

Aliah University



Syllabus for

4 Year B. Tech Programme

In

Civil Engineering

Aliah University

A-II/27, New Town

Kolkata-700160

w. e. f 2019-20

(Applicable from:2019-2020)

Dept. of Civil Engineering

A. Programme Outcomes:

PO1-Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2- Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3- Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4- Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5- Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6- The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7- Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8- Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9-Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10- Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11-Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12-Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B. Programme Specific Outcomes:

PSO-1: To be able to identify a problem, to be able to analyse the various parameters influencing it.

PSO-2: To be able to develop solutions for the problem and also to be able to design it.

PSO-3: To be able to develop and upgrade oneself to meet the rising challenges in the Civil Engineering Field.

PSO-4: To be able to excel in teamwork and always be aware of the various codes of conduct in Civil Engineering practice and be able to take professional ethical decisions.

Detailed Course Structure with Credit Distribution

1st Year 1st Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
I/I	Engineering Mechanics	ESC	MENUGES01	3-1-0	4	19.5
I/I	Basic Electronics Engineering	ESC	ECEUGES01	3-0-0	3	
I/I	Engineering Mathematics I	BSC	MATUGBS01	4-0-0	4	
I/I	Engineering Physics	BSC	PHYUGBS01	3-0-0	3	
I/I	Engineering Graphics & Design	ESC	CENUGES01	1-0-3	2.5	
I/I	Basic Electronics Engineering Lab	ESC	ECEUGES02	0-0-3	1.5	
I/I	Engineering Physics Lab	BSC	PHYUGES02	0-0-3	1.5	
I/I	Elementary Arabic & Islamic Studies	MC	UCCUGAU01	4-0-0	0	

1st Year 2nd Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
I/II	Programming for Problem Solving	ESC	CSEUGES01	3-0-0	3	24
I/II	Basic Electrical Engineering	ESC	EENUGES01	3-0-0	3	
I/II	Engineering Mathematics II	BSC	MATUGBS02	4-0-0	4	
I/II	Engineering Chemistry	BSC	CHMUGBS01	3-0-0	3	
I/II	Communicative English	HSMC	ENGUGHU01	3-0-0	3	
I/II	Programming for Problem Solving Lab	ESC	CSEUGES02	0-0-4	2	
I/II	Basic Electrical Engineering Lab	ESC	EENUGES02	0-0-3	1.5	
I/II	Workshop Practice	ESC	MENUGES02	0-1-2	2	
I/II	Engineering Chemistry Lab	BSC	CHMUGBS02	0-0-3	1.5	
I/II	Language Lab	HSMC	ENGUGHU02	0-0-2	1	

2nd Year 3rd Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
II/III	Introduction to Civil Engineering	HMC	CENUGHU01	2-0-0	2	19
II/III	Mechanics of Materials	PCC	CENUGPC01	2-1-0	3	
II/III	Surveying & Geomatics	PCC	CENUGPC02	2-1-0	3	
II/III	Building materials	PCC	CENUGPC03	3-0-0	3	
II/III	Indian Constitution	MC	UCCUGMC03	2-0-0	0	
II/III	Engineering Mathematics III	BSC	MATUGBS03	4-0-0	4	
II/III	Estimation, Costing & Valuation	PCC	CENUGPC04	1-0-3	2.5	
II/III	Civil Engineering Drawing Lab.	PCC	CENUGPC05	0-0-3	1.5	

Detailed Course Syllabus

Course Name: Introduction to Civil Engineering

Course Code: CENUGHU01

L+T+P :2-1-0

Contact hrs: 20

Course Objective: When the students enter the college to pursue a degree in Civil Engineering and as well pursue a career in Civil Engineering after graduation, they need to understand the breadth and depth available in this field for possible engagement. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Civil Engineering student should realize the solid foundations available in this mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all pervasive field of engineering.

Course Outcomes:

- **CO-1:** To understand what constitutes Civil Engineering.
- **CO-2:** To identify the various areas available to pursue and specialize within the overall field of Civil Engineering.
- **CO-3:** To explore the various possibilities of a career in this field by understanding the depth of engagement possible within the different specializations of Civil Engineering.
- **CO-4:** To understand the vast interfaces this field has with the society at large.
- **CO-5:** To provide inspiration for doing creative and innovative work.
- **CO-6:** To showcase the many monuments, heritage structures, nationally important infrastructure, and impressive projects to serve as sources of inspiration.
- **CO-7** To emphasize on possibilities for taking up entrepreneurial activities in this field.
- **CO-8:** To provide a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering.

Module I/Unit I: What is Civil Engineering/ Infrastructure, History of Civil Engineering, Overview of ancient & modern civil engineering marvels.

Module II/Unit I: Current national planning for civil engineering/ infrastructure projects
Scope of work involved in various branches of Civil Engineering- Architecture & Town planning, Surveying & Geomatics, Structural Engineering, Construction Management,

Construction materials, Hydrology and Water Resources Engineering, Hydraulic Engineering, Environmental Engineering & Sustainability, Pavement Engineering and construction, Traffic & Transportation Engineering and Management, Geotechnical Engineering, Ocean Engineering.

Module III/Unit I: Building Energy Efficiency, Basics of Contract Management, Professional Ethics, Avenues for entrepreneurial working, Creativity & Innovativeness in Civil Engineering.

Suggested Readings:

1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract.
2. The National Building Code, BIS, (2017).
3. RERA Act, (2017).
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset.
5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai.
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House.
8. Anson W.R.(1979), Law of Contract, Oxford University Press.
9. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration.
10. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co.
11. Wadhwa (2004), Intellectual Property Rights, Universal Law Publishing Co.
12. P. S. Narayan (2000), Intellectual Property Rights, Gogia Law Agency.
13. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House.
14. Bare text (2005), Right to Information Act.
15. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers.
16. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act.
17. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House.
18. Vee, Charles & Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss. 2, pp 117-127, MCB UP Ltd.
19. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application.
20. Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill.
21. Engineering Ethics, National Institute for Engineering Ethics, USA.
22. www.ieindia.org.
23. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins.
24. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (Teaching Case Study) -S. Ramakrishna Velamuri -CEIBS.
25. CONSTRUCTION CONTRACTS, <http://www.jnormanstark.com/contract.htm>.
26. Internet and Business Handbook, Chap 4, CONTRACTS LAW, <http://www.laderapress.com/laderapress/contractslaw1.html>.
27. Contract&Agreements
<http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm>
28. Contracts, <http://206.127.69.152/jgretch/crj/211/ch7.ppt>.
29. Business & Personal Law. Chapter 7. “How Contracts Arise”, <http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt>.

30. Types of Contracts, <http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt>.
31. IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS, <http://www.worldbank.org/html/opr/consult/guidetxt/types.html>.
32. Contract Types/Pricing Arrangements Guideline- 1.4.G (11/04/02),, <http://www.sandia.gov/policy/14g.pdf>.

