SHIV NADAR UNIVERSITY
DELHI NCR

DEPARTMENT OF
CIVIL ENGINEERING

SCHOOL OF ENGINEERING (SoE)

UNDERGRADUATE (B.TECH.) PROSPECTUS

(2021-2025)

FOR

CIVIL ENGINEERING DEPARTMENT (CED)

I. Overview of Department of Civil Engineering

The Civil Engineering (CE) Department is part of the School of Engineering (SoE) at Shiv Nadar University (SNU), and this Department aims to be a global leader in developing engineering solutions to societal-scale challenges. Although, traditional civil engineering practice is the backbone of related engineering solutions, the current stage is somehow a transition phase in India to provide a window with more inter-disciplinary approaches. This has been evidenced from the objectives of India's 12th Five-Year Plan in the perspectives of challenges for civil engineering in India, quoted as follows:

"As urban population and incomes increase, demand for every key service such as water, transportation, sewage treatment, low income housing will increase five- to sevenfold in cities of every size and type. And if India continues on its current path, urban infrastructure will fall woefully short of what is necessary to sustain prosperous cities."

Therefore, the Civil Engineering Department has taken this to heart and is working to address these challenges both through wide-ranging research in fields as varied as geographic information systems, climate studies, infrastructure policy, complex networks, disaster management, energy studies, biomaterials, nanotechnology, and communications and information technology, as well as through a flexible curriculum which does not limit students at any level to the traditional boundaries of the discipline of Civil Engineering. In addition to expertise in core Civil Engineering (environmental engineering, geoinformatics engineering, geotechnical engineering, hydraulic engineering, structural engineering, and transportation engineering), faculty members of the Department have a range of research and teaching interests those overlap with chemical, mechanical, and material engineering, as well as with the biological, chemical, computer, geological, mathematical, and physical sciences.

The curriculum at both the undergraduate and Master's level is designed to produce high quality professionals who can meet industry requirements, including in leading research and development (R & D) organizations and academic institutions. Keeping in mind the breadth of the Civil Engineering domain, the academic programs are focused towards building analytical capabilities and project-based learning to enable students to understand and resolve a wide variety of practical problems. Our hope is that we will equip students with a strong skill set such that they not only become outstanding professional civil engineers, but also learn to engage with social and management sciences to consider the larger social, economic, and environmental ramifications of civil works

At present, the CE department offers the following programs:

Undergraduate Programs

(I) Bachelor of Technology in Civil Engineering (B.Tech. in CE) with the option of doing minor in any other stream of interest

Graduate Programs

(I) M.Tech in Civil Engineering
(II) Ph.D. in Civil Engineering

II. Credit Break-up of UG Curriculum in Civil Engineering (CE) Courses (Major in Civil Engineering)

Table 1: Overall Credit Distribution

S. No.	Category	Credits
(1)	Core Common Curriculum (CCC)	18
(2)	University Wide Elective (UWE)	18
(3)	CCC and/or UWE	6
(4)	Basic Sciences (BS)	20
(5)	Engineering Sciences (ES)	13
(6)	Major Core	55
(7)	Major Elective	15
(8)	Project	15
	Total Credits	**160**

Table 2: Semester-wise Credit Distribution

S. No.	Category	Credits
1	Semester I	16
2	Semester II	20
3	Semester III	21
4	Semester IV	21
5	Semester V	23
6	Semester VI	22
7	Semester VII	22
8	Semester VIII	15
	Total Credits	**160**

Table 3: Basic Sciences for CE

S. No.	Course Title	L:T:P	Credits	Semester offered
1	Physics-I	3-1-0	4	1
2	Mathematical Methods I	3-1-0	4	1
3	Mathematical Methods II	3-1-0	4	2
4	Physics-II	3-1-1	5	2
5	Mathematical Methods III	3-0-0	3	3
	Total Credits		**20**	

Table 4: Engineering Sciences for CE

S. No.	Course Code	Course Title	L:T:P	Credits	Semester offered
1	CSD 101	Introduction to Computing and Programming	3-0-1	4	2
2	CED 101	Engineering Mechanics	3-1-0	4	2
3	CED 102	Engineering Graphics	1-0-1	2	1
4	CED 104	Building and Construction Materials	3-0-0	3	1
Total Credits				**13**	

Table 5: Major Electives for CE

S. No.	Course Title	L:T: P	Credits	Semester offered
1	Major Elective - I		3	6
2	Major Elective - II		3	6
3	Major Elective - III		3	7
4	Major Elective - IV/ (Online course)		3	8
5	Major Elective - V/ (Online course)		3	8
Total Credits			**15**	

Table 6: Project for CE

S. No.	Course Code	Course Title	L:T:P	Credits	Semester offered
1	CED 418	Project-I	0-0-9	9	7
2	CED 419	Project-II	0-0-6	6	8
Total Credits				**15**	

Detailed rules and regulations regarding B.Tech. Program in SNU can be found in UG handbook (Available at: https://snulinks.snu.edu.in/snuPolicies/students/)

III. Semester-wise Course Distribution for CE (Major)

Table 7: First Semester for CE

S. No.	Course Title	L:T: P	Credits
1	CCC-I		3
2	Mathematical Methods-I	3-1-0	4
3	Physics-II	3-0-1	4
4	Engineering Graphics	1-0-1	2
5	Building and Construction Materials	3-0-0	3
Semester Credits			**16**

Table 8: Second Semester for CE

S. No.	Course Title	L:T: P	Credits
1	CCC-II		3
2	Mathematical Methods-II	3-1-0	4
3	Physics-2	3-1-1	5
4	Engineering Mechanics	3-1-0	4
5	Introduction to Computing and Programming	3-1-0	4
	Semester Credits		**20**

Table 9: Third Semester for CE

S. No.	Course Title	L:T: P	Credits
1	CCC-III		3
2	UWE-I		3
3	Mathematical Methods-III	3-0-0	3
4	Strength of Materials	3-0-1	4
5	Fluid Mechanics	3-0-1	4
6	Element of Surveying	3-0-1	4
	Semester Credits		**21**

Table 10: Fourth Semester for CE

S. No.	Course Title	L:T: P	Credits
1	CCC-IV		3
2	UWE-II		3
3	CCC/UWE-I		3
4	Engineering Hydrology	2-0-0	2
5	Structural Analysis-I	3-0-0	3
6	Concrete Technology	3-0-1	4
7	Hydraulic Engineering	2-0-1	3
	Semester Credits		**21**

Table 11: Fifth Semester for CE

S. No.	Course Title	L:T: P	Credits
1	CCC-V		3
2	UWE-III		3
3	Structural Analysis-II	3-0-0	3
4	Geotechnical Engineering	3-0-1	4
5	Transportation Engineering	3-0-1	4
6	Water Resource Engineering	3-0-0	3
7	Design of RCC Structures	3-0-0	3
	Semester Credits		**23**

Table 12: Sixth Semester for CE

S. No.	Course Title	L:T: P	Credits
1	CCC-VI		3
2	UWE-IV		3
3	Design of Steel Structures	3-0-0	3
4	Foundation Analysis and Design	3-0-0	3
5	Environmental Engineering	3-0-1	4
6	Major Elective-I	3-0-0	3
7	Major Elective-II	3-0-0	3
	Semester Credits		**22**

Table 13: Seventh Semester for CE

S. No.	Course Title	L:T: P	Credits
1	UWE-V		3
2	UWE-VI		3
3	Estimating, Costing, and Project Management	3-0-1	4
4	Major Elective-III	3-0-0	3
5	Major Project-I	0-0-9	9
	Semester Credits		**22**

Table 14: Eighth Semester for CE

S. No.	Course Title	L:T: P	Credits
1	Internship	0-0-6	6
2	Major Elective-IV (Online course)	3-0-0	3
3	Major Elective-V (Online course)	3-0-0	3
4	CCC/UWE-II	3-0-0	3
	or		
1	Major Project II	0-0-6	6
2	Major Elective-IV	3-0-0	3
3	Major Elective-V	3-0-0	3
4	CCC/UWE-II	3-0-0	3
	Semester Credits		**15**

For CCC/UWE, students should earn total 42 credits from CCC & UWE category in 4 year duration of course with minimum of 18 credits in each category. Hence, the CE Department gives the flexibility to the students for earning CCC/UWE credits at any of their semesters. In addition, in case of earning credits under major electives, students can undertake a major elective in any of their semester, if it does not have pre-requisite requirement.

