AMRITA VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY
School of Engineering

AMRITAPURI, BENGALURU, COIMBATORE, CHENNAI

DEPARTMENT OF CIVIL ENGINEERING

B.Tech. in CIVIL ENGINEERING
(BTC-CIE)

CURRICULUM AND SYLLABI
(2019)

GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM

Cat	-	Category
L	-	Lecture
T	-	Tutorial
P	-	Practical
Cr	-	Credits
ENGG	-	Engineering Sciences (including General, Core and Electives)
HUM	-	Humanities (including Languages and others)
SCI	-	Basic Sciences (including Mathematics)
PRJ	-	Project Work (including Seminars)

AES	-	Aerospace Engineering
AIE	-	Computer Science and Engineering - Artificial Intelligence
BIO	-	Biology
CCE	-	Computer and Communication Engineering
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CIE	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
HUM	-	Humanities
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics

Course Outcome (CO) – Statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.

Program Outcomes (POs) – Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

PROGRAM OUTCOMES FOR ENGINEERING

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.

6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **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.

Program Educational Objectives

- Achieve excellence in Civil engineering skills to engage in diverse career choices
- Develop an attitude of lifelong learning through research, multidisciplinary studies and professional organizations
- Demonstrate the ability to function in a team environment along with leadership, communication and management skills.
- Exhibit sensitivity in serving society as ethical and responsible professionals.

Program Specific Outcomes

- Ability to solve problems related to structural/ geotechnical/ transportation/ environmental engineering
- Provide design details with specifications and estimates for systems like buildings and hydraulic structures.
- Apply concepts of construction engineering, management and sustainability in a project environment

CURRICULUM

SEMESTER I

Cat.	Code	Title	Credit
HUM	19ENG111	Technical Communication	3
SCI	19MAT101	Single Variable Calculus	1
SCI	19MAT102	Matrix Algebra	2
ENGG	19CSE100	Problem Solving and Algorithmic Thinking	4
SCI	19PHY102	Engineering Physics - B	3
SCI	19PHY182	Engineering Physics Lab - B	1
ENGG	19MEE101	Engineering Drawing	3
ENGG	19EEE100	Basic Electrical and Electronics Engineering	3
ENGG	19EEE181	Basic Electrical and Electronics Engineering Lab	1
HUM	19CUL101	Cultural Education - I	2
		TOTAL	23

SEMESTER II

Cat.	Code	Title	Credit
SCI	19MAT111	Multivariable Calculus	2
SCI	19MAT112	Linear Algebra	3
SCI	19CHY101	Engineering Chemistry - A	3
SCI	19CHY181	Engineering Chemistry Lab - A	1
ENGG	19CSE102	Computer Programming	4
ENGG	19MEE182	Computer Aided Drafting	1
ENGG	19CIE111	Introduction to Civil Engineering	2
ENGG	19CIE102	Mechanics : Statics and Dynamics	3
ENGG	19MEE112	Basic Mechanical Engineering	3
ENGG	19MEE181	Manufacturing Practice	1
HUM	19CUL111	Cultural Education - II	2
		TOTAL	25

SEMESTER III

Cat.	Code	Title	Credit
SCI	19MAT208	Transforms & Partial Differential Equations	3
ENGG	19CIE201	Solid Mechanics	4
ENGG	19CIE202	Principles of Fluid Mechanics	3
ENGG	19CIE203	Principles of Surveying	4
ENGG	19CIE204	Construction Materials and Methods	3
HUM		Free Elective I**	2
HUM	19MNG300	Disaster Management	P/F
HUM	19AVP201	Amrita Values Program I	1
		TOTAL	20

SEMESTER IV

Cat.	Code	Title	Credit
SCI	19MAT215	Complex Analysis & Probability Theory	4
ENGG	19CIE211	Geology & Soil Mechanics	3
ENGG	19CIE212	Structural Analysis	4
ENGG	19CIE213	Hydraulic Engineering	3
ENGG	19CIE214	Transportation Engineering I	3
ENGG	19CIE281	Hydraulic Engineering Laboratory	1
ENGG	19CIE282	Materials Testing and Evaluation	2
HUM	19SSK211	Soft Skills I	2
HUM	19AVP211	Amrita Values Program II	1
		TOTAL	23

SEMESTER V

Cat.	Code	Title	Credit
ENGG	19CIE301	Geotechnical Engineering	3
ENGG	19CIE302	Environmental Engineering I	3
ENGG	19CIE303	Basic Reinforced Concrete Design	4
ENGG	19CIE304	Transportation Engineering II	2
ENGG		Professional Elective I*	3
ENGG	19CIE381	Computer aided Civil Engineering Drawing	2
ENGG	19CIE382	Geotechnical Engineering Laboratory	1
PRJ	19CIE390	Industry Internship (Vacation)	P/F
ENGG	19LIV390	[Live-in - Labs]***	[3]
HUM	19SSK301	Soft Skills II	2
HUM	19ENV300	Environmental Science	P/F
		TOTAL	20[+3]

SEMESTER VI

Cat.	Code	Title	Credit
ENGG		Professional Elective II*	3
ENGG	19CIE311	Environmental Engineering II	3
ENGG	19CIE312	Basic Steel Design	4
ENGG	19CIE313	Estimation, Costing and Professional Practice	3
ENGG	19CIE314	Hydrology & Water Resources Engineering	3
ENGG		Professional Elective III*	3
HUM	19SSK311	Soft Skills III	2
HUM	19LAW300	Indian Constitution	P/F
ENGG	19LIV490	[Live-in –Labs]***	[3]
		TOTAL	21[+3]

SEMESTER VII

Cat.	Code	Title	Credit
ENGG	19CIE402	Construction Management	3
ENGG		Professional Elective IV*	3
ENGG	19CIE401	Structural Design and Detailing	3
ENGG		Professional Elective V*	3
ENGG	19CIE491	Professional project	2
PRJ	19CIE492	Comprehensive Examination	1
PRJ	19CIE490	Industry Internship (Vacation)	P/F
PRJ	19CIE495	Minor Project	2
		TOTAL	17

SEMESTER VIII

Cat.	Code	Title	Credit
HUM		Free Elective II**	2
ENGG		Professional Elective VI*	3
PRJ	19CIE499	Project	10
		TOTAL	15

		TOTAL CREDITS		164

***Professional Elective -** Electives categorised under Engineering, Science, Mathematics, Live-in-Labs, and NPTEL Courses. Student can opt for such electives across departments/campuses. Students with CGPA of 7.0 and above can opt for a maximum of 2 NPTEL courses with the credits not exceeding 8.

**** Free Electives -** This will include courses offered by Faculty of Humanities and Social Sciences/ Faculty Arts, Commerce and Media / Faculty of Management/Amrita Darshanam -International Centre for Spiritual Studies).

***** Live-in-Labs** - Students undertaking and registering for a Live-in-Lab project, can be exempted from registering for an Elective course in the higher semester.

PROFESSIONAL ELECTIVE COURSES (with Pre Requisite)			
Structural Engineering			
Cat.	**Code**	**Title**	**Credit**
ENGG	**19CIE431**	**Advanced Concrete Design**	**3**
ENGG	**19CIE432**	**Advanced Steel Design**	**3**
ENGG	**19CIE433**	**Advanced Structural Analysis**	**3**
ENGG	**19CIE434**	**Prestressed Concrete - Analyses, Design and Construction**	**3**
ENGG	**19CIE435**	**Structural Dynamics & Seismic Design**	**3**
ENGG	**19CIE437**	**Bridge Engineering**	**3**
ENGG	**19CIE438**	**Finite Element Methods**	**3**
Geotechnical Engineering			
Cat.	**Code**	**Title**	**Credit**
ENGG	**19CIE451**	**Ground Improvement Techniques**	**3**
ENGG	**19CIE452**	**Advanced Foundation Engineering**	**3**
ENGG	**19CIE453**	**Environmental Geotechnology**	**3**
ENGG	**19CIE454**	**Geotextile engineering**	**3**
ENGG	**19CIE455**	**Geotechnics and Geosynthetics Engineering**	**3**
Environmental Engineering			
Cat.	**Code**	**Title**	**Credit**
ENGG	**19CIE471**	**Advanced Environmental Engineering**	**3**
ENGG	**19CIE472**	**Industrial Waste Treatment**	**3**
Construction Technology and Management			
Cat.	**Code**	**Title**	**Credit**
ENGG	**19CIE441**	**Concrete Technology**	**3**
ENGG	**19CIE442**	**Repair and Rehabilitation of Structures**	**3**
ENGG	**19CIE443**	**Introduction to Architectural Science**	**3**
ENGG	**19CIE444**	**Sustainable Construction**	**3**
ENGG	**19CIE445**	**Construction Economics and Finance**	**3**
Transportation Engineering			
Cat.	**Code**	**Title**	**Credit**
ENGG	**19CIE461**	**Pavement Design**	**3**
ENGG	**19CIE462**	**Urban Transportation Planning**	**3**
ENGG	**19CIE463**	**Traffic Engineering and Management**	**3**
Hydraulics and Water Resources Engineering			
Cat.	**Code**	**Title**	**Credit**
ENGG	**19CIE473**	**Ground Water Hydrology**	**3**
ENGG	**19CIE474**	**Water Resources Systems Planning and Design**	**3**

PROFESSIONAL ELECTIVE COURSES (without Pre Requisite /Open to all)			
Cat.	**Code**	**Title**	**Credit**
ENGG	19CIE475	Environmental Impact Assessment	3
ENGG	19CIE476	Remote sensing & GIS	3
ENGG	19CIE477	Transportation System Management and Control	3

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY			
Cat.	**Code**	**Title**	**Credit**
SCI	19CHY243	Computational Chemistry and Molecular Modelling	3
SCI	19CHY236	Electrochemical Energy Systems and Processes	3
SCI	19CHY240	Fuels and Combustion	3
SCI	19CHY232	Green Chemistry and Technology	3
SCI	19CHY239	Instrumental Methods of Analysis	3
SCI	19CHY241	Batteries and Fuel Cells	3
SCI	19CHY242	Corrosion Science	3
PHYSICS			
SCI	19PHY340	Advanced Classical Dynamics	3
SCI	19PHY342	Electrical Engineering Materials	3
SCI	19PHY331	Physics of Lasers and Applications	3
SCI	19PHY341	Concepts of Nanophysics and Nanotechnology	3
SCI	19PHY343	Physics of Semiconductor Devices	3
SCI	19PHY339	Astrophysics	3
Mathematics			
SCI	19MAT341	Statistical Inference	3
SCI	19MAT342	Introduction to Game Theory	3
SCI	19MAT343	Numerical Methods and Optimization	3

FREE ELECTIVES

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM			
Cat.	**Code**	**Title**	**Credit**
HUM	**19MNG331**	**Financial Management**	**3**
HUM	**19MNG332**	**Supply Chain Management**	**3**
HUM	**19MNG333**	**Marketing Management**	**3**
HUM	**19MNG334**	**Project Management**	**3**
HUM	**19MNG335**	**Enterprise Management**	**3**
HUM	**19MNG338**	**Operations Research**	**3**
HUM	**19MEE401**	**Industrial Engineering**	**3**
HUM	**19MEE346**	**Managerial Statistics**	**3**
HUM	**19MEE347**	**Total Quality Management**	**3**
HUM	**19MEE342**	**Lean Manufacturing**	**3**
HUM	**19CSE358**	**Software Project Management**	**3**
HUM	**19CSE359**	**Financial Engineering**	**3**
HUM	**19CSE360**	**Engineering Economic Analysis**	**3**
HUM	**19MNG331**	**Financial Management**	**3**
HUM	**19CSE362**	**Information Systems**	**3**

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS			
Cat.	**Code**	**Title**	**Credit**
HUM	19CUL230	Achieving Excellence in Life - An Indian Perspective	2
HUM	19CUL231	Excellence in Daily Life	2
HUM	19CUL232	Exploring Science and Technology in Ancient India	2
HUM	19CUL233	Yoga Psychology	2
HUM	19ENG230	Business Communication	2
HUM	19ENG231	Indian Thought through English	2
HUM	19ENG232	Insights into Life through English Literature	2
HUM	19ENG233	Technical Communication	2
HUM	19ENG234	Indian Short Stories in English	2
HUM	19FRE230	Proficiency in French Language (Lower)	2
HUM	19FRE231	Proficiency in French Language (Higher)	2
HUM	19GER230	German for Beginners I	2
HUM	19GER231	German for Beginners II	2
HUM	19GER232	Proficiency in German Language (Lower)	2
HUM	19GER233	Proficiency in German Language (Higher)	2
HUM	19HIN101	Hindi I	2
HUM	19HIN111	Hindi II	2
HUM	19HUM230	Emotional Intelligence	2
HUM	19HUM231	Glimpses into the Indian Mind - the Growth of Modern India	2
HUM	19HUM232	Glimpses of Eternal India	2
HUM	19HUM233	Glimpses of Indian Economy and Polity	2
HUM	19HUM234	Health and Lifestyle	2
HUM	19HUM235	Indian Classics for the Twenty-first Century	2
HUM	19HUM236	Introduction to India Studies	2
HUM	19HUM237	Introduction to Sanskrit Language and Literature	2
HUM	19HUM238	National Service Scheme	2
HUM	19HUM239	Psychology for Effective Living	2
HUM	19HUM240	Psychology for Engineers	2
HUM	19HUM241	Science and Society - An Indian Perspective	2
HUM	19HUM242	The Message of Bhagwad Gita	2
HUM	19HUM243	The Message of the Upanishads	2

HUM	**19HUM244**	**Understanding Science of Food and Nutrition**	**2**
HUM	**19JAP230**	**Proficiency in Japanese Language (Lower)**	**2**
HUM	**19JAP2313**	**Proficiency in Japanese Language (Higher)**	**2**
HUM	**19KAN101**	**Kannada I**	**2**
HUM	**19KAN111**	**Kannada II**	**2**
HUM	**19MAL101**	**Malayalam I**	**2**
HUM	**19MAL111**	**Malayalam II**	**2**
HUM	**19SAN101**	**Sanskrit I**	**2**
HUM	**19SAN111**	**Sanskrit II**	**2**
HUM	**19SWK230**	**Corporate Social Responsibility**	**2**
HUM	**19SWK231**	**Workplace Mental Health**	**2**
HUM	**19TAM101**	**Tamil I**	**2**
HUM	**19TAM111**	**Tamil II**	**2**

SYLLABUS

SEMESTER I

19ENG111	TECHNICAL COMMUNICATION	L-T-P-C: 2-0-3-3

Course Objectives

To introduce the students to the fundamentals of mechanics of writing
To facilitate them with the style of documentation and specific formal written communication
To initiate in them the art of critical thinking and analysis
To help them develop techniques of scanning for specific information, comprehension and organization of ideas
To enhance their technical presentation skills

Course Outcome

CO1: To gain knowledge about the mechanics of writing and the elements of formal correspondence.
CO2: To understand and summarise technical documents.
CO3: To apply the basic elements of language in formal correspondence.
CO4: To interpret and analyze information and to organize ideas in a logical and coherent manner.
CO5: To compose project reports/ documents, revise them for language accuracy and make technical Presentations.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3				
CO2				1						2				
CO3										3				
CO4				1						2				
CO5									2	1				

Syllabus

Unit 1
Mechanics of Writing: Grammar rules -articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers
General Reading and Listening comprehension - rearrangement & organization of sentences

Unit 2
Different kinds of written documents: Definitions- descriptions- instructions-recommendations- user manuals - reports – proposals
Formal Correspondence: Writing formal Letters
Mechanics of Writing: impersonal passive & punctuation
Scientific Reading & Listening Comprehension

Unit 3

Technical paper writing: documentation style - document editing – proof reading - Organising and formatting
Mechanics of Writing: Modifiers, phrasal verbs, tone and style, graphical representation
Reading and listening comprehension of technical documents
Mini Technical project (10 -12 pages)
Technical presentations

Reference(s)

Hirsh, Herbert. L "Essential Communication Strategies for Scientists, Engineers and Technology Professionals". II Edition. New York: IEEE press, 2002
Anderson, Paul. V. "Technical Communication: A Reader-Centred Approach". V Edition. Harcourt Brace College Publication, 2003
Strunk, William Jr. and White. EB. "The Elements of Style" New York. Alliyan& Bacon, 1999.
Riordan, G. Daniel and Pauley E. Steven. "Technical Report Writing Today" VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.
Michael Swan. '' Practical English Usage'', Oxford University Press, 2000

Evaluation Pattern

Assessment	Internal	External
Periodical 1	20	
Periodical 2	20	
Continuous Assessment (Lab) (CAL)	40	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19MAT101	SINGLE VARIABLE CALCULUS	L-T-P-C: 1- 0 - 0 -1

Course Objectives

- Understand the various functions and their graphs.
- Understand the basic concept of continuous function and find the extreme values of the continuous functions.
- Understand the definite integral and various integration techniques.

Course Outcomes

CO1: To understand the concepts of single variable calculus.
CO2: To sketch graphs for functions using the concepts of single variable calculus and apply the fundamental theorem of calculus to evaluate integrals.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	---	---	---	---	---	---	---	---	---	---		
CO2	1	2	---	---	2	---	---	---	---	---	---	---		

Syllabus

Unit 1

Calculus
Graphs: Functions and their Graphs. Shifting and Scaling of Graphs. (1.5)

Unit 2
Limit and Continuity**:** Limit (One Sided and Two Sided) of Functions. Continuous Functions, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity. (2.1, 2.6)

Unit 3
Graphing : Extreme Values of Functions, Concavity and Curve Sketching, (4.1, 4.4).

Unit 4
Integration: Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques. (5.2 - 5.3, 8.1 – 8.5)

Text Book

Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.

Reference
'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002

Evaluation pattern

At the end of the course, a two-hour test will be conducted for 50 marks. The marks will be converted to 100 for grading.

19MAT102	MATRIX ALGEBRA	L-T-P-C: 2- 0 -0- 2

Course Objectives

- Understand basic concepts of eigen values and eigen vectors.
- Apply eigen values and eigen vectors for diagonalization and quadratic form.
- Apply various iterative techniques to solve the system of equations.

Course Outcomes

CO1: Understand the notion of eigenvalues and eigenvectors, analyse the possibility of diagonalization and hence compute a diagonal matrix, if possible.
CO2: Apply the knowledge of diagonalization to transform the given quadratic form into the principal axes form and analyse the given conic section.
CO3: Understand the advantages of the iterative techniques and apply it to solve the system of equations and finding eigenvectors.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	2	3	1									
CO3	3		1									

Syllabus

Unit 1
Review: System of linear Equations, linear independence.
Unit 2
Eigen values and Eigen vectors: Definitions and properties. Positive definite, negative definite and indefinite
Unit 3
Diagonalization and Orthogonal Diagonalization. Properties of Matrices. Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian Matrices and Orthogonal matrices.
Unit 4
Numerical Computations: L U factorization, Gauss Seidal and Gauss Jacobi methods for solving system of equations. Power Method for Eigen Values and Eigen Vectors.

Text Book
Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.

Reference Books
Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.
Engineering Mathematics', Srimanta Pal and Subhodh C Bhunia, John Wiley and Sons, 2012, Ninth Edition.

Evaluation Pattern

Assessment	Weightage
Class Test/Assignment/Tutorial	30
End of course Test (2hrs)	70

19CSE100	PROBLEM SOLVING AND ALGORITHMIC THINKING	L-T-P-C: 2-1-3-4

Course Objectives

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides foundation for developing computational perspectives of one's own discipline.

Course Outcomes

CO 1: Apply algorithmic thinking to understand, define and solve problems

CO 2: Design and implement algorithm(s) for a given problem

CO 3: Apply the basic programming constructs for problem solving

CO 4: Understand an algorithm by tracing its computational states, identifying bugs and correcting them

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1												
CO2	3	2	3		3			3	3	3				
CO3	2	1												
CO4	1	1	2		2									

Syllabus

Unit 1

Problem Solving and Algorithmic Thinking Overview – problem definition, logical reasoning; Algorithm – definition, practical examples, properties, representation, algorithms vs programs.

Unit 2

Algorithmic thinking – Constituents of algorithms – Sequence, Selection and Repetition, input-output; Computation – expressions, logic; algorithms vs programs, Problem Understanding and Analysis – problem definition, input-output, variables, name binding, data organization: lists, arrays etc. algorithms to programs.

Unit 3

Problem solving with algorithms – Searching and Sorting, Evaluating algorithms, modularization, recursion. C for problem solving – Introduction, structure of C programs, data types, data input, output statements, control structures.

Text Book(s)

Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC press; 2014 Mar 27.

Reference(s)

Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.

Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.

Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you become a computational thinker. World Scientific Publishing Company; 2017.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19PHY102	ENGINEERING PHYSICS - B (Aerospace, Civil, Mechanical and Chemical)	L-T-P-C: 2- 1- 0- 3

Course Objectives

- To enable the student to apply fundamental principles of mechanics, optics, modern physics including elements of quantum mechanics and its role in materials with specific focus on engineering problems.

Course outcomes

CO1: Apply Newton's formulation to dynamical system including central force problem and conservation laws.
CO2: Understand the elements of optics including phenomena of interference, diffraction and polarization.
CO3: Be exposed to the Einstein's theory of matter radiation interaction and different types of lasers.
CO4: Be familiar with basic idea of quantum mechanics and its application to particle in a box and tunnelling.
CO5: Be introduced to crystal physics – free electron theory and the concept of energy band and fermi energy.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2	3	2										
CO3	3	2	1									
CO4	3	2										
CO5	3	2	1									

Syllabus

Unit 1
Mechanics
Newton's laws of motion – forces, frictional forces, dynamics of uniform circular motion, work, kinetic energy, work-energy theorem, potential energy, conservation of energy, Newton's law of gravitation, motion in uniform gravitational field, centre of mass, conservation of linear and angular momentum.