Course Name: Mechanics of Materials

Course Code: CENUGPC01

L+T+P :2-1-0

Contact hrs: 30

Course Objective: The objective of this Course is to provide an understanding of all kinds of stresses, deformations, and how to calculate them in a wide range of simple, practical structural problems, and an understanding of the mechanical behaviour of materials under various load conditions.

Course Outcomes:

- **CO-1:** To understand the mechanical behaviour of materials under different loading conditions.
- **CO-2:** To make use of capabilities forces and moments for design.
- **CO-3:** To develop knowledge of engineering principles to apply in civil engineering principles.

Module I/Unit I: Simple Stresses and Strains - Concept of stress and strain, Elasticity and plasticity.

Module I/Unit II: Types of stresses and strains, Hooke's law, stress – strain diagrams, Poisson's ratio and volumetric strain, Relationship between elastic constants

Module I/Unit III: Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress.

Module II/Unit I: Bending moment and Shear Force Diagrams, Determination of bending stresses – Section modulus.

Module III/Unit I: Shear stress distribution across various beam sections, Slope and deflection- Moment area method, Macaulay's method.

Module IV/Unit I: Stability of Columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load.

Module V/Unit I: Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity.

Module V/Unit II: Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion.

Module VI/Unit I: Thin and thick Cylinders and Spheres- Derivation of formulae and calculations of hoop stress.

Module VI/Unit II: Longitudinal stress in a cylinder, and sphere subjected to internal pressures.

Suggested Readings:

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New

- York, USA.
2. Kazmi, S. M. A., ‘Solid Mechanics’ TMH, Delhi, India.
 3. Hibbeler, R. C. *Mechanics of Materials*. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004.
 4. Gere, J. M., and S. P. Timoshenko. *Mechanics of Materials*. 5th ed. Boston: PWS Kent Publishing, 1970.

Course Name: Surveying & Geomatics

Course Code: CENUGPC02

L+T+P :2-1-0

Contact hrs: 30

Course Objective: The objective of this Course is to introduce the basic concepts of surveying and remote sensing integrated with geographical information system. This subject further focus on the determination of relative position of any objects or points of the earth, the distance and angle between the different objects and to prepare a map or plan to represent an area on horizontal plan.

Course Outcomes:

- **CO-1:** To apply the basic tools and technology to engineering and surveying activities.
- **CO-2:** To translate the knowledge gained for the implementation of Civil infrastructure facilities.
- **CO-3:** To relate the knowledge on Surveying to the new frontiers of science, Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.

Module I/Unit I: Introduction: Definition, classification of surveying, objectives, principles of surveying, Errors and Accuracy, Linear measurement and corrections.

Module II/Unit I: Chain survey -Chain and its types, ground features by offsets – Field book. Errors in chain surveying and their elimination: Problems.

Module III/Unit I: Prismatic compass survey- Local attraction and its adjustments.

Module IV/Unit I: Traversing: Principles and Adjustments of Traverse, Problems.

Module V/Unit I: Levelling: Methods of levelling – Differential, Profile & fly Leveling, Effect of curvature and refraction, Automatic levels, Plotting longitudinal sections and Cross sections.

Module VI/Unit I: Theodolite: Instrument Specifications, Adjustments and Principles of Angle Measurement, Trigonometric and Geodetic Survey.

Module VII/Unit I: Total Station with Field applications.

Module VIII/Unit I: Introduction to GPS, GIS and Remote Sensing.

Suggested Readings:

1. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi.
2. Arora K R “Surveying Vol 1, 2 & 3), Standard Book House, Delhi, 2004.
3. Prof. T.P. Kenetkar and Prof. S.V. Kulkarni - Surveying and Levelling, Pune Vidyarthi Griha Prakashan,2004.
4. S.K. Duggal - Surveying Vol. II, Tata McGraw Hill Ltd , Reprint 2015.

Course Name: Building Materials**Course Code: CENUGPC03****L+T+P :3-0-0****Contact hrs: 30**

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

Course Outcomes:

- **CO-1:** To understand various conventional construction materials, properties and their uses.
- **CO-2:** To Describe various latest and modern construction methods and their applications.

Module I/Unit I: Bricks: Classification, Characteristics of bricks, ingredients of brick earth, testing of bricks as per BIS.

Module II/Unit I: Aggregates: Classification, Characteristics, Alkali –aggregates reaction, Fine aggregates, coarse aggregates, Testing of aggregates.

Module III/Unit I: Lime: Classification, Slaking and hydration, Hardening, Testing, Storage, Handling.

Module IV/Unit I: Cement and Concrete: Cement, Chemical Composition of Cement, Hydration of Cement, Heat of Hydration and Strength, Tests on Cement.

Module V/Unit I: Admixtures – Different types, effects, uses, Retarders and Super plasticizers. Light-weight, Polymer and Fibre-reinforced concrete.

Module VI/Unit I: Mortars: Classification, Uses, Characteristics of good mortar, Ingredients.

Module VII/Unit I: Wood and Wood Products, Paints, Enamels and Varnishes: Composition of oil paint, characteristic of an ideal paint, preparation of paint, covering power of paints, Painting: Plastered surfaces, painting wood surfaces, painting metal Surfaces.

Module VIII/Unit I: Wall, Doors and Windows.

Module VIII/Unit II: Foundations, Stairs.

Module VIII/Unit III: Roofs, Brick & Stone Masonry. Formworks.

Suggested Readings:

1. Building Materials by Rangawala.
2. Building Materials and Construction by B. C. Punmia.
3. Building Construction and Foundation Engineering by Jha and Sinha.
4. Concrete Technology by M. S. Shetty.
5. Building Materials by S. K. Duggal.
6. Building Materials by P.C. Varghese.

Course Name: Estimation, Costing & Valuation

Course Code: CENUGPC04

L+T+P :1-0-3

Contact hrs: 25

Course Objective: The objective of this course is to determine the quantities of items and labour requirement of civil engineering works. Preparation of estimate of the civil engineering works. To introduce the students in depth knowledge of professional practice as well the quantity, analysis of construction works like, multi-storied structures, Water works & sanitary works, Irrigation works, Road estimates, culverts, etc.

Course Outcomes:

- **CO-1:** To prepare tender documents.
- **CO-2:** To prepare estimates for various engineering structures.

Module I/Unit I: Introduction: Purpose of estimating and valuation, Types of estimates. Building Estimate: Main items and their unit of measurement.

Module II/Unit I: Methods of Measurement: Methods of estimating quantities, Estimating quantities of building.

Module II/Unit II: Methods of Measurement: Estimation of quantity of load bearing structure with single room & two rooms, Estimation of quantity single storied residential building.

Module II/Unit III: Methods of Measurement: Estimation of quantity of different R.C.C. structures.

Module II/Unit IV: Methods of Measurement: Estimation of quantity of water supply and sanitary works.

Module II/Unit V: Methods of Measurement: Estimation of quantity of culverts and bridges.

Module II/Unit VI: Methods of Measurement: Road estimating, Estimation of quantity of Trusses.

Module III/Unit I: Market Survey: Traditional and modular materials, Market survey of materials of Construction, Wages of labour, Tools plant and equipment of construction.

