

**COURSE OUTCOMES:**

On successful completion the students will be able to

- CO1** Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- CO2** Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- CO3** Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

**CE3401****APPLIED HYDRAULICS ENGINEERING****L T P C**  
**3 1 0 4****COURSE OBJECTIVES:**

- To impart basic knowledge to the students about the open channel flows with analysis of uniform flow, gradually varied flow and rapidly varied flow and to expose them to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, Centrifugal and Reciprocating pumps.

**UNIT I UNIFORM FLOW****9+3**

Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Fundamental equations - Sub-critical, Super-critical and Critical flow - Velocity distribution in open channel - Steady uniform flow: Chezy's equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force.

**UNIT II VARIED FLOWS****9+3**

Dynamic equations of gradually varied - Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination by Numerical method: Direct step method and Standard step method – Change in Grades.

**UNIT III RAPIDLY VARIED FLOWS****8+3**

Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation – Positive and Negative surges.

**UNIT IV TURBINES****9+3**

Turbines - Classification - Impulse turbine – Pelton wheel - Reaction turbines - Francis turbine - Kaplan turbine - Draft tube - Cavitation - Performance of turbine - Specific speed - Runaway speed – Minimum Speed to start the pump.

**UNIT V PUMPS****9+3**

Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitation's in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work done.

**TOTAL: (L: 45+ T: 15) 60 PERIODS****COURSE OUTCOMES:**

On completion of the course, the student is expected to

- CO1** Describe the basics of open channel flow, its classification and analysis of uniform flow in steady state conditions with specific energy concept and its application
- CO2** Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with change in water surface profiles due to change in grades.
- CO3** Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges.
- CO4** Design turbines and explain the working principle
- CO5** Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps.

**TEXT BOOKS:**

1. Jain. A.K., Fluid Mechanics, Khanna Publishers, Delhi, 2010.
2. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017

**REFERENCES:**

1. Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 19th edition, 2013.
3. Mays L. W., Water Resources Engineering, John Wiley and Sons (WSE), New York, 2019
4. Subramanya K., Flow in open channels, Tata McGraw Hill, New Delhi, 2019.

**COs- PO's & PSO's MAPPING**

PO/PSO	Course Outcome					Overall Correlation of COs to POs
	CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	3	3	3	3	3
PO2	Problem analysis	3	3	3	3	3
PO3	Design / development of solutions	2	2	2	3	2
PO4	Investigation	3	3	3	3	3
PO5	Modern Tool Usage	1	2	1	1	1
PO6	Engineer and Society	2	2	2	2	2
PO7	Environment and Sustainability	2	2	2	2	2
PO8	Ethics	1	1	1	1	1
PO9	Individual and Team work	2	2	2	2	2
PO10	Communication	1	1	1	1	1
PO11	Project Management and Finance	1	1	1	1	1
PO12	Life Long Learning	3	3	3	3	3
PSO1	Knowledge of Civil Engineering discipline	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and innovation	2	2	2	2	2
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	2	2	3	3	3

PROGRESS THROUGH KNOWLEDGE

**CE3402****STRENGTH OF MATERIALS****L T P C****3 0 0 3****COURSE OBJECTIVES:**

- To learn the fundamental concepts of Stress in simple and complex states and to know the mechanism of load transfer in beams and the induced stresses due to simple bending and unsymmetrical bending and to determine the deformation in determinate beams and to know the basic concepts of analysis of indeterminate beams.

**UNIT I SIMPLE AND COMPOUND STRESSES****9**

Stresses in simple and compound bars – Thermal stresses – Elastic constants - Thin cylindrical and spherical shells – Biaxial state of stress – Principal stresses and principal planes – Mohr's circle of stresses - Torsion on circular shafts.

**UNIT II BENDING OF BEAMS****9**

Types of beams and transverse loadings– Shear force and bending moment for simply supported, cantilever and over-hanging beams - Theory of simple bending – Bending stress distribution – Shear stress distribution.