Unit 2
Waves and Optics
Huygens' Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Newton's Rings, Michelson interferometer.
Fraunhofer diffraction from single slit and circular aperture, Rayleigh criterion for limit of resolution and its application to vision, diffraction gratings and their resolving power.
Polarization: Unpolarized, polarized and partially polarized lights, polarization by reflection, double refraction by uniaxial crystals, Polaroid, half wave and quarter wave plates.

Unit 3

Lasers

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (Ruby, Neodymium), dye lasers.

Unit 4

Quantum Mechanics

De Broglie waves, wave functions, wave equation, Schrodinger wave equation: time dependent and time independent form, operators – Eigen functions and Eigen values, uncertainty principle, particle in a finite potential one -dimensional box, tunnelling effect (Qualitative).

Unit 5

Introduction to Solids

Crystal systems – Miller indices, crystal planes and directions, packing fraction, Classification of solids: Metals, semiconductors and insulators (qualitative), free electron theory of metals, Fermi level, Density of states, Kronig-Penney model and origin of energy bands.

Text Books

Halliday, Resnick, Jearl Walker, "Principles of Physics", 10th Edition, Wiley,2015.
Ajay Ghatak, "Optics", 6th Edition, McGraw Hill Education India Private Limited, 2017.
Eugene Hecht, A R Ganesan, "Optics", 4th Edition, Pearson Education, 2008.
Arthur Beiser, ShobhitMahajan, S RaiChoudhury "Concepts of Modern Physics" McGraw Hill Education India Private Limited, 2017.
Charles Kittel, "Introduction to Solid State Physics" 8th Edition, Wiley, 2012.

Reference Books

David Kleppner, Robert Kolenkow, "An Introduction to Mechanics", 1st Edition, McGraw Hill Education, 2017.
F A Jenkins, H E White, "Fundamental of Optics", 4thEdition,McGraw Hill Education India Private Limited, 2017.
David J Griffiths, "Introduction to Quantum Mechanics",2nd Edition, Pearson Education,2015
M A Wahab, "Solid State Physics", 3rd Edition, Narosa Publishing House Pvt. Ltd., 2015.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19PHY182	ENGINEERING PHYSICS LAB - B (Aerospace, Civil, Mechanical and Chemical)	L-T-P-C: 0- 0-3- 1

Course Objective

- To introduce experiments for testing the understanding of physics concepts in the areas of mechanics, optics, solid state and quantum mechanics and electricity and magnetism.
- To make the student to acquire practical skills in finding properties of mater, optical properties, electrical characteristics of semiconductor materials and quantum behavior of materials

.

Course Outcomes

CO1: Be able to perform experiment to study elastic properties of materials.
CO2: Be able to design, perform experiments on dispersion, interference and diffraction.
CO3: Be able to design; perform experiments to measure semiconducting properties.
CO4: Perform experiment to study atomic spectrum of H_2 atom and quantum nature of light.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1									
CO2	3	1	1									
CO3	3	1	1									
CO4	3	1	1									

List of Experiments:

1. Young's modulus - non-uniform bending. [CO 1]
2. Rigidity modulus – moment of inertia of the disc and rigidity modulus of the wire using torsional oscillation. [CO 1]
3. Spectrometer- dispersive power of the material of prism. [CO 2]
4. Radius of curvature of given convex lens- Newton's rings method. [CO 2]
5. Laser- wavelength of diode laser and mean size of Lycopodium particles. [CO 2]
6. Band gap of a semiconductor. [CO 3].
7. Solar cell - determining efficiency and fill factor. [CO 3].
8. Photoelectric effect - Planck's constant and work function of the given metal. [CO 4]
9. Experiment to verify the quantum nature of hydrogen atom by measuring the wavelengths of spectral lines in Balmer series. [CO 4].

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA-Basic principles of experiment, skill, result analysis and viva

19MEE101	ENGINEERING DRAWING	L-T-P-C: 2-0-3-3

Course Objectives

The course is expected to enable the students.
To develop drawings using Bureau of Indian Standards (BIS) .
To communicate effectively through drawings .
To enhance visualization skills, which will facilitate the understanding of engineering systems.
Keywords: Conic sections, Orthographic projections, Isometric projections, Building drawing.

Course Outcome

CO1: Understand the engineering drawing standards and their usage.
CO2: To understand and summarise technical documents Interpret engineering drawings.
CO3: Construct and dimension geometric entities and simple machine parts.
CO4: Improve coherent visualization skills.
CO5: Understand the concepts of orthographic projections and isometric projection.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1	2	3	1	2	3		3	2	2
CO2	3	3	3	3		2	3	1	2	3		3	2	2
CO3	3	3	3	3	3	2	3	1	2	3		3	2	2
CO4	3	3	3	3		2	3	1	2	3		3	2	2
CO5	3	3	3	3	3	2	3	1	2	3		3	2	2

Syllabus

Unit 1
Basic principles of engineering drawing, Standards and conventions, Drawing instruments and their uses, Lettering and types of lines. Concept of scale in drawings, Dimensioning of drawings. Construction of conic sections, involutes and cycloids

Unit 2
Orthographic projections of points, lines, planes and solids. Sections of regular solids, Development of lateral surface of regular solids, frustum and truncations.

Unit 3
Introduction to isometric views and projections, Orthographic projections of isometric drawings. Floor plans of simple buildings.

Text Books:
Basant Agarwal and C M Agarwal., "Engineering Drawing", 2e, McGraw Hill Education, 2015

Reference Books:
Bhat N.D. and Panchal V.M. , " Engineering Drawing Plane and Solid Geometry , 42e, Charoatar Publishing House , 2010
James D. Bethune, "Engineering Graphics with AutoCAD", Pearson Education, 2014
K.R. Gopalakrishna, "Engineering Drawing", 2014, Subhas Publications
Narayan K.L. and Kannaiah P, Engineering Drawing, SciTech Publications, 2003
John K.C., "Engineering Graphics for Degree", 1e, Prentice Hall India, 2009

Evaluation Pattern

Assessment	Internal	End Semester
CIA– Sketch Book evaluation	20	
CIA- Lab session assessment	40	
Mid-Term Examination	20	
End Semester		20

19EEE100	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Aerospace, Civil, Mechanical, ECE,CCE and Chemical)	L-T-P-C: 3-0-0-3

Course Objectives

- To impart basic knowledge of electrical quantities and provide working knowledge for the analysis of DC and AC circuits.
- To understand the construction and working principle of DC and AC machines.
- To facilitate understanding of basic electronics and operational amplifier circuits.

Course Outcomes

CO 1: Understand the basic electric and magnetic circuits
CO 2: Analyse DC and AC circuits
CO 3: Interpret the construction and working of different types of electrical machines
CO 4: Analyse basic electronic components and circuits.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	1		-	-	-	-	-	-	-	-	-
CO3	3	3	-	-		-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	1	-	-	-	-	-	-	-	-

Syllabus

Unit 1
Introduction to Electrical Engineering, Current and Voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Energy and Power – Series parallel combination of R, L, C components, Voltage Divider and Current Divider Rules – Super position Theorem, Network Analysis – Mesh and Node methods- Faraday's Laws of Electro-magnetic Induction, Magnetic Circuits, Self and Mutual Inductance, Generation of sinusoidal voltage, Instantaneous, Average and effective values of periodic functions, Phasor representation. Introduction to 3-phase systems, Introduction to electric grids.

Unit 2
Electrical Machines: DC Motor: Construction, principle of operation, Different types of DC motors, Voltage equation of a motor, significance of back emf, Speed, Torque, Torque-Speed characteristics, Output Power, Efficiency and applications. Single Phase Transformer: Construction, principle of operation, EMF Equation. Regulation and Efficiency of a Transformer. Induction Machine: Three Phase Induction Motor: Construction and Principle of Operation, Slip and Torque, Speed Characteristics. Stepper motor: Construction, principle and mode of operation.

Unit 3
PN Junction diodes, VI Characteristics, Rectifiers: Half wave, Full wave, Bridge. Zener Diode- characteristics, Optoelectronic devices. BJT – characteristics and configurations, Transistor as a Switch. Junction Field Effect

Transistors - operation and characteristics, Thyristor – Operation and characteristics. Fundamentals of DIAC and TRIAC. 555 Timer, Integrated circuits. Operational Amplifiers – Inverting and Non-inverting amplifier – Instrumentation amplifiers.

Text Books

Edward Hughes. "Electrical and Electronic Technology", 10th Edition, Pearson Education Asia, 2019.
D. P. Kothari, I J Nagrath, "Electric Machines", 5th Edition, Tata McGraw Hill, 2017.
A. P. Malvino, "Electronic Principles", 7th Edition, Tata McGraw Hill, 2007.

References

S. K. Bhattcharya, "Basic Electrical and Electronics Engineering", Pearson, 2012.
Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India Private Limited, 2nd Edition, 2003.
David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
Michael Tooley B. A., "Electronic circuits: Fundamentals and Applications", 3rd Edition, Elsevier Limited, 2006.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19EEE181. BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB L-T-P-C: 0-0-3-1
(Aerospace, Civil, Mechanical, ECE, CCE and Chemical)

Course Objective

- To understand the basics of electrical connections and analyse the performance of electrical machines and electronic circuits.

Course Outcome

CO1: To create basic electrical connections for domestic applications
CO2: To measure the various electrical parameters in the circuit
CO3: To Analyse the performance of electrical machines.
CO4: To Analyse basic electronic circuits.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2			2			3			1		
CO2	3				2				3			1		
CO3	3	1	2	2					3			1		
CO4	3	1	2						3					

LIST OF EXPERIMENTS:

Electrical

1. a) Wiring practices
   b) Study of Electrical protection systems.
2. Verification of circuit theorem
3. Experiment on DC machine
4. Experiment on single phase Transformer
5. Experiment on induction motor
6. VI characteristics of PN junction and Zener diode
7. Implementation of Half wave and Full wave rectifier using PN junction diode
8. Transistor as a switch
9. Experiment on Thyristor
10. Implementation of inverting and non-inverting amplifier using Op-amp

REFERENCES / MANUALS / SOFTWARE:
Lab Manuals

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CUL101	CULTURAL EDUCATION I	L-T-P-C: 2-0-0-2

Course Objective

- The course is designed as an introductory guide to the variegated dimensions of Indian cultural and intellectual heritage, to enable students to obtain a synoptic view of the grandiose achievements of India in diverse fields.
- It will equip students with concrete knowledge of their country and the mind of its people and instil in them some of the great values of Indian culture.

Course Outcomes

CO1: Be introduced to the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education**.**

CO2: Understand the foundational concepts of Indian civilization like *puruśārtha*-s, law of karma and *varṇāśrama.*

CO3: Gain a positive appreciation of Indian culture, traditions, customs and practices**.**

CO4: Imbibe spirit of living in harmony with nature, and principles and practices of Yoga.

CO5: Get guidelines for healthy and happy living from the great spiritual masters

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	2	3				2		
CO2						3	1	3				2		
CO3						3	1	3				2		
CO4						3	3	3				2		
CO5						3	1	3				2		

Syllabus

Unit 1

Introduction to Indian culture; Understanding the cultural ethos of Amrita Vishwa Vidyapeetham; Amma's life and vision of holistic education.

Unit 2

Goals of Life – Purusharthas; Introduction to Varnasrama Dharma; Law of Karma; Practices for Happiness.

Unit 3

Symbols of Indian Culture; Festivals of India; Living in Harmony with Nature; Relevance of Epics in Modern Era; Lessons from Ramayana; Life and Work of Great Seers of India.

Text Book

Cultural Education Resource Material Semester-1

Reference Book(s)

The Eternal Truth (A compilation of Amma's teachings on Indian Culture)
Eternal Values for a Changing Society. Swami Ranganathananda. BharatiyaVidyaBhavan.
Awaken Children (Dialogues with Mata Amritanandamayi) Volumes 1 to 9
My India, India Eternal. Swami Vivekananda. Ramakrishna Mission.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER II

19MAT111	MULTIVARIABLE CALCULUS	L-T-P-C: 2-0-0-2

Course Objective

- To understand parameterisation of curves and to find arc lengths.
- To familiarise with calculus of multiple variables.
- To use important theorems in vector calculus in practical problems.

Course Outcomes

CO1: Select suitable parameterization of curves and to find their arc lengths
CO2: Find partial derivatives of multivariable functions and to use the Jacobian in practical problems.
CO3: Apply Fundamental Theorem of Line Integrals, Green's Theorem, Stokes' Theorem, of Divergence Theorem to Evaluate integrals.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	---	---	---	---	---	---	---	---	---	---
CO2	1	2	---	---	2	---	---	---	---	---	---	---
CO3	2	2			3							

Syllabus

Unit 1

Functions of severable variables

Functions, limit and continuity. Partial differentiations, total derivatives, differentiation of implicit functions and transformation of coordinates by Jacobian. Taylor's series for two variables.

Unit 2

Vector Differentiation

Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

Unit 3

Vector Integration

Line Integral, Line Integrals Independent of Path.

Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem.

Unit 4

Lab Practice Problems:

Graph of functions of two variables, shifting and scaling of graphs. Vector products. Visualizing different surfaces.

Text Book

Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.

Reference Book(s)

Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.

'Engineering Mathematics', Srimanta Pal and Subhodh C Bhunia, John Wiley and Sons, 2012, Ninth Edition.

'Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.

Evaluation Pattern

Assessment	Weightage
Class Test/Assignment/Tutorial	30
End of course Test (2hrs)	70

19MAT112	LINEAR ALGEBRA	L-T-P-C: 2-1-0-3

Course Objectives

- Understand the basic concepts of vector space, subspace, basis and dimension.
- Familiar the inner product space. Finding the orthogonal vectors using inner product.
- Understand and apply linear transform for various matrix decompositions.

Course Outcomes

CO1: Understand the basic concepts of vector space, subspace, basis and dimension.
CO2: Understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution.
CO3: Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, range and apply it to change the basis, to get the QR decomposition, and to transform the given matrix to diagonal/Jordan canonical form.
CO4: Understand the concept of positive definiteness, matrix norm and condition number for a given square matrix.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	3	2	1									
CO2	3	3	2									
CO3	3	3	2									
CO4	3	2	1									

Syllabus

Pre-request: Matrices

Review of matrices and linear systems of equations. (2 hrs)
Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis - Dimension - Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis. (12 hrs)
Orthogonal complements - Projection on subspace - Least Square Principle. (6 hrs)

Linear Transformations: Positive definite matrices - Matrix norm and condition number - QR- Decomposition - Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation. (10 hrs)
Change of basis - Nilpotent transformations - Similarity of linear transformations - Diagonalisation and its applications - Jordan form and rational canonical form. (10 hrs)
SVD.

Text Book
Howard Anton and Chris Rorrs, "Elementary Linear Algebra", Ninth Edition, John Wiley & Sons, 2000.

Reference Book(s)
D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
Gilbert Strang, "Linear Algebraand its Applications", Third Edition, Harcourt College Publishers, 1988.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CHY101	ENGINEERING CHEMISTRY - A (Aerospace, Mechanical, Civil and Chemical Engineering)	L-T-P-C: 2-1-0-3

Course Objectives

- The main objective of the course is to impart knowledge on the fundamentals concepts of chemistry involved in application of several important engineering materials that are used in the industry/day-to day life

Course Outcomes

CO1: Understand the basic principles behind the properties of engineering materials through sound knowledge in Chemical bonding, photochemistry and electrochemistry**.**

CO2: Apply the chemistry concepts to assess and justify the choice of materials for industrial applications.

CO3: Evaluate the physical and chemical parameters for the selection of suitable materials for industrial processes and Applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-									
CO2	3	3	2									
CO3	2	3	2									

Syllabus

Unit 1

Atomic Structure and Chemical Bonding

Fundamental particles of atom – their mass, charge and location – atomic number and mass number – Schrondinger equation. Significance of ψ and ψ^2 – orbital concept – quantum numbers - electronic configuration. Periodic properties. Formation of cation and anion by electronic concept of oxidation and reduction – theories on bonding- octet, Sidgwick and Powell, VSEPR and VBT-MOT. Formation of electrovalent, covalent and coordination compounds. Chemistry of weak interactions – van der Waals force and hydrogen bonding.

Unit 2

Electrochemical energy system

Faradays laws, origin of potential, electrochemical series, reference electrodes, Nernst equation, introduction to batteries – classification – primary, secondary and reserve (thermal) batteries. Characteristics – cell potential, current, capacity and storage density, energy efficiency. Construction, working and application of Leclanche cell-Duracell, Li-MnO_2 cell, lead acid batteries. Ni-Cd battery, Lithium ion batteries. Fuel cell - construction and working of PEMFC.

Unit 3

Photochemistry and solar energy

Electromagnetic radiation. Photochemical and thermal reactions. Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram - photophysical and photochemical processes, photosensitization, photo-polymerization and commercial application of photochemistry.
Solar energy - introduction, utilization and conversion, photovoltaic cells – design, construction and working, panels and arrays. Advantages and disadvantages of PV cells. DSSC (elementary treatment).

Unit 4

Corrosion control and metal finishing

Introduction, causes and different types of corrosion and effects of corrosion, theories of corrosion – chemical corrosion, Pilling Bed-worth ratio, electrochemical corrosion and its mechanism, factors affecting corrosion – galvanic series. Corrosion control methods – cathodic protection, sacrificial anode, impressed current cathode. Surface coatings - galvanizing, tinning, electroplating of Ni and Cr, organic surface coatings – paints, constituents and functions. Anodising and electroplating of aluminium.

Unit 5

Water Technology

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA. Numerical problems – boiler troubles (scale and sludge). Treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning). External treatment – Reverse Osmosis, ion exchange process.

Text Books:

Vairam and Ramesh "Engineering Chemistry", Wiley, 2012Amrita Vishwa Vidyapeetham, Department of sciences, "Chemistry Fundamentals for Engineers", McGraw Hill Education, 2015.

Reference Books:

Jain and Jain, "Engineering Chemistry", DhanpatRai Publishing company, 2015
Puri, Sharma and Patania, " Principles of Physical chemistry", Vishal Publishing Co., 2017.
Atkins, "Physical Chemistry", OUP, Oxford, 2009

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CHY181	ENGINEERING CHEMISTRY LAB - A (Aerospace, Mechanical, Civil and Chemical Engineering)	L-T-P-C: 0-0-3-1

Course Objective

- The objective of the laboratory sessions is to enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.

Course Outcomes

CO1: Estimate the quantity of chemical substance in the given sample by electrochemical methods
CO2: Determine the water quality parameters using titrimetric analysis for domestic and industrial applications.
CO3: Examine the physical and chemical parameters of materials for engineering applications.
CO4: Examine the separation of components and analyze the sample by spectrophotometry.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2	1									
CO 3	3	2										
CO4	3	2										

Lab

1. Estimation of alkalinity in given water samples
2. Adsorption of acetic acid by charcoal
3. Potentiometric titration – acid-base/redox
4. Conductometric titration
5. Estimation of hardness by ion-exchange method
6. Determination of kinematic viscosity by Redwood Viscometer
7. Anodisation of Aluminium – Relation between current and thickness
8. Determination of acid value of an oil
9. Separation techniques – TLC, Column chromatography
10. Verification of B-L law by UV-spectrophotometer

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

* CA – Principles of experiment, skill, result analysis and report

19CSE102	COMPUTER PROGRAMMING	L-T-P-C: 3- 0-3- 4

Pre-Requisite(s): 19CSE100 Problem Solving and Algorithmic Thinking

Course Objectives

- This course provides the foundations of programming.
- Apart from the usual mechanics of a typical programming language, the principles and methods will form the main focus of this course.
- Shift from learn to program to programming to learn forms the core of this course.

Course Outcomes

CO 1: Understand the typical programming constructs: data (primitive and compound), control, modularity, recursion etc. thereby to understand a given program
CO 2: Understand and analyze a given program by tracing, identify coding errors and debug them
CO 3: Make use of the programming constructs appropriately and effectively while developing computer programs
CO 4: Develop computer programs that implement suitable algorithms for problem scenarios and applications

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1							1						
CO2	1	1	1					1						
CO3	1	2	2					2						
CO4	2	3	2					3						

Syllabus

Unit 1
Introduction and Review of C language constructs. Functions – inter function communication, standard functions, scope. Recursion – recursive definition, recurivse solution, designing recursive functions, limitations of recursion. Arrays – 1D numeric, searching and sorting, 2D numeric arrays.

Unit 2
Pointers: introduction, compatibility, arrays and pointers, Dynamic memory allocation, arrays of pointers, pointer arithmetic. Strings: fixed length and variable length strings, strings and characters, string input, output, array of strings, string manipulation functions, sorting of strings.

Unit 3
Structures: structure vs array comparison, complex structures, structures and functions, Union. Files and streams, file input output, command line arguments.

Text Book(s)
Forouzan BA, Gilberg RF. Computer Science: A structured programming approach using C. Third Edition, Cengage Learning; 2006.

Reference(s)

Byron Gottfried. Programming With C. Fourth Edition, McGrawHill,; 2018.
Brian W. Kernighan and Dennis M. Ritchie. The C Programming Language. Second Edition, Prentice Hall, 1988.
Eric S. Roberts. Art and Science of C. Addison Wesley; 1995.
Jeri Hanly and Elliot Koffman. Problem Solving and Program Design in C. Fifth Edition, Addison Wesley (Pearson); 2007.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CIE102	MECHANICS: STATICS AND DYNAMICS	L-T-P-C: 2-1-0-3

Course Objectives

To understand the procedure for analysis of static objects; concepts of force, moment, and mechanical equilibrium.
To analyze forces and moments in two and three dimensions due to concentrated and distributed forces in various systems such as beams, frames and trusses.
To analyze the bodies which are in motion using the basics of kinetics and kinematics.