Module IV/Unit I: Rate Analysis : Prerequisites, factors affecting rate analysis, procedure for rate analysis, schedule of rates, Labour requirement for different works, material requirement for different works, Rate analysis of different Items of work.

Module V/Unit I: Tenders And Contracts: Tender notice, tender document, Terms and conditions of contract.

Module VI/Unit I: Valuation: Purpose of valuation, types of property- Depreciation.

Suggested Readings:

1. B. N. Dutta, Estimating and Costing In Civil Engineering, Ubs Publishers Distributors Ltd.
2. S. C. Rangwala, Estimating And Costing, Charotar Publishing House, Anand
3. G. S. Biridi, Textbook of Estimating & Costing, Dhanapat Rai & Sons. Delhi.
4. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing & Valuation, S.K Kataria & Sons, New Delhi.
5. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication.

Course Name: Civil Engineering Drawing Lab

Course Code: CENUGPC05

L+T+P :0-0-3

Contact hrs: 15

Course Objective: The objective of this course is to equip the students to prepare Civil Engineering Drawings for various residential and commercial projects.

Course Outcomes:

- **CO-1:** To equip the students with the very basics of Civil Engineering Drawing.
- **CO-2:** To enable the students to interpret Civil Engineering Drawings in site required for execution.
- **CO-3:** To enable the students to interpret Civil Engineering Drawings in site required for execution.
- **CO-4:** To apply the knowledge of Civil Engineering Drawing to industrial, commercial and residential projects.

Module I/Unit I: Introduction: Introduction to concept of drawings, Reading of specific drawings, Planning drawings to show information precisely and comprehensively; optimal layout of drawings and choosing of appropriate Scales; Introduction to computer aided drawing, co-ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

Module II/Unit I: Symbols and Sign Conventions: Materials, Architectural, Structural, Electrical, Mechanical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

Module III/Unit I: Masonry Bonds: English Bond and Flemish Bond – Corner wall and Cross walls -One brick wall and one and half brick wall, Header Bond and Stretcher Bond, King Post Truss and Queen Post Truss.

Module IV/Unit I: Building Drawing: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity.

Module V/Unit I: Pictorial View: Principles of isometrics and perspective drawing. Perspective view of building. Basic introduction to fundamentals of Building Information Modelling (BIM).

Suggested Readings:

1. Subhash C Sharma & Gurucharan Singh (2005), “Civil Engineering Drawing”, Standard Publishers
2. Pradeep Jain & A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House (2019)
3. Ajeet Singh (2002), “Working with AUTOCAD 2000 with updates on AUTOCAD 2001”, Tata- Mc Graw-Hill Company Limited, New Delhi
4. Sham Tickoo Swapna D (2009), “AUTOCAD for Engineers and Designers”, Pearson Education,
5. Venugopal (2007), “Engineering Drawing and Graphics + AUTOCAD”, New Age International Pvt. Ltd.,
6. Shah, Engineering Drawings and Computers, Pearson
7. Balagopal and Prabhu (1987), “Building Drawing and Detailing”, Spades publishing KDR building, Calicut,
8. (Corresponding set of) CAD Software Theory and User Manuals.
9. V.B.Sikka., A Course in Civil Engineering Drawing, Katson Books.
10. Rangwala., Civil Engineering Drawing,
11. S. C. Rangwala, Estimating And Costing, Charotar Publishing House, Anand
12. G. S. Biridi, Textbook of Estimating & Costing, Dhanapat Rai & Sons. Delhi.
13. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing & Valuation, S.K Kataria & Sons, New Delhi.
14. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication.

2nd Year 4th Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
II/IV	Biology for Engineers	BSC	BIOUGBS01	2-0-0	2	18.5
II/IV	Environmental Science	MC	UCCUGMC02	2-0-0	0	
II/IV	Fluid Mechanics & Hydraulics	PCC	CENUGPC06	3-1-0	4	
II/IV	Structural Analysis	PCC	CENUGPC07	3-1-0	4	
II/IV	Design of RCC Structures	PCC	CENUGPC08	2-1-0	3	
II/IV	Engineering Geology	PCC	CENUGPC09	2-0-1	2.5	
II/IV	Concrete Lab.	PCC	CENUGPC10	0-0-3	1.5	
II/IV	Surveying Lab.	PCC	CENUGPC11	0-0-3	1.5	

Course Name: Fluid Mechanics & Hydraulics

Course Code: CENUGPC06

L+T+P :3-1-0

Contact hrs: 40

Course Objective:

The objective of this course is to introduce fundamentals of static, kinematic and dynamic principle of mechanics and its application to stagnant and flowing fluid through different conduits.

Course Outcomes:

- **CO-1:** To understand the broad principles of fluid statics, kinematics and dynamics.
- **CO-2:** To apply the continuity, momentum and energy principles on the flowing system through different conduits.
- **CO-3:** To apply principle of dimensional analysis for modelling various fluid behaviour on the hydraulic system.

Module I/Unit I: Introduction: Fluid properties, types of fluids, continuum principle.

Module II/Unit I: Principles of Fluid Statics: Basic equations, manometers, hydrostatic forces on submerged surfaces, buoyancy.

Module III/Unit I: Kinematics of Flow: Visualization of flow, types of flow, streamline, path line, streak line, principle of conservation of mass, velocity, acceleration, velocity potential and stream function, vorticity, circulation.

Module IV/Unit I: Fluid Dynamics: Control volume approach, Euler's equation, Bernoulli's equation and its applications, momentum and angular momentum equations and their applications.

Module V/Unit I: Pipe Flow & Boundary Layer Theory, Dimensional Analysis and Similitude: Dimensional homogeneity, Buckingham's π theorem, dimensionless numbers, similitude.

Suggested Readings:

1. Som, S.K. and Biswas, G., "Fluid Mechanics and Fluid Mechanics", Tata McGraw Hill.
2. Garde, R.J. and Mirajgaoker, A.G., "Engineering Fluid Mechanics", Nem Chand & Bros.
3. Fox, R.W. and McDonald, A.T., "Introduction to Fluid Mechanics", John Wiley & Sons.
4. Asawa, G.L., "Fluid Flow in Pipes and Channels", CBS Publishers.
5. Schlichting, H. and Gersten, K., "Boundary Layer Theory", Springer.
6. Streeter, V.L. and Benjamin, W.E., "Fluid Mechanics", McGraw-Hill.
7. Hydraulics And Fluid Mechanics Including Hydraulic Machines (In SI Units) by P.N. Modi, S.M. Seth.
8. A textbook of Fluid mechanics by R.K Bansal: Laxmi Publication.

Course Name: Structural Analysis

Course Code: CENUGPC07

L+T+P :3-1-0

Contact hrs: 40

Course Objective:

The objective of this course is to ensure that a structure has the proper strength, rigidity, safety, and deformations within permissible limit. The aim of this course is to integrate the disciplines of mechanics, dynamics, and failure theories to compute the internal forces and stresses on the structures to be designed.