IV. List of 'Major Core' & 'Major Elective' courses offered in Civil Engineering Department

Table 15: Major Core courses for CE

S. No.	Course Code	Course	L:T:P	Credits
(1)	CED 201	Strength of Materials	3:0:1	4
(2)	CED 202	Fluid Mechanics	3:0:1	4
(3)	CED 203	Engineering Hydrology	2:0:0	2
(4)	CED 204	Structural Analysis-1	3:0:0	3
(5)	CED 205	Concrete Technology	3:0:1	4
(6)	CED 206	Elements of Surveying	3:0:1	4
(7)	CED 207	Hydraulic Engineering	2:0:1	3
(8)	CED 301	Structural Analysis –II	3:0:0	3
(9)	CED 302	Geotechnical Engineering	3:0:1	4
(10)	CED 303	Water Resource Engineering	3:0:0	3
(11)	CED 304	Transportation Engineering	3:0:1	4
(12)	CED 305	Design of RCC Structures	3:0:0	3
(13)	CED 306	Foundation Analysis and Design	3:0:0	3
(14)	CED 307	Estimating, Costing and project management	3:1:0	4
(15)	CED 308	Environmental Engineering	3:0:1	4
(16)	CED 401	Design of Steel Structures	3:0:0	3
		Total Credits		**55**

Table 16: Major Elective courses for CE

S. No.	Course Code	Course	L:T:P	Credits
(1)	CED 208	Building Planning and Drawing	2:0:1	3
(2)	CED 210	Sustainable Infrastructure	3:0:0	3
(3)	CED 309	Transportation Engineering - II	3:0:0	3
(4)	CED 310	Introduction to Remote Sensing and GIS	2:0:1	3
(5)	CED 311	Watershed Management	3:0:0	3
(6)	CED 315	Environmental Management in Industries	3:0:0	3
(7)	CED 402	Statistics in Engineering	1:0:2	3
(8)	CED 403	Pavement Design	3:0:0	3
(9)	CED 404	Photogrammetry and GPS	2:1:0	3
(10)	CED 405	Air Quality Science and Engineering	3:0:0	3
(11)	CED 406	Analysis of Tall Building	2:0:1	3
(12)	CED 407	Transportation Systems	3:0:0	3
(13)	CED 408	Spatial Analysis and Digital Image Processing	2:0:1	3

(14)	CED 409	Geotechnical Earthquake Engineering	3:0:0	3
(15)	CED 411	Earthquake Engineering	3:0:0	3
(16)	CED413	Biological Process in Environmental Engineering	3:0:0	3
(17)	CED420	Building Physics	3:0:0	3
(18)	CED 421	Public Transport Systems	3:0:0	2
(19)	CED422	Transportation Law Seminar	2:0:0	2
(20)	CED426	Transport Infrastructure	3:0:0	3
(21)	CED431	Hydropower Engineering	3:0:0	3
(22)	CED432	Mechanics of Geomaterials	3:0:0	3
(23)	CED433	Physico-chemical Processes in Environmental Engineering	3:0:0	3
(24)	CED213	Introduction to Building Information Modelling	3:0:0	3

V. Minor in Civil Engineering

Students from other disciplines can earn Minor in Civil Engineering after completing the following courses successfully.

Table 17: Courses for getting Minor in Civil Engineering

S. No.	Course Title (Code)	Offered in Semester	L: T: P	Credits
Compulsory Courses (All to be taken)				
1.	Engineering Mechanics (CED101)	I	3: 1: 0	4
2.	Strength of Materials (CED201)	III	3: 0: 1	4
3.	Elements of Surveying (CED206)	III	3: 0: 1	4
4.	Geotechnical Engineering (CED302)	V	3: 0: 1	4
5.	Transportation Engineering (CED304)	V	3: 0: 1	4
6.	Environmental Engineering (CED308)	VI	3: 0: 1	4
Optional Courses (At least 2 out of the five listed below. Electives may be substituted with the permission of the CED UG advisor and HOD.)				
(a)	Sustainable Infrastructure (CED210)	IV	3: 0: 0	3
(b)	Concrete Technology (CED205)	IV	3: 0: 1	4
(c)	Structural Analysis- I (CED204)	IV	3: 0: 0	3
(d)	Foundation Engineering & Design (CED306)	VI	3: 0: 0	3
(e)	Estimating, Costing & Project Management (CED307)	VI	3: 1: 0	4

VI. Specialization for UG students

Civil Engineering Department is considering to offer Specializations to its UG students in various research thrust areas. With prevailing UG curriculum at present, an UG student has to earn 15 credits in major project (research-based) during final year, and 15 credits from the basket of major elective courses. The course structure for UG curriculum is presented in the Table-1 of Annexure-I. The basket of major elective courses are presented in Table-2 of Annexure-I. Every major elective course is comprised of 3 credits. Hence, each civil engineering student completes 5 major elective courses from the Department. At present scenario, the faculty members have the capabilities in 5 specialized thrust areas to supervise research projects during execution of major projects of students. In addition, the Department offers multiple options for choosing courses from the basket of major elective courses.

Therefore, student who wish to get a specialization in one of the thrust areas should complete minimum of three courses as major electives and major research project (15 credits) in the same thrust area. This concept of awarding specialization in civil engineering will be applicable for existing final year students (Year 2020 batch) and successive batches. The list of specializations is provided, as follows:

(I) Structural Engineering
(II) Environmental Engineering
(III) Geotechnical Engineering
(IV) Hydraulic Engineering
(V) Transportation Engineering

VII. Brief description of courses offered in CE Department

(1) CED101 (Engineering Mechanics) (L: T: P)-(3:1:0)

Understanding basic concepts of statics, kinematics and dynamics, application of the knowledge of mathematics, science, and engineering, and to expand this knowledge into the vast area of Engineering. This course enhances students' ability to design by requiring the solution of open ended problems, and helps to prepare the students for higher level courses, namely Strength of Materials, Structural Analysis, Structural Dynamics, and Structural Design. Specific contents: Introduction, Fundamentals of Mechanics, Equivalent Force-Couple Systems, Simple Resultant, Equilibrium of 2D and 3D Systems, Truss, Friction, Methods of Virtual Work and Potential Energy, Dynamics and Vibrations.

Recommended Book (s):

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics: Statics, Wiley, 2013.
2. J. L. Meriam and L. G. Kraige, Engineering Mechanics: Dynamics, Wiley, 2013.
3. Beer, Johnston, Mazurek, Cornwell, and Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, TATA McGraw Hill, 2013.
4. S. Timoshenko, D.H. Young, J.V. Rao, S. Pati, Engineering Mechanics, McGraw Hill, 2013.

(2) CED104 (Building and Construction Materials) (L: T: P)-(3:0:0)

Theory of Building Systems and Architectural Components: Structural morphology, basic structural elements and force systems & material behavior. Building Systems: Mechanical properties (strength, structural performance) & Non-Mechanical properties (physical properties, durability). Classical building materials: Stone, Bricks, Lime, Wood, Bamboo, Timber. New age building materials: Cement: Composition of ordinary portland cement-functions of cement, ingredients characteristics and types of cement and uses; Mortar: Characteristics of mortar - types of mortar using lime, cement, mud, - composite mortars using fly ash and surkhi; Concrete: Characteristics of concrete, types of concrete, production of concrete and mechanical properties of concrete; Steel: Composition, classification, production and mechanical and structural properties. Miscellaneous materials: Brief introduction to soil and other materials used for geo-technical structure and transport engineering; Thermal and acoustic materials, plastics, metals, water proofing and damp proofing materials, composite materials and geosynthetics; Relation between materials and their applications in buildings / case studies / structural and non-structural applications.

Recommended Book (s):

1. S.K.Duggal, "Building Materials", (Fourth Edition) New Age International (P) Limited, 2016
2. National Building Code(NBC) of India.
3. P C Vergese, "Building Materials", PHI Learning Pvt. Ltd
4. Building Materials and Components, CBRI, 1990, India
5. Dr. B.C.Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) ltd., New Delhi.
6. Rangawala S. C. "Engineering Materials", Charter Publishing House, Anand, India.

(3) CED201 (Strength of materials) (L: T: P)-(3:0:1)

Stresses and Strains: Free body diagram, Mechanical properties, Different states of stress, Mohr's circle of stresses. Deformable bodies, Strain at a point, Different states of strain, Mohr's circle for plane strain. Constitutive Relationships: Generalized Hooke's law, Lame's constant, elastic modulus, bulk modulus, Relationship between different elastic constants. Beam statics: Reactions and support conditions, Method of sections, Axial forces, shear forces and bending moments, BM and SF diagrams for cantilevers, simply supported and fixed beams with or without overhangs and calculation of maximum BM and SF and the point of contraflexure, Effect of concentrated moments. Beam Bending: Symmetric (pure) bending, Prismatic homogenous beams (Elastic flexure formula, neutral axis, bending stress, elastic section modulus), Beams of composite section, Unsymmetrical (skew) bending, Generalised flexure formula, Combined axial and bending stresses. Torsion: Geometry of deformation of a twisted circular shaft, Stress and deformation in twisted circular solid and hollow shafts, Strain energy due to torsion, Power transmitted by circular shafts. Shear Stress: Shear flow, Shear stress formula for beams, Beams of rectangular cross section, variation across height of cross section, Flanged sections (I-section), Shear stresses in flanges for thin-walled sections, Shear centre. Columns and struts: Stable and unstable equilibrium, Euler's formula for long columns, Members with eccentric loading, Rankine's formula.

Recommended Book (s):

1. Engineering Mechanics of Solids by Egor P. Popov

2. Advanced Mechanics of Solids by LS Srinath
3. Mechanics of Materials by Gere and Timoshenko

(4) CED 202 (Fluid Mechanics) (L: T: P)-(3:0:1)

Fluid mechanics is the branch of physics that studies fluids (liquids, gases, and plasmas) and the forces on them. Fluid mechanics can be divided into fluid statics, the study of fluids at rest; fluid kinematics, the study of fluids in motion; and fluid dynamics, the study of the effect of forces on fluid motion. Sub topics covered are: Fundamental Concepts of Fluid Flow; Fluid statics; Fluid kinematics; Fluid dynamics; Flow through pipes; Dimensional analysis and similitude; Boundary Layer Analysis; & Flow Measurement Devices.