Course Outcome

CO1: Able to analyze force systems in plane and also in space

CO2: Able to solve two and three dimensional rigid body static equilibrium problems.

CO3: Able to determine the centroid of planes, center of gravity of masses and evaluate their moment of inertia.

CO4: Able to evaluate velocity and acceleration of a particle in rectangular and cylindrical coordinate systems and angular velocity of rigid bodies that are in plane motion.

CO5: Able to solve the problem related to bodies in dynamic equilibrium and bodies undergoing forced and free vibration using the laws of kinetics.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3										1	3		
CO2	3	3										1	3		
CO3	3	3										1	3		
CO4	3	3										1	3		
CO5	3	3										1	3		

Syllabus

Unit 1
Principles of statics: Introduction to vector approach – free body diagrams –forces in plane – forces in space – concurrent forces - resolution of forces –equilibrium of particle.
Statics of rigid bodies in two dimensions and three dimensions: Moment of a force about a point – moment of a force about an axis – moment of a couple – equivalent force couple system – rigid body equilibrium – support reactions.

Unit 2
Applications of statics: Friction – contact friction problems. Analysis of trusses –method of joints – method of sections.
Properties of surfaces and solids - Centroid, Moment of inertia, Polar moment of inertia, Mass moment of inertia, Product of inertia and Principal moment of inertia.

Unit 3
Dynamics: Rectangular and cylindrical coordinate system - Combined motion of rotation and translation - Newton's second law in rectilinear translation - D'Alembert's principle - Mechanical vibration - free and forced vibrations, resonance and its effects; Degree of freedom; Frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems

Text Book(s)

Beer, F. P. and Johnston, E. R., "Vector Mechanics for Engineers- Statics and Dynamics", 8/e, McGraw Hill International Book Co., 2008.

Shames, I. H, "Engineering Mechanics – Statics and Dynamics", 4/e, Prentice–Hall of India Pvt. Ltd., 2003.

Reference Books

Hibbeler, R. C., "Engineering Mechanics', 12/e, Pearson Education Pvt. Ltd., 2007.

Meriam, J. L., "Dynamics", 5/e, John Wiley & sons, 2003.

K. L. Kumar, "Engineering Mechanics", 3/e, Tata McGraw Hill, 2003.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End semester		100

•CA – Can be Quizzes, Assignment, Projects, and Reports

19MEE182	COMPUTER AIDED DRAFTING	L-T-P-C: 0-0-3-1

Course Objectives

Demonstrate the importance of Computer Aided Drafting packages for industry practice
Introduce standards and codes to produce engineering drawings
Understand and interpret the engineering drawings
Provide hands on training to become proficient with 2D Computer Aided drafting of simple machine elements / assemblies

Course Outcome

CO1: Appreciate the standard drawing codes and practices which is required for producing engineering drawings.
CO2: Construct accurate 2D geometry as per the dimensions following standard drawing practices with proper dimensioning using Computer Aided drafting software.
CO3: Create 2D representations of 3D objects as plan view, elevations, side views and sections / auxiliary views using Computer Aided drafting software.
CO4: Develop isometric drawings using orthographic views using Computer Aided drafting software.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3				
CO2				1						2				
CO3										3				
CO4				1						2				
CO5									2	1				

Syllabus

Unit 1
Drawing Standards - Introduction to CAD software – CAD user interface – Data input modes - Coordinate systems - Units and precision – Setting Limits and display units – Drawing templates - Features of GUI. Sketching basic geometric entities.
Sketching simple geometric entities: points, lines, circles, arcs, ellipse, rectangle, polygons, polylines, splines – Use of object snaps - Practice exercises using simple geometric entities.

Unit 2
Modifying drawings: Move, copy, rotate and offset drawings; Mirroring, Scaling, Trim, extend, erase, explode - Fillet and chamfering – Rectangular, Polar and Path array - Drawing exercise: Sketching and modifying 2D drawings.

Unit 3
Drawing properties: Line type, Line weight, Object properties – Hatch and gradient – Working with Layers - Dimensioning and annotations – Adding tolerance to dimensions – Working with text and tables – Sketching with blocks and groups - Use of attributes – Working with external references – Layout, printing and publishing drawings - Exercise involving sketching 2D orthographic views of 3D geometries with dimensions and tolerances. Introduction to 3D - Isometric drafting - Conversion of orthographic projections of simple components into isometric views.

Project: Students have to complete a project involving creating orthographic views of the simple machine elements / assemblies such as centrifugal pumps, hydraulic cylinders, gear boxes etc. with dimensions following standard drawing practices using CAD software.

Text Book(s)

James D Bethune, "Engineering Graphics with AutoCAD 2017", Pearson Education, 2018.
Gopalakrishna, K.R., and SudheerGopalakrishna "Computer Aided Engineering Drawing", Subhas Publications, 2015.
AUTO-CAD manual (In-House)

Evaluation Pattern:

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE111	INTRODUCTION TO CIVIL ENGINEERING	L-T-P-C: 1-0-3-2

Course Objectives

To give an understanding about the areas of specializations available in the field of Civil Engineering
To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.
To expose the students to the various avenues available for doing creative and innovative work by showcasing many monuments and inspiring projects of public utility.

Course Outcome :

CO1: Understand the relationship between the knowledge of basic science to civil engineering practice.
CO2: Illustrate the importance of different component fields within civil engineering.
CO3: Visualize the importance of civil engineering practice in the most ethical manner for sustainable development.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												1		
CO2							1		3				1		
CO3						2	3						1		

Syllabus
What is Civil Engineering/ Infrastructure, History of Civil Engineering, Overview of ancient & modern civil engineering marvels, 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, Building Energy Efficiency, Basics of Contract Management, Professional Ethics, Avenues for entrepreneurial working, Creativity & Innovativeness in Civil Engineering.
Introduction to the civil engineering undergraduate curriculum map - the relationship between the courses in the curriculum.

References
Valdengrave Okumu, "An Introduction to Civil Engineering", Create Space Independent Publishers, 2014.
S. T. Mau and Sami Maalouf, "Introduction to Civil Engineering: A Student's Guide to Academic and Professional Success", Cognella, Inc; 2014
Bhavikatti. S. S., "Basic Civil Engineering", New Age International Publishers, 2010.
National Building Code of India, BIS, (2016)
Code of ethics - www.ieindia.org

Evaluation Pattern:

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CUL111	CULTURAL EDUCATION II	L-T-P-C: 2-0-0-

Course Objective

- To deepen students' understanding and further their knowledge about the different aspects of Indian culture and heritage.
- To in still into students a dynamic awareness and understanding of their country's achievements and civilizing influences in various fields and at various epochs.

Course Outcome

CO1: Get an overview of Indian contribution to the world in the field of science and literature.
CO2: Understand the foundational concepts of ancient Indian education system.
CO3: Learn the important concepts of Vedas and *Yogasutra*-s and their relevance to daily life.
CO4: Familiarize themselves with the inspirational characters and anecdotes from the *Mahābhārata* and *Bhagavad-Gītā* and Indian history.
CO5: Gain an understanding of Amma's role in the empowerment of women

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3					2		
CO2						1		3				2		
CO3						3	3	3				2		
CO4						3	3	3				2		
CO5						1		1						

Syllabus

Unit 1
To the World from India; Education System in India; Insights from Mahabharata; Human Personality. India's Scientific System for Personality Refinement.

Unit 2
The Vedas: An Overview; One God, Many Forms; Bhagavad Gita – The Handbook for Human Life; Examples of Karma Yoga in Modern India.

Unit 3
Chanakya's Guidelines for Successful Life; Role of Women; Conservations with Amma.

Text Book
Cultural Education Resource Material Semester-2

Reference Book(s)

Cultural Heritage of India. R.C.Majumdar. Ramakrishna Mission Institute of Culture.
The Vedas. Swami ChandrashekharaBharati. BharatiyaVidyaBhavan.
Indian Culture and India's Future. Michel Danino. DK Publications.
The Beautiful Tree. Dharmapal. DK Publications.
India's Rebirth. Sri Aurobindo. Auroville Publications.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER III

19MAT208 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L-T-P-C: 2-1-0-3

Course Objectives

Understand the concepts of Laplace and Fourier transforms and its properties to transform a function from time domain to the frequency domain.
Obtain the Laplace and Fourier transform and its inverse transform of impulsive, discontinuous and some complicated periodic signals.
Solve the initial value problems' using Laplace and Fourier transforms on signals arising by changing over to frequency domain.
Define the Fourier series for periodic functions and determine the Fourier coefficients.

Course Outcomes

CO1: Understand the basic definition and properties of Laplace Transform.
CO2: Apply Laplace transform to solve the differential equations
CO3: Understand the periodic functions and obtain the Fourier series for certain functions.
CO4: Understand the Fourier transform and its properties and apply to some periodic signals.
CO5: Understand the formation of partial differential equations and apply some standard methods to obtain its solutions.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	---	---	---	---	---	---	---	---	---	---
CO2	1	2	---	---	2	---	---	---	---	---	---	---
CO3	2	1	1									
CO4	1	3	---	---	---							
CO5	1	2	---	---	2							

Laplace Transform
Laplace Transforms, Inverse Transforms, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential Equations, Unit Step Function, Second Shifting Theorem, Dirac's Delta Function. Differentiation and Integration of Transforms. Convolution, Integral Equations, Partial Fractions, Differential Equations, Systems of Differential Equations. (Sections: 6.1 to 6.7)

Fourier Series: Fourier series, Half range Expansions, Parseval's Identity, Fourier Integrals, Fourier integral theorem. Sine and Cosine Integrals. (Sections: 11.1 -11.3)

Fourier Transforms: Sine and Cosine Transforms, Properties, Convolution theorem**.** (Sections: 11.1 -11.3, 11.7-11.9)

Partial Differential Equations:
Basic Concepts, Modeling; Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series, Heat Equation; Solution by Fourier Series. (Sections: 12.1-12.5)

Text Book
Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2016.

Reference Book(s)

Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.
Engineering Mathematics, Srimanta Pal and Subodh c Bhunia, Oxford press, 2015.
Larry C. Andrews and Bhimson. K. Shivamoggi, The Integral Transforms for Engineers, Spie Press, Washington, 1999.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CIE201	SOLID MECHANICS	L-T-P-C: 2-1-3-4

Course Objectives

- To explain the properties of materials and concepts of stress and strain
- To illustrate the deformational characteristics of elements and components.
- To highlight the response of structural elements under various loading conditions.

Course Outcome

CO1: Understand the concepts of mechanics of deformable solids and apply to problems on the strength and stability of structural elements and mechanical components.

CO2: Evaluate the shear force, bending moment and stress variation in structural elements subjected to static loads.

CO3: Understand the basic principles and analyze problems pertaining to structural members subjected to axial load, torsion, bending, transverse shear, and combination loading

CO4: Develop the necessary theoretical background necessary for courses in structural analysis and design.

CO5: Conduct experiments to validate physical behaviour of material and prepare laboratory reports on the interpretation of experimental results

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3										1	3		
CO2	3	3										1	3		
CO3	3	3										1	3		
CO4	3	3										1	3		
CO5	2	1						1	3	3		1	2		

Syllabus

Unit 1

Simple Stresses and Strains- Concept of stress and strain, Elasticity and plasticity – Types of stresses and strains, Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – principal stresses and Mohr's circle.

Bars of varying section – composite bars –thermal stresses – strain energy in tension, compression and shear - resilience – stresses due to impact and suddenly applied load.

Unit 2

Different types of beam – statically determinate beams - shear force and bending moment diagrams - relationship between intensity of loading, shear force and bending moment. Theory of simple bending - Stress distribution at a cross-section due to bending moment for statically determinate beams. Shear stress distribution. Shear center and Unsymmetrical bending.

Torsion of circular solid and hollow shafts – combined bending moment and torsion on shafts.

Unit 3

Deflection of beams – double integration method –Area Moment method – Conjugate beam method. Theory of columns – members subjected to axial load and bending moment – Euler's theory for long columns – assumptions and limitations – Rankine's formula, Thin cylinders.

List of Experiments:

- Tension test on metals
- Measurement of strain in a bar
- Shear test
- Torsion test on shaft
- Measurement of deflections in statically determinate beam,
- Tests on closely coiled and open coiled springs
- Buckling of columns
- Fatigue test on metals

Virtual Lab Exercises (http://vlab.amrita.edu/index.php?sub=77&brch=299)

- Beam Theory – I
- Beam Theory – II
- Young's modulus & Poisson's ratio on UTM
- Saint Venant Principle
- Stress distribution around a circular hole
- Stress distribution around a Notch using UTM
- Creep Test

Text Book(s)

Gere, J.M. and Goodno.B.J., "Mechanics of Materials", CL Engineering, 2012.
Beer, Johnston, DeWolf, Mazurek., "Mechanics of Materials", McGraw-Hill Education, 2013

Reference(s)

Timoshenko, S.P., and Young, D.H., "Elements of Strength of Materials", East West Press, New Delhi, 2003.
Popov E.P., "Mechanics of Materials", Prentice Hall India, New Delhi, 2002
Crandall, S.H.., Dahal, N.C., and Lardener,T.J., "An Introduction to Mechanics of Solids", McGraw hill Books Co, 1985, 2nd Edition 2017
Nash W.A. "Strength of Materials", McGraw Hill Book Company, 2006

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE202	PRINCIPLES OF FLUID MECHANICS	L-T-P-C: 2-1-0-3

Course Objectives

- To develop basic knowledge about hydrostatic law, principle of buoyancy and stability of floating bodies.
- To explain the application of mass, momentum and energy equation in fluid flow
- Exposure on the methods to estimate the flow and losses in pipe network under various conditions.
- To explain the concepts of dimensional analysis and model testing

Course Outcome

CO1: Explain the behavior of fluids under various flow conditions
CO2: Analyze the hydrostatic forces, conditions of buoyancy and stability of various floating bodies.
CO3: Apply mass, momentum and energy equations in the measurement of fluid flow.
CO4: Solve pipe network problems by considering major and minor losses.
CO5: Calculate laminar flow characteristics through pipes and parallel plates.
CO6: Formulate dimensional analysis using various methods and apply the concept of similarities.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3											3		
CO4	3	3											3		
CO5	3	3											3		
CO6	3	3	1										3		

Syllabus

Unit 1
Elementary concepts – properties - concept of gauge and absolute pressure, measurement of pressure using manometers of different types.
Hydrostatic force on plane and curved surface – center of pressure – lock gates - buoyancy and stability of submerged and floating bodies - metacentric height - period of oscillation.
Types of flow, definitions and explanations of unsteady, steady, non-uniform, laminar and turbulent flows. Ideal flow - rotational and irrotational, stream function, potential function. Path line, streak line and stream line – continuity equation – derivation, application of one dimensional steady flow – circulation and vorticity - Basic flow fields such as uniform flow, source, sink, doublet, vortex flow, spiral flow – superposed flows.

Unit 2
Derivation of Bernoulli's energy equation and Euler's equation, examples illustrating the use of energy equation. Flow meters - venturimeter, Orifice meter, nozzle, derivation of equations of discharge, pitot tubes – applications to flow measurements- notches and weirs.
Laminar flow through circular pipe – shear stress, pressure gradient, velocity profile, Hagen-poiseuille's equation, power calculations, laminar flow between parallel plates - Couette flow and Poiseuille flow.
Flow in closed conduits – friction loss and flow calculations, turbulent flow, Reynolds number, Darcy-Weisbach equation. Use of Moody's diagram, minor losses – pipe networks – pipes in parallel and series - equivalent length.

Unit 3

Analysis – Rayleigh's method – Buckingham Pi-theorem – Hydraulic Similitude – model analysis – dimensionless numbers – Model testing of partially submerged bodies – Distorted models and scale effects.
Introduction to Boundary layer theory.

Text Book(s)

Streeter Victor L and E. Benjamin Wylie, "Fluid Mechanics", Tata McGraw Hill, 2010.
Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics including Fluid Machines", Standard Publishers & Distributors, 2015.

Reference(s)

Cengel and Cimbala, "Fluid Mechanics", Tata McGraw Hill Publishers, 2017.
Som S K, Gautam Biswas and Suman Chakrabarty, "Introduction to Fluid Mechanics and Fluid Machines", Tata Mc-Graw Hill Education Pvt.Ltd, Third Edition.
N.N.Pillai, "Fluid Mechanics and Fluid Machines", Universities Press, 2009.
Subramanya K., "Theory and Applications of Fluid Mechanics", Tata McGraw Hill Publishing Co, 1993.
J. F. Douglas, J. M. Gasiorek and J. A. Swaffield., "Fluid Mechanics", Pearson Education, 2008.
White, Frank.M., "Fluid Mechanics", Tata McGraw Hill, 2011.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE203	PRINCIPLES OF SURVEYING	L-T-P-C: 2-1-3-4

Course Objectives

- To highlight the importance of linear/angular measurement methods in site plan preparation
- To impart basic skills of levelling and theodolite survey.
- To explain about errors in measurements and their adjustments in a traverse.
- To provide an exposure on the use of minor and modern instruments in surveying

Course Outcome

CO1: Understand the principles, types and methods of surveying, to apply them in practice with minimum or no error
CO2: Analyse and rectify the errors in the horizontal-linear and horizontal-angular measurements to calculate area.
CO3: Analyse and evaluate the measurements in leveling to obtain reduced levels, contour lines and earthwork estimation.
CO4: Analyse and evaluate the horizontal and vertical coordinates using a theodolite
CO5: Understand and use minor instruments and advanced technologies in surveying.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			1	1	1		1						
CO2	3	3					1		1				2		
CO3	3	3					1		1				3		
CO4	3	3			1		1		1				3		
CO5	3	2			1		1		1				3		

Syllabus

Unit 1
Introduction - classification of surveys – reconnaissance - principle of working from whole to part – provision of control – conventional signs.
Principles, linear, angular and graphical methods: Chain survey – instruments – principles of chain survey – field book – plotting – tie line and check line. Compass survey – types of compass – types of bearings – dip and declination – local attraction – traversing – plotting - error of closure. Plane table survey - two point problem – three point problem – errors in plane tabling.

Unit 2
Levelling – levelling instruments and its adjustments – fly levelling – booking - corrections for refraction and curvature – reciprocal levelling – longitudinal levelling and cross sectioning – contour surveying – definition – characteristics, methods and uses of contouring – plotting.
Areas and volumes – earthwork volume calculation.
Triangulation and Trilateration: Theodolite surveying – study of theodolite and its adjustments - measurement of horizontal angles - vertical angles – intervisibility of heights and distances – theodolite traverse –triangulation – network - calculation of co-ordinates – corrections – traversing conditions for closure.

Unit 3

Tangential system – direct reading tacheometer - subtense bar – trigonometric levelling.
Curves – elements of simple, compound, transition and reverse curves - vertical curves - curve setting by various methods.
Minor instruments: hand levels – clinometer – Ceylon ghat tracer – hypsometer – pantagraph – ediograph – box sextant - telescopic alidade.
Modern field survey systems: EDM - total station - introduction to photogrammetry -electro-magnetic spectrum - remote sensing - global positioning systems - Geographic information systems – advantages and applications.

Survey Practice

1. Chain & Compass survey- Traversing and plotting of details
2. Plane table survey - three point problem
3. Levelling - Plane of collimation & Rise and fall method
4. Contour surveying
5. Theodolite surveying - Measurement of angles and traversing
6. Heights and distances by tacheometry and solution of triangles (single plane and double plane)
7. Total Station – Traversing and Area Calculation
8. Contour surveying using total station
9. Heights and distances by total station and solution of triangles (single plane and double plane)
10. Demo: Planimeter, Mapping using GPS, Study of Minor instruments and Study of modern survey instruments – automatic levels.

Text Book(s)

Kanetkar T.P. and Kulkarni S.V., "Surveying and Levelling", Vol I & II, Vidyarthi Griha Prakashan, 2006.
Arora K.R., "Surveying", Vol I & II, Standard Publishers, 2010.

Reference(s)

Bannister, A. and Baker, R., "Solving Problems in Surveying", Addison Wesley Longman, 1996.
R.Agor, "Textbook of Surveying and Levelling", Khanna Publishers,2012.
S.K Duggal, "Surveying", Vol 1 & 2, McGraw Hill Education, 2013.
R.Subramanian, "Surveying and Levelling", Oxford University Press, 2012.
Pradip Kumar Guha, "Remote Sensing for the Beginner", Affiliated East West Press, 2003

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE204	CONSTRUCTION MATERIALS AND METHODS	L-T-P-C: 2-1-0-3

Course Objectives

To expose students to the various building and general construction materials and products.
To impart knowledge of common construction systems and methods.

Course Outcome

CO1: Understand role of building regulations and materials in construction.
CO2: Select appropriate materials for construction of buildings.
CO3: Understand and recommend options in substructure and superstructure construction.
CO4: Choose suitable finishes and services for buildings.
CO5: Identify the uses of modern construction materials.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				2		1							3
CO2	3	3							1						3
CO3	3	3													3
CO4	3	3	2												3
CO5	3	3			2		1								

Syllabus

Unit 1
Buildings and structures in general - Functional requirements of buildings and necessity of byelaws, NBC, Loads on buildings. Role of materials in construction, Introduction to structures and properties of materials.
Lime, cement – types, properties. Concrete - Concrete making materials, properties in fresh and hardened state, durability, special concrete. Masonry materials – stone, brick, block, mortar.