Course Outcomes:

- **CO-1:** To apply their knowledge of structural mechanics in addressing design problems of structural engineering.
- **CO-2:** To possess the skills to solve problems dealing with different loads in concrete and steel structures.

- **CO-3:** To develop knowledge in structural engineering.

Module I/Unit I: Introduction; Classification of structures; Determinate and Indeterminate structures.

Module I/Unit II: Strain energy, work done by forces, Total strain energy, Minimum potential energy, Castigliano's theorems.

Module II/Unit I: Classification of structural Analyses; Displacement method: Joint displacement method for trusses.

Module II/Unit II: Slope displacement method for beams and frames, Force/ compatibility/ method.

Module II/Unit III: Unit load method; Application to indeterminate trusses and frames; Moment distribution method.

Module II/Unit III: Influence lines and Moving loads; Different load cases, Influence lines for forces for determinate beams; Influence lines for pin-jointed trusses.

Module II/Unit IV: Influence lines for indeterminate beams using Muller Breslau principle

Module III/Unit I: Influence lines for Arches and stiffening girders.

Suggested Readings:

- 1) Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" McGraw Hill, Tokyo, Japan.
- 2) Wang C.K., Intermediate Structural Analysis, Tata McGraw Hill book Company, New Delhi.
- 3) C.S. Reddy , Basic Structural Analysis - Tata McGraw Hill Pub. Co. Ltd. New Delhi.
- 4) Hibbler R C; Structural Analysis; Pearson.

Course Name: Design of RCC Structures

Course Code: CENUGPC08

L+T+P :2-1-0

Contact hrs: 30

Course Objective:

The objective of this course is to perform analysis and design of reinforced concrete members, connections, and to be able to identify, and interpret the appropriate relevant industry design codes. Also to become familiar with professional and contemporary issues in the design and construction of reinforced concrete structures.

Course Outcomes:

- **CO-1:** To understand the general mechanical behavior of reinforced concrete.
- **CO-2:** To analyze and design of reinforced concrete structures.
- **CO-3:** To possess the skills to solve problems dealing with different loads in concrete structures.

Module I/Unit I: Introduction; Study of the strength, behavior of reinforced concrete structures; Load and stresses, load combinations.

Module I/Unit II: Working stress and limit state approach. Analysis and design of sections in bending – working stress and limit state method.

Module I/Unit III: Rectangular and T-sections, Beams with reinforcement in compression, Design for shear and bond, Mechanism of shear and bond failure, Design of shear using limit state concept.

Module II/Unit I: Development length of bars; Design of sections in torsion. Design of one way and two-way slabs; Design of flat slab, Placement of reinforcement in slabs,

Module III/Unit I: Design of compression members; Short column, Columns with uni-axial and bi-axial bending, use of design charts.

Module IV/Unit I: Design of foundation; Wall footing, Isolated and combined footing for columns.

Suggested Readings:

- 1) Nilson, A. H. *Design of Concrete Structures*. 13th edition. McGraw Hill, 2004
- 2) MacGregor, J. G., *Reinforced Concrete: Mechanics and Design*, 3rd Edition, Prentice Hall, New Jersey, 1997.
- 3) Jain, A.K., *Design of Concrete Structure by Nem Chand & Bros.*; Seventh edition (2012)
- 4) Menon, P. *Reinforced Concrete Design*, Third Edition, McGraw Hill

Course Name: Engineering Geology

Course Code: CENUGPC09

L+T+P :2-0-1

Contact hrs: 25

Course Objective:

The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects.

Course Outcomes:

- **CO-1:** To perform characterization and how to collect, analyse, and report geologic data using standards in engineering practice
- **CO-2:** To perform rock mass characterization.

Module I/Unit I: Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects.

Module II/Unit I: Mineralogy-Mineral, Origin and composition. Physical properties of minerals. **Petrology-** Igneous petrology, Sedimentary petrology, Metamorphic petrology.

Module III/Unit I: Physical Geology- Weathering. Erosion and Denudation.

Module IV/Unit I: Strength Behavior of Rocks- Dip and Strike. Outcrop, Inliers, Outliers, Fold, Faults, Joints & Unconformity, Importance of structural elements in engineering operations, Earthquake and Subsidence.

Module V/Unit I: Rock masses as construction material- Building stones, Road materials.

Module VI/Unit I: Geology of dam and reservoir site-Required geological consideration for selecting dam and reservoir, site Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions.

Suggested Readings:

- 1) Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
- 2) Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
- 3) Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

Course Name: Concrete Lab

Course Code: CENUGPC10

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this Laboratory is to enable the students to understand the composition, properties of concrete and also to prepare a concrete of certain grade by the process of mix design.

Course Outcomes:

- **CO-1:** To demonstrate the method and findings of tension and compression tests on concrete.
- **CO-2:** To understand the concepts of different test on hardened concrete.
- **CO-3:** To calculate the specific gravity of concrete ingredients.
- **CO-4:** To find out the mix proportion of high grade of concrete.
- **CO-5:** To measure the workability of concrete mix.
- **CO-6:** To know about the quality of concrete
- **CO-7:** To understand the different properties of cement.

Experiment List:

- 1. Test on Fine aggregates:** Bulking, Specific gravity, Bulk Density, Percentage voids, Fineness Modulus. Grading curve.
- 2. Test on Coarse aggregates:** Specific gravity, Bulk Density, Percentage voids, Fineness Modulus. Grading curve.
- 3. Test on Cement:** Normal consistency, fineness, Initial setting and final setting time of cement. Specific gravity, soundness and Compressive strength of Cement.
- 4. Test on Fresh Concrete:** Concrete mix design, Various workability tests – slump, compacting factor, vee-bee test.
- 5. Test on Hardened Concrete:** Split-tensile strength test, Flexure test, NDT Tests (Rebound hammer and Ultra-sonic pulse velocity), Poission ratio.

Course Name: Surveying Lab

Course Code: CENUGPC11

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this field work is to enable the students to understand the various types of engineering survey works required for different construction projects.

Course Outcomes:

CO-1: To state the interdependency and advancement of different surveying methods.

- **CO-2:** To comprehend the working principles of different surveying instruments and experiments.
- **CO-3:** To execute the different methods of surveying to measure the features of interest.
- **CO-4:** To investigate the results obtained from the surveying experiments.

- **CO-5:** To critically evaluate the different techniques of surveying in measuring and assessing the features of interest.
- **CO-6:** To fabricate and construct solutions for the real world problems pertaining to surveying.

Experiment List:

1. Chain Surveying
2. Levelling
3. Compass Surveying
4. Theodolite Traversing
5. Plane Table Surveying
- 6, Setting out of Simple Circular Curves
7. Use of Total Station

3rd Year 5th Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
III/V	Design of Steel Structures	PCC	CENUGPC12	2-1-0	3	18
III/V	Open Channel Flow	PCC	CENUGPC13	2-1-0	3	
III/V	Soil Mechanics	PCC	CENUGPC14	2-1-0	3	
III/V	Transportation Engg	PCC	CENUGPC15	2-1-0	3	
III/V	Open Elective-I	OEC	---	3-0-0	3	
III/V	RCC Design Sessional	PCC	CENUGPC16	0-0-3	1.5	
III/V	Hydraulics & Hydraulics M/c Lab.	PCC	CENUGPC17	0-0-3	1.5	

Course Name: Design of Steel Structures

Course Code: CENUGPC12

L+T+P :2-1-0

Contact hrs: 30

Course Objective:

The objective of this course is to learn the behavior and design of structural steel components (members, connections, trusses and frame structures) and to gain an educational and comprehensive experience in the design of simple steel structures.