Recommended Book (s):

1. Fluid Mechanics: Including Hydraulic Machines, by A. K. Jain; Khanna Publishers; 2008.
2. Hydraulics and Fluid Mechanics Including Hydraulics Machines, by P. N. Modi; Standard Book House; 2009. , ISBN: 8189401262, ISBN-13: 9788189401269.
3. Fluid Mechanics by R. K. Rajput; S. Chand; 2011, ISBN: 81-219-1666-6
4. Fluid Mechanics, by Frank White; Tata McGraw Hill Education Pvt. Ltd.; 2011.
5. Fluid Mechanics and Machinery by C.S.P. Ojha et.al, Oxford University Press, 2010, ISBN: 0-19-569963-7.

(5) CED 203 (Engineering Hydrology) (L: T: P)-(2:0:0)

Precipitation: Hydrologic cycle, Types of precipitation, Forms of precipitation, Measurement of Rainfall, Frequency analysis of point rainfall – Intensity, duration, frequency relationship, Probable maximum precipitation. Abstraction from Precipitation and Losses: Losses from precipitation, Evaporation process, Infiltration process, Infiltration capacity, Measurement of infiltration, Effective rainfall, W-Index and φ – Index. Stream Flow Measurement: Determination of stream flow using various methods-Direct determination, Indirect determination. Hydrographs: Runoff, Runoff characteristics, Discharge formulae, characteristics of a Run off hydrograph, Factors affecting Hydrograph, Base flow separation, Unit hydrograph, Derivation of unit hydrograph, S curve hydrograph, Unit hydrograph of different deviations, Synthetic Unit Hydrograph, Mass Flow hydrograph, Instantaneous hydrograph. Floods and Flood Routing: Flood peak estimation, Rational method, Empirical method, Unit hydrograph method, Flood frequency studies, Recurrence interval, Gumbel's method, Flood routing, Reservoir flood routing, Muskingum's Channel Routing, Flood control.

Recommended Book (s):

1. Subramanya, "Engineering Hydrology", Tata McGraw-Hill Education, 2008.
2. Ven Tee Chow, David Maidment, Larry Mays, "Applied Hydrology", 2nd Edition, McGraw-Hill Companies, Incorporated, 2013.
3. Deodhar M. J., "Elementary Engineering Hydrology", Pearson Education India, 2009.
4. Das, Ghanshyam, "Hydrology & Soil Conservation Engineering", PHI Learning Pvt. Ltd., 2009.
5. Ray K. Linsley, Max Adam Kohler, Joseph L. H. Paulhus, "Hydrology for engineers", Edition

3, illustrated, McGraw-Hill series in water resources and environmental engineering, McGraw-Hill, 1982.

(6) CED 204 (Structural Analysis-I) (L: T: P)-(3:0:0)

Introduction: Structural analysis, structure, load, response. Force response in statically determinate structures: Support reactions; Internal forces in beams, Axial forces in trusses; Axial forces in cables and funicular arches; Internal forces in frames, Influence lines - using direct equilibrium and principle of virtual displacements. Displacement response in statically determinate structures: Deflection in beams, conventional methods; principle of virtual forces; Basic energy methods. Analysis of statically indeterminate structures (propped cantilever, fixed and continuous beams, trusses and plane frames): Introduction; Method of consistent deformations; theorem of least work; Introduction to displacement methods.

Recommended Book (s):

1. Devdas Menon, Structural Analysis, Narosa Publishing House, 2008.
2. Hibbeler, R.C., Structural Analysis, 7th Edition, Prentice Hall, 2008.
3. Reddy, C.S., Basic Structural Analysis, Tata McGraw Hill, 3rd edition 2010.

(7) CED 205 (Concrete Technology) (L: T: P)-(3:0:1)

Concrete Materials: Types of material, Cement: cement production, composition, and properties; cement chemistry; Types of cements; special cements. Aggregates: mineralogy; properties, types of aggregates tests and standards. Brief idea about laboratory tests meant for cement and aggregate. Chemical and mineral admixtures: Admixtures: structure properties, and effects on concrete properties. Introduction to supplementary cementing materials and pozzolans. fly ash, blast furnace slag, silica fume, and metakaolin - their production, properties and effects on concrete properties. Other mineral additives - reactive and inert, water reducers, air entrainers, set controllers. Concrete Mix Design: Mix Design - factors influencing mix proportion - Mix design by ACI method and I.S. code method - Design of high strength concrete. Properties of fresh and hardened concrete: Workability, Factors affecting workability, type of tests. Water cement ratio, gain of strength with age, effect of maximum size of aggregate, relationship between compressive and tensile, strength, high strength concrete, high performance concrete. Elasticity, shrinkage and creep of concrete. Durability of concrete: Introduction to durability; relation between durability and permeability. Chemical attack of concrete; corrosion of steel rebars; other durability issues**.** Special concrete: Lightweight concrete. high density concrete, hot weather and cold weather concreting, polymer concrete.

Recommended Book (s):

1. Concrete Technology: M. L. Gambhir.
2. Properties of concrete: A.M. Neville.
3. Concrete Technology: M. S. Shetty.

(8) CED 206 (Elements of Surveying) (L: T: P)-(3:0:1)

Overviews and Introduction (Basics of Surveying): Overview of elements of surveying; Brief

ideas of technical terminologies and survey equipment; Fundamental concepts; Surveying measurements; Mapping and conventional signs. Linear Measurement (Chain and Tape Surveying): Chain survey; Instruments (chains, tapes, ranging rods, etc.); Uses of cross staff and optical square; Offsets; Obstacles in chaining. Compass Surveying: Prismatic compass; Surveyor's compass; Bearing: whole circle (W.C.B) and reduced bearing (R.B); Local attraction and its adjustments; Traversing. Plane Table Surveying: Plane Table Instruments and Accessories; Merits and demerits; Methods; Orientation; Two and three point problems; Errors in plane tabling. Theodolite Surveying: Study of theodolite, Temporary and permanent adjustments; Measurement of horizontal and vertical angles; Overview on Optical and Electronic theodolites. Traverse Surveying: Traverse Surveying; Tacheometric surveying; Stadia method, Movable hair method; Trigonometric leveling and various methods. Levelling: Principle and definition; Levelling instruments; Dumpy level; Auto and Digital level; Booking and reducing levels; Curvature and refraction corrections; Bubble tube and its sensitiveness; Difficulties in Levelling. Contouring: Contour survey; Definition, Characteristics of contours; Methods of contouring; Interpolations; Uses of contour maps. Area and Volume Surveying: Areas and Volume computation; Trapezoidal rule; Simpson's rule; Other relevant methods for area and volume computation. EDM, and Minor instrumentation: Introduction to Electro-Magnetic Distance Measurement (EDM); EDM basic functions; Types of EDM instruments; Total Station Surveys. Minor Instruments: Box sexant; Planimeter; Pantagraph; Clinometer.

Recommended Book (s):

1. Punmia, B. C., "Surveying" Vol I and II, Laxmi Pub (1994).
2. Kanetkar T.P., "Surveying and Levelling", Vols. I and II, United Book Corporation, Pune (1994).
3. Duggal, S. K., "Surveying" Vol 1, Tata, McGraw Hill (2004).
4. S. K. Roy, Fundamentals of Surveying, PHI.

(9) CED 207 (Hydraulics Engineering) (L: T: P)-(2:0:1)

Types of open channel flow, resistance relationships in open channel flow, Uniform Flow, use of momentum principle in open channel flow, concept of specific energy and specific force, velocity measurement, flow profiles, draw down and back water curves, hydraulic jumps, basic characteristics of jump, energy dissipation due to jumps, types of turbines, operating characteristic curves, cavitation.

Recommended Book (s):

1. Electrical Machinery P. S. Bhimbra, Khanna publishers, 2012.
2. Generalized Theory of Electrical Machines, P. S. Bhimbra. Khanna publishers, 1998.
3. Electrical Machinery, Fitzgerald and Kingsley, McGraw- Hill Higher education, 7th edition, 2013.
4. Electrical Machines, D. P. Kothari and I. J. Nagrath, McGraw- Hill Higher education, 4th edition, 2010.
5. John E. Gribbin, "Introduction to Hydraulics & Hydrology: With Applications for Stormwater Management", Delmar Cengage Learning; 2 edition (September 11, 2001).
6. Hubert Chanson, "The Hydraulics of Open Channel Flow: An Introduction", Butterworth Heinemann; 0002- edition (July 15, 2004)

(10) CED 210 (Sustainable Infrastructure) (L: T: P)-(3: 0: 0)

It has been said that "infrastructure is the backbone of nations," and that "it is a society's inventory of systems and facilities that allow it to function properly and smoothly." We will walk through infrastructure topic areas –energy, water, transportation, communication, natural resources and ecology – and frame the discussion around the key issues to consider and evaluate in planning for a sustainable and resilient infrastructure. This course is an exploration into methods, materials, processes, technologies, practices, and operations which play a part in
making infrastructure sustainable. The intersection between policies necessary for sustainable infrastructure and political, economic, social, societal, and cultural factors will also be examined. Class discussions will center on three of the largest challenges of our times:

1) rapid urbanization; 2) existing scarcity of basics like clean water, clean air, food and land, all of which gets exacerbated by rapid urbanization; and 3) the inability and/or unwillingness of governments to anticipate problems and plan in advance of these phenomena.