### **UNIT III DEFLECTION OF BEAMS**

**9**

Double Integration method – Macaulay's method – Area moment method – Conjugate beam method – Strain energy method for determinate beams.

### **UNIT IV INDETERMINATE BEAMS**

**9**

Propped Cantilever and Fixed Beams – Fixed end moments reactions, slope and deflection for standard cases of loading — Continuous beams – support reactions and moments – Theorem of three moments – Shear Force and Bending Moment Diagrams.

### **UNIT V ADVANCED TOPICS**

**9**

Unsymmetrical bending of beams - shear center applied - Thick cylinders - Theories of failure – Principal stress, principal strain, shear stress, strain energy and distortion energy theories – application problems.

**TOTAL: 45 PERIODS**

#### **COURSE OUTCOMES:**

Students will be able to

**CO1** Understand the concepts of stress and strain, principal stresses and principal planes.

**CO2** Determine Shear force and bending moment in beams and understand concept of theory of simple bending.

**CO3** Calculate the deflection of beams by different methods and selection of method for determining slope or deflection.

**CO4** Analyze propped cantilever, fixed beams and continuous beams for external loadings and support settlements.

**CO5** Determine the stresses due to Unsymmetrical bending of beams, locate the shear center, and study the various theories of failure

#### **TEXTBOOKS**

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2018.
2. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.
3. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures" (SMTS) Vol -II, Laxmi Publishing Pvt Ltd, New Delhi 2017.
4. Basavarajiah and Mahadevapa, Strength of Materials, University press, Hyderabad, 2016
5. Vazirani.V.N, Ratwani.M.M, Duggal .S.K Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1, Khanna Publishers, New Delhi 2014.

#### **REFERENCES:**

1. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2017
2. William A .Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw Hill Publishing company, 2017.
3. Singh. D.K., " Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2021
4. Egor P Popov, "Engineering Mechanics of Solids", 2<sup>nd</sup> edition, PHI Learning Pvt. Ltd., New Delhi, 2015
5. Irwing H.Shames, James M.Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, New Delhi, 2002
6. Beer. F.P. & Johnston.E.R. "Mechanics of Materials", Tata McGraw Hill, Sixth Edition, New Delhi 2010.
7. James M.Gere., Mechanics of Materials, Thomas Canada Ltd., Canada, 2006.
8. Egor. P.Popov, Engineering Mechanics of Solids, Prentice Hall of India, Second Edition New Delhi 2015.

**COs- PO's & PSO's MAPPING**

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	3	3	3	3	3	3
PO2	Problem analysis	3	3	3	3	3	3
PO3	Design / development of solutions	3	3	3	3	3	3
PO4	Investigation	3	3	3	3	3	3
PO5	Modern Tool Usage	2	2	2	2	2	2
PO6	Engineer and Society	3	3	3	3	3	3
PO7	Environment and	1	1	1	1	1	1
PO8	Ethics	3	3	3	3	3	3
PO9	Individual and Team work	2	2	2	2	2	2
PO10	Communication	3	3	3	3	3	3
PO11	Project Management and Finance	1	1	1	1	1	1
PO12	Life Long Learning	3	3	3	3	3	3
PROGRAM SPECIFIC OUTCOMES(PSO)							
PSO1	Knowledge of Civil engineering discipline	3	3	3	3	3	3
PSO2	Civil Engineering Performance Evaluation and coordination	3	3	3	3	3	3
PSO3	Conceptualization of Civil Engineering Systems	3	3	3	3	3	3

**CE3403****CONCRETE TECHNOLOGY**
**L T P C**  
**3 0 0 3**
**COURSE OBJECTIVES:**

- To study the properties of concrete making materials.
- To have better knowledge about the chemical and mineral admixtures in concrete.
- To familiarize with the IS method of mix design as per the latest code .
- To understand the fresh and hardened properties of concrete. To know the importance and applications of special concretes

**UNIT I      CONSTITUENT MATERIALS****9**

Cement-Different types-Chemical composition and Properties -Tests on cement-IS Specifications- Aggregates-Classification-Mechanical properties and tests as per BIS Grading requirements-Water- Quality of water for use in concrete.