Course Outcomes:

- **CO-1:** To understand the general mechanical behavior of steel structures.
- **CO-2:** To design members and connections of steel structures.
- **CO-3:** To possess the skills to solve problems dealing with different loads in steel structures.

Module I/Unit I: Introduction; Properties of materials, loads and stresses.

Module II/Unit I: Design of semi-rigid, rigid and moment resistant connections.

Module III/Unit I: Design of tension members subjected to axial tension and bending, splicing of tension member.

Module IV/Unit I: Design of compression members, Built-up sections; Beam-column connections.

Module V/Unit I: Design of columns and their bases; Design of flexural members and Plate girder.

Module VI/Unit I: Loads, specification and design of Industrial buildings; loads, design of purlins, trusses, bracings; gantry girders.

Module VII/Unit I: Introduction to Plastic analysis; Simple cases of beams and frames.

Suggested Readings:

- 1) McCormac, J.C., Nelson, J.K. Jr., *Structural Steel Design*. 3rd edition. Prentice Hall, N.J., 2003.
- 2) Design of steel structure by Arya&Ajmani, NEM CHAND & BROS; 2015 edition.
- 3) Duggal, S.K. Limit State Design of Steel Structures, Second Edition, McGraw Hill.

Course Name: Open Channel Flow

Course Code: CENUGPC13

L+T+P :2-1-0

Contact hrs: 30

Course Objective:

The objective of this course is to introduce the basic hydraulic phenomenon in open channel system. This subject explains the type, behaviour and governing principle in open channel system.

Course Outcomes:

- **CO-1:** To develop the open channel flow equations from the basic conservation equations.
- **CO-2:** To identify, analyze and design the various hydraulic structures associated with open channel system.

Module I/Unit I: Introduction: Difference between open channel flow and pipe flow, classification of flow in Channels, geometrical parameters of a channel, continuity equation, Momentum equation and Energy equation.

Module II/Unit I: Specific Energy: Critical depth, concepts of specific energy and specific force, Alternate depths, Conditions for maximum discharge and Channel transition.

Module III/Unit I: Uniform flow, Chezy's and Manning's equations for uniform flow in open channel, velocity distribution, most efficient channel section.

Module IV/Unit I: Non-Uniform Flow: Equation of gradually varied flow and its limitations, flow classification and surface profiles, Hydraulic jump: loss of energy and length, application of specific energy principle for interpretation of open channel phenomena, flow through vertical and horizontal contractions. integration of varied flow equation by analytical, graphical and numerical methods, flow in curved channels.

Suggested Readings:

- 1) Chow, V.T., “Open Channel Hydraulics”, McGraw Hill.
- 2) Chaudhry, M.H., “Open Channel Flow”, Prentice-Hall, New Jersey, USA.
- 3) Chanson, H., “The Hydraulics of Open Channel Flow: An Introduction”, Elsevier Scientific.
- 4) Subramanya, K., “Flow in Open Channels”, Tata McGraw-Hill.
- 5) Ranga Raju, K.G., “Flow through Open Channels”, Tata McGraw-Hill.

Course Name: Soil Mechanics

Course Code: CENUGPC14

L+T+P :2-1-0

Contact hrs: 30

Course Objective:

This course seeks to provide an introduction to the mechanics of soil, its engineering behavior and various properties which predicts the quality of the soil as foundation material or construction material. Through lectures, and laboratory experiment student will learn to understand soil behavior with the mineralogy present and also be able to do seepage analysis for finding discharge calculation and stability of structure.

Course Outcomes:

- **CO-1:** To develop the open channel flow equations from the basic conservation equations.
- **CO-2:** To identify, analyze and design the various hydraulic structures associated with open channel system.

Module I/Unit I: Introduction to geotechnical engineering, Formation and types of soil, Weight and volume relationships,

Module II/Unit I: Consistency limits, particle size distribution, Identification and classification of soil, Soil structure and clay mineralogy, Soil water suction and capillary rise, effective and pore water pressure,

Module III/Unit I: Permeability and ground water flow–Darcy's law, factors affecting permeability. Laboratory and field determination of permeability, permeability of stratified deposits. Seepage pressure; quick condition,

Module IV/Unit I: Laplace's equation; construction and use of flow nets, piping and heaving, Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart.

Module V/Unit I: Contact pressure under rigid and flexible area, computation of displacements from elastic theory, Compaction of soil–compaction phenomena, laboratory compaction test and field compaction control,

Module VI/Unit I: Compressibility and consolidation of soil–Terzaghi's theory of one-dimensional consolidation.

Suggested Readings:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao.
2. Engineering (Civil and Environmental Engineering) by V.N.S. Murthy.
3. Soil Mechanics and Foundations by B. C. Punmia,, Ashok Kumar Jain and Arun Kumar Jain.
4. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation
5. Soil Mechanics by Craig R.F., Chapman & Hall.
6. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons.
7. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy.

Course Name: Transportation Engineering

Course Code: CENUGPC15

L+T+P :2-1-0

Contact hrs: 30

Course Objective:

An introduction to highway engineering. The capability to know about the highway alignment. The ability to know about the highway geometric design. An understanding about the pavement design. The introduction to pavement construction technique. An understanding about the special problems on highways.

Course Outcomes:

- **CO-1:** To execute surveys involved in planning and highway alignment.
- **CO-2:** To design the geometric elements of highways and expressways.

- **CO-3:** To perform traffic studies and implement traffic regulation and control measures and intersection design.
- **CO-4:** To characterize pavement materials.
- **CO-5:** To design flexible and rigid pavements as per IRC.

Module I/Unit I: Highway development and planning-Classification of roads, road development in India, Current Road projects in India; highway alignment and project preparation.

Module II/Unit I: Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems.

Module III/Unit I: Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems,

Module IV/Unit I: Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems,

Module V/Unit I: Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems.

Suggested Readings:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017.
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles of Transportation Engineering, PHI Learning.
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley.
5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

Course Name: RCC Design Sessional

Course Code: CENUGPC16

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this sessional is to enable the students to design RCC structures for various industrial and residential projects.

Course Outcomes:

- **CO-1:** To understand material properties and design methodologies for reinforced concrete structures.
- **CO-2:** To assess different type of loads and prepare layout for reinforced concrete structures.
- **CO-3:** To identify and apply the applicable industrial design codes relevant to the design of reinforced concrete members.
- **CO-4:** To analyse and design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase.
- **CO-5:** To assess serviceability criteria for reinforced concrete beam and slab.
- **CO-6:** To prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format.