Recommended Book (s):

None. Readings will be assigned from multiple sources throughout the course of the class.

(11) CED301 (Structural Analysis-II) (L: T: P)-(3:0:0)

Introduction to Statically Indeterminate Structures: Review of analysis for statically determinate structures, Degree of indeterminancy and stability of structures, Overview of analysis of indeterminate structures by force methods and displacement methods, Importance of matrix analysis. Analysis of Statically Indeterminate Beams: Theorem of three moments, energy methods, flexibility coefficients, Two hinged arches: Reaction, horizontal thrust, effect of yielding of supports, temperature change, Column analogy method: method development, analysis of beams by column analogy method. Analysis of Statically Indeterminate Structures Moment distribution method: Introduction, method development, solution of continuous beam, effect of settlement and rotation of support, frames with or without lateral sway Kani's method: Introduction, basic concepts, application to beams and frames with and without side sway Slope deflection method: Introduction, development of slope deflection equations, application to continuous beams and frames with and without lateral sway. Matrix Stiffness method Introduction, stiffness and flexibility coefficient, member stiffness matrix, transformation, compatibility and equilibrium, assemblage of structural stiffness matrix, Imposing support conditions, banded property of structural stiffness matrix, computer implementation. Plastic Analysis Introduction, stress-strain curve, beams in pure bending, plastic moment of resistance, shape factor, load factor, plastic hinge and mechanism, plastic analysis of simple structures, upper and lower bound theorems.

Recommended Book (s):

1. Basic Structural Analysis, C.S. Reddy, Tata McGraw Hill Publication, 2 nd Edition.
2. Structural Analysis, R. C. Hibbeler, Pearson Education India.
3. Structural Analysis-A matrix approach, G. Pandit, S. Gupta, Mc Graw Hill Education

(12) CED302 (Soil Mechanics) (L: T: P)-(3: 0: 1)

This course is intended to provide an understanding of the nature of soil and fundamentals of mechanical behavior of soil. It provides basic knowledge of the principles of soil mechanics and its applications to geotechnical engineering problems. This course illustrates how, why, and with what limitations these principles can be applied in practice, and it helps develop the engineering judgment. Soil formation and nature, Soil description and classification, Soil compaction, Permeability, Seepage, In-situ stresses, Effective stress and pore pressure, Stresses in a soil mass, Compressibility of soil, and Shear strength of soil.

Recommended Book (s):

1. Braja M. Das (2010). Principles of Geotechnical Engineering (7th Edition), Cengage Learning India Pvt. Ltd.
2. Many Soil Mechanics (also known as Geotechnical Engineering) books are available in SNU Central Library. Students may refer any Soil Mechanics book.

(13) CED 303 (Water Resources Engineering) (L: T: P)-(3:0:0)

Irrigation Engineering, Engineering structures for water control including Canals systems, Diversion Head works, Canal Falls, Canal regulation works, Cross Drainage works. Dams and reservoirs, Gravity dams, Earth dams, Spillways.

Recommended Book (s):

1. Irrigation and Water Power Engineering by Punmia, B. C., Lal, P. B. B, Jain, A. K., Jain, A. K., Laxmi Publications.
2. Irrigation Engineering and Hydraulic Structures by Garg, S. K., Khanna Publishers Irrigation, Water
3. Elements of Water Resources Engineering by Duggal, K. N. and Soni, J. P., New Age International
4. Irrigation Water Resources and Water Power Engineering by Modi, P. N, Standard Book House.

(14) CED 304 (Transportation Engineering) (L: T: P)-(3:0:1)

Introduction: Breadth and scope of Transportation Engineering, modes of transportation and their comparison, effect of transportation systems on economy, impact on environment; Road transport Characteristics, Classification of roads, Road development plans in India, network patterns. Traffic Engineering: Traffic Studies, Origin-Destination studies, speed and delay studies, accident analysis, volume studies, passenger car equivalent, etc.; Traffic control Devices, marking, Signs, Signals, Regulations; Speed-flow- density relationship, Greenshields model, signal timing estimation, apacity and Level-of- Service analysis. Roadway Geometry: Road, road user and vehicle characteristics, factors affecting design standards, cross-section elements, Stopping and overtaking sight distances, Road alignment, site selection, plan evaluation, Horizontal alignment, vertical alignment, design of summit and valley curves. Materials: Sub-grade soil, classification, group index, sub-grade soil stabilization; Aggregate, physical properties, mechanical properties, test on aggregates;

Bituminous material, classification, tests on bitumen. Pavement Design: Necessity of pavement, types of pavements & characteristics, design parameters, wheel loads and axle loads, tyre pressure, load repetitions, ESWL; rigid and flexible pavement design, stresses in rigid pavement. Lab Work based on various testing methods for materials such as soil, aggregates, and bitumen as well as exercises based on traffic engineering concepts.

Recommended Book (s):

1. S. K. Khanna and C. E. G. Justo, "Highway Engineering",9th Edition, Nem Chand and Brothers (2011).
2. L.R. Kadiyali, "Traffic Engineering and Transport Planning",Khanna Publishers (2011).
3. Paul H. Wright and Karen K. Dixon, "Highway Engineering",7th Edition, Wiley India (2012).
4. Yang H. Huang, "Pavement Analysis and Design", Pearson Education India.
5. Ajay K. Duggal and Vijay P. Puri, "Laboratory Manual in Highway Engineering", New Age International.

(15) CED305 (Design of Reinforced Cement Concrete (RCC) Structures) (L: T: P)-(3:0:0)

Introduction to reinforced concrete, loads and load combinations, design philosophies. Flexural analysis and design of singly and doubly reinforced beams. Flexural analysis and design of flanged beams. Shear, diagonal tension and torsion in beams. Mid-term examination (as per University Examination Timetable). Bond, anchorage, development length, curtailments of reinforcement bars. Design of slabs, design of staircases. Design of columns. Design of footings. Limit states of serviceability. Final examination (as per University Examination Timetable).

Recommended Book (s):

1. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, 2013.
2. J. N. Bandyopadhyay, Design of Concrete Structures, Prentice Hall India, 2011.
3. H. Nilson, D. Darwin and C. W. Dolan, Design of Concrete Structures, Tata McGraw Hill, 2010.
4. E. G. Nawy, Reinforced Concrete - A Fundamental Approach, Prentice Hall, 2003.
5. M. L. Gambhir, Fundamentals of Reinforced Concrete Design, Prentice Hall India, 2006.
6. S. U. Pillai and D. Menon, Reinforced Concrete Design, Tata McGraw Hill, 2009.
7. P. C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall India, 2008.
8. K. Jain, Reinforced Concrete: Limit State Design, Nem Chand and Bros., 1999.
9. S. N. Sinha, Reinforced Concrete Design, Tata McGraw-Hill, 2nd Edition, 2002.
10. N. Krishna Raju, Design of Reinforced Concrete Structure (IS: 456-2000), CBS Publishers & Distributors, 2008.
11. R. Park and W. L. Gamble, Reinforced Concrete Slabs, John Wiley & Sons, 2002. XVII.

Indian Standard Codes of Practice:

1. IS 456: 2000 – Code of practice for plain and reinforced concrete, 2000.
2. IS 875: 1987 (Part 1 to Part 5) – Code of practice for design loads (other than earthquake) for buildings and structures, 1987.
3. SP 16: 1980 – Design Aids for Reinforced Concrete, 1980.

4. SP 24: 1983 – Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced Concrete, 1983.
5. SP 34: 1987 – Handbook of Concrete Reinforcement and Detailing, 1987.

(16) CED 306 (Foundation Engineering and Design) (L: T: P)-(3:0:0)

Geotechnical investigation for determination of physical and engineering properties of subsurface soils. This will include planning and conducting field investigations and laboratory testing. Theory of lateral earth pressure; Methods of analyses; Bearing capacity theories; Design of shallow foundations: strip footings, isolated footings, combined footings, rafts; Design of deep foundations: single piles, pile groups, pile caps, caissons, vertical uplift and lateral capacity; Design of retaining structures: rigid and flexible walls, coffer dams, diaphragm walls, braced cuts; Foundations in difficult grounds; Ground improvement techniques; Soil reinforcement. The lectures include an overview of geotechnical site investigation methods and in situ tests used to estimate engineering parameters. The course emphasizes the importance of parameter selection in calculations of ultimate and serviceability limit state calculations for both shallow and deep foundations, and discusses methods of soil improvement. The section on earth retaining structures considers systems ranging from gravity walls to composite construction (reinforced earth), from structural support to field monitoring of excavations (bracing, tieback anchors etc.).