Unit 2
Soils & Excavations - shoring. Foundations - deep and shallow foundations, basements. Wall construction - Load bearing and partition walls, arches, lintels, scaffolding.
Concrete construction - RCC, framed construction, Expansion and construction joints - precast concrete. Steel - metallurgy, properties and types; steel components; structural steel construction.
Timber and allied products, wood construction. Roofing - Flat and pitched roofs, formwork

Unit 3
Glass and glazing. Windows and doors. Floor and ceiling finishes. Building finishes – Plastering, pointing, painting, stucco, natural stone, adhered veneer.
Building services - vertical transportation, plumbing. Damp proofing materials and techniques.
Use of Light gauge steel, Aluminium, Polymers, Plastics, Composites, Sealants, Adhesives, Smart materials.
Introduction to sustainable building products

Text Book(s)
Duggal, S.K, "Building materials", New Age International Publishers, 2019.
Punmia, B.C., Ashok Kumar Jain, Arun Kumar Jain, "Building Construction", Laxmi Publications; 2016.

Reference(s)

Gambir. M.L. and Neha Jamwal, "Building Materials Products, Properties and Systems", McGraw Hill Education, 2017.
Arora, S.P. and Bindra, S.P., "Building Construction", Dhanpat Rai Publications, 2010.
National Building Code, Bureau of Indian Standards, New Delhi, 2016.
Mehta, Scarborough, Armpriest, "Building Construction: Principles, Materials, and Systems", Pearson Education India, 2011.
Mamlouk, Zaniewski, "Materials for Civil and Construction Engineers", Pearson Education India, 2014.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AVP201	**AMRITA VALUES PROGRAM I**	**1 0 0 1**
19AVP211	**AMRITA VALUES PROGRAM II**	**1 0 0 1**

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Course Outcome

CO1: Understanding the impact of *itihasas* on Indian civilization with a special reference to the *Adiparva* of Mahabharata

CO2: Enabling students to importance offighting*adharma* for the welfare of the society through Sabha and Vanaparva.

CO3: Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishma parvas.

CO4: Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas.

CO5: Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas.

CO-PO Mapping

CO/PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	-	-	-	-	-	2	2	3	3	3	-	3	-	-
CO2	-	-	-	-	-	3	3	3	3	2	-	3	-	-
CO3	-	-	-	-	-	3	2	3	3	3	-	3	-	-
CO4	-	-	-	-	-	3	-	3	3	3	-	3	-	-
CO5	-	-	-	-	-	3	-	3	3	2	-	3	-	-

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World
Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enrichedby Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana
Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata
Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads
Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita
Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda
Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India
Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature
The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation
The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting
Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability
Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems
Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India
India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

TEXT BOOKS/REFERENCES:

1. Rajagopalachari. C, *The Ramayana*

2. Valmiki, *The Ramayana*, Gita Press

SEMESTER IV

19MAT215 COMPLEX ANALYSIS AND PROBABILITY THEORY L-T-P-C: 3-1-0-4

Course objectives

- To perform calculus for complex variables.
- To understand the residues and pole and evaluate the complete integrations.
- To understand discrete and continuous random variables and to compute important measures.
- To understand and apply correlations and regressions for given data set.

Course outcomes

CO1: To carry out differentiation for complex functions.
CO2: To perform integral calculus in complex variables.
CO3: To understand the theory of probability and apply to some problems.
CO4: To find out probabilistic measures of discrete and continuous random variables.
CO5: To obtain correlation and regression for the given data.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		2							
CO2	2	3	2		1							
CO3	1	2	2		1							
CO4	2	2	1		1							
CO5	1	1	3		1							

Complex Analysis
Complex Numbers, Complex Plane, Polar Form of Complex Numbers. Powers and Roots. Derivative: Analytic Functions, Cauchy - Riemann Equations, Laplace Equation, Conformal mapping, Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarthims, General Power, Linear Fractional Transformation. (Sections :13.1-13.4) Complex Line Integral, Cauchy Integral Theorem, Cauchy Integral Formula, Derivatives of Analytic Functions. (Sections : 14.1-14.3) Power Series, Taylor Series and Maclaurin Series. Laurent Series, Zeros and Singularities, Residues, Cauchy Residue Theorem, Evaluation of Real Integrals usingResidue Theorem. (Sections : 15.3,15.4, 16.16.4)

Probability Definition of probability, conditional probabilities and Bayes' Theorem.

Random Variable and Distributions
Introduction to random variable – discrete and continuous distribution functions- mathematical expectations – moment generating functions and characteristic functions. Binomial, Poisson, Exponential, Normal distribution functions.
Two dimensional random variables. Joint and marginal density functions. Transformation of random variables. Correlations and Regressions.

Text Book(s)
Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2016.
Douglas C. Montgomery and George C.Runger, Applied Statistics and Probability for Engineers, (2005) John Wiley and Sons Inc.

Reference Book(s)
Advanced Engineering Mathematics, Ray Wylie and Louis Barrett, McGraw Hill, Sixth Edition, 2016.

Engineering Mathematics, Srimanta Pal and Subodh c Bhunia, Oxford press, 2015.
J. Ravichandran, "*Probability and Random Processes for Engineers*", First Edition, IK International, 2015.
Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, *Probability and Statistics for Engineers and Scientists, 8th Edition (2007),* Pearson Education Asia.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE211	GEOLOGY & SOIL MECHANICS	L-T-P-C: 2-1-0-3

Course Objectives

To explain the influence of geological conditions of the earth on construction practices.
To provide an exposure to the concept of three phase system and apply it for estimation of soil properties.
To elucidate the role of water in soil behavior and its applications in soil stresses, permeability and seepage.
To explain the volume-change behavior in soil and consolidation settlement.

Course Outcome

CO1: Identify and classify rocks using basic geologic features and to apply those concepts on rock engineering projects and understand the role of geology in construction processes.
CO2: Ability to classify soils with reference to their characteristics and to evaluate their index and engineering properties.
CO3: Analyze and evaluate permeability characteristics of soils and estimate seepage through soils.
CO4: Analyze stress distribution in soil and relate compaction of soil to its properties.
CO5: Evaluate consolidation properties of soils and apply those properties to settlement problems frequently encountered in civil engineering.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2	2	1					3		
CO2	3	3		2									3		
CO3	3	3											3		
CO4	3	3											3		
CO5	3	3		2									3		

Syllabus

Unit 1
General geology – Weathering - Geological work of wind and water. Mineralogy, Petrology - Three–fold classification of rocks and their characteristic features. Structural geology - Types and classification of structures (Folds and faults) and their effect on civil engineering projects.
Geology in Civil Engineering - Tunnels, dams, reservoirs, bridges, runways, roads and buildings.
Origin and formation of soils. Soil structure and clay mineralogy – Adsorbed water – Mass- volume relationship – Relative density.

Unit 2
Index Properties of Soils: Grain size analysis – Sieve and hydrometer methods – consistency limits and indices – I.S. Classification of soils.
Permeability: Soil water – capillary rise – flow of water through soils – Darcy's law- Permeability – Factors affecting permeability – Laboratory determination of coefficient of permeability –Permeability of layered systems.
Seepage through soils: Total, neutral and effective stresses –Quick sand condition – Seepage through soils – Flownets: characteristics and uses.

Unit 3

Stress distribution in soils: Boussinesq's and Westergaard's theories for point loads and areas of different shapes – Newmark's influence chart.

Compaction: Mechanism of compaction – factors affecting – effects of compaction on soil properties – Field compaction equipment - compaction control.

Consolidation: stress history of clay; e-p and e-log p curves – magnitude and rate of 1-D consolidation – Terzaghi's Theory.

Text Book(s)

Venkat Reddy,.D., "Engineering Geology", Vikas Publishing House, 2010.

Gopal Ranjan and A.S.R. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, 2005.

Reference(s)

Blyth.F.G.H. and M. H. De Freitas, "Geology for Engineers", 7th Edition, Elsevier Science, 2006.

Parbin Singh., "Engineering and General Geology", S.K. Kataria and Sons, 2009.

Das, B.M., "Principles of Geotechnical Engineering", CL Engineering, 2013.

C. Venkataramiah, "Geotechnical Engineering", New Age International Publishers, 2006.

T.W. Lambe and Whitman, "Soil Mechanics", Wiley, 2008.

Manoj Dutta and Gulhati S.K, "Geotechnical Engineering", Tata McGraw Hill Publishers, 2005.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE212	STRUCTURAL ANALYSIS	L-T-P-C: 3-1-0-4

Course Objectives

To impart knowledge on different methods of analyzing determinate and indeterminate structures.
To explain the structural behavior and analysis of cables and arches.
To introduce the matrix methods of structural analysis

Course Outcome

CO1: Analyze the determinate and indeterminate structures by applying the energy principles
CO2: Categorize the structures and analyze the structural elements using force and displacement method of analysis
CO3: Analyze the response in structural elements for the moving loads using method of influence line diagram.
CO4: Calculate the internal forces in arch and cable structures by applying the basic engineering knowledge.
CO5: Form stiffness and flexibility matrix for elements and structures

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1								3	3		
CO2	3	3	1	1								3	3		
CO3	3	3	1	1								3	3		
CO4	3	3	1	1								3	3		
CO5	3	3	1	1								3	3		

Syllabus

Unit 1
Statically indeterminate structures - degree of static and kinematic indeterminacies. Introduction to force and displacement methods of analysis.
Energy principles – Castigliano's theorems - Engessor's theorem - Maxwell Betti's theorem - Principle of least work – Method of virtual work (unit load method) - applications in statically determinate and indeterminate structures (analysis of Propped cantilever and fixed beams).

Unit 2
Introduction to theorem of three moments for continuous beams, Slope deflection method – analysis of statically indeterminate beams with and without settlement of supports - rigid jointed plane frames with and without side sway. Moment distribution method – analysis of statically indeterminate beams with and without settlement of supports - rigid jointed plane frames with and without side sway.

Unit 3
Analysis of three hinged and two hinged arches, cables. Moving loads and influence lines – influence lines (IL) for statically determinate and indeterminate beams for reaction, SF and BM.
Matrix methods of structural analysis - Formation of stiffness and flexibility matrices for elements and structure.

Text Book(s)

Devdas Menon, "Structural Analysis", Narosa Book Distributers Pvt Ltd, 2010.
S P Gupta and G S Pundit, "Theory of Structures", Vol I & II, Tata McGraw Hill, 2017

Reference(s)

Hibbeler, R. C., "Structural Analysis", Pearson, 2008.
Wang C.K., "Intermediate Structural Analysis"Tata McGraw - Hill Education 2010.
Norris C.H, Wilbur J.B. and Utku.S., "Elementary Structural Analysis", Tata McGraw Hill, 2016.
Sujit Kumar Roy and Subrata Chakrabarty, "Fundamentals of Structural Analysis",S.Chand& Co., 2010.
S. B. Junnarkar and H. J. Shah, "Mechanics of Structures Vol. II", 20th Edition, Charotar Publishing House, 2008.
Reddy C.S., Basic Structural Analysis, Tata McGraw Hill, New Delhi, 2010.
L.S.Negi and R.S.Jangid, Structural Analysis, Tata McGraw Hill, 2004.
D S PrakashRao, "Structural Analysis - A Unified Approach", Universities Press (India) Ltd.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE213	HYDRAULIC ENGINEERING	L-T-P-C: 2-1-0-3

Course Objectives

To explain the concepts of momentum principles and its applications in the working of pumps and turbines.
To understand the open channel flow for different flow conditions and the hydraulic design of channels.
To understand the concepts of specific energy, critical flow and their applications
To understand the various irrigation canal systems.

Course Outcome

CO1: Apply the linear momentum principle to evaluate the forces exerted by the jet on inclined, curved and stationary bodies.
CO2: Apply the principles of basic engineering to analyze and choose suitable hydraulic machinery.
CO3: Select most economical channel section and to analyze uniform flow.
CO4: Apply the principles of energy to analyze non-uniform flow conditions in open channel.
CO5: Understand the general aspects of irrigation canals and design the irrigation canal systems for field conditions

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3	2	
CO2	3	3	1										3	2	
CO3	3	3	1										3	2	
CO4	3	3	1										3	2	
CO5	3	3	1										3	2	

Syllabus

Unit 1
Impulse momentum principle – application – impact of jet - force exerted by a jet on normal, inclined and curved surfaces for stationary and moving cases – torque in rotating machines – jet propulsion.
Hydroelectric power: low, medium and high head plants - Power house components – Microhydel schemes. Turbines - classifications – construction and working of Pelton Wheel, Francis and axial flow reaction turbines - selection of turbines – draft tube.
Classification of pumps – Centrifugal pumps – types and working – characteristics. Reciprocating pumps - types and working – selection of pumps.

Unit 2
Open channel flow - Comparison with pipe flow, Types of channels - Classification of flow, uniform flow – Uniform flow using Chezy's and Manning's formulae - Most efficient channel section – Circular, Rectangular and Trapezoidal channel sections, open channel section for constant velocity at all depths of flow. Specific energy and critical depth, Specific force curve, critical flow computation.
Non-uniform flow, Gradually Varied Flow, Dynamic equation for gradually varied flow, Different forms of the dynamic equation, Flow profiles in prismatic channels, integration of the varied flow equation - Computation of the length of the backwater curve and afflux. Rapidly Varied Flow- Hydraulic Jump, Hydraulic jump equations for a rectangular channel - Practical applications.

Unit 3

Rivers - behaviour - Control and training. Design of stable channels in India - problem in India - Classification of irrigation canals, Canal alignment, Design procedure for an irrigation channel - Considerations for fixing longitudinal section of a channel - Cross sections of an irrigation channel, Maintenance of canals, Canals in alluvial soils, Silting in canals, Scour and protection against scour. Canal lining - losses in irrigation canals, Advantages and disadvantages of lining, Types of lining. Water logging - Causes and preventive measures. Designof lined canals - irrigation canals - Kennedy's Theory- Lacey's Theory.

Text Book(s)

Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics including Fluid Machines", Standard Book House, 2017.
Garg, S. K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2006.

Reference(s)

Chow V.T., "Open Channel Hydraulics", McGraw Hill, Inc.. 2009.
Rajput R K ,"Fluid Mechanics and Hydraulic Machines", S Chand Publishers, 2016.
N.N.Pillai, "Fluid Mechanics & Fluid Machines", Universities Press, Third Edition, 2009.
K.Subramanya, "Flow in Open Channels", Tata McGraw Hill, 1997.
M. Hanif Chaudhry, "Open Channel Flow", Prentice Hall of India, 2007.
K. G. Rangaraju, "Flow Through Open Channels", Tata McGraw Hill, 2001.
Jagdish Lal, "Hydraulic Machines including Fluidics", Metropolitan Book Co, 2016.
P.N.Modi, "Irrigation, Water Resources, and Water power Engineering", Standard Publishers Distributors, 2014.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE214	TRANSPORTATION ENGINEERING - I	L-T-P-C: 2-1-0-3

Course Objectives

To introduce the historical road development activities in India
To highlight the important factors in highway alignment
To introduce the design approaches for flexible and rigid pavements
To explain the basic principles of traffic engineering and design of intersections

Course Outcome

CO1: Explain the history of road development in India
CO2: Carry out geometric deign of highways
CO3: Analyse the suitability of materials for construction of pavements
CO4: Design of Flexible and Rigid Pavements
CO5: Explain the principles of Traffic Engineering and conduct surveys
CO6: Perform analysis and design of intersections

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		1			2	1						3		
CO2	3	2	3	2		2						3	3		
CO3	3	2	1	2				1				3	3		
CO4	3	2	3	3				1				3	3		
CO5	3	2	3	3								3	3		
CO6	3	2	3	3								3	3		

Syllabus

Unit 1
Highway development and planning - Classification of roads. Road development in India - Salient features of first, second, third and fourth road development plans in India. Current road projects in India - NHDP, PMGSY and Bharatmala project. Highway alignment and project preparation.
Geometrical Design – highway cross section elements, sight distance, design of horizontal alignment and design of vertical alignment.

Unit 2
Pavement Materials – Aggregate and Bitumen - desirable properties, tests, requirements for different types of pavements. Bituminous Mix Design-Marshall Mix Design.
Pavement Design Introduction – types of pavements and their use. 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 rigid pavements; stresses in rigid pavements; design of rigid pavements as per IRC.

Unit 3
Traffic engineering and control: Introduction - Road user, vehicle and traffic characteristics. Speed and volume studies. Design of at-grade intersections – roundabouts and signalized intersections. Traffic regulation and control - traffic signs and road markings. Parking Facilities -Multimodal transportation - ITS and automated highways

Text Book(s)

Khanna, S. K., Justo, C. E. G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017.

L. R. Kadiyali and N.B. Lal 'Principles and Practices of Highway Engineering', Khanna, Publishers, 7th Edition 2019.

Kadiyali, L. R., "Traffic Engineering and Transportation Planning", Khanna, Publishers, 2008.

Chakraborty, P. and Das, A., ' Principles of Transportation Engineering, PHI Learning, 2017.

Reference(s)

Papacostas, C. S. and Prevedouros, P. D, "Transportation Engineering and Planning", Prentice Hall, 2009.

Chandola, S. P., "A Text Book of Transportation Engineering", S Chand & Co. Ltd., 2001.

IRC 73- 1990, "Geometric Design Standards for Rural (Non-Urban) Highways"

IRC 37- 2018, "Guidelines for the Design of Flexible Pavements"

IRC 58-2015, "Guidelines for the Design of Plain Joined Rigid Pavements for Highways"

IRC SP 41-1994, "Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas"

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE281	HYDRAULIC ENGINEERING LABORATORY	L-T-P-C: 0-0-3-1

Course Objectives

To impart knowledge in measuring pressure and discharge of fluid flow using various instruments
To highlight the major and minor Losses in pipe flow
To train the students in performance analysis of Hydraulic Turbines and Pumps

Course Outcome

CO1: Conduct experiments to understand the principles and working of different hydraulic machines like pumps and turbines.
CO2: Examine and analyze fluid flow through various discharge and pressure measuring instruments.
CO3: Prepare laboratory reports on the interpretation of experimental results.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		3					3	3		3	3	1	
CO2	3	3		3					3	3		3	3	1	
CO3	3	3		3					3	3		3	3		

Syllabus

1. Study of instruments: pressure gauge - piezometer - manometer-pressure transducers - pilot tubes - current meter.
2. Verification of Bernoulli's equation.
3. Determination of Coefficient of discharge for a small orifice by a constant head method.
4. Determination of Coefficient of discharge for an external mouth piece by variable head method.
5. Calibration of Triangular Notch
6. Determination of friction factor of pipes
7. Impact of jet on vanes
8. Calibration of Venturimeter, Orificemeter, rotameter and watermeter
9. Determination of metacentric height
10. Performance test on Pelton wheel turbine and Francis turbine.
11. Efficiency test on centrifugal pump and reciprocating pump.
12. Open channel flow: Manning's coefficient, specific energy curve, Tracing back water profiles / draw down profiles, Hydraulic jump parameters

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)	80	
End Semester		20

19CIE282	MATERIALS TESTING & EVALUATION	L-T-P-C: 0-1-3-2

Course Objectives

To deal with experimental determination and evaluation of mechanical characteristics and behavior of metallic and non-metallic structural materials.

Introduce to experimental procedures and common measurement instruments, equipment and devices.

To provide students with information concerning practical application of mechanical characteristics.

Course Outcome

CO1: Compute engineering values from laboratory measures and identify failure modes of construction materials.

CO2: Analyze stress versus strain curve for modulus, yield strength and other related attributes

CO3: Prepare the laboratory reports on the interpretation of experimental results

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			3					3	3		1	1		1
CO2	1			3					3	3		1	1		1
CO3				3						3		2	1	1	

Syllabus

Material Testing:

Introduction to "Material Engineering"; Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundamentals and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure. Impact test and transition temperatures; Fatigue of material; Creep.

List of Experiments:

1. Tests on cement
Fineness, Normal consistency, Initial and Final Setting times, Specific gravity, Compressive strength, Soundness
2. Tests on fine aggregate
Grain size distribution – Uniformity coefficient and fineness modulus, Specific gravity, Density, Void ratio, Bulking & Absorption
3. Tests on coarse aggregate
Grain size distribution – Uniformity coefficient and fineness modulus, Specific gravity, Density, Void ratio, Absorption, Crushing & Impact values, Flakiness & Elongation, Los Angel's Abrasion test
4. Concrete mix proportioning approaches
5. Test on fresh and hardened concrete
(a) Workability test - Slump test, Compaction factor test, Flow table test, Vee-Bee Consistometer,
(b) Use of water reducing admixtures
(c) Compressive strength, Split tensile strength, Flexure test on beams, Modulus of elasticity
6. Tests on bricks – Crushing strength, water absorption and efflorescence
7. Basic tests on unmodified bitumen and modified binders with polymers.
8. Tensile and Compressive strength of materials & concrete composites
9. Bending tests on beams – Timber, Metal, Composite

10. Yield/tensile strength, Bend test of steel bar
11. Hardness tests (Brinnel and Rockwell)
12. Impact test
13. Tests on polymers and polymer based materials
14. Theories of Failure and Corroboration with Experiments

Reference(s)

Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)	80	
End Semester		20

19SSK211	SOFT SKILLS I	L-T-P-C: 1-0-2-2

Course Outcome

CO 1 - Soft Skills: At the end of the course, the students would have developed self-confidence and positive attitude necessary to compete and challenge themselves. They would also be able to analyse and manage their emotions to face real life situations.

CO 2 - Soft Skills: Soft Skills: At the end of the course, the students would hone their presentation skills by understanding the nuances of content creation, effective delivery, use of appropriate body language and the art of overcoming nervousness to create an impact in the minds of a target audience.

CO 3 - Aptitude: At the end of the course, the student will have acquired the ability to analyze, understand and classify questions under arithmetic, algebra and logical reasoning and solve them employing the most suitable methods. They will be able to analyze, compare and arrive at conclusions for data analysis questions.

CO 4 – Verbal: At the end of the course, the students will have the ability to dissect polysyllabic words, infer the meaning, inspect, classify, contextualise and use them effectively.

