of the Course:	L	T	P	Cr
Hydraulics Laboratory (5CV271)	0	0	2	1

Pre-Requisite Courses: Fluid Mechanics and Hydraulics

Textbooks:

1. RangarajuK.G., "Flow in Open Channels", Tata McGraw Hill Publication Co. Ltd., New Delhi, 1st Edition, 1993.
2. Aswa G.L. "Experimental Fluid Mechanics", Vol. I&II, Nem Chand & Bros., Roorkee,1stEdition,1983.
3. Likhi, S.K., "Hydraulics: Laboratory Manual", New Age International Publishers, 1st Edition, 1995.

References:

1. P.M. Modi and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, 9th Edition,2013.
2. SubramanyaK.,"Theory and Applications of Fluid Mechanics" Tata McGraw Hill Publishing Co., Ltd., 7th Edition2000.
3. VenTe Chow,"Open channel Hydraulics", Tata McGraw Hill Publishing, 1st Edition,2000.

Course Objectives :

1. Explore the fundamental principles of fluid mechanics through experimentation
2. Demonstrate and analyze key hydraulic phenomena using hands-on physical devices
3. To provide students' knowledge about the working of centrifugal pump and Pelton wheel turbine.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	***Compute*** velocity and manning's constant forthe open channel flow and apply knowledge for analysis uniform and non-uniform flow.	2	Understanding
CO2	***demonstrate***the flow measuring devices for the open channel flow and apply the knowledge for analysis of uniform flow and non uniform flow	2,3	Applying
CO3	***analyze***the performance and working of centrifugal pump and Pelton wheel turbine.	4	Analyzing

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

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

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments	Hrs.
1. Measurement of velocity for open channel flow by using pitot tube and current meter.	**2**
2. Determination of Manning's and Chezy's constant for open channel flow by using uniform flow formulae	**2**
3. Study of nape profile over a sharp crested weirby providing with and without ventilation below the lower nape.	**2**
4. Measurement of open channel flow by using Triangular Notch and Rectangular Notch	**2**
5. Measurement of open channel flow by using Broad Crested Weirand Round Crested Weir.	**2**
6. Measurement of open channel flow by using Venturi flume.	**2**
7. Develop SpecificEnergy and Specific Force diagrams ofHydraulic Jumpin the open channel flow.	**2**
8. Develop the different type of Hydraulic Jumps in open channel flow and estimation of lossof energy.	**2**
9. Study of characteristics of Centrifugal Pumpunder constant speed.	**2**
10. Study of characteristics of PeltonWheel Turbine under constant speed.	**2**

Title of the Course: **Building Planning and Design- Mini Project (5CV272)**	L	T	P	Cr
	-	-	2	1

Pre-Requisite Courses: Exposure to course in Basic Materials and Construction

Textbooks:

1. N. Kumarswamy and A. Kameshwar Rao., "Building Planning and Design," Chraotar Publishing House Pvy. Ltd., 8th edition, 2010.
2. V. B. Sikka, A Course in Civil Engineering Drawing, S. K. Kataria and Sons, 7th Edition, 2015.
3. National Building Code of India 2005 and SP- 7, Bureau of Indian Stds. 2nd Edition.

References:

1. Pierce S Rowland, Planning: The Architect's Handbook "E. & OE", Iliffe Books Ltd. London
2. Callender, Time saver's standard's of Architectural design data, Tata Mc Graw Hill Pub.
3. Shah, Kale & Patki, "Building drawing with Integrated approach", Tata Mc Graw Hill Pub.
4. S. C. Agarwal, "Architecture and Town Planning".