Recommended Book (s):

1. J. E. Bowles, Foundation Analysis and Design, McGraw Hill, 1996.
2. Braja M. Das, Shallow Foundations: Bearing Capacity and Settlement, CRC Press, 1999.
3. Braja M. Das, Principles of Foundation Engineering, Cengage Learning India Pvt Ltd, 2013.
4. P. C. Varghese, Foundation Engineering, PHI Learning Pvt. Ltd., 2009.
5. V. N. S. Murthy, Advanced Foundation Engineering, CBS Publishers & Distibutors, 2010.
6. M. R. Hausmann, Engineering Principles of Ground Modification, McGraw Hill, 1990.
7. R. B. Peck, W. E. Hanson and T. H. Thornburn, Foundation Engineering, John Wiley & Sons, 1974.
8. K. Terzaghi, R. B. Peck and G. Mesri, Soil Mechanics in Engineering Practice, John Wiley & Sons, 1996.
9. K. R. Arora, Soil Mechanics and Foundation Engineering: Geotechnical Engineering, Standard Publishers Distributors, 1992.

(17) CED307 (Estimating, Costing and project management) (L: T: P)-(3:1:0)

Introduction to Construction Projects, stakeholders, phases in a project. Construction Economics. Client's Estimation of Project Cost. Construction Contract, Cost estimating and bidding-Contractor's perspective: material estimates, labour and equipment costs. Construction Planning, Project selection using time value of money concept, Project planning and network analysis-PERT, CPM, and Precedence Network. Resource scheduling, Time Cost trade off. Project Monitoring and Control system, Time -cost monitoring and control using S-curve and earned value analysis. Construction Claims, Disputes, and Project Closure. Introduction to use of project management software.

Recommended Book (s):

1. Bernard W. Taylor III. - Introduction to Management Science" (10 th edition, 2009), PEARSON - Prentice Hall.
2. Meredith, Wong, Woodhead and Wortman. "Design and Planning of Engineering Systems" (2 nd edn, Prentice Hall, 1985).
3. Kumar Neeraj Jha. “Construction Project Management”, Pearson Education (2011).
4. K. K. Chitkara. “Construction Project Management : Planning, Scheduling and Controlling 2nd Edition”, Tata McGraw - Hill Education.
5. Dutta, B.N “Estimation and Costing”, UBS Publisher.
6. M. Chakraborti Rangwala S. C. “Elements of Estimating and Costing” Charotar Publishing Pvt Ltd.Anand. (1998).

(18) CED 308 (Environmental Engineering) (L: T: P)-(3:0:1)

Introduction to water and waste water engineering: water and wastewater quality enhancement- philosophy of treatment, removal of turbidity and pathogens, IS standards for drinking water supply. Water and waste water quantity estimation: Water consumption rate, population forecasting methods for estimation of water demands. Water and wastewater characteristics: Sources of raw water, physical and chemical characteristics, Biological aspects, kinetic aspects of BOD, COD and other characteristics. Unit operations and processes of water treatment systems: Briefs of different operations and processes taking place during water treatment. Sedimentation: Discrete Particles, average settling velocity, designing circular settling basin, tube settlers or inclined plate settling. Coagulation and flocculation: colloidal stability, energy barrier-net attractive force, flocculation, design of flocculators. Softening and filtration: lime and soda ash requirement, Filtration, types of filters, filter washing, design of filters. Disinfection: Mechanism, Mechanism of Chlorine disinfection, Inhibition of respiratory enzymes. Introduction to domestic waste-water treatment: Waste-water management, schematic of waste-water treatment plant, primary, secondary and tertiary treatments, system of sanitation, sewage appurtenances, sewage and storm water pumping stations, quantity estimation of sewage and storm water, hydraulic design of sewers and storm water. Physical treatment processes: Flow equalization, aeration, screening, design of fine screens, grit, effect of grit, grit removal facility, skimming tank, water quality and estimation of organic content. Waste water treatment analysis: Introduction to microbiology, biological processes. Activated sludge process and lagoons. Attached growth aerobic process. Trickling filters and rotating biological contractors. Sequential batch reactor. Anaerobic treatment. Anaerobic process-UASB reactor. Membrane technology for waste-water treatment. Introduction to water and waste water engineering.

Recommended Book (s):

1. Howard S. Peavy, Donald R. Rowe, and George Tchobanoglous “Environmental Engineering”, McGraw-Hill Book Co.,
2. Arcadio Sincero, and Pacquiao Sincero. “Environmental Engineering: A design approach”, PHI Learning Pvt Ltd.,
3. Metcalf and Eddy “Inc., Wastewater Engineering, Treatment and Reuse." McGraw-Hill Higher Education.
4. Masters, Gilbert M., and Wendell Ela. “Introduction to Environmental Engineering and

Science." PHI Learning Pvt Ltd.,
5. Santosh Kumar Garg, "Water Supply Engineering" Khanna Publishers.
6. Santosh Kumar Garg, "Environmental Engineering: Sewage Disposal and Air Pollution Engineering" Khanna Publishers.
7. B. C. Punmia, Arun Kumar Jain, Ashok Kumar Jain "Water Supply Engineering", Laxmi Publications.
8. Dr. B. C. Punmia Ashok Kr. Jain Arun Kr. Jain "Environmental Engineering – II Waste Water Engineering", Laxmi Publications.

(19) CED 309 *(*Transportation Engineering - II) (L: T: P)-(3:0:0)

Railway Engineering: Location surveys and alignment - Permanent way - Gauges - Components - Functions and requirements - Geometric design, Track Junctions-Points and crossings - types and functions - design and layout - simple problems - Railway stations and yards. Signaling and interlocking - control systems of train movements. Airport Engineering: Aircraft characteristics - Airport obstructions and zoning - Runway - taxiways and aprons- Terminal area planning. Docks and Harbors: Types - Layout and planning principles- breakwaters - docks- wharves and quays - Transit sheds- warehouses- navigation aids. Urban transportation systems: Bus transit - Mass Rapid Transit System - Light Rail Transit. Intelligent Transportation Systems (ITS)

Recommended Book (s):

1. Saxena and Arora. Railway Engineering. Dhanpat Rai Publications.
2. Saxena, S.C. Airport Engineering : planning and design
3. Rangwala, S.C. Airport Engineering. Charotar Publishing House
4. Srinivasan, R. Harbour, Dock and Tunnel Engineering. Charotar Publishing House

(20) CED 310 (Introduction to Remote Sensing and GIS) (L: T: P)-(2: 0: 1)

Introduction to Remote Sensing: Definition of Remote Sensing, History and scope of remote sensing, Electromagnetic Radiation (EMR) and atmospheric windows, Types of remote sensing. Thermal Emission of Radiation, Black body radiation, Radiation Principles: Plank's Law, Stephen Boltezman law, Wien's displacement law, Kirchoffs Law, Spectral signatures, Reflectance characteristics of Earths cover types. Satellite platforms, sensors and resolutions: Platforms: Airborne and Space borne, Sensors: Passive and Active, resolutions across track and along the track scanning, Optical sensors, Thermal scanners, and Microwave radar. Aerial Photography Satellite missions and image characteristics: Landsat series SPOT series, IRS satellite series, NOAA and MODIS series, etc. Image resolution: Spatial (IFOV), Spectral, Radiometric and Temporal, Image Preprocessing: radiometric, atmospheric and geometric corrections. Application Studies: Applications of Remote sensing in Environmental monitoring and assessment, Applications of Remote sensing in Disaster Management, Land use/ Land Cover Analysis. Concepts on GIS: Definition, Basics of GIS and History, Geographic objects: point, line, area and their computer. Representation, Applications of GIS in various sectors. GIS Database (types, structures) and data Model, Geographic information and spatial data types (Map, Attributes, Image data). Data formats and Models: Raster data formats, vector data formats, advantages and disadvantages of raster and vector data formats. Data acquisition and analysis: Data acquisition (Inputs from RS imagery, GPS), Data entry & preparations (input, editing and attributing). Map scanning and digitizing, data conversion, linking of spatial and non-

spatial data. Data manipulation and Spatial Data Analysis (Vector/Raster Geoprocessing)- Buffering, Viewshed Analysis, Raster/Vector Overlay Analysis, Map Algebra Introduction to GIS software and Case studies, Issues in spatial data quality, introduction to metadata and its importance. GIS Software, Introduction to Open Source GIS

Recommended Book (s):

1. Remote Sensing and Image Interpretation, 6th edition, T. Lillesand, R. Kiefer and J. Chipman, John Wiley.
2. Remote Sensing: Principles and Interpretation, 3rd edition, by: F. F. Sabins, W. H. Freeman & Co.; 1996, ISBN: 0-71- 672442-1.
3. Burrough, P.A. and McDonnell, R.A. (1998). Principles of Geographic Information System, Oxford University Press, Oxford.
4. Concepts and Techniques of Geographic Information Systems. (Author: YEUNG, ALBERT K. W., LO, C. P.) ISBN: 978-81- 203-3914- 9, Edition: 2nd Edition, PHI Learning, India.

(21) CED 314 (Structural Dynamics) (L: T: P) - (3:0:0)

To discuss the theory of structural response to dynamic loads and to understand and appreciate the importance of vibrations: to appreciate the need and importance of dynamic analysis in structural and mechanical designs, to determine the response of SDOF and MDOF systems (with and without damping) due to free vibrations, harmonic vibrations, and arbitrary excitations, students will learn to compute the dynamic response of structural systems under dynamic loads such as blast and earthquake excitations.