CO 5 - Verbal: At the end of the course, the students will have the ability to understand the nuances of English grammar and apply them effectively.

CO 6 – Verbal: At the end of the course, the students will have the ability to identify, analyse and interpret relationship between words and use the process of elimination to arrive at the answer. They will also have the ability to judge, evaluate, summarise, criticise, present and defend their perceptions convincingly.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								2	3	3		3
CO2									2	3		3
CO3		3		2								
CO4										3		3
CO5										3		3
CO6									3	3		3

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work - environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, Self motivation and continuous knowledge upgradation.

Self-confidence: Characteristics of the person perceived, characteristics of the situation, characteristics of the perceiver. Attitude, values, motivation, emotion management, steps to like yourself, positive mental attitude, assertiveness.

Presentations: Preparations, outlining, hints for efficient practice, last minute tasks, means of effective presentation, language, gestures, posture, facial expressions, professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy, etc. Faulty comparison, wrong form of words

and confused words like understanding the nuances of spelling changes and wrong use of words. Listening skills: The importance of listening in communication and how to listen actively.

Prepositions, articles and punctuation: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving level I: Number system; LCM &HCF; Divisibility test; Surds and indices; Logarithms; Ratio, proportions and variations; Partnership;

Problem solving level II: Time speed and distance; work time problems;

Data interpretation: Numerical data tables; Line graphs; Bar charts and Pie charts; Caselet forms; Mix diagrams; Geometrical diagrams and other forms of data representation.

Logical reasoning: Family tree; Deductions; Logical connectives; Binary logic; Linear arrangements; Circular and complex arrangement; Conditionalities and grouping; Sequencing and scheduling; Selections; Networks; Codes; Cubes; Venn diagram in logical reasoning; Quant based reasoning; Flaw detection; Puzzles; Cryptogrithms.

TEXTBOOKS

A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
The Hard Truth about Soft Skills, by Amazone Publication.
Quantitative Aptitude by R. S. Aggarwal,S. Chand
Quantitative Aptitude – Abijith Guha, TMH.
Quantitative Aptitude for Cat - Arun Sharma. TMH.

REFERENCES:

Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.
More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.
The BBC and British Council online resources
Owl Purdue University online teaching resources
www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

SEMESTER V

19CIE301	GEOTECHNICAL ENGINEERING	L-T-P-C: 2-1-0-3

Course Objectives

To familiarize methods of soil investigation,
Analysis of slope stability and design reinforced slopes
Analysis of earth pressure theories and design of reinforced earth structures.
To determine safe bearing capacity of shallow and deep foundation
Settlement consideration for various ground conditions and understand the effects due to inclusion of drains

Course Outcome

CO1: Identify and suggest site investigation program to evaluate soil behaviour and obtain design parameters.
CO2: Analyze the stability of natural and reinforced slopes
CO3: Analyze the stability of retaining walls and geotextile reinforced earth retaining structures.
CO4: Estimate settlement of soil and accelerated consolidation due to geosynthetic drains.
CO5: Estimate allowable bearing pressures and load carrying capacities of shallow and deep foundation systems.

CO-PO Mapping

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2													
CO2	3	3	2	1									3		2
CO3	3	3	2										3		2
CO4	3	3	3										3		2
CO5	3	3	3										3		

Syllabus

Unit 1

Soil Exploration: Need – Methods of soil exploration – Boring and Sampling methods – Field tests – Penetration Tests – Plate load test – Pressuremeter – Planning of programme and preparation of soil investigation report.
Liquefaction Analysis: Introduction to liquefaction of soil, Critical Void Ratio Concept, Liquefaction resistance, Evaluation of liquefaction potential.

Unit 2

Earth Slope Stability: Infinite and finite earth slopes-types of failures, Factor of safety of infinite slopes, Stability analysis by Swedish Arc method, Standard Method of Slices, Bishop's Simplified method, Taylor's Stability Number.

Slope stabilization –Soil reinforcement – Geosynthetics- Types of geosynthetics- Geotextiles, Geogrid, Geomembranes, Geocomposites- functions of geotextiles- Seperation, drainage, fluid barrier, reinforcement- Principle and mechanism of reinforced soil – Design concepts for slope stabilization- Brief overview of different IS code- Case studies on geotextile-stabilized slopes

Earth Pressure Theories: Rankine's theory of earth pressure, Earth pressure in layered soils, Coulomb's earth pressure theory, Culmann's graphical method, Friction Circle Method.
Toe Walls, Types of Retaining Walls & Modes of Failure-Rigid retaining walls, Flexible retaining walls and MSE retaining walls. IS Recommendation. Soil retention by soil reinforcement using geotextiles- Design and construction of geosynthetics, Reinforced

soil retaining structures, Walls and slopes.
Brief discussion on ground improvement methods: geotextiles and their types, Soil Nailing, Gabion Walls, Sand Compaction Piles and Stone Columns.

Unit 3

Shallow Foundations: Types - choice of foundation – Location of depth – Safe Bearing Capacity – Terzaghi, Meyerhof, Skempton and IS Methods. Bearing Capacity calculations based on various Field Test and Settlement, Design of a footing in soil based on settlement and bearing capacity criteria. Bearing capacity improvement using geotextiles- geocell reinforced sand overlaying soft clay- preloading with prefabricated vertical drains -Rate of settlement with geotextile drainage-
Pile Foundation: Types of piles, Pile load tests, Load carrying capacity of piles based on Static pile formulae & Dynamic pile formulae, Load carrying capacity of pile groups in sands and clays, Settlement of pile groups, IS Recommendations. Basics of Laterally loaded piles & Under-reamed piles.

Text Book(s)

Venkat Reddy, D., "Engineering Geology", Vikas Publishing House, 2010.
Gopal Ranjan and A.S.R. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, 2005.
Shukla, S.K. and Yin, J.-H. (2006). Fundamentals of Geosynthetic Engineering. Taylor and Francis, London, UK.
Shukla, S.K. (2002). Geosynthetics and Their Applications. Thomas Telford Publishing, London, UK.

Reference(s)

Blyth F.G.H. and M. H. De Freitas, "Geology for Engineers", 7th Edition, Elsevier Science, 2006.
Parbin Singh., "Engineering and General Geology", S.K. Kataria and Sons, 2009.
Das, B.M., "Principles of Geotechnical Engineering", CL Engineering, 2013.
P. Purushothama Raj, "Soil Mechanics & Foundation Engineering", Pearson, 2nd Edition.
T.W. Lambe and Whitman, "Soil Mechanics", Wiley, 2008.
Dutta, M., and Gulhati S.K, "Geotechnical Engineering", Tata McGraw Hill Publishers, 2005.
B. C. Punmia, Jain, A. K. & Jain, A. K., "Soil Mechanics & Foundations", Firewell Media, 2005.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA - Can be Quizzes, Assignment, Projects and Reports

19CIE302	ENVIRONMENTAL ENGINEERING - I	L-T-P-C: 2-1-0-3

Course Objectives

To discuss the current status of Indian Environment and responsible Government agencies.
To explain the different water quality parameters and their significance.
To explain the different water treatment options for domestic consumption.
To explain the different techniques of solid waste management

Course Outcome

CO1: Understand the impact of humans on environment and environment on humans and be conversant with basic environmental legislation.
CO2: Analyze the water quality of different sources and estimate the domestic water demand for a society.
CO3: Select and design the appropriate technique for the treatment of water.
CO4: Select the appropriate techniques for treatment of solid waste and control of air pollution.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											2		
CO2	3	3	3	1	1		1		1	1	1		2	2	
CO3	3	2	3										2	2	
CO4	2	2			1								2		

Syllabus

Unit 1
Introduction to current status of Indian environment – Land , Water and Air. Energy and Food security. Role of Government authorities in water supply, sewerage disposal, solid waste management and monitoring/control of environmental pollution – related legislation.
Water: Sources of water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements – Design period - Population forecasting Components of water supply system; Intake structures -Transmission of water, Types of pipe conduits-distribution system, Pumps, Various valves used in W/S systems, service reservoirs and design.

Unit 2
Water Treatment Units: Conventional surface water treatment flow charts - Principles of coagulation, flocculation and sedimentation - Design principles -Filtration - Principles –Classification: slow sand filters and rapid sand filters. Disinfection - methods and disinfectants
Design of complete water treatment units
Introduction to advanced treatments like adsorption, ion exchange, membrane processes. Building Plumbing-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing

Unit 3

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal). Special MSW and waste from commercial establishments, construction activities, biomedical wastes - Disposal methods- Hazardous waste – regulations - Integrated solid waste management

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

Text Book(s)

Birdie G.S and Birdie J. S, "Water Supply and Sanitary Engineering", Dhanpat Rai & Sons, 9th Edition, 2018

Garg S. K, "Environmental Engineering", Vol. I and II, Khanna Publishers, 33rd Edition

Reference(s)

Gilbert Masters, "Introduction to Environmental Engineering and Science" Prentice Hall, New Jersey, 3rd Edition.

P. Aarne Vesilind, Susan M. Morgan, "Introduction to Environmental Engineering" by, Belmont, CA : Thomson/ Brook/Cole, c2004, 3rd Edition.

Peavy, H.s, Rowe, D.R, Tchobanoglous, G. "Environmental Engineering", Mc-Graw - Hill International Editions, New York, Indian Edition,2017

Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.

Tchobanoglous, Theissen& Vigil, "Integrated Solid Waste Management". McGraw Hill Publication, Indian edition.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE303	BASIC REINFORCED CONCRETE DESIGN	L-T-P-C: 3-1-0-4

Course Objectives

To equip the students with basic understanding of theory and application of analysis and design of reinforced concrete structures.

Understand the behavior and design of reinforced concrete components and systems subjected to gravity loads according to INDIAN STANDARD building code requirements

Course Outcome

CO1: Apply knowledge of material properties, understanding design philosophies and methodologies.

CO2: Apply knowledge of design philosophies and basic structural analysis to design and analyze simple structural elements.

CO3: Evaluate, analyze and design structural elements necessary for a simple building.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3	2	2										3		
CO3	3	3	3		2				2	1			3		

Syllabus

Unit 1

Introduction to R.C structures – Review of basic material properties - Concrete and Reinforcing steel. Design philosophies - Working stress method (WSM), Ultimate load method (ULM), Limit state method (LSM). Design of Beams - singly and doubly reinforced rectangular and flanged sections. Serviceability requirements. Behaviour in Shear and Torsion; analysis and design with and without shear reinforcement.

Unit 2

Design for Bond: development length, splicing, curtailment. Design of one-way slabs and two-way rectangular slabs (wall-supported) - as per IS 456: 2000. Design of Compression Members: effective length, short columns subject to axial compression with and without uniaxial / biaxial eccentricities.

Unit 3

Introduction to types of footing. Design of isolated footing for axially loaded & eccentrically loaded columns and combined footing.

Text Book(s)

Pillai S.U. and Menon D, "Reinforced Concrete Design", Tata McGraw Hill, 2009.
M.L.Gambhir , " Design of Reinforced Concrete Structures", PHI learning, 2009.

Reference(s)

Park and Paulay, "Reinforced Concrete Structures", Wiley India (P) Ltd, 2010
Varghese P.C., "Limit State Design of Reinforced Concrete", PHI Learning, 2013
P.Dayaratnam, "Design of Reinforced Concrete Structures",Published by Medtech, New Delhi 2018
Jain A.K., "Reinforced Concrete - Limit State Design- 7th Edition", Nem Chand & Bros., 2012
Sinha S.N., "Reinforced Concrete Design", Tata McGraw Hill, 2014.
BIS Codes (IS 456-2000, IS 875-1987Part (I&II), SP 16-1980, SP24-1983, SP34-1999)
Arthur H Nilson, "Design of Concrete Structures", Tata McGraw-Hill Publications, 2005

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE304	TRANSPORTATION ENGINEERING – II	L-T-P-C: 2-0-0-2

Course Objectives

To explain the importance of the various components of a railway track
To impart knowledge on the design of various geometric elements of a railway track
To highlight the factors in site selection for an airport
To explain the design guidelines for various elements of a harbor

Course Outcome

CO1: Identify and explain the role of different components in a railway track
CO2: Design the geometric elements of a railway track
CO3: Assess the suitable location for an airport and design the landing area
CO4: Specify design guidelines for the various elements within the harbor

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2			2	1					1	3		
CO2	3	3	2						1			1	3		
CO3	3	3	2			2	1		1				3		2
CO4	1		2				1						3		2

Syllabus

Unit 1
Railway Engineering: Components and Geometrical Design of Railways – Horizontal Curves, Radius, Super elevation, Cant Deficiency, Transitional Curves, Different types of Gradients, Grade Compensation, Points and Crossings and their Design; Signaling & Interlocking.

Unit 2
Airport Engineering – Factors affecting site selection and spacing of airports. Components of an airport and their functions. Typical layout. Geometrical Design Considerations – Taxiways, Runways and Aprons. Basic Runway Length and corrections - Runway Orientation.

Unit 3
Harbour engineering - Requirements of ports and harbours - classification of harbours. Selection of site and planning of harbours. Various component and general layout. Principles of harbour design, turning basin, harbour entrances, breakwaters, berthing structures - jetties, fenders, piers, wharves. Docks and Repair Facilities.

Text Book(s)
Satish Chandra and M. M Agarwal", Railway Engineering", Oxford university Press, Second Edition 2013.
Rangwala, "Airport Engineering", Charotar Publishing House, 17th Edition 2018.

Reference(s)
Arora and Saxena, "Railway Engineering", Dhanpat Rai Publications, 2011.
R Srinivasan, "Harbour, Dock and Tunnel Engineering", Charotar Publishing House, 2012.
Khanna S K, Arora, M G and Jain S S., "Airport Planning and Design", Nem Chand and Bros, 2009.
Oza, H. P and Oza, G. H., "Dock and Harbour Engineering", Charotar Book House, 2011

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE38	COMPUTER AIDED CIVIL ENGINEERING DRAWING	L-T-P-C: 1-0-3-2

Course Objectives

To develop graphical skills for communicating concepts, ideas and designs
To train students for preparing and interpreting 2D & 3D drawings for conventional structures

Course Outcome

CO1: Prepare the drawing for building components
CO2: Prepare the plan, elevation and sectional views of the residential, commercial and public building from the line sketch.
CO3: Prepare the detailed plan, manually and using IT tool for different buildings according to the given requirements and site conditions

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		1	1	3	2	1		1	3		1	1	3	1
CO2	1		3	3	3				3	3		3	1	3	
CO3	1		3	3	3	3	1		3	3	3	3	1	3	1

Syllabus

Part A
Detailed drawing of components
- Footings
- Roof trusses
- Reinforced Concrete staircase

From given line sketch and specification, develop working drawings of:
- Single storied residential building with flat and tiled roof
- Public buildings like office, dispensary, post office, bank etc.
- Factory building with trusses

Part B
Functional planning – Building development rules - Space planning of buildings – Design process – planning principles.
Preparation of drawings as per building development rules.
- Residential building- flat and pitched roof, economic domestic units, cottages, bungalows
- Public building – small public utility shelters, dispensaries, banks, schools, offices, libraries, hostels, restaurants, commercial complexes, factories etc.
- Preparation of site plans and service plans as per Building Rules

Text Book(s)
Balagopal T S Prabhu, "Building Design and Civil Engineering Drawing", Spades Publishers, 2008.
Shaw, Kale and Patki, "Building Drawing with an Integrated Approach to Built Environment", McGraw Hill Education; 2017.

Reference(s)

SP 7: National Building Code of India, Bureau of Indian Standards, 2016.
G. Muthu Shoba Mohan, "Principles of Architecture", Oxford University Press, 2006.
Crosbie, M.J. and Callender, J.H., "Time-Saver Standards for Architectural Design Data", McGraw Hill Education, 2017.
Sham Tickoo, "Autodesk Revit architecture 2010 for architects and designers", CADCIM Technologies, 2009.

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

*Drawings, Assignments/Quiz, Term project

19CIE382	GEOTECHNICAL ENGINEERING LABORATORY	L-T-P-C: 0-0-3-1

Course Objectives

To give an exposure on the laboratory tests for determination of Index and Engineering properties of soil.
Provide students the basic knowledge to carry out field investigations and to identify soils in geotechnical engineering practice.

Course Outcome

CO1: Conduct experiments to find the index and engineering properties of different types of soil.
CO2: Prepare laboratory reports on the interpretation of experimental results.
CO3: Assess the strength parameters of soil using various field tests.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		3					3	3		3	3	1	1
CO2	3	3		3					3	3		3	3	1	
CO3	3	3		3					3	3		3	3	1	1

List of experiments

1. Specific gravity of coarse and fine-grained soils
2. Grain size analysis
3. Atterberg's limits and indices
4. Determination of field density (a) sand replacement method (b) core cutter method
5. Determination of coefficient of permeability by (a) Constant head method; (b)Variable head method
6. Consolidation test
7. Compaction test (a) IS light compaction test (b) IS heavy compaction test
8. California Bearing Ratio test
9. Direct shear test
10. Triaxial shear test
11. Unconfined compressive strength test & Laboratory vane shear test
12. Demonstration of Plate Load & Standard Penetration Tests

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)	80	
End Semester		20

19CIE390	INDUSTRY INTERNSHIP (VACATION)	L-T-P-C: 0-0-3-P/F

Course Objectives

To expose students to the industry working environment and get acquainted with the organization structure, business operations and administrative functions.

To have hands-on experience so that they can relate and reinforce the teaching-learning process.

To promote cooperation and to develop synergetic collaboration between industry and the institution

To set the stage for future recruitment by potential employers.

Course Outcome

CO1: Work in actual working environment**.**
CO2: Utilize technical resources
CO3: Prepare technical documents and give oral presentations related to the work completed.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2	2	2	2		2	2	2	2	2	2
CO2		2			2				2			2			
CO3									2	3					

Students have to undergo minimum of one-week practical training in Civil Engineering related organizations of their choice with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

Evaluation Pattern
This course is mandatory and a student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made.

Assessment	Internal	External
*Continuous Assessment (CA)	80	
**End Semester		20

*Continuous Assessment: Duration of the training, report
**End Semester: Presentation/Viva voce

19SSK301	SOFT SKILLS II	L-T-P-C: 1-0-2-2

Course Outcomes

CO # 1 - Soft Skills: At the end of the course, the students will have the ability to communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation. They would further develop their inter-personal and leadership skills.

CO # 2 - Soft Skills: At the end of the course, the students shall learn to examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arrive at a consensus.

CO # 3 - Aptitude: At the end of the course, students will be able to identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability and combinatorics.

CO # 4 – Verbal: At the end of the course, the students will have the ability to relate, choose, conclude and determine the usage of right vocabulary.

CO # 5 - Verbal: At the end of the course, the students will have the ability to utilise prior knowledge of grammar to recognise structural instabilities and modify them.

CO # 6 – Verbal At the end of the course, the students will have the ability to comprehend, interpret, deduce and logically categorise words, phrases and sentences. They will also have the ability to theorise, discuss, elaborate, criticise and defend their ideas.

Syllabus

Professional grooming and practices: Basics of corporate culture, key pillars of business etiquette. Basics of etiquette: Etiquette – socially acceptable ways of behaviour, personal hygiene, professional attire, cultural adaptability. Introductions and greetings: Rules of the handshake, earning respect, business manners. Telephone etiquette: activities during the conversation, conclude the call, to take a message. Body Language: Components, undesirable body language, desirable body language. Adapting to corporate life: Dealing with people.

Group discussions: Advantages of group discussions, structured GD – roles, negative roles to be avoided, personality traits to do well in a GD, initiation techniques, how to perform in a group discussion, summarization techniques.

Listening comprehension advanced: Exercise on improving listening skills, grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving level III: Money related problems; Mixtures; Symbol based problems; Clocks and calendars; Simple, linear, quadratic and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics.

Data sufficiency: Concepts and problem solving.

Non-verbal reasoning and simple engineering aptitude: Mirror image; Water image; Paper folding; Paper cutting; Grouping of figures; Figure formation and analysis; Completion of incomplete pattern; Figure matrix; Miscellaneous.

Spacial aptitude: Cloth, leather, 2D and 3D objects, coin, match sticks, stubs, chalk, chess board, land and geodesic problems etc., related problems.

TEXTBOOK(S)

A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
The Hard Truth about Soft Skills, by Amazone Publication.
Quick Maths – Tyra.
Quicker Arithmetic – Ashish Aggarwal
Test of reasoning for competitive examinations by Thorpe.E. TMH
Non-verbal reasoning by R. S. Aggarwal, S. Chand

REFERENCE(S)

Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova
More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.
The BBC and British Council online resources
Owl Purdue University online teaching resources
www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

Course Objectives

19LIV390	LIVE-IN-LAB I	L-T-P-C: 0-0-0-3

Course Objectives

- Identify and analyse the various challenge indicators present in the village by applying concepts of Human Centered Design and Participatory Rural Appraisal.
- User Need Assessment through Quantitative and Qualitative Measurements
- Designing a solution by integrating Human Centered Design concepts
- Devising proposed intervention strategies for Sustainable Social Change Management

Course Outcome

CO1: Learn ethnographic research and utilise the methodologies to enhance participatory engagement.
CO2: Prioritize challenges and derive constraints using Participatory Rural Appraisal.
CO3: Identify and formulate the research challenges in rural communities.
CO4: Design solutions using human centered approach.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3		3		1	1		3	3		3
CO2		3						3	3	3		
CO3		3					1		3	3		3
CO4	3		3				3	3	3	3		3

Syllabus

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.