Sessional Work:

Design of a small RCC framed building using Limit State method of design including preparation of necessary working drawing and report.

Course Name: Hydraulics & Hydraulics M/c Lab

Course Code: CENUGPC17

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this Laboratory is to enable the students to understand the Hydraulic & hydraulic M/c.

Course Outcomes:

CO-1: To equip the students with Hydraulic & hydraulic M/c

CO-2: To equip the students with Hydraulic M/c.

- 1) Hydrostatic pressure (Centre of pressure)
- 2) Metacentric height of a floating body
- 3) Verification of Bernoulli's Theorem
- 4) Impact of jet on vane apparatus
- 5) Trainer test rig for Orifice and Mouth Piece
- 6) Friction loss along a pipe
- 7) Pelton Turbine test rig
- 8) Francis Turbine test rig
- 9) Test rig for Venturimeter and Orifice meter
- 10) Centrifugal pump test rig
- 11) Standard glass sided tilting flow channel

3rd Year 6th Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
III/VI	Environmental Engineering	PCC	CENUGPC18	3-0-0	3	19.5
III/VI	Open Elective-II	OEC	---	3-0-0	3	
III/VI	Foundation Engineering	PCC	CENUGPC19	3-0-0	3	
III/VI	PEC-I	PEC	CENUGPE01	3-0-0	3	
III/VI	PEC-II	PEC	CENUGPE02	3-0-0	3	
III/VI	Steel Design sessional	PCC	CENUGPC20	0-0-3	1.5	
III/VI	Soil Mechanics Lab	PCC	CENUGPC21	0-0-3	1.5	
III/VI	Transportation Engg. Lab	PCC	CENUGPC22	0-0-3	1.5	

Course Name: Environmental Engineering

Course Code: CENUGPC18

L+T+P :3-0-0

Contact hrs: 30

Course Objective:

To know various water systems, drinking water standards, water demand and its collections. How to design a water treatment unit, a waste water treatment unit and its disposal.

Course Outcomes:

- **CO-1:** To acquire basic knowledge of drinking water standards and water supply network.
- **CO-2:** To design water and waste water treatment units based upon the properties of water and waste water respectively.
- **CO-3:** To solve problems pertaining to air pollution.
- **CO-4:** To design solid waste management schemes.
- **CO-5:** To design waste water treatment plants and sewerage schemes.

Module I/Unit I: Water: -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, Water demand industrial and agricultural water requirements; Various valves used in W/S systems.

Module II/Unit I: Water Treatment: Aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module III/Unit I Air: Composition and properties of air, Quantification of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Air quality standards.

Module IV/Unit I: Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module V/Unit I Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Suggested Readings:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - Hill International Editions, New York 1985.
4. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill, New Delhi.
5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
6. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.
7. Sewage waste and Air pollution by S.K Garg.

Course Name: Foundation Engineering

Course Code: CENUGPC19

L+T+P :3-0-0

Contact hrs: 30

Course Objective:

This course aims at providing students with knowledge on types and purposes of different foundation systems and structures. This course may lead them to have an exposure to the systematic methods for designing foundations. They

will be able evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behaviour. Also they will have necessary theoretical background for design and construction of foundation systems.

Course Outcomes:

- **CO-1:** To apply theory of soil mechanics and other related techniques to design of foundation.
- **CO-2:** To apply various Methods for site and soil exploration.
- **CO-3:** To calculate bearing capacity and settlements.
- **CO-4:** To design shallow and deep foundation; bracing and retaining structures.

Module I/Unit I: Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. Unconfined compression test, vane shear test.

Module II/Unit I: Stress distribution, Newark's chart, Boussinesq's theory, pressure bulb.

Module III/Unit I: Foundations and their suitability; Foundation requirement and placement, types of foundations, choice of foundation; rigid and flexible footings; contact pressure. Evaluation of bearing capacity from plate load test, cone penetration, standard penetration test and other tests. Settlement of foundations; immediate and consolidation settlement; allowable settlement; differential settlement. Proportioning of footings for equal settlement in different types of soil. Combined footings; raft foundation; buoyant raft; analytical methods of design.

Module IV/Unit I: Pile foundations; types of piles, pile capacity, static and dynamic formulae; design of piles groups; pile load test.

Suggested Readings:

- 1) Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
- 2) Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy
- 3) Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri
- 4) Foundation Analysis and Design by Joseph E. Bowles
- 5) Pile Foundation Analysis and Design by H.G. Poulos and Davis.

Course Name: Railway Engineering (PEC-I)

Course Code: CENUGPE01

L+T+P :3-0-0

Contact hrs: 30

Course Objective:

The Course will try to introduce the basic engineering principles that help in the planning, design, construction, operation and maintenance of Railways and Airports.

Course Outcomes:

- **CO-1:** To carry out the design, construction, and operation of railroads and mass transit systems that use a fixed guide way.
- **CO-2:** To determine horizontal and vertical alignment design, station location and design, and construction cost estimating.

Module I/Unit I: Introduction to Railway Engineering, Gauges and Permanent Way, Wheel and Axles, Coning of Wheels, Track Resistances, Hauling Capacity, Track Modulus.

Module II/Unit I: Stresses in Track, Rails, Stresses in Components of Track, Creep in Rails, Wears & Failures in Rails, Jointed or Welded rails, Sleepers, Ballast, Fastenings,

Module III/Unit I: Geometric Design - Alignment of Track, Horizontal Curve &, Super elevation, Speeds on Track, Transition Curve & Widening of Track, Vertical Curve & Gradients.

Module IV/Unit I: Turnouts-Components, Crossing and Design of Turnout, Track Junctions and Designs, Signals, Part-1, Signals Part-2.

Module V/Unit I: Train Control Systems, Interlocking of Track, High Speed Tracks.

Suggested Readings:

1. Saxena S.P. & Arora S.P, A Textbook of Railway Engineering, Dhanpat Rai & Sons
2. Agarwal M.M, Indian Railway Track, Sachdeva Press, 1991.

Course Name: Surface Hydrology (PEC-II)

Course Code: CENUGPE02

L+T+P :3-0-0

Contact hrs: 30

Course Objective:

The basic objective of the course is to enable the students to comprehend basic concepts of the water cycle and hydrology, to study occurrence movement and distribution of water resource, to know diverse methods of collecting the

hydrological information, which is essential to understand surface and also to study the occurrence movement and distribution of water resource.

Course Outcomes:

- **CO-1:** To learn to compute hydrologic mass balance in a closed basin.
- **CO-2:** To learn about procedures for analysis of various hydrometeorological and hydrological processes
- **CO-3:** To conduct frequency analysis on hydrologic data to determine return period or recurrence interval.
- **CO-4:** To effectively communicate hydrologic concepts.
- **CO-5:** To collect hydrologic data and their analysis
- **CO-6:** To develop unit hydrographs based on streamflow data, and conduct basic unit hydrograph analysis.