Course Contents: Fundamentals of vibration, Dynamic equilibrium of structures, Formulation of dynamic models for discrete and continuous structures, Response of single degree of freedom systems to periodic and non-periodic excitations, Response spectra, Response of two degree of freedom systems, Response of multi-degree of freedom systems, Response of continuous systems, Random Vibrations.

Recommended Book (s):

1. J. L. Humar, Dynamics of Structures, CRC Press, 2012.
2. S. S. Rao, Mechanical Vibrations, Prentice Hall, 2010.
3. R. W. Clough and J. Penzien, Dynamics of Structures, CBS, 2015.
4. K. Chopra, Dynamics of Structures: Theory and Applications to Earthquake Engineering, Pearson, 2007.
5. P. Paultre, Dynamics of Structures, Wiley, 2011
6. S. G. Kelly and S. K. Kudari, Mechanical Vibrations, TMH, 2010
7. W. J .Palm, Mechanical Vibration, Wiley India, 2013
8. W. T. Thomson and M. D. Dahleh, Theory of Vibration with Applications, Prentice Hall, 1997.
9. M. Paz and W. Leigh, Structural Dynamics: Theory and Computation, Springer, 2013.

(22) CED 315 (Environmental Management in Industries) (L: T: P)-(3:0:0)

Sources and Types of Wastes: Solid, liquid and gaseous wastes. Water Use in Industry:

Industrial water quality requirements, deterioration of water quality. Control and Removal of Specific Pollutants in Industrial Wastewaters: oil and grease, cyanide, fluoride, toxic organics, heavy metals, radioactivity. Solid and Hazardous Wastes: Definitions, concepts and management aspects. Control of Gaseous Emissions: hood and ducts, tall stacks. Particulate and Gaseous Pollutant Control: Recent trends in industrial waste management, cradle to grave concept, life cycle analysis, clean technologies. Monitoring of air and water pollution parameters in industries: Measurement methods of criteria air pollutants in industries, measurement of water pollution parameters in waste water released from industrial treatment process. Environmental Audit: definitions and concepts, environmental audit versus accounts audit, compliance audit, relevant methodologies, regulations, Introduction to ISO and ISO 14000. Environmental Impact Assessment of Infrastructure Projects: road project, hydroelectric power plant, thermal power plant, building projects. Case Studies of Industries: Dairy, fertilizer, distillery, sugar, pulp and paper, iron and steel, metal plating, and thermal power plants. Field visit: A field visit to an industrial plant (thermal power plant or cement industry or pharmaceutical industry) in the NCR with good environmental management practice.

Recommended Book (s):

1. Bhaskar, N., Hens, L., Nath, B., Compton, P., & Devuyst, D. (Eds.). (1999). Environmental.
2. Management In Practice: Volume 2-Compartments, Stressors and Sectors. Taylor & Francis.
3. Gupta, R. C. (2012). Energy and Environmental Management in Metallurgical Industries. PHI Learning Pvt. Ltd.
4. Li, H., & Chen, Z. (2007). Environmental management in construction: a quantitative approach. Routledge.
5. Lawrence, D. P. (2003). How to Make EIAs More Practical. Environmental Impact Assessment: Practical Solutions to Recurrent Problems, 209-265.
6. Canter, L. W. (1996). Environmental impact assessment (No. Ed 2.). McGraw-Hill Inc.

(23) CED 401 (Design of Steel Structure) (L: T: P)-(3:0:0)

Introduction: Properties of Structural Steel, I. S. Rolled Sections, I. S. Specifications. Design Approach: Factor of Safety, Permissible and Working Stresses, Elastic Method, Plastic Method, Introduction to Limit States of Design. Connections: Type of Connections, Riveted, Bolted and Welded Connections, Strength, Efficiency and Design of Joints, Modes of Failure of a Riveted Joint, Advantages and Disadvantages of Welded Joints, Design of Fillet and Butt Welds, Design of Eccentric Connections. Tension Members: Net Sectional Area, Permissible Stress, Design of Axially Loaded Tension Member, Design of Member Subjected to Axial Tension and Bending. Compression Members: Modes of Failure of a Column, Buckling Failure- Euler's Theory, Effective Length, Slenderness Ratio, Design Formula: I.S. Code Formula, Design of Compression Members, Design of Built-Up Compression Members: Laced and Battened Columns. Plastic analysis of structure: Basics of plastic analysis, Plastic hinge, Shape factor, Principles of plastic analysis, Mechanism and methods. Beams: Design Procedure, Built-Up Sections, Plate Thickness, Web Crippling, Web Buckling, Connections and Curtailment of Flange Plates.

Recommended Book (s):

1. Limit state design in structural steel: M.R. Shiyekar.
2. Design of steel structure: N. Subramaniam.
3. Limit state design of steel structures: S.K. Duggal.

(24) CED 402 (Statistics in Structural Engineering) (L: T: P)-(1:0:2)

Importance of statistics, Data generation for statistics, Random Sampling, Hypothesis testing and goodness of fit, Analysis of variance, Statistics in the context of Civil Engineering: Normal distribution, Characteristic strength, Factor of Safety, Design loads and ultimate capacity, Economic implications of confidence factor and design methodology.

Recommended Book (s):

1. Rice, Mathematical Statistics and Data Analysis, CENGAGE Learning.
2. A.K. Bhargava, C.P. Sharma, Mechanical Behavior and Testing of Materials, Prentice Hall of India, 2011.

(25) CED 403 (Pavement Design) (L: T: P)-(3:0:1)

Pavement Types, Wheel Loads, Design Factors, Vehicle and Traffic Considerations, Climate, and Environment. Properties of pavement component materials and material characterization. Stresses in Flexible Pavements. Stresses in Rigid Pavements. Philosophy of design of flexible and rigid pavements. Design of flexible and rigid pavements using different methods. Design of overlays and drainage system. Pavement failure and maintenance.

Recommended Book (s):

1. Yang H. Huang, Pavement Analysis and Design, 2nd Edition, Pearson Prentice Hall, 2004.
2. Yoder and Witzech, Pavement Design, 2nd Edition, Wiley.
3. All relevant IRC Codes (IRC-15, IRC-37, IRC-58, IRC-82).

(26) CED 404 (Photogrammetry and GPS) (L: T: P) - (3:0:0)

Using aerial photographs for managing resources is common. Aerial photographs and photography is essential component. This course introduces students to its basics such as its history, importance, using aerial photographs for measurements of various structures on earth's surface. The process involves basics about using stereo pairs, parallax bars and other relevant instruments.

Another component of this course is Global Positioning System (GPS). GPS term is rapidly becoming ubiquitous; however, it is essential to know the basics. The course will introduce students to its basic functionality, various signals associated with it, methods of capturing data using GPS, determining and increasing accuracy of GPS data, various policies associated with GPS, and finally its applications.

Recommended Book (s):

1. Punmia, B. C., "Surveying" Vol II & III, Laxmi Pub (1994).
2. Duggal, S. K., "Surveying" Vol 2, Tata, McGraw Hill (2013).

3. Ahmed El-Rabbany; Introduction to GPS: The Global Positioning System, Second Edition;published by Artech House; ISBN 978-1-59693-017-9.
4. YEUNG, ALBERT K. W., LO, C. P. Concepts and Techniques of Geographic Information Systems, ISBN: 978-81-203-3914-9.
5. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (2005). Geographic Information Systems and Science. Chichester: Wiley. 2nd edition.
6. Thurston, J., Poiker, T.K. and J. Patrick Moore. (2003). Integrated Geospatial Technologies: A Guide to GPS, GIS, and Data Logging. Hoboken, New Jersey: Wiley.
7. Alfred Leick, "GPS Satellite Surveying", 3rd Edition, John Wiley and Sons 2004.

(27) CED 405 (Air Quality Science and Engineering) (L: T: P)-(3:0:0)

Introduction to air quality science and engineering; Basics of air pollution including unit of expression and measurement techniques; Sources of air pollutants in the environment; Aerosol/particulate matter, and classification of particulate matter; Atmospheric transformation of air pollutants; Meteorology as applied to air pollution and dispersion of air pollutants; Air quality dispersion modeling techniques; Selection of control equipment; Engineering control concepts; Process change; Fuel change; Pollutant removal and disposal of pollutants; Control devices and systems; Removal of dry particulate matter; Liquid droplets and mist removal; Gaseous pollutants and odor removal; Control of stationary and mobile sources; and Source apportionment modeling techniques.

Recommended Book (s):

1. Wang, L. K., Pereira, N. C., & Hung, Y. T. (Eds.). (2004). Air pollution control engineering (Vol. 1). Totowa, NJ: Humana press.
2. De Nevers, N. (2010). Air Pollution Control Engineering. Waveland Press, USA.
3. Kreith, F., Schnelle, K. B., & Brown, C. R. (2002). Air pollution control technology handbook.

(28) CED 407 (Transportation Systems) (L: T: P)-(3:0:1)

This course serves as an introduction to basic issues relevant to transportation systems, with particular emphasis on India. Topics will include modes of transportation, transportation economics, transportation planning, financing and pricing, issues of equity in transportation, transportation safety, transportation regulation and policy, and sustainable transportation systems.

Recommended Book (s):

Readings from multiple sources. A reading list will be available prior to start of classes. Instructors may add or delete readings during the semester.