**UNIT II      CHEMICAL AND MINERAL ADMIXTURES****9**

Accelerators-Retarders- Plasticisers- Super plasticizers- Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline -Their effects on concrete properties

**UNIT III      PROPORTIONING OF CONCRETE MIX****9**

Principles of Mix Proportioning-Properties of concrete related to Mix Design-Physical properties of materials required for Mix Design - Design Mix and Nominal Mix-BIS Method of Mix Design - Mix Design Examples

**UNIT IV FRESH AND HARDENED PROPERTIES OF CONCRETE****9**

Workability-Tests for workability of concrete-Slump Test and Compacting factor Test-Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS - Properties of Hardened concrete- Stress-strain curve for concrete-Determination of Modulus of elasticity.

**UNIT V SPECIAL CONCRETES****9**

Light weight concretes - High strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete - SIFCON - Shotcrete – Polymer concrete - High performance concrete- self compacting concrete - Geopolymer Concrete.

**TOTAL : 45 PERIODS****COURSE OUTCOMES:**

At the end of the course the student will be able to

**CO1** Understand the requirements of cement, aggregates and water for concrete

**CO2** Select suitable admixtures for enhancing the properties of concrete

**CO3** Design concrete mixes as per IS method of mix design

**CO4** Determine the properties of concrete at fresh and hardened state.

**CO5** Know the importance of special concretes for specific requirements.

**TEXTBOOKS:**

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003

**REFERENCES:**

1. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London,1995
2. Gambhir.M.L.Concrete Technology,Fifth Edition, McGraw Hill Education,2017.
3. Job Thomas., Concrete Technology, Cengage learning India Private Ltd, New Delhi, 2015.
4. IS10262-2019 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi.

**COs- PO's & PSO's MAPPING**

PO/PSO		Course Outcome					Overall Correlation of CO s to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	3	3	3	3	3	3
PO2	Problem analysis	1	1	2	1	1	1
PO3	Design / development of solutions	1	1	3	1	1	2
PO4	Investigation	2	1	3	1	1	2
PO5	Modern Tool Usage	1	1	1	1	1	1
PO6	Engineer and Society	3	3	3	3	3	3
PO7	Environment and Sustainability	3	3	3	3	3	3
PO8	Ethics	2	1	1	2	2	2
PO9	Individual and Team work	1	1	1	1	1	1
PO10	Communication	1	1	1	1	1	1
PO11	Project Management and Finance	1	1	1	1	2	1
PO12	Life Long Learning	2	2	2	2	2	2
PROGRAM SPECIFIC OUTCOMES(PSO)							
PSO1	Knowledge of Civil Engineering discipline	3	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and innovation	2	2	2	2	2	2
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	3	3	3	3	3	3

**COURSE OBJECTIVES**

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification. To familiarize the students about the fundamental concepts of compaction, flow through soil, stress transformation, stress distribution, consolidation and shear strength of soils. To impart knowledge of design of both finite and infinite slopes.

**UNIT I SOIL CLASSIFICATION AND COMPACTION 9**

Formation of soil - Soil description – Particle – Size shape and colour – Composition of gravel, sand, silt, clay particles – Particle behaviour – Soil structure – Phase relationship – Index properties – Significance – BIS classification system – Unified classification system – Compaction of soils – Theory, Laboratory and field tests – Field Compaction methods – Factors influencing compaction of soils.

**UNIT II EFFECTIVE STRESS AND PERMEABILITY 9**

Soil - water – Static pressure in water - Effective stress concepts in soils – Capillary phenomena– Permeability interaction – Hydraulic conductivity – Darcy's law – Determination of Hydraulic Conductivity – Laboratory Determination (Constant head and falling head methods) and field measurement pumping out in unconfined and confined aquifer – Factors influencing permeability of soils – Seepage - Two dimensional flow – Laplace's equation – Introduction to flow nets – Simple problems. (Sheet pile and weir).