Module I/Unit I: Introduction: Hydrologic Cycle, history of Hydrology, applications in Engineering,

Module II/Unit I: Catchment: Physical Characteristics, Channel Characteristics, delineation of catchment boundary, Precipitation: Types, measurements and analysis, rain gauge network, error in estimation, missing data, consistency of rainfall records, measurement, DAD, IDF, PMP curves,

Module III/Unit I: Losses from Precipitation: Evaporation: factors affecting evaporation, saturation vapour pressure, humidity, estimation of evaporation- Meyer's formula and other empirical formula,

Module IV/Unit I: Evapo-transpiration: Process affecting factors, estimation and measurement techniques-Balney Criddle formula.

Module V/Unit I: Infiltration: Process affecting factors, measurement and estimation, Infiltration Indices., Runoff: Components and factors affecting runoff, methods of estimation of runoff volume and peak runoff, rating curve, rainfall–runoff relationships,

Module VI/Unit I: Hydrograph: components, factors affecting hydrographs, base flow separation, Direct Runoff Hydrograph,

Module VII/Unit I: Unit Hydrograph: Theory and assumptions. Derivation of Unit Hydrograph, Synthetic Unit Hydrograph

Suggested Readings:

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.

3. K Subramanya, Water Resources Engineering through Objective Questions, Tata McGraw Hill.
4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.
6. J D Zimmerman, Irrigation, John Wiley & Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.
8. Saxena S.P. & Arora S.P, A Textbook of Railway Engineering, Dhanpat Rai & Sons
9. Agarwal M.M, Indian Railway Track, Sachdeva Press, 1991.

Course Name: Steel Design Sessional

Course Code: CENUGPC20

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this sessional is to enable the students to design Steel structures for various industrial and residential projects.

Course Outcomes:

- **CO-1:** To understand material properties and design methodologies for steel structures.
- **CO-2:** To assess different type of loads and prepare layout for reinforced steel structures.
- **CO-3:** To identify and apply the applicable industrial design codes relevant to the design of steel structures.
- **CO-4:** To prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format.

Sessional Work:

Design of a steel structure including preparation of necessary working drawing and report.

Course Name: Soil Mechanics Lab

Course Code: CENUGPC21

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this laboratory is to enable the students to know the engineering properties of soil.

Course Outcomes:

- CO-1: To understand soil.
- CO-2: To assess different type of testing methods on soil.

The list of experiments are as follows.

- 1) Moisture content
- 2) Specific gravity
- 3) Sieve analysis
- 4) Hydrometer analysis
- 5) Liquid limit, plastic limit & shrinkage limit
- 6) Constant head and Falling head permeability test
- 7) Standard Proctor compaction test
- 8) Modified Proctor compaction test
- 9) In situ density test (core cutter and sand replacement method)
- 10) Relative density test
- 11) Consolidation test
- 12) Unconfined compression test
- 13) Undrained triaxial test
- 14) Direct shear test
- 15) CBR test
- 16) Vane shear test

Course Name: Transportation Engineering. Lab

Course Code: CENUGPC22

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this laboratory is to enable the students to know the engineering properties of soil.

Course Outcomes:

- CO-1: To understand road material and various testing methods on bitumen and aggregate .
- CO-2: To know mix design of asphalt mix.

The lists of experiments are as follows:

- 1) Grading of coarse and fine aggregates
- 2) Shape test of aggregate
- 3) Los-Angeles Abrasion test
- 4) Soundness test of aggregate
- 5) Specific gravity and moisture absorption of aggregate
- 6) Ductility of Bitumen
- 7) Penetration of bitumen
- 8) Softening point of bitumen
- 9) Flash point and Fire point of bitumen
- 10) Stripping value of road aggregate
- 11) Mix design by Marshall method

4th Year 7th Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
IV/VII	PEC-III	PEC	CENUGPE03	3-0-0	3	20.5
IV/VII	PEC –IV	PEC	CENUGPE04	3-0-0	3	
IV/VII	Open Elective – III (Metro Systems & Engineering) -- Suggested	OEC	---	3-0-0	3	
IV/VII	Industrial Economics & Management	HSMC	MBAUGHU01	4-0-0	4	
IV/VII	Project I	PROJ	CENUGPR02	0-0-8	4	
IV/VII	Summer Internship	PROJ	CENUGPR01	---	2	
IV/VII	Environmental Engineering Lab	PCC	CENUGPC23	0-0-3	1.5	

Course Name: Air and Noise Pollution and Control (PEC-III)

Course Code: CENUGPE03

L+T+P :3-0-0

Contact hrs: 30

Course Objective:

The basic objective of the course is to provide the students an overview about the fundamentals of air and noise pollution and to enable them to frame proper measures to curb their impact on the surrounding environment.

Course Outcomes:

- **CO-1:** To develop the basic concept of air pollution, air quality monitoring and air quality modelling.
- **CO-2:** To plan air quality control measures.
- **CO-3:** To develop the basics of noise pollution, noise pollution control measures and noise quality monitoring.

Module I/Unit I: Air Pollutants Sources; Classification; Effects on Human, Vegetation, Material Effects of Air pollution on Atmosphere: Photochemical Smog, Ozone Layer Depletion, Acid Rain, Greenhouse Effect and Global Warming.

Module II/Unit I: Air Pollution Meteorology Lapse Rate; Atmospheric Stability; Inversion; Plume Pattern.

Module III/Unit I: Dispersion of Air Pollutants Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height.

Module IV/Unit I: Air Quality Methods of Measurement: Gaseous pollutants, Particulate pollutants Air Quality Standards and Indices: Ambient Air Quality Standard, NAAQS, Emission Standard, Air Quality Indices.

Module V/Unit I: Air Pollution Control Control of Gaseous Pollutants: Adsorption, Absorption, Condensation Control of Particulate Pollutants: Settling chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators Control of Pollution from Automobiles.

Module VI/Unit I: Physics of Noise Basics of Acoustics; Sound Pressure, Power and Intensity and their Interrelations.

Module VII/Unit I: Measurement of Noise Noise Level; Interrelation between Noise, Pressure, Power and Intensity Levels; Noise Meter; Noise Networks; Frequency Band Analysis; Decibel Addition Measurement of Community Noise: LN, Leq, Ldn,, LNP.

Module VIII/Unit I: Source and Effect of Noise Psychoacoustics and noise criteria; effects of noise on health; annoyance rating schemes.

Module IX/Unit I: Noise Pollution Control Noise Standards and Limits; Methods of Noise Pollution Control.

Suggested Readings:

1. Introduction to Environmental Engineering and Science Masters, G.M., Ela, W.P. Prentice Hall / Pearson.
2. Environmental Engineering: A Design Approach. Sincero, A., Sincero, G. Prentice Hall
3. Environmental Engineering. Volume-1 and Volume-2. Garg, S.K. Khanna Publishers
4. Air Pollution Rao, M.N., Rao, H.V.N. Tata McGraw Hill

Course Name: Irrigation Engineering (PEC-IV)

Course Code: CENUGPE04

L+T+P :3-0-0

Contact hrs: 30

Course Objective:

The basic objective of the course is to provide the students an overview about Irrigation Engineering, an idea about planning and design of irrigation project, lined and unlined canal and also designing and planning of reservoir storage. The course is also aimed at imparting knowledge to the students about different hydraulic structures.