(29) CED 409 (Geotechnical Earthquake Engineering) (L: T: P)-(3:0:1)

This course aims to introduce the fundamentals of soil dynamics emphasizing on the behavior of soils under seismic and dynamic loading, and the effect of superficial geology on strong-motion. It will help to understand the fundamental physics and mathematics governing soil response to earthquake loading, the parameters controlling that response, and seismic performance assessment.

Specific contents: Vibration theory; Engineering seismology; Wave propagation through soils; Dynamic soil properties; Strong ground motion; Seismic hazard analysis; Seismic ground response analysis; Liquefaction and lateral spreading; Seismic microzonation; Seismic analysis and seismic performance assessment of structures.

Recommended Book (s):

1. Steven L. Kramer, Geotechnical Earthquake Engineering, Pearson Education, 2007.
2. Ikuo Towhata, Geotechnical Earthquake Engineering, Springer, 2010.
3. Nozomu Yoshida, Seismic Ground Response Analysis, Springer, 2014.
4. Robert W. Day, Geotechnical Earthquake Engineering Handbook, McGraw Hill, 2012.
5. Several selected research papers will be referred during the course.

(30) CED 411 (Earthquake Engineering) (L: T: P)-(3:0:0)

Earthquakes: Causes of earthquakes and seismic waves; Measurement of earthquakes and measurement parameters: Magnitude and Intensity; Recording instruments and time history records; Base line correction and frequency contents of ground motion; Predominant period; Power spectral density function of ground motion; Concept of response spectrums of earthquake; Design response spectrum; Seismic hazard assessment. Linear earthquake analysis: idealization of structures, equations of motion for SDOF and MDOF systems; Undamped free vibration of SDOF and MDOF systems; Mode shapes and frequencies of MDOF systems; Rayleigh damping matrix; Time domain and frequency domain analysis of MDOF systems; Modal analysis in time and frequency domain; Response spectrum analysis. Nonlinear earthquake analysis: force-deformation relationships, equation of motion, controlling parameters; Ductility demand and allowable ductility; Concepts of inelastic spectrum; Push over analysis; Time history analysis of 3D tall buildings. Vibration control systems; Concepts of active and passive controls; Base isolation for earthquake resistant design of structures: isolation systems and their modeling.

Recommended Book (s):

1. A.K. Chopra, Dynamics of Structures: Applications to Earthquake Engineering, Prentice-Hall, New York, 1997.
2. P. Agarwal and M. Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall of India, 2006.
3. D.J. Dowrick, Earthquake Resistant Design and Risk Reduction, John Wiley and Sons, 2009.
4. S.L. Kramer, Geotechnical Earthquake Engineering, Prentice Hall, international series, Pearson Education (Singapore) Pvt. Ltd., 2004.
5. R.W. Clough and J. Penzien, Dynamics of Structures, 2nd edition, McGraw-Hill, New York, 1993.
6. T. Paulay and M. N. J. Priestly, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons, 1992.
7. S.K. Duggal, Earthquake Resistant Design of Structures, Oxford University Press, 2007.
8. IS: 1893 – 2002, Criteria for Earthquake Resistant Design of Structures.

(31) CED 414 (Soil Dynamics) (L: T: P)-(3:0:0)

Vibration of elementary system, Degrees of freedom, Analysis of system with one degree of

freedom, spring-mass system, harmonic vibration, uniform circular motion, natural frequency, free and forced vibrations with and without damping, types of damping. Wave propagation in elastic rods, in an elastic infinite medium, and in semi-elastic half space, wave generated by surface footing. Field and laboratory tests for evaluation of dynamic properties of soil under vertical vibration, coefficient of elastic uniform compression, coefficient of elastic uniform shear, damping ratio and shear modulus of soils. Liquefaction of soils, criterion and factor affecting liquefaction of soil, laboratory and field studies on liquefaction, liquefaction studies in oscillatory simple shear, evaluation of liquefaction potentials, liquefaction of clay.

Recommended Book (s):
Braja M. Das (2014). *Principles of Soil Dynamics* (2nd Edition), Cengage Learning.

(32) CED 421 (Public Transport Systems) (L: T: P)-(3:0:0)

This course will describe the evolution and role of urban public transportation modes, systems, and services, focusing on bus and rail. Technological characteristics and their impacts on capacity, service quality, and cost will be described. Current practice and new methods for data collection and analysis, performance monitoring, route design, frequency determination, and vehicle and crew scheduling will also be discussed. In addition, the effect of pricing policy and service quality on ridership and methods for estimating costs associated with proposed service changes will be presented together with means to improve operations through real time intervention. Specific contents: Transit System; Estimation of Transit Demand; Route planning techniques; Bus Scheduling; Transit Corridor identification and planning; Mass Transport Management Measures; Integration of Public Transportation Modes; Public transport Infrastructure; Case Studies; Multimodal Transportation Systems.

Recommended Book (s):

1. Vukan R. Vuchic, "Urban Public Transportation: Systems and Technology",1st Edition, Prentice-Hall; 1st edition (1981).
2. Vukan R. Vuchic, "Urban Transit : operations, planning and economics", New.Jersey. : J. Wiley & Sons, ©2005.
3. Ceder, Avishai and Haifa, Israel, "Public transit planning and operation : theory, modelling and practice", London ; Burlington, MA : Elsevier , ©2007.

(33) CED 433 Physico-chemical Processes in Environmental Engineering (L: T: P)-(3:0:0)

This course will provide a basic understanding of different Physico-chemical process relevant to Environmental Engineering. It will impart an in depth knowledge of the common physicochemical processes occurring in natural environments i.e. in rivers, lakes, aquifers, etc. and ultimately demonstrate how the same processes are utilized in engineered systems (e.g., water treatment plants) for improvement of water quality. The primary objective of this course is to understand the source of different pollutants in surface and sub-surface waters and wastewater and its treatment using the Physico-chemical process. This course also covers the conventional and advanced Physico-chemical treatment process for the treatment of emerging contaminants found in our environment

Recommended Book (s):

1. Howard S. Peavy, Donald R. Rowe, and George Tchobanoglous “Environmental Engineering”, McGraw-Hill Book Co.
2. Environmental Engineering Science. First Edition (2001). By: William W. Nazaroff and Lisa AlvarezCohen. John Wiley and Sons Inc.
3. Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, TMH publication, 4 th Edition, 2003.

(33) CED 413 Biological Processes in Environmental Engineering (L: T: P)-(3:0:0)

This course will provide a basic understanding of Biological Process in Environmental Engineering. The course content includes the composition and classification of microorganisms relevant to Environmental Engineering. It also provides an overview of various biological units for the removal of biodegradable organics and nutrients found in water and wastewater. At the end of the course the student will have a basic understanding of type of microorganisms in the environment and its role in treatment of wastewater, which will help in design of various biological reactors for treatment of emerging contaminant found in our environment.

Recommended Book (s):

1. Pelczar, M. J. (Jr), Chan, E C S and Krief, N. R., Microbiology, 5 th Ed., McGraw-Hill, 1996.
2. Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, TMH publication, 4 th Edition, 2003.
3. Howard S. Peavy, Donald R. Rowe, and George Tchobanoglous “Environmental Engineering”, McGraw-Hill Book Co.
4. Bruce Rittmann, Perry Mccarty Enviornmental Biotechnology: Principles and Applications, McGraw Hill Education, 1st edition, 2018

VII. Brief information about Faculty Members

(1) Dr. Ghanshyam Pal, (Ph.D., University of Mississippi, USA) – Associate Professor & HoD

Dr. Ghanshyam Pal has obtained his Ph.D. from the Department of Civil Engineering, University of Mississippi, USA, M.S. (Structural Engineering) from the Department of Civil Engineering, Vanderbilt University, USA, M.S. (Materials Engineering) from the Department of Civil Engineering, University of Mississippi, USA and B.E. from the Department of Metallurgical and Materials Engineering from the University of Roorkee (Now, IIT Roorkee), India.

During his Post-doc at Department of Mechanical and Materials Engineering (MME), Masdar Institute of Science and Technology, UAE, he has focused his research on finite element modelling of high efficiency Carbon nanostructure – Epoxy composites for high ampacity overhead power lines. His Ph.D. dissertation was a part of U.S. Department of Homeland Security supported research project on developing blast resistant polymer coatings for critical infrastructure in United States. He also worked as a Structural Design Engineer at Logan Patri Engineering, Nashville, USA after his M.S. in Structural Engineering. During this tenure, his job responsibilities included design of steel, concrete

and wood residential and commercial structures, retrofit design for various facilities and infrastructure, technical support to Principal Engineer, proposal/report writing and development of in-house computerized analysis procedures. His research interests are in the areas of Materials Engineering, including novel cementitious composites, materials for improving energy efficiency of buildings and multi-scale modelling, Building Physics and Sustainability.