Course Objectives : To impart the class

1. the approach to functionally plan and design a typical building by applying concepts of principal of planning and implementation of byelaws.
2. necessary knowledge to apply the various building services viz. plumbing, electrification and furniture within the buildings.
3. awareness of aesthetics and architectural ornamentation in buildings through engineering drawings.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	***Comprehend*** the requirements of residential/public building in terms of structural, functional, architectural aspects and apply the principles of planning, bye laws during planning process and designing buildings.	2, 3, 6	Understand, Apply,
CO2	***Perceive and apply*** different building services namely, water supply, drainage facilities and electrification services.	2, 3	Understand Apply
CO3	Communicate and interact as a team to ***apply*** the drawing techniques and ***compose*** buildings using conventional and modern tools.	3, 6	Apply, Design

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

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

CO1: *is mapped to PO's 2 moderately as the candidate will have to attain this outcome by* identifying *a specific building type, formulate its requirements by visiting existing buildings of such types and is further expected to apply the planning concepts using principles of engineering sciences* in *consideration for the*

inhabitant's health, safety, cultural, societal needs and thus mapped strongly to PO3.

CO2*: is mapped with PO 3 (moderately) as this outcome expects the candidate to exhibit his knowledge in applying necessary services to make the building operational and safe, with sensitivity towards economizing energy consumption by adopting passive designs and thus mapped strongly with PO7.*

CO3*: is mapped moderately with POs 1 and 5 as the candidate is expected to exhibit his graphics skills in technical drawings, manually using appropriate scale and also applying modern tools like AutoCAD. As the mini-project is handled by a group of 4-5 candidates, they are expected to work as team and exhibit teamwork and leadership attributes and present their project work orally and submit a report, and thus this outcome is mapped lightly to PO 9 and 10.*

All the course outcomes are mapped to PSO1 moderately as in all phases of planning, design and execution, the candidate needs to apply such knowledge in any of the infrastructure projects.

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments	**Hrs.**
Activities / Assignments	
Forming groups of 4-5 students in each batch and allocating a type of building as a project work. An overall picture of the various planning phases will be explained to the students. Each group will be presenting each phase about the development in planning for the given problem during the practical hours.	**2 hrs in 1st week**
Exercise 1: (CO 3) For the given type of building, groups will visit at least 3 such existing buildings and a presentation on the following is expected, Size & nature of plot, Soil conditions and gradient, Structural system, Requirements of the building, Drawings to be submitted, scales to be adopted.	**2 hrs in 3rd week**
Exercise 2: (CO1) For the given type of building, presentation on the following, Circulation diagram, Grouping of various rooms, a tentative plan of the building based on principles of planning privacy, ventilation, light, sizes for comfort, openings.	**2 hrs in 4th week**

Exercise 3: (CO2) For the given type of building, presentation on the following, Planning revisions based on orientation of buildings, climate, Minimizing internal heat gain, Design of staircase.	**2 hrs in 5th week**
Exercise 4: (CO2) For the given type of building, presentation on the following, Planning revisions based on Plumbing for water supply and drainage, Design of the system,	**2hrs in 6th week**

Electrification, Location of Switchboards, min. no. of points, safety devices, earthing details	
Exercise 5: (CO3) The various phases and improvements in of planning process will be a continuous activity and should lead to a final ideal plan for which detailed drawings are to be submitted • **Municipal drawings**- Plan, section and front elevation, site plan, area calculations and statement. • **Construction details** of foundation, Doors, windows, Lintel & Chajja, Lofts, Parapet, beam layout for sunken slabs of bath & w/c • Plans showing furniture and electrification details • Plan showing water supply and plumbing layout, terrace slope and drainage, table of materials used.	**2 hrs in 9th week 10th week**
Exercise 6: (CO3) Students will have to draw the municipal drawing of their finalized building using AutoCAD and attach its print along with the previous sheets as submission work.	**2 hrs in 11th week**
Exercise 7: Students will have to draw the two point perspective of their finalized building.	**2 hrs in 12th week**

Title of the Course:	L	T	P	Cr
Advanced Surveying Laboratory (5CV274)	-	-	2	1

Pre-Requisite Courses:

Engineering Surveying (4CV205) and Engineering surveying Laboratory (4CV253)

Text Books:

1. B. C. Punmia and Jain "Surveying", Vol.1, 2 & 3, Laxmi Publications, 17th edition, 2015, New Delhi.
2. N. N. Basak, "Surveying and Levelling", Tata Mcgraw Hill Education Pvt Ltd, 2nd edition , 2017, New Delhi.
3. K.R. Arora "Surveying", Vol.1 & 2, Standard Book House, 16th edition, 2018, Kota.