Evaluation Pattern

Assessment	**Marks**
Internal (Continuous Evaluation) [75 marks]	
Workshop (Group Participation)	15
Village Visit Assignments & Reports	15
Problem Identification and Assessment	15
Ideation: Defining the Needs, Proposed Designs & Review	20
Poster Presentation	10
External [25 marks]	
Research Paper Submission	25
Total	**100**
Attendance (To be added separately)	5
Grand Total	**105**

SEMESTER VI

19CIE311	ENVIRONMENTAL ENGINEERING - II	L-T-P-C: 2-0-3-3

Course Objectives

- the steps involved in design of waste water collection system
- the different treatment techniques for treating domestic waste water
- the procedure for the determination of various water and waste water quality parameters

Course Outcome

CO1: Design and estimate the cost for a typical waste water collection schemes
CO2: Design and estimation for a typical domestic sewage treatment plant
CO3: Analyze experimentally the water and waste water quality from different sources and suggest the type of treatment required.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1		1						1		
CO2	2	3	3		1								2	2	
CO3	3	2	3						1	1	1		2	2	

Syllabus

Unit 1
Waste water- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water.

Unit 2
Sewage and Sullage, Disposal of waste water on water bodies and land – effluent discharge standards- self purification of streams– oxygen sag curve – sewage farming - National River cleaning plans .
Wastewater treatment scheme - Objectives – Selection of unit operation and process – aerobic and anaerobic treatment systems - suspended and attached growth systems.

Unit 3
Activated sludge process and its types – Design of conventional activated sludge process- recycling of sewage – quality requirements for various purposes- Sludge treatment and disposal.

Practical Work: List of Experiments
1. Physical characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride, sulphate, sulphide, iron and manganese
5. Optimum coagulant dose

6. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
7. Chemical Oxygen Demand (COD)
8. Break point chlorination
9. Bacteriological quality measurement: MPN,
10. Ambient air quality monitoring (TSP, RSPM, SOx, NOx)
11. Ambient noise measurement

Text Book(s)

Birdie G.S and Birdie J. S, "Water Supply and Sanitary Engineering", Dhanpat Rai& Sons, 9th Edition, 2018
Garg S. K, "Environmental Engineering", Vol. I and II, Khanna Publishers, 33rd Edition

Reference(s)

Gilbert Masters, " Introduction to Environmental Engineering and Science" Prentice Hall, New Jersey, 3rd Edition.
P. Aarne Vesilind, Susan M. Morgan, "Introduction to Environmental Engineering" by, Belmont, CA : Thomson/ Brook/Cole, c2004, 3rd Edition.
Peavy, H.s, Rowe, D.R, Tchobanoglous, G. "Environmental Engineering", Mc-Graw - Hill International Editions, New York, Indian Edition,2017
MetCalf and Eddy. "Wastewater Engineering, Treatment, Disposal and Reuse", Tata McGraw-Hill, New Delhi, Indian Edition
Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development
Standard method for the examination of water and waste water, APHA, AWWA, WPCF Publication.

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	10	
Continuous Assessment (Lab) (CAL)	40	
End Semester		30

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE312	BASIC STEEL DESIGN	L-T-P-C: 3-1-0-4

Course Objectives

To equip the students with basic understanding of theory and application of analysis in steel structure design. Understand the material properties and behavior of various connections in the design of structural steel components and systems subjected to gravity and lateral loads according to the INDIAN STANDARD building code requirements.

Course Outcome

CO1: Apply the knowledge of material properties, geometric properties, understanding the design philosophies and methodologies.
CO2: Apply the knowledge of design philosophies and basic structural analysis to design and analyze simple structural elements.
CO3: Evaluate, analyze and design structural elements necessary for a simple structure

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3	2	2										3		
CO3	3	3	3		2				2	1			3		

Syllabus

Unit 1
Introduction to structural steel sections, material property, geometric properties, classes of sections, stresses, residual temperature stresses in rolled steel sections, loads. Types of design - rigid, semi rigid. Limit state design method – basic concepts, partial safety factors, load combinations, deflection limitations as per IS: 800. Analysis and design of bolted and welded connections to resist direct force and moment. Design of tension members - single and double angle ties.

Unit 2
Plastic behaviour of structural steel – shape factor – plastic hinge concept – collapse load – methods of plastic analysis – plastic analysis of beams and portal frames. Analysis and design of laterally restrained & unrestrained simple & compound beams - Design for flexure, shear, bearing and check for serviceability criteria.

Unit 3
Compression members: Axially and eccentrically loaded compression members - built up columns and lacings. Industrial roofs: Introduction to steel roof systems-various elements - loads - wind load estimation for plane roof trusses.

Text Book(s)
Subramanian N, "Design of Steel Structures limit states method,", Oxford University Press, 2016
Duggal, S.K., "Limit State Design of Steel Structures", Tata McGraw Hill, 2017.

Reference(s)

Ramchandra and Gehlot, "Limit State Design of Steel Structures", Scientific Publishers, 2015.
Dayaratnam P, "Design of Steel Structures", S.Chand & Co., 2012.
Arya and Ajmani, "Design of Steel Structures", Nem Chand Brothers, 2007.
BIS codes (IS 800-2007, IS 875-1987-Parts I, II, IS 875-2016-Parts III, SP:6 – Part 1 to 6).
Emil Smith and Robert Scanlan, "Wind Effects on Structures". Wiley-Interscience, 1996.
Edwin Gaylord, "Design of Steel Structure", Tata McGraw Hill Publishing CompanyLimited, 2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE313 ESTIMATION, COSTING AND PROFESSIONAL PRACTICE L-T-P-C: 2-0-3-3

Course Objectives

To provide students with theoretical and practical base to enable them to measure, cost and specify construction resources

To develop the skill to assess the monetary value of a facility/property.

To make the students understand the types of roles they are expected to play in the society as practitioners.

Course Outcome

CO1: Quantify the items of work and estimate material requirement for construction
CO2: Derive the cost rates and build up the overall cost of the structure.
CO3: Apply the technical specifications for various works to be performed for a project.
CO4: Understand and apply the basic principles for valuation of properties.
CO5: Understand the ethics governing the profession and recognize the roles of stakeholders in professional practice.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			2				3			3		3	
CO2	3	3			2				3			3		3	
CO3	3	3							3			3		3	
CO4	3	3							3			2		3	
CO5	3	2						3	3			2		3	

Syllabus

Unit 1

Estimation - Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, Use of Computers in quantity surveying; BIM and quantity take-offs.

Unit 2

Specifications - Types, requirements and importance. Detailed specifications for common building materials and items of work as per I.S specifications - Preparation of conveyance statement - Calculation of quantities of materials for items of work - Analysis of rate for items of works required for civil engineering works. - Preparation of abstract of estimate of civil engineering works. Percentage breakup of the cost, cost sensitive index.

Unit 3

Valuation - Types of values – concept of time-value of money - sinking fund - years purchase - Depreciation - obsolescence - valuation of real property - valuation of land - lease and lease hold property.

Professional Practice – Respective roles of various stakeholders: Government; Standardization Bodies; professional bodies; Clients/ owners; Developers; Consultants; Contractors; Manufacturers/ Vendors/ Service agencies.

Ethics – Definition, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Professional Responsibility, Conflict of Interest, Environmental breaches, Negligence; Vigil Mechanism, Whistleblowing.

Exercises / Term Work Assignments:

1. Types of estimate - plinth area method - cubic rate method - unit rate method - bay method - approximate quantity from bill method - comparison method - cost from materials and labour - preparation of detailed estimate
2. Preparation of detailed estimate using Centre line method
3. Preparation of detailed estimate using Long wall - short wall method
4. Preparation of detailed estimate for R.C.C Structures.
5. Preparation of detailed estimate for Steel Structures.
6. Preparation of detailed estimate for roads
7. Preparation of detailed estimate for sanitary and water supply works
8. Preparation of valuation report.
9. Assignments on:
    a. market survey of basic materials
    b. rate analysis
    c. specifications
    d. simple estimates.

Text Book(s)

Chakraborti, M., "Estimation, Costing, Specification and Valuation in Civil Engg", Chakraborti , 2008.
B.N. Dutta " Estimating& Costing in Civil Engineering Theory and Practice", UBS Publishers & Distributors Limited, 2016.

Reference(s)

Rangwala, Estimating, Costing and Valuation, Charotar Publishing House, 2017.
B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
The National Building Code, BIS, 2016
RERA Act, 2017
Vee, Charles &Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss2, pp 117-127, MCB UP Ltd
American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
Ethics in Engineering- M.W.Martin&R.Schinzinger, McGraw-Hill
Engineering Ethics, National Institute for Engineering Ethics, USA
www.ieindia.org
Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
Kohli, D.D and Kohli,R.C, "A text book of Estimating and Costing (Civil)", S.Chand& Company Ltd., 2004.
IS : 1200 – 1974 – Parts 1 to 25, Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards, New Delhi.
Standard Data Books of Central Public Works Departments and Public Work Department of States.

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE31	HYDROLOGY AND WATER RESOURCES ENGINEERING	L-T-P-C: 2-1-0-3

Course Objectives

To explain the relevance of various components of hydrologic cycle, which impacts the spatial and temporal distribution of water resources.

To provide an insight on the groundwater resources under different hydro-geological conditions and movement of groundwater.

To impart the knowledge about design of various water resources infrastructure

Course Outcome

CO1: Understand and quantify the hydrological processes
CO2: Apply basics of storm hydrology to estimate the catchment rainfall and runoff for various hydrological applications.
CO3: Understand and apply the reservoir planning characteristics and operational practices for various purposes.
CO4: Comprehend the channel flow theories and apply in design of irrigation water distribution systems

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2												2	
CO2	3	3	2	2										2	
CO3	3	3	2											2	
CO4	2	2												2	

Syllabus

Unit 1

Introduction to Hydrology – Hydrologic cycle – hydrologic processes – water balance equation - global water balance – applications.

Precipitation – forms of precipitation – monsoons in India – precipitation measurement – rain gauge network – areal precipitation – rainfall intensity-duration-frequency (IDF) relationships – depth-area-duration (DAD) relationships.

Evaporation – evaporation process - measurement methods – evaporimeters - analytical methods – mass transfer method – energy budget method – combination method. Evapotranspiration – measurement methods – empirical equations – potential and actual evapotranspiration.

Infiltration – rainfall hyetograph - measurement – infiltration capacity – infiltration indices.

Unit 2

Runoff – runoff volume – SCS-CN method – hydrographs – factors affecting runoff hydrograph – components of hydrograph – base flow separation – effective rainfall – unit hydrograph – flow duration curve – floods – rational method – flood frequency – design flood – design storm – risk, reliability and safety factor.

Flow measurement – methods – velocity area method – dilution method – stage-discharge curve.

Groundwater and well hydrology – types of aquifers - aquifer properties – Darcy's law – well hydraulics – determination of hydraulic conductivity – steady state flow in wells – steady state equations for confined and unconfined aquifers – aquifer test.

Unit 3

Dams – classification – design considerations. Gravity dam – forces on gravity dam – stress analysis. Spillways – components – types – hydraulic jump.

Reservoirs – capacity estimation methods – mass curve – sequent peak algorithm – performance indices – storage-yield-performance function – reservoir operation for irrigation, hydropower and flood control.

Irrigation – water requirement of crops – duty and delta – soil-water relationship – root zone soil water – irrigation requirement – types of irrigation.

Water distribution system – canal systems – design of irrigation channels – Kennedy's and Lacey's theory of regime channels. Canal drops – regulators – canal escapes.

Text Book(s)

Subramanya K, 'Engineering Hydrology', 4th Edition, McGraw Hill Education (India), New Delhi, 2013
Ragunath, H M, 'Hydrology-Principles, Analysis and Design, Wiley Eastern Ltd., 2006
Todd, D K, 'Groundwater Hydrololgy' John Wiley & Sons, 2006

Reference(s)

Chow V T, Maidment D R, Mays L W, 'Applied Hydrology', Tata-McGraw Hill Education, New Delhi, 2010.
Linsley R K, Franzini J B, Freyberg D L, Tchobanoglous G, 'Water Resources Engineering', 4th Edition, McGraw Hill, 1992
Singh V.P, Elementary hydrology, Prentice Hall, Englewood Cliffs, New Jersey, 1992.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19SSK311	SOFT SKILLS III	L-T-P-C: 1-0-3-2

Course Outcomes:

CO # 1 - Soft Skills: At the end of the course, the students will have the ability to prepare a suitable resume (including video resume). They would also have acquired the necessary skills, abilities and knowledge to present themselves confidently. They would be sure-footed in introducing themselves and facing interviews.

CO # 2 - Soft Skills: At the end of the course, the students will have the ability to analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.

CO # 3 - Aptitude: At the end of the course, students will be able to interpret, critically analyze and solve logical reasoning questions. They will have acquired the skills to manage time while applying methods to solve questions on arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions.

CO # 4 – Verbal: At the end of the course, the students will have the ability to understand and use words, idioms and phrases, interpret the meaning of standard expressions and compose sentences using the same.

CO # 5 - Verbal: At the end of the course, the students will have the ability to decide, conclude, identify and choose the right grammatical construction.

CO # 6 – Verbal: At the end of the course, the students will have the ability to examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them. They will also have the ability to create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience / recipient using their communication skills in English.

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation / knowledge about the company, professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level IV: Geometry; Trigonometry; Heights and distances; Co-ordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics). Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOK(S)

A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
The Hard Truth about Soft Skills, by Amazone Publication.
Data Interpretation by R. S. Aggarwal, S. Chand
Logical Reasoning and Data Interpretation – Niskit K Sinkha
Puzzles – Shakuntala Devi
Puzzles – George J. Summers.

REFERENCE(S)

Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.
More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
The BBC and British Council online resources
Owl Purdue University online teaching resources

www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

19LIV490	LIVE-IN-LAB II	L-T-P-C: 0-0-0-3

Course Objectives

- Proposal writing in order to bring in a detailed project planning, enlist the materials required and propose budget requirement.
- Use the concept of CoDesign to ensure User Participation in the Design Process in order to rightly capture user needs/requirements.
- Building and testing a prototype to ensure that the final design implementation is satisfies the user needs, feasible, affordable, sustainable and efficient.
- Real time project implementation in the village followed by awareness generation and skill training of the users (villagers)

Course Outcome

CO1: Learn co-design methodologies and engage participatorily to finalise a solution
CO2: Understand sustainable social change models and identify change agents in a community.
CO3: Learn Project Management to effectively manage the resources
CO4: Lab scale implementation and validation
CO5. Prototype implementation of the solution

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	3			1	3	3	3		3
CO2									3	3		
CO3									3	3	3	
CO4	3		3			3	1	3	3	3		3
CO5			1						3	3		

Syllabus

The students shall visit villages or rural sites during the vacations (after 6th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

Evaluation Pattern

Assessment	Marks
Internal (Continuous Evaluation) [63 marks]	
1. Proposed Implementation Presentation Round 1	**2**
2. Proposal Submission + Review	**6**
3. Co-design	**6**
i. Village Visit I (Co-Design Field Work Assignments)	4
ii. Presentation of Co-design Assessment	2
4. Prototype Design	**14**
i. Prototype Design	4
ii. Prototype Submission	8
iii. Sustenance Plan	2
5. Implementation	**35**
i. Implementation Plan Review	3
ii. Implementation	24
iii. Testing & Evaluation	4
iv. Sustenance Model Implementation	4
External [37 marks]	
6. Research Paper	**18**
7. Final Report	**15**
8. Poster Presentation	**4**
Total	**100**
Attendance	5
Grand Total	**10**

SEMESTER VII

19CIE402	CONSTRUCTION MANAGEMENT	L-T-P-C: 2-1-0-3

Course Objectives

To provide a basic idea on construction dynamics - various stakeholders, project objectives, processes and resources required.

To develop an ability to plan, control and monitor construction projects with respect to time and cost

To provide an insight on how construction projects are administered with respect to contract structures and issues

Course Outcome

CO1: Apply knowledge of network scheduling techniques to identify critical activities
CO2: Apply knowledge of construction procedures in assessing different contract options
CO3: Assess quality and safety aspects in project environment
CO4: Take decisions on inventory and transportation of construction materials.
CO5: Select appropriate equipment for various construction activities

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			1						1		1		3
CO2		3									3				3
CO3		2	1			3									3
CO4	2	3									2		1		3
CO5	2	3									2		1		3

Syllabus

Unit 1

Construction management environment - Construction activities and sequence. Construction planning - Network scheduling - Bar chart, linked bar chart, work-breakdown structures, activity-on-arrow diagrams - event based networks. Critical path method. PERT network analysis. Introduction to Precedence networks.

Unit 2

Network compression - Time-cost study. Resource management. Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value. Construction procedure – contracts – types – bidding process – contract conditions - specifications – quality management principles. Construction safety.

Unit 3

Materials management - inventory control. Transportation model and application for distribution of materials. Construction equipment - selection factors - planning of equipment – equipment for excavation, transport, hoisting, piling, and concrete construction. Basics of Lean Construction and BIM in project management. Introduction to project management softwares.

Text Book(s)

Kumar Neeraj Jha, "Construction Project Management", Pearson Education, 2015.
R. L. Peurifoy and Schexnayder, "Construction Planning, Equipment, and Methods", Tata McGraw Hill, 2013.

Reference(s)

Gahlot, P. S. and Dhir, B. M., "Construction Planning and Management", New Age International, 2018.
Jerome D. Wiest, Ferdinand K. Levy, "A Management guide to PERT / CPM", PHI Learning, 2009.
L.S. Srinath, "PERT and CPM - Principles and Applications", Affiliated to East West Press, 2001.
Shrivastava. U. K., 'Construction Planning and Management', Galgothia Publications Pvt. Ltd, New Delhi, 2013.
Chitkara, K. K. "Construction Project Management - Planning, Scheduling and Control", McGraw Hill Education, 2014.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE401	STRUCTURAL DESIGN AND DETAILING	L-T-P-C: 0-2-3-3

Prerequisite(s): 19CIE303 Basic RC Design, 19CIE312 Basic Steel Design

Course Objectives

The objective is to equip the students to understand the techniques and method of communicating engineering design and detailing to industry on par with INDIAN STANDARD building code requirements.

Course Outcome

CO1: Design and detail the RC structural elements.
CO2: Design and detail the steel structural elements.
CO3: Use software packages for analysis, design and drafting.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2			3	3	3		3	3	1
CO2	3	3	3	3	3	2			3	3	3		3	3	1
CO3	3	1	1		3				3	3	3		3	3	

Syllabus

Design drawing and detailing of RC elements / structures – preparation of detailed design documents, schedules of structural elements and reinforcement details (structural drawing).
Beams – Singly Reinforced, Doubly Reinforced and T beam
Slab – One way Slab, Two way slab (Corners held up and corners held down)
Columns – Axial loaded, Uniaxial, Biaxial
Footing – Isolated and combined footing

Design and detailing of steel elements / structures
Tension members – laterally supported and unsupported beams – laced columns
Connections – Bolted and Welded

Computer aided analysis and design:
Multi-storey frame analysis for dead and live load.

Text Book(s)

N. Krishna Raju, "Structural Design and Drawing – Reinforced Concrete and Steel", Universities Press, 2005.
M.L.Gambhir, "Design of Reinforced Concrete Structures", PHI Learning, 2009.

Reference(s)

D.Krishnamoorthy, "Structural Design & Drawing- Vol-I&II", CBS Publishers, 2012.
Karve, Shah, "Illustrated Design of R. C. Buildings (G+3)", Standard Publishers Distributors, 2008.
SP:34-1987, "Handbook on Concrete Reinforcement and Detailing", BIS.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE491	PROFESSIONAL PROJECT	L-T-P-C: 0-1-3-2

Course Objectives

Improve the design capability of the student to handle practical problems through proper guidance.

Course Outcome

CO1: Apply the engineering knowledge acquired to make preliminary investigations and do functional and/or structural design of a facility.
CO2: Estimate the material and/or cost requirement involved in a project.
CO3: Present the project with clarity, following ethical norms in oral and written mode
CO4: Develop a team and effectively participate in the team to execute the project
CO5: Address environmental / social / engineering problems through the project

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3									3		
CO2											3			3	
CO3								3	3	3		3			
CO4								3	3						
CO5					3	3	3	3	3			3			3

This course conceives purely a design problem in any one of the disciplines of Civil Engineering; e.g., Design of an RC structure, Design of a waste water treatment plant, Design of a foundation system, Design of traffic intersection etc. The design problem can be allotted to a group of students comprising of not more than four. At the end of the course the group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings which follow the design.

Evaluation Pattern

Assessment	Internal	End Semester
Continuous Assessment (CA)	80	
End Semester		20

19CIE492	COMPREHENSIVE EXAMINATION	L-T-P-C: 0-0-3-1

Course Objectives

To provide overview of all Civil Engineering topics covered in the curriculum
To assess the overall knowledge level of Civil Engineering topics and guide them to take corrective measures where deficiencies are identified.

Course Outcome

CO1: Review and apply the engineering knowledge acquired to different situations.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3			1						1	3	3	3

Syllabus

Review of the following topics of civil engineering:

- Characteristics of various engineering materials.
- Basics of Engineering Mechanics and Solid Mechanics.
- Various classical methods in analysis of structures.
- Matrix methods of analysis of structures.
- Overview of Design of RCC and Steel Structures.
- Overview on Fluid Mechanics and Machinery.
- Overview of Elements of Irrigation and Hydraulic Structures.
- Overview on Surveying.
- Overview on Water Supply and Sewerage.
- Overview of Transportation Engineering covering Roads, Railway, Docks and Airport Engineering.
- Overview of Aspects of Geotechnical Engineering.
- Principles of Construction Engg. & Management

Reference(s)

Vazirani V.N., Chandola S.P., "Concise Handbook of Civil Engineering", S Chand, 3rd Revised edition, 2000
Khanna P.N, "Indian Practical Civil Engineers Handbook", UBS Publishers' Distributors Ltd, Second edition

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

· CA – Can be Multiple examinations of objective type question paper pattern covering all aspects of civil engineering covered under UG programmme

19CIE490	INDUSTRY INTERNSHIP (VACATION)	L-

Course Objectives

To expose students to the industry working environment and get acquainted with the organization structure, business operations and administrative functions.