(2) Dr. Sailesh N. Behera, (Ph.D., Indian Institute of Technology, Kanpur) – Associate Professor

Dr. Sailesh N. Behera has been working as Assistant Professor in the Department of Civil Engineering at Shiv Nadar University, Greater Noida, Uttar Pradesh, India since July 2015. He obtained his Ph.D. in Civil Engineering from Indian Institute of Technology Kanpur, India. Before joining at Shiv Nadar University, he worked as a Post-Doctoral Fellow in the Department of Civil and Environmental Engineering at National University of Singapore, Singapore. His research thrust areas include Fate and control of water and wastewater contaminants, Air quality monitoring and modeling, Waste management, and Water-air-soil Interactions. He has published more than 30 peer-reviewed articles in Impactful International Journals of the field, and several National/International conference papers. The scope of his current research project includes insight into environmental fate and associated health effects of diesel engine exhausts under controlled laboratory conditions. His teaching interest has been seen with all aspects of Environmental Engineering including Water and wastewater engineering, Solid waste management, Environmental management in industries, and Air pollution control.

(3) Dr. Gopal Das Singhal, (Ph.D., Indian Institute of Technology, Roorkee) – Assistant Professor

Dr. Gopal is a renowned in the field of Civil Engineering. He has worked in Hydro engineering assignments in the areas of hydraulic structure, dam safety, Hydropower, sediment removal structure like vortex settling basin or desilting tank for hydraulic design evaluation of engineering structures.

(4) Dr. Jagabandhu Dixit, (Ph.D., Indian Institute of Technology, Bombay) – Assistant Professor

Dr. Jagabandhu Dixit is serving as an Assistant Professor at Shiv Nadar University since November 2012 and his native place is Budei in Baleshwar District of Odisha. He is currently working in the area of Natural Hazards Assessment and Disaster Risk Reduction with the primary focus on multiple hazard mapping, mapping of spatial-temporal assessment of the natural hazards, vulnerability, and sustainability. Specifically, his research includes Natural Hazards and Disaster Risk Reduction, Disaster Mitigation and Emergency Management, Earthquake Engineering and Structural Dynamics, Soil Mechanics and Foundation Engineering. His teaching interest includes wide range of Civil Engineering courses in the specializations of Structural, Geotechnical, and Earthquake Engineering.

(5) Dr. Sumedha Moharana, (Ph.D., Indian Institute of Technology, Delhi) – Associate Professor

Dr. Sumedha has completed her Ph.D. from IIT, Delhi. During her doctoral studies she handled many research projects funded by DRDO, ISRO, DST and MHRD. Her major research interests are, smart

structure, piezo-impedance based structural health monitoring, shear lag effect and piezo-structure interaction. In addition, she is also interested in composite structure, dynamic behavior of thin wall structure.

(6) Dr. Gyan Vikash, (Ph.D., Indian Institute of Technology, Kanpur) – Associate Professor

With specialization of Geotechnical Engineering, Dr. Gyan Vikash has research interests in the areas of Earthquake Engineering, Seismic Soil Structure Interaction, Constitutive Modeling of Granular Materials, and Computational Geomechanics. He has been awarded with young scientist project captioned as "Experimental Investigation of Diffusion Process During CRS Consolidation under Monotonic Loading and Unloading-Reloading Stages" under the Fast Track Scheme run by DST, New Delhi, India cost of INR 15 lakh.

(7) Dr. Shalini Rankavat, (Ph.D., Indian Institute of Technology Delhi) – Assistant Professor

Dr. Shalini Rankavat has completed her Ph.D. from IIT Delhi. Her research topic during Ph.D. was "Estimation of Actual & Perceived risks faced by Pedestrians – Case Study Delhi". Her research interests are towards the increase in safety of non-motorized transportation. She is having industrial experience of working as design engineer in highway department for 4.5 years and teaching experience of 2 years. With her professional and research experience, she is good at using software like Arc-GIS, MX-Road, STATA-13, SPSS and Auto CAD.

(8) Dr. Susant Kumar Padhi, (Ph.D., Indian Institute of Technology, Guwahati) – Assistant Professor

Dr. Susant Kumar Padhi has completed his Ph.D. from IIT, Guwahati with a specialization in Environmental Engineering. His major research interests include Biological Processes for Treatment of Wastewater and Waste Gas, Membrane Technology, Air Pollution Control, and Designing and Optimisation of Reactor for Treatment of Waste Streams. He is having post-doc experience of 1 year and teaching experience of 1.5 year.

(9) Dr. Hitesh Upreti, (Ph.D., Indian Institute of Technology, Roorkee) – Assistant Professor

Dr. Hitesh Upreti obtained his Ph.D. from Indian Institute of Technology Roorkee in 2018. His Ph.D. was focussed on evapotranspiration analyses and soil moisture modeling in cropped area that can be used for irrigation scheduling. His present research interests include applications of remote sensing in hydrology, evapotranspiration, irrigation water requirements and use of implementable methods for the efficient management of available water resources.

(10) Dr. Ellora Padhi, (Ph.D., Indian Institute of Technology, Kharagpur) – Assistant Professor

Ellora Padhi obtained her Ph.D. from the Department of Civil Engineering, Indian Institute of Technology Kharagpur, India in 2020. Her doctoral research topic was hydrodynamics of gravel beds including experimental studies on turbulent flow over the water-worked gravel-bed. Her areas of research interests include open-channel hydraulics, river meandering, turbulence and sediment transport. At present, she is working on flow over dunal bedforms. In natural stream flows, owing to the sediment transport, continuous deposition and erosion of sediments occurs. The dunal surface in natural streams is amongst most common examples, where turbulence is closely linked. The proposed research shows a blueprint of finding the signature of turbulence in most common flows. This study reveals hidden pearls of turbulence from the experimental frameworks.

(11) Dr. Nitin B Burud, (Ph.D., Indian Institute of Science, Bangalore) – Assistant Professor

Dr. Nitin B. Burud obtained his Ph.D. from the Indian Institute of Science, Bangalore, in December 2020. Before joining the Ph.D. program, he worked as an Assistant professor at Sir Padampat Singhania University, Udaipur, Rajasthan. He specializes in structural engineering and expertise in experimental investigations on concrete fracture and fatigue.

VIII. Contact details of Faculty members, lab staffs and Ph.D. students

Table 18: Contact details of faculty members in Civil Engineering

S. No	Name	Phone Extension	Office Location	Email ID
1	Sailesh N. Behera	745	D-334D	sailesh.behera@snu.edu.in
2	Ghanshyam Pal	615	D036D	ghanshyam.pal@snu.edu.in
3	Gopal Das Singhal	209	D-236-K	gopal.singhal@snu.edu.in
4	Jagabandhu Dixit	237	C-214-G	jagabandhu.dixit@snu.edu.in
5	Gyan Vikash	225	D-132-L	gyan.vikash@snu.edu.in
6	Sumedha Moharana	296	C-322-A	sumedha.maharana@snu.edu.in
7	Shalini Rankavat	699	D-036-K	shalini.rankavat@snu.edu.in
8	Susant Kumar Padhi	633	C-214A	susant.padhi@snu.edu.in
9	Hitesh Upreti	403	D-132B	hitesh.upreti@snu.edu.in
10	Ellora Padhi	439	A-111A	ellora.padhi@snu.edu.in
11	Nitin B Burud	458	A-111B	nitin.burud@snu.edu.in

Table 19: Contact details of Laboratory and Supportive staffs in Civil Engineering

S. No.	Name	Phone Extension	Office Location	Email ID
1	Jitendra K. Tripathi	6767	C-017	jitendra.tripathi@snu.edu.in
2	Rajneesh Kumar	294	C-009	rajneesh.kumar@snu.edu.in
3	Raju Gupta	306/261	C-014/ C-006	rg868@snu.edu.in
4	Surendra K. Sharma	452	C-109	Surendra.Sharma@snu.edu.in

Table 20: Contact details of PhD Scholars in Civil Engineering

S. No.	Name	Phone Extension	Office Location	Email ID
1	Dharmaraj	263	C-116	dp301@snu.edu.in
2	Vishnu Kumar	263	C-116	vishnu.kumar@snu.edu.in
3	Siddharth Jain	263	C-116	sj887@snu.edu.in
4	Laxmi Gupta	263	C-116	lg100@snu.edu.in
5	Vipin Chauhan	263		vc477@snu.edu.in
6	Vikalp Saxena	6767	C-017	vs154@snu.edu.in
7	Smrithy Subash	263	C-006	ss831@snu.edu.in
8	Vikalp Chauhan	263	C-009	vc651@snu.edu.in
9	Navdeep Agarwal	263	C-006	na655@snu.edu.in
10	Lukesh Parida	263	C-006	lp617@snu.edu.in
11	Aditi Yadav		C-009	ay453@snu.edu.in
12	Rajeev Kumar		D117A	rk978@snu.edu.in
13	Amit Jain		D117A	aj112@snu.edu.in

Table 21: Details of Laboratories in Civil Engineering

S. No.	Name of Laboratory	Location/ Contact Person/ Phone Extension
1	Survey & Geology Lab	C-109/ Surendra Sharma /452
2	Strength of Materials Lab	C-006/ Surendra Sharma /261
3	Fluid Mechanics Lab	C-009/ Rajneesh Kumar /294

4	Soil Mechanics Lab	C-014/ Raju Gupta /306
5	Concrete Technology Lab	F-001/ Raju Gupta /859
6	Environmental Engineering Lab	C-017/ Jitendra Tripathi /264
7	Civil Software Lab	C-116/ Jitendra Tripathi /263
8	Highway Materials Lab	C-118/ Jitendra Tripathi /262