**UNIT III STRESS DISTRIBUTION AND SETTLEMENT 9**

Stress distribution in homogeneous and isotropic medium – Boussinesq theory – (Point load, Line load and udl) Use of New marks influence chart –Components of settlement — Immediate and consolidation settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. -  $\sqrt{t}$  and  $\log t$  methods–  $e$ - $\log p$  relationship.

**UNIT IV SHEAR STRENGTH 9**

Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Cyclic mobility – Liquefaction.

**UNIT V SLOPE STABILITY 9**

Stability Analysis - Infinite slopes and finite slopes – Total stress analysis for saturated clay – Friction circle method – Use of stability number – Method of slices – Fellenious and Bishop's method - Slope protection measures.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

On completion of the course, the student is expected to be able to

- CO1** Demonstrate an ability to identify various types of soils and its properties, formulate and solve engineering Problems
- CO2** Show the basic understanding of flow through soil medium and its impact of engineering solution
- CO3** Understand the basic concept of stress distribution in loaded soil medium and soil settlement due to consolidation
- CO4** Show the understanding of shear strength of soils and its impact of engineering solutions to the loaded soil medium and also will be aware of contemporary issues on shear strength of soils.
- CO5** Demonstrate an ability to design both finite and infinite slopes, component and process as per needs and specifications.

**TEXTBOOKS:**

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2015
2. Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Ltd. International Publisher New Delhi (India) 2006.

**REFERENCES:**

1. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations". Prentice-Hall, 2006.
2. Coduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India Pvt.Ltd. New Delhi, 2010.
3. Das, B.M., "Principles of Geotechnical Engineering". Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.
4. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 2005.

**COs- PO's & PSO's MAPPING**

PO/PSO		Course Outcome					Overall Correlation of CO s to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	2	3	3	2	3	3
PO2	Problem analysis	3	2	3	3	3	3
PO3	Design / development of solutions	2	3	2	3	2	2
PO4	Investigation	2	2	2	2	2	2
PO5	Modern Tool Usage	3	3	2	2	2	2
PO6	Engineer and Society	1	1	2	1	1	1
PO7	Environment and Sustainability	1	1	1	1	1	1
PO8	Ethics	1	1	1	1	1	1
PO9	Individual and Team work	2	2	2	1	1	2
PO10	Communication	1	1	1	1	1	1
PO11	Project Management and Finance	2	2	2	2	1	2
PO12	Life Long Learning	3	3	3	3	3	3
PROGRAM SPECIFIC OUTCOMES(PSO)							
PSO1	Knowledge of Civil Engineering discipline	3	2	2	2	2	2
PSO2	Critical analysis of Civil Engineering problems and innovation	3	2	2	2	3	2
PSO3	Conceptualization and evaluation of Engineering solutions to Civil engineering issues	2	3	3	3	2	3

**CE3405****HIGHWAY AND RAILWAY ENGINEERING****L T P C****3 0 0 3****COURSE OBJECTIVE:**

- To give an overview about the highway and railway engineering with respect to, planning, design, construction and maintenance as per IRC standards, specifications and methods.

**UNIT I HIGHWAY ENGINEERING****9**

Classification of highways – Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment –Typical cross sections of Urban and Rural roads – Engineering surveys for alignment- Conventional and Modern method

**UNIT II      DESIGN OF HIGHWAY ELEMENTS      9**  
Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves – Sight distances – Vertical curves, gradients– pavement components and their role - Design practice for flexible and rigid pavements (IRC methods only).

**UNIT III      HIGHWAY CONSTRUCTION AND MAINTENANCE      9**  
Highway construction materials, properties, testing methods – Construction practice of flexible and concrete pavement- Highway drainage – Evaluation and Maintenance of pavements.

**UNIT IV      RAILWAY PLANNING AND CONSTRUCTION      9**  
Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods-Geometric design of railway, gradient, super elevation, widening of gauge on curves (Problems)-Railway drainage- Level Crossings-Signalling.