References:

1. Duggal S. K, "Surveying", Tata Mcgraw Hill Education Pvt Ltd, 4th edition, 2017, Delhi.
2. Bannister and Raymond, "Surveying", ELBS, Longman Group Ltd., England.
3. R.E. Davis, F. Foote and J. Kelly, "Surveying; Theory and Practice", McGraw Hill Book Company, New York.

Course Objectives:

1. To study advanced surveying techniques through field exercises.
2. To develop and retain a basic understanding of employing special functions of advanced survey instruments for land Surveys.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	***Implement*** appropriate surveying functions available with digital level, digital theodolite, auto reduction tacheometer and total station	3	Applying
CO2	***Study*** topographic feature	4	Analyzing
CO3	***Verify*** suitability of special functions for major engineering project	5	Evaluating

CO-PO Mapping :

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

Assessments

Teacher Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25

Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments	**Hrs.**
Part I: Field Exercises (inside the campus) 1. Levelling a. Study of Digital level b. Levelling exercises c. Digital data processing	**4**
2. Digital Theodolite a. Angle measurement and traversing b. Trigonometric levelling	**4**
3. Auto reduction Tacheometry Auto reduction tacheometry for length, gradient, and area determination	**2**
4. Study of Total Station a. Exercises based on various functions b. Digital data processing	**10**
Part II: Field Projects (outside the campus) Customized field exercises for project surveys like alignment, contouring, earthwork computations, drawing preparation etc. with relevant advanced instrument and software	**4**

Title of the Course: **Material Testing Lab (5CV275)**	L	T	P	Cr
	-	-	02	01

Pre-Requisite Courses: Solid Mechanics

Textbooks:

1. Hibbeler R. C., "Mechanics of Materials", Pearson Education, 10th Edition, 2016.
2. Popov E. B., "Mechanics of Materials", Pearson Education, 2nd Edition, 2015.
3. Gere and Timoshenko, "Mechanics of Materials", CBS publishers, 2nd Edition, 2004.

References:

1. Beer and Johnston, "Mechanics of Material", Tata McGraw Hill publication, 7th Edition, 2014.
2. Andrew Pytel and Jaan Kiusalaas, "Mechanics of Materials", Cengage Learning, USA, 2nd Edition, 2011.
3. Timoshenko. S. & Young. D. H, "Strength of Material", McGraw Hill Book Company Publication, 4th Edition, 2006.

Course Objectives :

1. To demonstrate laboratory experiments for testing of various building materials.
2. To conduct experiments to evaluate various properties of materials for quality control.
3. To provide the knowledge of permissible values of material properties as per codal requirements.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** the methodology of conducting experiments on construction materials as per codal provisions.	2	Understanding
CO2	**Evaluate** the properties of construction materials by conducting Laboratory tests.	5	Evaluating
CO3	**Analyze** and **interpret** properties of construction materials for acceptance criteria.	4	Analyzing

CO-PO Mapping :

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

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
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Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

LIST OF EXPERIMENTS:	**Hrs.**
1. Tension Test on Mild steel & high strength deform bars.	2
2. Compression test on Mild steel & Cast iron.	2
3. Shear test on Mild Steel.	2
4. Hardness test on different materials.	2
5. Bending test on Timber.	2
6. Compression test on Timber.	2
7. Impact Test for Different Metals.	2
8. Bending test on flooring tiles.	2
9. Water Absorption test on bricks.	2
10. Bend and Re-bend Test	2
11. Bending Test on Plywood.	2