To have hands-on experience so that they can relate and reinforce the teaching-learning process.

To promote cooperation and to develop synergetic collaboration between industry and the institution.

To set the stage for future recruitment by potential employers.

Course Outcome

CO1: Work in actual working environment**.**
CO2: Utilize technical resources
CO3: Prepare technical documents and give oral presentations related to the work completed.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2	2	2	2		2	2	2	2	2	2
CO2		2			2				2			2			
CO3									2	3					

Students have to undergo minimum of two-week practical training in Civil Engineering related organizations of their choice but with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

Evaluation Pattern

This course is mandatory and a student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made**.**

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
**End Semester		20

*Continuous Assessment: Duration of the training, report
**End Semester: Presentation/Viva voce

19CIE495	MINOR PROJECT	L-T-P-C: 0-0-6-2

Course Objectives

To work on a topic in the field of Civil Engineering which could involve theoretical and/or fabrication and/or experimental and/or computational work.

Course Outcome

CO1: Apply the engineering knowledge acquired to do literature survey and make preliminary studies to investigate an engineering problem.
CO2: Present the project with clarity, following ethical norms in oral and written mode
CO3: Develop a team and effectively participate in the team to execute the project
CO4: Address environmental / social / engineering problems through the project

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3									3		
CO2								3	3	3		3			
CO3								3	3						
CO4					3	3	3	3	3			3			3

The student is expected to start the initial planning and preparation for the final semester project. They have to identify their team, project advisor and, plan the objectives, scope, methodology and the work schedule. A detailed literature review is also expected in this phase.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
**End Semester		20

*Continuous Assessment: Reviews
**Presentation

SEMESTER VIII

19CIE499	PROJECT	L-T-P-C: 0-0-30-10

Course Objectives

To work on a topic in the field of Civil Engineering which could involve theoretical and/or fabrication and/or experimental and/or computational work or as a capstone design.

Course Outcome

CO1: Create a set up through proper design and investigate the system using the engineering knowledge acquired
CO2: Estimate and manage the time, material and cost aspects of the project
CO3: Present the project with clarity, following ethical norms in oral and written mode
CO4: Develop a team and effectively participate in the team to execute the project
CO5: Address environmental / social / engineering problems through the project

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3									3		
CO2											3			3	3
CO3								3	3	3		3			
CO4								3	3						
CO5					3	3	3	3	3			3			3

Depending on the satisfactory performance of students in 'Minor project', they can continue the work for the 'Project'. Students eligible for distinction and those who are aiming higher studies will be encouraged to continue with the research oriented works. Instead of research oriented projects, students will also have the option of doing Capstone designs as the requirement for 'Project', preferably with guidance from an industry mentor.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
**End Semester		20

*Continuous Assessment: Internal Reviews
**End Semester : External Review

PROFESSIONAL ELECTIVE COURSES (With Prerequisites)

Structural Engineering

19CIE443	ADVANCED STRUCTURAL ANALYSIS	L-T-P-C:3-0-0-3

Prerequisite(s): 19CIE212 Structural Analysis

Course Objectives

Introduce to the approximate methods for analyzing Multi-storey frames.
To make the student familiar with latest computational techniques used in structural analysis softwares.

Course Outcome

CO1: Analyze the multistory frames using approximate methods.
CO2: Apply flexibility matrix method to analyze the beams, frames and truss system.
CO3: Analyze the beams, frames and truss system using stiffness matrix method.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1								3	3		
CO2	3	3	1	1								3	3		
CO3	3	3	1	1								3	3		

Syllabus

Unit 1
Kani's method – Analysis of simple beams, Approximate Methods of Analysis of Multistoried Frames: Analysis for vertical loads – substitute frames - loading conditions for maximum moments in beams and columns – portal method and cantilever method for lateral load analysis.

Unit 2
Matrix methods of structural analysis – Flexibility method - Formation of flexibility matrices for elements and structure. analysis of simple continuous beams, simple rigid jointed frames and plane trusses.

Unit 3
Matrix methods of structural analysis – Stiffness method - Formation of Stiffness matrices for elements and structure. analysis of simple continuous beams, simple rigid jointed frames and plane trusses.

Text Book(s)
Devdas Menon, "Structural Analysis", Narosa Book Distributers Pvt Ltd, 2010.
Devdas Menon, "Advanced Structural Analysis", Narosa Book Distributers Pvt Ltd, 2017.
S P Gupta and G S Pundit, "Theory of Structures", Vol I & II, Tata McGraw Hill, 2017

Reference(s)

Hibbeler, R. C., "Structural Analysis", Pearson, 2008.
Wang C.K., "Intermediate Structural Analysis" Tata McGraw - Hill Education 2010.
Norris C.H, Wilbur J.B. and Utku.S., "Elementary Structural Analysis", Tata McGraw Hill, 2016.
Sujit Kumar Roy and Subrata Chakrabarty, "Fundamentals of Structural Analysis",S.Chand& Co., 2010.
Reddy C.S., Basic Structural Analysis, Tata McGraw Hill, New Delhi, 2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE431	ADVANCED CONCRETE DESIGN	L-T-P-C:3-0-0-3

Prerequisite(s): 19CIE303 Basic Reinforced Concrete Design

Course Objectives

The course focuses on understanding the behavior, design and detailing of reinforced concrete retaining walls, storage structures and Bridge components according to the INDIAN STANDARD building code requirements and on par with current Industry practices

Course Outcome

CO1: Design the various types of retaining walls, RC walls and shear wall**.**
CO2: Apply the concept of various theories in designing the storage structures and domes.
CO3: Analyse and design transportation structures

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3	2	2										3		
CO3	3	3	3		2				2	1			3		

Syllabus

Unit 1
Earth Retaining structures - Retaining walls- types - cantilever and counterfort - design - drainage and other construction details. Design of RC walls - Shear walls.

Unit 2
Design of Spherical and Conical Domes- detailing- Liquid Retaining structure - Water tanks - types - square, rectangular, circular - Design of underground and elevated tanks - design of staging. Design of circular silo using Jansen's theory

Unit 3
Design of corbels, Design of long columns– Transportation structures - Bridges - Slab Bridge - Design of single span slab bridge - Tee Beam Bridge with cross girders.

Text Book(s)
Jain A.K., "Reinforced Concrete - Limit State Design- 7th Edition", Nem Chand & Bros., 2012
Varghese P.C., "Advanced Reinforced Concrete Design", PHI, 2010.
N.KrishnaRaju, "Design of bridges", Oxford University Press, 2019.

Reference(s)

N. Krishnaraju, "Advanced Reinforced Concrete Design", CBS Publisher, 2016
R.D. Anchor., "Design of Liquid Retaining Concrete Structures – Second edition" British Library Cataloguing in Publication Data, 1992.
D.Johnson Victor, "Essentials of bridge engineering", Oxford University Press, 2019.
Mosley. B., John B., & Ray Hulse "Reinforced Concrete Design to Eurocode-2"Red Globe Press, 2012.
BIS codes (IS 456 -2000, IS 4995 – 1978 Part (I&II), IS 3370- 2009 Part I&II), IS3370 – 1967 Part IV, IS1893-2016 PART 1, IS13920-2016, SP16-1980, SP24-1983, SP34-1999)
IRC Codes (IRC 5 – 2015, IRC 6-2017, IRC 112-2011, IRC SP105-2015, IRC SP13-2004)

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE432	ADVANCED STEEL DESIGN	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE312 Basic Steel Design

Course Objectives

Understand the behavior and analysis of steel structures subjected to gravity load, lateral load combined loads. To understand the design and detailing of steel structures according to the INDIAN STANDARD building code requirements and on par with current Industry practices.

Course Outcome

CO1: Design the eccentrically loaded compression members and their base plates.
CO2: Analyze and design the plate girder, gantry girder and its components
CO3: Evaluate, analyze and design the PEB and its components.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3	2	2										3		
CO3	3	3	3		2				2	1			3		

Syllabus

Unit 1
Introduction to beam-column - behavior - strength interaction - design of beam column - beam column subjected to combined forces - column bases - slab base - gusseted base - moment resistant base plate.

Unit 2
Bolted and Welded plate girders – analysis and design using IS800-2007 - curtailment of flange plates –stiffeners – Web yielding, web crippling, bearing stiffeners. Introduction to hybrid girders - analysis and design of gantry girder - design of girder splice.

Unit 2
Analysis and design of Pre-engineered Building - design of purlins and wall girts using Channel and Angle sections; cold formed steel purlin – Design of wind bracings.

Text Book(s)
Duggal, S.K., "Limit State Design of Steel Structures", Tata McGraw Hill, 2017..
N. Subramanian, "Design of Steel Structures Limit States Method", Oxford University Press, 2016.

Reference(s)
Ramchandraand Gehlot, "Limit State Design of Steel Structures", Scientific Publishers, 2015.
G.W.Owens andP.R.Knowles,"Steel Designers' Manual",John Wiley & Sons, 2012.
Lin and Breslar, "Design of Steel Structures", John Wiley & Sons, 1968.
BIS codes (IS 800-2007, IS801-1975, SP 6 PART (1 TO 6),)

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE434 PRESTRESSED CONCRETE - ANALYSES, DESIGN AND CONSTRUCTION L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE303 Basic Reinforced Concrete Design

Course Objectives

The objective is to equip the students with basic understanding of theory and application of analysis and design of prestressed concrete structures. The course focuses on understanding the behavior and design of reinforced concrete components and systems subjected to gravity loads according to the INDIAN STANDARD code requirements and on par with current Industry practices.

Course outcomes

CO1: Understand the concept of prestressing and apply it suitably in construction.
CO2: Analyse and design the prestressed concrete members for ULS and SLS of flexure, shear and torsion
CO3: Design the pre-stressed concrete pipes and tanks

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1										3	
CO2	3	2	2											3	
CO3	3	2	2											3	

Syllabus

Unit 1

Historical developments – Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Analysis of sections of stresses by stress concept, strength concept and load balancing concept – Location of pressure line - Losses of prestress in post -tensioned and pre-tensioned members.

Unit 2

Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per I.S.1343 Code – Design of sections of Type I and Type II post-tensioned beams –Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by I.S. 1343 code – design of anchorage zone reinforcement – Check for strength limit based on I.S. 1343 Code – Layout of cables in post-tensioned beams – Design for shear based on I.S. 1343 Code.

Unit 3

Analysis and design of composite beams - Shrinkage strain and its importance.
Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.
Circular prestressing- Design of Prestressed Concrete Pipes and water tanks

Text Book(s)

N. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill, 6th Edition, 2018.
Naaman, A.E., "Prestressed Concrete Analysis and Design - Fundamentals," 3rd Edition, Techno Press, 2012.

Reference(s)

Edward. G .Nawy, Prestressed Concrete, Prentice Hall, 5 th Edition, 2010.
Arthur. H. Nilson, Design of Prestressed Concrete, John Wiley and sons, 2 nd Edition, 1987
T.Y. Lin, Ned H. Burns, "Design of Prestressed Concrete Structures", John Wiley & Sons, 2010.
P. Dayaratnam, "Prestressed Concrete", Oxford & IBH, 2018.
R. Rajagopalan, "Prestressed Concrete", Narosa publishers, 2017.
IS 1343-2012, "Code of Practice for Prestressed Concrete", 2012.
ACI 318-14 Building Code Requirements for Structural Concrete and Commentary, 2014
PCI Design Handbook, Seventh Edition, 2017

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE435	STRUCTURAL DYNAMICS & SEISMIC DESIGN	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE212 Structural Analysis**,** 19CIE303 Basic Reinforced Concrete Design.

Course Objectives

To explain the concept of dynamics for single degree and two degree of freedom structures
To introduce the key points of engineering seismology and the earthquake responses
To give an exposure on the earthquake resistant design and the basic design concepts.

Course Outcome

CO1: Explain the importance of structural dynamics with basic terminology
CO2: Assess and analyse the single dof and 2 dof structures and its responses
CO3: Familiarize the elements of seismology
CO4: Understand the concept of analysis and design of earthquake resistant simple framed structures.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				1						2	3		
CO2	3	2	2						2				3		
CO3	3					1						2	3		
CO4	3	3	3	1	2	2			2				3	2	

Syllabus

Unit 1

Introduction to structural dynamics – importance of structural dynamics - types and sources of dynamic loads - distinguishing features of a dynamic problem – methodology for dynamic analysis – types of structural vibration - basic terminology.

Single Degree of Freedom**:** Linear systems: Equation of motion - components of vibration system - natural frequency - viscous damping - response to undamped & damped free and forced vibration - response to support motion – principle of accelerometers and displacement meters.

Unit 2

Two Degrees of Freedom: Equations of motion - Eigen value problem - free vibration response – forced vibration response to harmonic excitation - response to support motion - modal analysis.

Elements of Engineering Seismology - Indian Seismicity – faults – seismic waves – earthquake intensity and magnitude – earthquake ground motion - behaviour of structures in the past Earthquakes – basic terminology.
Earthquake Response: Linear systems: Earthquake ground motion – response spectrum - response history analysis

Unit 3

Earthquake Resistant Design: IS codal provisions for the determination of lateral loads – modal analysis. Soil liquefaction – soil-structure interaction effects.

Design Concepts: Seismic Design Concepts - design spectrum - Earthquake Resistant Design of simple framed structures - IS 1893 codal provisions - ductile detailing of Reinforced Concrete frames as per IS 13920.

Text book(s)

Mario Paz," Structural Dynamics", Spinger, 2007.

Pankaj Agarwal, Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI Learning, 2009.

Reference book(s)

Anil K Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson Education, 2008.

Duggal.S.K., "Earthquake Resistant Design of Structures", Oxford University Press, 2013.

IS:1893 - (Part I), Criteria for Earthquake Resistant structures-General Provisions and Buildings

IS:13935 – Repair and Seismic strengthening of buildings

IS:4326 - Earthquake Resistant Design and Constructions of buildings

IS:13920 – Ductile detailing of RC Structures subject to Seismic forces

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE437	BRIDGE ENGINEERING	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE303 Basic Reinforced Concrete Design, 19CIE 434 Pre-stress concrete analyses, Design and Construction and 19CIE312 Basic Steel Structures

Course Objectives

The course focuses on understanding the behavior and design of various bridge components according to the Specification of Indian Road Congress code requirements and on par with current Industry practices

Course Outcome

CO1: Understand the need and importance of preliminary investigation on bridge construction site.
CO2: Familiarize the specification of road bridges and loads to be considered.
CO3: Design components of different types of bridges and assess load carrying capacity of bridges.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3	2	2										3		
CO3	3	3	3		2				2	1			3		

Syllabus

Unit 1
Components of bridges - Classification of bridges – Importance and investigation for bridges – Hydrology - design flood discharge, linear waterway and scour depth – Choice of Bridge Type, subsoil exploration, location of piers and abutments. Specification of road bridges – width of carriage way, IRC loads to be considered, calculation of live load by effective width method.

Unit 2
General Design Consideration – design of pipe culvert, design of Slab Bridge, design of T-beam Bridge, design of box culverts – Components and design principles of RC balanced cantilever bridge and Prestress concrete bridges.
Type of sub structures – Forces acting on substructures – Design of abutments, piers – Types of Foundations

Unit 3
Importance of bearings - types of bearings- design of elastomeric bearings – joints – types of joints. Construction and maintenance of bridges - Assessment of load carrying capacity of bridges - Lessons from bridge failures.

Text book(s)
D.Johnson Victor, "Essentials of bridge engineering", Oxford University Press, 2019.
N.Krishna Raju, "Design of bridges", Oxford University Press, 2019.
Mosley. B., John B., & Ray Hulse "Reinforced Concrete Design to Eurocode-2"Red Globe Press, 2012.

Reference book(s)

E.J. O'Brien and D.L. Keogh, "Bridge deck analysis", Spons Architecture,1999.
Raina,V.K. "Concrete Bridge Practice", Shroff Pub & Dist. Pvt. Ltd, 2007.
Ponnuswamy,S., "Bridge Engineering", Tata McGraw - Hill Education, 2007.
IRC Codes (IRC 5 – 2015, IRC 6-2017, IRC 112-2011, IRC SP105-2015, IRC SP13-2004,IRC SP37 -2010 , IRC SP114-2018, MORT&H)

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE438	FINITE ELEMENT METHODS	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE212 Structural Analysis

Course objectives

- Explain the fundamental concepts of finite element method and solve structural problems by selecting a suitable element, developing stiffness & force matrices and incorporating boundary conditions.
- Use mathematical and approximate methods to solve the boundary value problems

Course Outcome

CO1: Solve boundary value problems using various approximate methods
CO2: Develop mathematical formulations for structural systems
CO3: Analyse the structural elements like truss, beam etc by formulating stiffness matrix

CO PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3										3	3		
CO2	3	3										3	3		
CO3	3	3										3	3		

Syllabus

Unit 1
Boundary value problems and the need for numerical discretisation: Introduction, examples of continuum problems, history of finite element method.
Weighted residual methods: Approximation by trial functions, weighted residual forms, piecewise trial functions, weak formulation, Galerkin method, examples of one-, two- and three-dimensional problems.
Variational methods: Variational principles, establishment of natural variational principles, approximate solution of differential equations by Rayleigh-Ritz method, the use of Lagrange multipliers, general variational principles, penalty functions, least-square method.

Unit 2
Isoparametric formulation: The concept of mapping, isoparametric formulation, numerical integration, mapping and its use in mesh generation.
Higher order finite element approximation: Degree of polynomial in trial functions and rate of convergence, the patch test, shape functions for C0 and C1 continuity, one-, two- and three-dimensional shape functions.

Unit 3
Coordinate Transformation: Transformation of vectors and tensors, transformation of stiffness matrices, degree of freedom within elements, condensation, condensation and recovery algorithm, substructuring, structural symmetry.
Formulation of stiffness matrix, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, Equilibrium and compatibility in solution- applications to truss and beam.

Text book(s)
Rao. S.S., "Finite Element Method in Engineering", Elsevier, 2011.
Reddy, J.N., "An Introduction to the Finite Element Method", Tata McGraw Hill, 2005.

Reference book(s)

Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall of India, 1996.
Cook R.D., Malkus D.S., Plesha M.F., and Witt.R.J., "Concepts & Applications of Finite Element Analysis", Wiley India, 2007.
Chandrupatla T.R. & Belegundu A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2007.
Zienkiewics O.C. & Taylor R.L.and Zhu, J.Z., "The Finite Element Method: Its Basis and Fundamentals", Butterworth-Heinemann, 2005.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

• CA – Can be Quizzes, Assignment, Projects, and Reports

Construction Technology & Management

19CIE441	CONCRETE TECHNOLOGY	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE204 Construction Materials & Methods

Course Objectives

To highlight the fundamental concepts and behavioural aspects of various materials in concrete, types of concrete and their manufacture and applications.
To introduce concrete mix proportioning for various conditions using Indian standards and ACI standards

Course Outcome

CO1: Select the suitable ingredients for concrete and suggest suitable laboratory test to check its property.
CO2: Evaluate the properties of ordinary concrete and special concrete based on the destructive and non -destructive tests.
CO3: Evaluate durability related issues in concrete and suggest preventive measures.
CO4: Apply the modern methods in concrete manufacturing
CO5: Proportion the concrete mixtures to meet performance requirements.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2			1	2					1			
CO2	1	1	1			1	1					1			
CO3	2	1	2			1	1					1			
CO4		1	1			1	2					1			
CO5	2	2	2			1	2					2			

Syllabus

Unit 1
Materials: cement - different types - chemical composition and physical properties - tests on cement - I.S. specifications - aggregates - classification - mechanical properties and tests as per I.S. - alkali aggregate reaction - grading requirements - heavy weight - light weight - normal weight - aggregate - sampling of aggregate - water - quality of water - admixtures - accelerators - retarders - water reducing agents – super plasticizers- use of silica fumes
Properties of fresh concrete - workability - factors affecting workability - tests for workability - segregation and bleeding.

Unit 2
Properties of hardened concrete - factors affecting strength of concrete - strength of concrete in compression, tension and flexure - stress- strain characteristics and elastic properties - shrinkage and creep - durability of concrete - permeability - chemical attack - sulphate attack - resistance to abrasion and cavitation - resistance to freezing and thawing - resistance to fire - marine atmosphere - quality control - frequency of sampling - test specimens - statistical analysis of test results - standard deviation - acceptance criteria
Manufacture of concrete - measurement of materials - storage and handling - batching plant and equipment - mixing - types of mixers - transportation of concrete - pumping of concrete - placing of concrete - under water concreting - compaction of concrete - curing of concrete - ready mixed concrete

Unit 3

Mix proportioning - nominal mixes - design mixes - factors influencing mix design - A.C.I method - I.S method - design for high strength mixes.

Special concretes - lightweight concrete - high density concrete - vacuum concrete - shotcrete - Fibre reinforced concrete-polymer concrete - ferrocement - high performance concrete - self compacting concrete.

Introduction to Non-destructive test methods.

Text book(s)

Neville.A.M. and Brooks.J.J., "Concrete Technology", Pearson Education, 2006.

Santha Kumar, A. R., "Concrete Technology", Oxford University Press, 2018.

Reference(s)

Mehta, P.K. and Monteiro, P.J.M., "Concrete - Microstructure, Properties and Materials", McGraw Hill Education, 2017.

Shetty, M. S, "Concrete Technology-Theory and Practice", S. Chand & Co., New Delhi, 2018.