**UNIT V      RAILWAY TRACK CONSTRUCTION MAINTENANCE AND OPERATION      9**  
Points and Crossings - Design of Turnouts, Working Principle-Track Circuiting - Construction & Maintenance – Conventional, Modern methods and Materials, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance - Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS Feasibility study, Planning and construction.

**TOTAL: 45 PERIODS**

#### **COURSE OUTCOMES**

On completion of the course, the student is expected to

- CO1** Plan a highway according to the principles and standards adopted in various institutions in India.
- CO2** Design the geometric features of road network and components of pavement.
- CO3** Test the highway materials and construction practice methods and know its properties and able to perform pavement evaluation and management.
- CO4** Understand the methods of route alignment and design elements in railway planning and constructions.
- CO5** Understand the construction techniques and maintenance of track laying and railway stations

#### **TEXTBOOKS:**

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2014.
2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai,2010
3. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 6th edition Delhi, 2015.
4. C. Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.

#### **REFERENCES:**

1. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Third Revision), IRC:37-2012
2. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, ( Third Revision), IRC:58-2012
3. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Ninth Impression, South Asia,2012
4. Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, 1st Edition, USA,2011
5. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd., New Delhi,2011
6. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi,2010
7. O'Flaherty.C.A "Highways, Butterworth – Heinemann, Oxford,2006
8. IRC-37–2012,The Indian roads Congress, Guidelines for the Design of Flexible Pavements, NewDelhi



9. IRC 58-2012. The Indian Road Congress, Guideline for the Design of Rigid Pavements for Highways, New Delhi
10. Saxena Subhash, C. and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998.

#### COs- PO's & PSO's MAPPING

PO/PSO		Course Outcome					Over all Correlation of Cos to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	3	2	2	3		2
PO2	Problem analysis		3	3			3
PO3	Design / development of solutions		3	2		3	3
PO4	Investigation	2	2	2			2
PO5	Modern Tool Usage		2	2		2	2
PO6	Engineer and Society	3		3	3		3
PO7	Environment and sustainability	1	2	3			2
PO8	Ethics	3	3	3	3		3
PO9	Individual and Team work		2			2	2
PO10	Communication				1		1
PO11	Project Management and Finance		2	3			3
PO12	Life Long Learning		3	3		2	3
PROGRAM SPECIFIC OUTCOMES (PSO)							
PSO1	Knowledge of Civil Engineering discipline	3	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and Innovation	2	3	3	2	3	3
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues				2	3	2

GE3451

**ENVIRONMENTAL SCIENCES AND SUSTAINABILITY**

**L T P C**

**2 0 0 2**

#### COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

#### UNIT I ENVIRONMENT AND BIODIVERSITY

**6**

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

**UNIT II ENVIRONMENTAL POLLUTION 6**  
Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

**UNIT III RENEWABLE SOURCES OF ENERGY 6**  
Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

**UNIT IV SUSTAINABILITY AND MANAGEMENT 6**  
Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

**UNIT V SUSTAINABILITY PRACTICES 6**  
Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

**TOTAL : 30 PERIODS**

**COURSE OUTCOMES:**

- CO1** To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- CO2** To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- CO3** To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- CO4** To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
- CO5** To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

**TEXTBOOKS:**

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

**REFERENCES :**

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.

4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

### COs- PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	1.8	-	-	-

- 1-low, 2-medium, 3-high, '-'- no correlation

NX3451		NCC Credit Course Level 2* (ARMY WING) NCC Credit Course Level - II		L T P C 3 0 0 3	
<b>PERSONALITY DEVELOPMENT</b>				<b>9</b>	
PD 3	Group Discussion: Change your mindset, Time Management, Social Skills			6	
PD 5	Public Speaking			3	
<b>LEADERSHIP</b>				<b>7</b>	
L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965			7	
<b>DISASTER MANAGEMENT</b>				<b>13</b>	
DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation			3	
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters			9	
DM 3	Fire Service & Fire Fighting			1	
<b>ENVIRONMENTAL AWARENESS &amp; CONSERVATION</b>				<b>3</b>	
EA 1	Environmental Awareness and Conservation			3	
<b>GENERAL AWARENESS</b>				<b>4</b>	
GA 1	General Knowledge			4	
<b>ARMED FORCES</b>				<b>6</b>	
AF 1	Armed Forces, Army, CAPF, Police			6	
<b>ADVENTURE</b>				<b>1</b>	
AD 1	Introduction to Adventure Activities			1	