Course Outcomes:

- **CO-1:** To learn to compute hydrologic mass balance in a closed basin.
- **CO-2:** To learn about procedures for analysis of various hydrometeorological and hydrological processes.
- **CO-3:** To conduct frequency analysis on hydrologic data to determine return period or recurrence interval.
- **CO-4:** To effectively communicate hydrologic concepts.
- **CO-5:** To collect hydrologic data and their analysis.
- **CO-6:** To develop unit hydrographs based on streamflow data, and conduct basic unit hydrograph analysis.

Module I/Unit I: Necessity of irrigation, Different Methods of Irrigation, surface irrigation- Basin irrigation: advantage, disadvantage, suitable crop, suitable soil, suitable slope, method of application of water, Border Irrigation-advantage, disadvantage, suitable crop, suitable soil, suitable slope, Furrow irrigation-advantage, disadvantage, suitable crop, suitable soil, suitable slope, Sprinkler irrigation-advantage, disadvantage, suitable crop, suitable soil, suitable slope, Drip irrigation-advantage, disadvantage, suitable crop, suitable soil, suitable slope; Selection of a particular method of irrigation; subsurface irrigation.

Module II/Unit I: Water requirements of crops: Soil-water plant relationship: Classification of soil water- soil moisture contents- depth of soil water available to plants, Base period, Duty Delta, Command area, intensity of irrigation, Irrigation efficiencies, permanent and ultimate wilting point. Depth of water applied during irrigation- Duty of water and delta, improvement of duty, command area and intensity of irrigation consumptive use of water and evapo-transpiration, irrigation efficiencies- assessment of irrigation water.

Module III/Unit I: Design of Irrigation Channel: Classification of Canals, canals in alluvium, design of canal in alluvial soil and non-alluvial soils- Kennedy's silt theory- Lacey's regime theory-Lacey's Regime diagrams- lining of irrigation channels- design of lined canal drainage behind lining, Economics of canal lining:

Module IV/Unit I: Diversion head works: Types- selection of the suitable site for the diversion headwork components of diversion headwork- Causes of failure of structure on pervious foundation- Khosla's theory.

Module V/Unit I: Cross drainage works: Types- selection of suitable type of cross drainage work, aqueduct and Syphon aqueduct, determination of maximum flood discharge and waterway for drain, fluming of canal- uplift pressure on underside of barrel roof and at the floor of the culvert- design of bank connections

Module VI/Unit I: Water storage-Flow mass curve, estimation of storage required for irrigation and other demands- Maintainable Demand.

Suggested Readings:

5. A.M. Micheal, "Irrigation, Theory and Practice", Vikas Publishing House Pvt. Ltd. New Delhi
6. Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi.
7. Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi.
8. Punmia, B.C., and B.B. Pande, "Irrigation and Water Power Engineering", Laxmi Publication Pvt. Ltd., New Delhi
9. Sharma, R.K., Text book of Irrigation Engineering and Hydraulic Structures, Oxford and IBK Publishing House, New Delhi.
10. Sharma, S.K., Principles and Practice of Irrigation Engineering, S. Chand & Company Pvt. Ltd, New Delhi.

Course Name: Environmental Engineering Lab

Course Code: CENUGPC23

L+T+P :0-0-3

Contact hrs: 15

Course Objective:

The objective of this Laboratory is to enable the students to understand the determination of different water quality and waste water quality parameters.

Course Outcomes:

- **CO-2:** To equip the students with the techniques to determine the water quality parameters.
- **CO-2:** To equip the students with the techniques to determine the waste water quality parameters.

Experiment List:

1. Determination of pH
2. Determination of colour of a water sample
3. Determination of Total solids, Suspended solids and Dissolved solids
4. Determination of Hardness of water sample
5. Determination of Turbidity of water sample
6. Determination of Chlorides of a water sample
7. Determination of Residual Chlorine
8. Determination of Available Chlorine and Chlorine Demand

9. Determination of Optimum Coagulant Dosage
10. Determination of Biochemical Oxygen Demand
11. Determination of Chemical Oxygen Demand

4th Year 8th Sem

Semester	Course Name	Course Type	Course Code	L-T-P	Course Credit	Semester Credit
IV/VIII	Construction Management	PCC	CENUGPC24	3-0-0	3	21
IV/VIII	PEC-V	PEC	CENUGPE05	3-0-0	3	
IV/VIII	PEC-VI	PEC	CENUGPE06	3-0-0	3	
IV/VIII	Professional Values and Ethics	HSMC	MBAUGHU02	2-0-0	2	
IV/VIII	Project II	PROJ	CENUGPR03	0-0-16	8	
IV/VIII	Grand Viva	PROJ	CENUGPR04	- - -	2	

Course Name: Construction Management

Course Code: CENUGPC24

L+T+P :3-0-0

Contact hrs: 30

Course Objective:

Specifying project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements, and selecting project participants.

Course Outcomes:

- **CO-1:** To inculcate an idea of how structures are built and projects are developed on the field.
- **CO-2:** To understand modern construction practices and also how construction projects are administered with respect to contract structures and issues.
- **CO-3:** To learn the basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics.

- **CO-4:** To plan, control and monitor construction projects with respect to time and cost and also to put forward ideas and understandings to others with effective communication processes.
- **CO-5:** To optimise construction projects based on costs.

Module I/Unit I: Basics of Construction- Unique features of construction, construction projects types and features, phases of a project, agencies involved and their methods of execution.

Module II/Unit I: Construction project planning- Stages of project planning: Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data.

Module III/Unit I: Techniques of planning- Bar charts, Gantt Charts. Networks: CPM networks: PERT- Assumptions underlying PERT analysis, determining three-time estimates.

Module IV/Unit I: Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods.

Module V/Unit I: Construction Equipment basics: Conventional construction methods Vs. Mechanized methods and advantages of latter; Equipments for construction works.

Module VI/Unit I: Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Manpower, Materials.

Module VII/Unit I: Project Monitoring & Control- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control.

Module VIII/Unit I: Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses.

Module IX/Unit I: Construction Costs: Make-up of construction costs; Classification of costs, time cost trade-off in construction projects, compression and decompression.

Suggested Readings:

- 1) Varghese, P.C., “*Building Construction*”, Prentice Hall India, 2007.
- 2) *National Building Code*, Bureau of Indian Standards, New Delhi, 2017.
- 3) Chudley, R., *Construction Technology*, ELBS Publishers, 2007.
- 4) Peurifoy, R.L. *Construction Planning, Methods and Equipment*, McGraw Hill, 2011
- 5) Nunnally, S.W. *Construction Methods and Management*, Prentice Hall, 2006
- 6) Jha, Kumar Neeraj., *Construction Project management, Theory & Practice*, Pearson Education India, 2015
- 7) Punmia, B.C., Khandelwal, K.K., *Project Planning with PERT and CPM*, Laxmi Publications, 2016.