<b>BORDER &amp; COASTAL AREAS</b>	<b>2</b>
BCA 1 History, Geography & Topography of Border/Coastal areas	2
<b>TOTAL: 45 PERIODS</b>	

<b>NCC Credit Course Level 2*</b>		
<b>NX3452</b>	<b>(NAVAL WING) NCC Credit Course Level - II</b>	<b>L T P C</b>
		<b>3 0 0 3</b>
<b>PERSONALITY DEVELOPMENT</b>		<b>9</b>
PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3
<b>LEADERSHIP</b>		<b>7</b>
L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7
<b>DISASTER MANAGEMENT</b>		<b>13</b>
DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1
<b>ENVIRONMENTAL AWARENESS &amp; CONSERVATION</b>		<b>3</b>
EA 1	Environmental Awareness and Conservation	3
<b>GENERAL AWARENESS</b>		<b>4</b>
GA 1	General Knowledge	4
<b>NAVAL ORIENTATION</b>		<b>6</b>
AF 1	Armed Forces and Navy Capsule	3
EEZ 1	EEZ Maritime Security and ICG	3
<b>ADVENTURE</b>		<b>1</b>
AD 1	Introduction to Adventure Activities	1
<b>BORDER &amp; COASTAL AREAS</b>		<b>2</b>
BCA 1	History, Geography & Topography of Border/Coastal areas	2
<b>TOTAL: 45 PERIODS</b>		

### NCC Credit Course Level 2\*

<b>NX3453</b>	<b>(AIR FORCE WING) NCC Credit Course Level - II</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

<b>PERSONALITY DEVELOPMENT</b>	<b>9</b>
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PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3

<b>LEADERSHIP</b>	<b>7</b>
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L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7
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<b>DISASTER MANAGEMENT</b>	<b>13</b>
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DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1

<b>ENVIRONMENTAL AWARENESS &amp; CONSERVATION</b>	<b>3</b>
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EA 1	Environmental Awareness and Conservation	3
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<b>GENERAL AWARENESS</b>	<b>4</b>
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GA 1	General Knowledge	4
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<b>GENERAL SERVICE KNOWLEDGE</b>	<b>6</b>
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GSK 1	Armed Forces & IAF Capsule	2
GSK 2	Modes of Entry in IAF, Civil Aviation	2
GSK 3	Aircrafts - Types, Capabilities & Role	2

<b>ADVENTURE</b>	<b>1</b>
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AD 1	Introduction to Adventure Activities	1
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<b>BORDER &amp; COASTAL AREAS</b>	<b>2</b>
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BCA 1	History, Geography & Topography of Border/Coastal areas	2
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**TOTAL: 45 PERIODS**

<b>CE3411</b>	<b>HYDRAULIC ENGINEERING LABORATORY</b>	<b>L T P C</b>
		<b>0 0 3 1.5</b>

**COURSE OBJECTIVES:**

- To provide hands on experience in calibration of flow meters, performance characteristics of pumps and turbines.

**LIST OF EXPERIMENTS (Any 10 of the following)**

**A. FLOW MEASUREMENT**

1. Calibration of Rotameter
2. Flow through Orifice meter/mouthpiece, Venturimeter and Notches
3. Bernoulli's Experiment

**B. LOSSES IN PIPES**

4. Determination of friction factor in pipes.
5. Determination of minor losses

**C. PUMPS**

6. Characteristics of Centrifugal pumps
7. Characteristics of Gear pump
8. Characteristics of Submersible pump
9. Characteristics of Reciprocating pump

**D. TURBINES**

10. Characteristics of Pelton wheel turbine
11. Characteristics of Francis turbine

**E. DETERMINATION OF METACENTRIC HEIGHT**

12. Determination of metacentric height of floating bodies.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

On completion of the course, the student is expected to

- CO1** Apply Bernoulli equation for calibration of flow measuring devices.  
**CO2** Measure friction factor in pipes and compare with Moody diagram  
**CO3** Determine the performance characteristics of rotodynamic pumps.  
**CO4** Determine the performance characteristics of positive displacement pumps.  
**CO5** Determine the performance characteristics of turbines.

**REFERENCES:**

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017.
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd. 2011

**COs- PO's & PSO's MAPPING**

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	2	3	3	3	3	3
PO2	Problem Analysis	2	2	3	3	3	3
PO3	Design / development of solutions	1	1	2	2	2	2
PO4	Investigation	3	3	3	3	3	3
PO5	Modern Tool Usage	1	1	1	1	1	1
PO6	Engineer and Society	2	2	2	2	2	2
PO7	Environment and Sustainability	2	2	2	2	2	2
PO8	Ethics	1	1	1	1	1	1
PO9	Individual and Team work	2	2	3	3	3	2
PO10	Communication	1	1	1	1	1	1
PO11	Project Management and Finance	1	1	1	1	1	1
PO12	Life Long Learning	2	2	2	2	2	2
PROGRAM SPECIFIC OUTCOMES(PSO)							
PSO1	Knowledge of Civil Engineering discipline	2	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and innovation	1	1	2	2	2	2
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	1	1	1	1	1	1

**COURSE OBJECTIVES:**

- To develop skills to test various construction materials.

**I. TESTS ON METALS**

- Tension test on steel rod
- Torsion test on mild steel rod
- Deflection test on metal beam
- Double shear test on metal
- Impact test on metal specimen (Izod and Charpy)
- Hardness test on metals (Rockwell and Brinell Hardness Tests)
- Compression test on helical spring
- Deflection test on carriage spring

**II. TESTS ON CEMENT**

- Determination of fineness of cement
- Determination of consistency of cement
- Determination of specific gravity of cement
- Determination of initial and final setting time of cement

**III. TESTS ON FINE AGGREGATE**

- Determination of specific gravity and water absorption of fine aggregate
- Determination of grading of fine aggregate
- Determination of water absorption for fine aggregate

**IV. TESTS ON COARSE AGGREGATE**

- Determination of compacted and loose bulk density of coarse aggregate
- Determination of impact value of coarse aggregate
- Determination of elongation index of coarse aggregate
- Determination of flakiness index of coarse aggregate
- Determination of aggregate crushing value of coarse aggregate
- Determination of specific gravity and water absorption of coarse aggregate

**V. TESTS ON BRICKS**

- Determination of compressive strength of bricks
- Determination of water absorption of bricks
- Determination of efflorescence of bricks

**VI. TESTS ON CONCRETE**

- Determination of slump of concrete
- Determination of compressive strength of concrete
- Determination of flowability of self-compacting concrete (Demo only)

**VII. TEST ON WOOD**

- Determination of Compression test on wood

**TOTAL: 60 PERIODS****COURSE OUTCOMES:**

On completion of the course, the student is expected to

- CO1** Determine the mechanical properties of steel.  
**CO2** Determine the physical properties of cement  
**CO3** Determine the physical properties of fine and coarse aggregate.  
**CO4** Determine the workability and compressive strength of concrete.  
**CO5** Determine the strength of brick and wood.

**COs- PO's & PSO's MAPPING**

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAM OUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	2	3	3	3	3	3
PO2	Problem analysis	2	2	3	3	3	3
PO3	Design / development of solutions	1	1	2	2	2	2
PO4	Investigation	3	3	3	3	3	3
PO5	Modern Tool Usage	1	1	1	1	2	1
PO6	Engineer and Society	2	2	2	2	2	2
PO7	Environment and Sustainability	2	2	2	2	2	2
PO8	Ethics	1	1	1	1	1	1
PO9	Individual and Team work	3	3	3	3	3	3
PO10	Communication	1	1	1	1	1	1
PO11	Project Management and Finance	1	1	1	1	1	1
PO12	Life Long Learning	2	2	2	2	2	2
PROGRAM SPECIFIC OUTCOMES(PSO)							
PSO1	Knowledge of Civil Engineering discipline	2	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and innovation	2	2	2	2	2	2
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	2	2	2	2	2	2

**CE3413****SOIL MECHANICS LABORATORY****L T P C  
0 0 3 1.5****COURSE OBJECTIVES:**

- To develop skills to test the soils for their index and engineering properties and to characterize the soil based on their properties.

**EXERCISES:****1. DETERMINATION OF INDEX PROPERTIES**

Specific gravity of soil solids

- Grain size distribution – Sieve analysis
- Grain size distribution - Hydrometer analysis
- Liquid limit and Plastic limit tests
- Shrinkage limit and Differential free swell tests

**2. DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS**

- Field density Test ( Sand replacement method)
- Determination of moisture – density relationship using standard proctor compaction test.

**3. DETERMINATION OF ENGINEERING PROPERTIES**

- Permeability determination (constant head and falling head methods)
- One dimensional consolidation test (Determination of co-efficient of consolidation only)
- Direct shear test in cohesion less soil
- Unconfined compression test in cohesive soil
- Laboratory vane shear test in cohesive soil
- Tri-axial compression test in cohesion less soil (Demonstration only)
- California Bearing Ratio Test



4. **TEST ON GEOSYNTHETICS (Demonstration only)**  
 Determination of tensile strength and interfacial friction angle.  
 a. Determination of apparent opening sizes and permeability.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

- On completion of the course, the student is expected to
- CO1** Conduct tests to determine the index properties of soils  
**CO2** Determine the insitu density and compaction characteristics.  
**CO3** Conduct tests to determine the compressibility, permeability and shear strength of soils.  
**CO4** Understand the various tests on Geosynthetics.

**REFERENCES:**

- Soil Engineering Laboratory Instruction Manual" published by Engineering College Co- operative Society, Anna University, Chennai, 2010.
- "Saibaba Reddy, E. Ramasastri, K. "Measurement of Engineering Properties of Soils", New age International (P) limited publishers, New Delhi, 2008.
- Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951. Digitized 2008.
- IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.
- G.Venkatappa Rao and Goutham .K. Potable, "Geosynthetics Testing – A laboratory Manual", Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.
- Braja M.Das., "Soil Mechanics: Laboratory Manual", Oxford University Press, eighth edition, 2012.

**COs- PO's & PSO's MAPPING**

PO/PSO		Course Outcome				Overall Correlation of CO s to POs
		CO1	CO2	CO3	CO4	
PROGRAM OUTCOMES(PO)						
PO1	Knowledge of Engineering Sciences	2	1	3	1	1
PO2	Problem analysis	2	2	3	2	2
PO3	Design / development of solutions	3	3	3	2	3
PO4	Investigation	3	3	3	3	3
PO5	Modern Tool Usage	1	1	1	2	1
PO6	Engineer and Society	1	1	1	1	1
PO7	Environment andSustainability	1	1	1	1	1
PO8	Ethics	1	1	1	1	1
PO9	Individual and Team work	3	3	3	3	3
PO10	Communication	1	2	1	1	1
PO11	Project Management and Finance	1	1	1	1	1
PO12	Life Long Learning	3	3	3	3	3
PROGRAM SPECIFIC OUTCOMES(PSO)						
PSO1	Knowledge of Civil Engineering discipline	3	2	2	2	2
PSO2	Critical analysis of Civil Engineering problems and innovation	3	3	3	2	3
PSO3	Conceptualization and evaluation of Engineering solutions to Civil engineering issues	3	2	3	3	3