A.M. Neville, "Properties of Concrete", Pearson Education, 2012.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE442	REPAIR & REHABILITATION OF STRUCTURES	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE204 Construction Materials & Methods

Course Objectives

To explain the mechanisms of degradation of structures
To introduce field monitoring and non-destructive evaluation of structures.
To give an exposure on the materials and techniques for strengthening or upgrading existing structural systems.

Course Outcome

CO1: Apply the knowledge of construction materials and techniques to analyze building durability problems
CO2: Evaluate the common defects and distress in construction through diagnostic procedures
CO3: Select suitable materials and methods for protection and repair.
CO4: Apply maintenance and strengthening approaches to situations
CO5: Analyze and develop report for simple maintenance and repair problems.
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CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2		
CO2	2	2		1	3								3		
CO3	3	3											2		
CO4	3	2				1						1	3		
CO5	1	1	1	1					1	1	1	1		2	

Syllabus

Unit 1
Durability: Life expectancy of different types of buildings – influence of environmental elements such as heat, moisture, precipitation and frost on buildings- Effect of biological agents like fungus, moss, plants, trees, algae - termite control and prevention - chemical attack and impact of pollution on building materials and components- Aspects of fire damage and assessment.

Unit 2
Building failures – causes and effects - cracks in buildings – types, classification. Investigation and condition assessment – Semi-destructive and Non destructive testing methods.
Common defects in buildings and control measures - maintenance philosophy - phases of maintenance.
Materials for repair - special mortar and concretes, concrete chemicals, admixtures, special cements and high grade concrete.

Unit 3
Techniques for repair - surface repair – material selection – surface preparation - rust eliminators and polymer coatings for rebars – repair methods of cracks in concrete and masonry - epoxy injection. Guniting and shotcreting. Waterproofing methods.
Strengthening measures- flexural strengthening, beam shear capacity strengthening, column strengthening, shoring, under pinning and jacketing
Conservation of historic buildings -materials and methods - examples.

Text book(s)

Peter H. Emmons, "Concrete Repair and Maintenance", Galgotia Publications, 2010.
Vidivelli.B., "Rehabilitation of Concrete Structures", Standard Publishers, 2009.

Reference(s)

James Douglas, Bill Ransom, "Understanding Building Failures", Taylor & Francis Group, 2007.
Philip.H.Perkins,"Repair, Protection and Water proofing of Concrete Structures", E & FN Spon, 1997.
SP : 25 - 1984, "Causes and prevention of cracks in buildings", BIS
Santhakumar.A.R., "Concrete Technology", Oxford University Press, 2018.
Sidney M. Johnson, "Deterioration, Maintenance and Repair of Structures", Krieger Publishing Company, 1980.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE443	INTRODUCTION TO ARCHITECTURAL SCIENCE	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE204 Construction Materials & Methods

Course Objectives

To expose the students to the concepts of functional design of building in tropical climates.
To introduce the principles of design for space lighting and noise control.

Course Outcome

CO1: Evaluate quality of indoor climate based on thermal comfort indices.
CO2: Apply knowledge of thermo-physical properties of materials in evaluating heat flow through buildings
CO3: Suggest thermal control methods for buildings
CO4: Evaluate the natural and artificial lighting of indoor spaces
CO5: Apply knowledge of behavior sound in free field and enclosures to analyze acoustical features.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3											2		
CO2	3	3											2		
CO3	2	3	2				2							2	
CO4	3	3	2											2	
CO5	2	3	1										2		

Syllabus

Unit 1
The Thermal Environment: Climatic elements: climate graph – comparison and classification of climates. Earth's thermal balance. Thermal balance of human body – thermal comfort indices – comfort zone.
Thermo-physical properties of building materials: resistance and transmittance – sol- air temperature - solar gain factor. Heat flow through buildings – thermal transmittance of structural elements - periodic heat flow.
Design criteria for control of climate – passive and active building design – passive approach. Active systems – low energy cooling.

Unit 2
The Luminous Environment: Types of visual tasks – principles of day lighting – day light factor - evaluation of lighting by windows, skylights – artificial lighting – illumination requirements –lamps and luminaries – design of artificial lighting - coefficient of utilisation – room index – maintenance factor – room reflectance - flood lighting of building exteriors.

Unit 3
The Sonic Environment: Physics of sound – airborne and structure borne propagation – effect of noise on man - behavior of sound in free field and enclosures – design criteria for spaces – acoustical defects – sound reduction, sound insulation and reverberation control – acoustic materials – properties – types and fixtures.

Text book(s)

Steven V. Szokolay., "Introduction to Architectural Science - The Basis of Sustainable Design", Routledge, 2014.

Reference(s)

Koenigseberger., "Manual of Tropical housing and Building – Climatic Design", Universities Press, 2010.
Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T) – 1987
Krishnan, "Climate Responsive Architecture", McGraw Hill Education, 2017.
Narasimham V., "An Introduction to Building Physics", Kabeer Printing Works, Chennai, 1974.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE444	SUSTAINABLE CONSTRUCTION	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE204 Construction Materials and Methods

Course Objective

Promote an approach to project conception and evaluation that is based on an appreciation of the needs of society and the potential for sustainable development.

Course Outcome

CO1: Understand building assessment standards and apply in documentation processes.
CO2: Assess building energy issues and suggest design options
CO3: Propose strategies for water conservation and recycling
CO4: Ensure proper indoor air quality during construction

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3					2								3
CO2	3	3	2				2								3
CO3	2	3	2			1	2								3
CO4	2	3			1	1	2								3

Syllabus

Unit 1
Sustainability in the built environment: sustainable development relative to ecological, economic and social conditions – efforts in sustainable development and construction – international organisations involved. Ethics and sustainability: environmental and resource concerns – resource consumption by construction industry-Green building movement. Ecological design – concept – major contributions. Building assessment and eco labels – standards (LEED, GRIHA) – assessment structure and process. Green building design process – documentation requirements.

Unit 2
Sustainable site and landscape – storm water management, heat island mitigation- assessment of sustainable sites. Building energy issues - building energy design strategy- building envelope – internal load reduction – energy optimisation - renewable energy systems. Reducing carbon footprint. Built environment hydrologic cycle – water resources issues – strategies for conservation and recycling – waste water and storm water handling strategies. Materials resources - Life cycle assessment – embodied energy – Green building materials and products – assessing for environmental impacts – design for deconstruction – LEED credits for different aspects.

Unit 3
Indoor environmental quality – issues and causes, components of integrated design – emissions from building materials. Construction operations – site planning, indoor air quality during construction – materials management – Construction and Demolition – waste management – building commissioning – LEED credits for different aspects. Green building economics – quantifying benefits. Recent advances in sustainable construction.

Text Book

"Sustainable Building Design Manual- Volume II", Published by TERI, New Delhi, 2009.

Reference(s)

Kibert, C.J., "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2016.
Steven V. Szokolay., "Introduction to Architectural Science - The Basis of Sustainable Design", Elsevier, 2008.
Sandy Halliday, "Sustainable Construction", Routledge, (Taylor & FrancisGroup), 2013.
Dejan Mumovic and Mat Santamouris (Ed), "A Handbook of Sustainable Building Design and Engineering", CRC Press, 2018..
Osman Attmann, "Green Architecture: Advanced Technologies and Materials", Mc-Graw Hill, 2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE445	CONSTRUCTION ECONOMICS AND FINANCE	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE402 Construction Management

Course Objective

To expose the students to the concepts of cconstruction finance such as comparing alternatives proposals, evaluating alternative investments, cost estimating and management of accounting.

Course Outcome

CO1: Apply time-value of money concept to compare alternatives
CO2: Analyse equipment cost and replacement alternatives.
CO3: Prepare different types of cost estimates
CO4: Understand the financial management procedures and estimate the financial ratios

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3									2				3
CO2	3	3									2				2
CO3	2	3									2				2
CO4	3	3									2				3

Syllabus

Unit 1
Engineering economics : Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A, A/P), Future payment compared to uniform series payments (F/A, A/F), Arithmetic gradient, Geometric gradient.

Unit 2
Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.
Depreciation, Inflation and Taxes
Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis.

Unit 3
Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, Parametric estimate, Life cycle cost.
Financial management: Construction accounting, Chart of Accounts, Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management.

Text book(s)
Bose, D. C., "Fundamentals of Financial management", 2nd ed., PHI, New Delhi, 2011.
Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", McGraw-Hill Education, 2019.

Reference(s)

Gould, F. E., "Managing the Construction Process", 4th ed., Pearson Education, 2012.
Harris, F. , McCaffer, R. and Edum-Fotwe, F., "Modern Construction Management", 6th ed., Wiley India, New Delhi, 2012.
Jha, K. N., "Construction Project Management, Theory and Practice", Pearson, New Delhi, 2015.
Peurifoy, R. L. and Oberlender, G. D., "Estimating Construction Costs", 6th ed., McGraw-Hill, 2015.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

Geotechnical Engineering

19CIE451	GROUND IMPROVEMENT TECHNIQUES	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE211 Geology and Soil Mechanics and 19CIE 301 Geotechnical Engineering

Course Objective
Introduction to the necessity, identification, and process of ground improvement
Finding alternative methods and suggesting recommendations for improving strength and drainage conditions.

Course Outcome
CO1: Evaluate the various ground improvement techniques using mechanical methods such as compaction, Vibro-flotation, preloading etc.
CO2: Analyze the various types of drainage techniques like incorporation of geosynthetics, pre-compression methods
CO3: Examining the effectiveness of chemical additives and reinforcing materials in ground improvement.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		2
CO2	3	2	2									2	3		2
CO3	3	2	3									2	3		2

Syllabus

Unit 1
Objective of ground improvement, in-situ ground improvement methods, Introduction to soil improvement without admixtures- mechanical methods like Surface compaction, Compaction methods: moisture density relations – compactive efforts – field methods – surface compaction, deep compactions- vibro-probes, Stone columns. Introduction to soil improvement with addition of admixtures, soil reinforcement - geosynthetics

Unit 2
Drainage methods- Sand drains, prefabricated vertical drains-geosynthetics: seepage, ground water seepage control – filter requirements, methods of dewatering – deep bored wells. Precompression & Vertical Drains: Compressibility of soils & consolidation, Preloading and surcharge fills - precompression principles, preloading methods, monitoring of compression, Vertical drains, Dynamic consolidation & Consolidaion by Electro-osmosis. Grouting and injection methods: principles, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications.

Unit 3
Stabilization methods: mechanical, use of admixtures- cement, lime, chemical methods of stabilization of soils – Reinforcing materials, reinforced earth retaining walls, reinforced embankments, soil nailing, Geosynthetics- types, general applications, types of geotextiles and geogrids, physical and strength properties of geotextiles and geogrids, Behavior of soils on reinforcing with geotextiles and geogrids, design aspects with geotextiles and geogrids.

Text book(s)
Moseley, "Text Book on Ground Improvement", Blackie Academic Professional, Chapman & Hall, 1994.
Purushothama Raj P., "Ground Improvement Techniques" Laxmi Publications, 2005.
Shukla, S.K. (2022). ICE Handbook of Geosynthetic Engineering. 3rd edition, ICE Publishing, London, UK.
Shukla, S.K. (2016). An Introduction to Geosynthetic Engineering. CRC Press, Taylor and Francis, London
Reference(s)
Shashi K. Gulati and Manoj Dutta, "Geotechnical Engineering", Tata Mcgraw Hill, 2005.

Boweven R., "Text Book on Grouting in Engineering Practice", John Wiley and Sons, 1981.
Jewell R.A., Soil reinforcement with geotextiles- CIRIA Special Publication, Thomas Telford, 1996.
Donald H Gray Robbin B Sotir, "Text Book on Biotechnical and Soil Engineering Slope Stabilization", Wiley International, 1996.
Rao G.V. & Rao G.V.S. "Text Book on Engineering with Geotextiles", Tata Mcgraw Hill, 1990.
Robert M. Koerner, Construction & Geotechnical methods in Foundation Engineering", McGraw Hill, 1986.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA - Can be Quizzes, Assignment, Projects and Reports

19CIE452	ADVANCED FOUNDATION ENGINEERING	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE211 Geology and Soil Mechanics

Course Objectives

Introduce to the problems in expansive soil and suitable remedial methods
To explain the dynamic properties of soil and design aspects of machine foundation.
To highlight features and design principles of shell foundation, foundation of storage structures and transmission lines

Course Outcome

CO1: Evaluate the properties of expansive soil and analyze the problems posed by them.
CO2: Select the suitable environmental or structural solution for the expansive soil based on the site condition.
CO3: Apply theory of vibration to assess the dynamic behavior of soil and to design suitable type of machine foundations.
CO4: Comprehend the concepts and general principles of special type of foundation systems.
CO5: Apply the knowledge of engineering judgement to analyze and design various geotechnical problems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3			2							3		
CO2	3	3	3			2							3		
CO3	3	3	3			2							3		
CO4	3	3	3			2							3		
CO5	3	3	3			2						3	3		

Syllabus

Unit 1
Foundation on expansive soils: Introduction to expansive soil - Clay mineralogy and mechanism of swelling - Identification of expansive soils - Swelling potential, swelling pressure, free swell - Free swell index - Classification of expansive soil - Tests for swell pressure (IS code method) - Damages in buildings on expansive soils - Elimination of swelling- Environmental solutions such as soil replacement techniques and lime columns - Principles of design of foundations in expansive soil deposits - Structural solutions such as provision of rigid foundation, under reamed piles, T Beams as strip footing for walls etc. (basic aspects).

Unit 2
Soil dynamics and Machine foundations: Introduction to soil dynamics - Soil behaviour under dynamic loads - Difference between static and dynamic load behaviour of soil - Dynamic soil properties - Free vibrations and forced vibrations - Types of machines - Types of machine foundations - Vibration analysis of a machine foundation - General design criteria for machine foundations - Design criteria for foundation for reciprocating machines (IS specifications) - Design procedure for block foundation for a reciprocating machine (IS code method) - Vibration isolation and control.

Unit 3

Special foundations: Introduction to shell foundations - Structural form and efficiency - Different types of shell foundations - General principles of geotechnical design of shell foundations.
Special features of the foundations for water tanks, silos, chimneys and transmission line towers.

Text book(s)

Varghese P.C., "Foundation Engineering", Prentice-Hall of India Private Ltd, 2009.
Swami saran, "Soil dynamics and Machine Foundations", Galgotias, 2012.

Reference(s)

Ninan P Kurian, "Design of Foundation Systems", Narosa Publishers, 2009
ShamsherPrakash, "Soil Dynamics", McGraw Hill, 1981.
Tomlinson M.J., "Foundation Design & Construction", Prentice-Hall, 2003.
Joseph E. Bowles, "Foundation Analysis & Design", Tata McGraw Hill, 1996.
Coduto, "Geotechnical Engineering Principles and Practices", PHI, New Delhi, 2010.
Srinivasalu and Vaidyanathan, "Handbook of Machine Foundations", Tata McGraw Hill, 2004.
Swami Saran, "Analysis and Design of Substructures", Oxford & IBH, 2008.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE453	ENVIRONMENTAL GEOTECHNOLOGY	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE211 Geology and Soil Mechanics

Course Objectives

To explain the effects of pollution on soil and its impact on soil properties.
Introduce to the mechanisms of groundwater contamination
Give an exposure to rules and regulations on waste handling and management
Introduction to design of landfill and soil remediation methods.

Course Outcome

CO1: Understand the effect of pollution on the various properties of soil and analyze the problems posed by them**.**
CO2: Analyze the different types of wastes, their generation and effects
CO3: Understand the general principles of groundwater contamination management
CO4: Apply the knowledge of engineering judgement to analyze and design engineering landfill.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3			2	3						3	3	
CO2	3	3	3			2	3						3	3	
CO3	3	3	3			2	3						3	3	
CO4	3	3	3			2	3						3	3	

Syllabus

Unit 1
Environmental cycles- Soil and water- Environmental interaction relating to geotechnical problems- Effect of pollution on soil- water behaviour
Origin, nature and distribution of soil - Soil fabric and structure- Basic structural units of clay minerals- Isomorphous substitution- Kaolinite mineral- Montmorillonite mineral- Illite mineral- Electric charges on clay minerals- Ion exchange capacity- Diffused double layer- Adsorbed water- Soil structure- Methods for the identification of minerals (introduction only)
Effect of drying on Atterberg limits- Shrinkage, swelling and cracking characteristics of soil - Electrochemical characteristics of soil-water System - Sensitivity of soil to environment - Soil-water-air interaction - Activity, sensitivity, causes of sensitivity- Influence of exchangeable cations, pH and organic matter on properties of soils- Permeability of soils- Hydraulic conductivity of different types of soils- Darcy' s law and its validity- Factors affecting permeability

Unit 2
Sources, types and composition of different wastes - Characteristics and classification of hazardous wastes- Generation rates- Potential problems in soils due to contaminants
Ground water flow - Sources of ground water contamination- Contaminant transport - Pollution of aquifers by mining and liquid wastes- Ground water pollution downstream of landfills - Transport mechanisms
CPCB rules and regulations on waste handling and management- Criteria for selection of sites for waste disposal- Disposal techniques-Disposal systems for typical wastes
Ground modification and waste modification techniques in waste management- Ground modification- Mechanical modification, hydraulic modification, chemical modification

Unit 3

Liners and covers for waste disposal- rigid and flexible liners- Leachate and gas collection system - Engineered landfills (including basal liner and cover liner systems)- components- design criteria
Hydrological design for ground water pollution control
Soil contamination and remediation technology for both ground and aquifers

Reference(s)

Mitchell J. (2005), "Fundamentals of soil behaviour", Third Edition, ISBN: 978-0-471- 46302-3, John Wiley and Sons.
Robert M. Koerner (1996), "Construction and Geotechnical methods in Foundation Engineering", McGraw Hill Book Co., ISBN: 0070664382, 9780070664388.
Abdel M.O. Mohamed and Hogan E. Antia (1998), "Developments in Geotechnical Engineering", ISBN: 978-0-444-89847-0, Elsevier.
Hari D. Sharma and Krishna R. Reddy (May 2004) "Geoenvironmental Engineering – Site Remediation, Waste Containment, Emerging waste management technologies", ISBN: 978-0-471-21599-8, John Wiley and sons.
Daniel D.E. (1993), "Geotechnical Practice for Waste Disposal", ISBN 978-0-412-35170-9, Chapman and Hall.
Hsai Yang Fang and John Daniel (2013) "Introduction to Environmental Geotechnology", CRC press, Second Edition ISBN-13: 9781439837306, Taylor and Francis.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE454	GEOTEXTILE ENGINEERING	L-T-P-C: 2-1-0-3

Prerequisite(s): 19CIE211 Geology and Soil Mechanics

Course Objective
To acquire knowledge about types and functions of various geosynthetics and their manufacturing process. To understand the design principles of reinforced soil structures.

Course Outcome
CO1: Testing and valuation of various properties of geosynthetics used in soil structures
CO2: Principle of soil reinforcement and design of reinforced soil retaining structures
CO3: Design of drains for consolidation

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3									1	3		1
CO2	3	2	3									1	3		1
CO3	3	2	3									1	3		1

Syllabus

Unit 1

Background of reinforced earth, mechanism and concepts- Basis of reinforced earth wall design- Geosynthetics classifications- functions- applications- raw materials used. Different types of Geosynthetics- manufacturing, system- Design and sustainability. Various properties of Geosynthetics, physical properties, mechanical properties, hydraulic properties & endurance properties- Nano material. Mechanism of filtration and drainage functions & their applications

Unit 2

Geogrid reinforced soil walls, geocell wall, gabion wall. Model for single and multi-layer reinforced slopes, guidelines for design of reinforced slopes, software for reinforced soil slopes. Design of basal reinforced embankment, placement of Geosynthetics, construction procedure, widening of existing road embankments.

Unit 3
Consolidation techniques, Development of design chart for prefabricated vertical drains, ground instrumentation and monitoring, Design of encased stone columns, geocell/geofoam systems. Bearing capacity of Geosynthetics reinforced soil system, geocell reinforced sand overlaying soft clay- Applications, advantage, function of geofoam, physical, mechanical and thermal properties of geofoam, design of embankment using geofoam, geofoam reinforced soil walls.

Text book(s)

Koerner, R. M.(2012). Designing with Geosynthetics, 6th Edition,Vol. 1 and 2,Xlibris corp., 914 p.

Giroud, J.P.(1984)."Geotextiles and Geomembranes. Definitions, Properties and Design," Selected Papers, Revisions and Comments, 4th ed., IFAIPublishers, 325 p.

Shukla, S.K. and Yin, J.-H. (2006). Fundamentals of Geosynthetic Engineering. Taylor and Francis, London, UK.

Shukla, S.K. (2002). Geosynthetics and Their Applications. Thomas Telford Publishing, London, UK.

Reference(s)

Holtz, R. D., Christopher,B. R. and Berg, R. R.(1997) Geosynthetic engineering,Bitech publishers Ltd., 452p.
Hausmann, M. R.(1990).Engineering Principles of Ground Modification, McGraw-Hill Publishing Company, New York, 632 p.
Ingold, T.S.(1982). Reinforced Earth, Thomas Telford Ltd., London, 141 p.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA - Can be Quizzes, Assignment, Projects and Reports

19CIE455	GEOTECHNICS AND GEOSYNTHETICS ENGINEERING	L-T-P-C: 2-1-0-3

Prerequisite(s): 19CIE211 Geology and Soil Mechanics

Course Objective
Understand the importance of geosynthetics in Civil Infrastructure development. To be able to design reinforced geo-structures

Course Outcome
CO1: Understand different types of geosynthetics.
CO2: Design of geosynthetics for geotechnical challenges
CO3: understand usage of geosynthetics for drainage functions.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3									2	3		
CO2	3	2	3										3		
CO3	3	2	3									2	3		

Syllabus

Unit 1

Geosynthetics: Introduction– Types, applications, Manufacturing, Testing. Retaining structures: Types, Load transfer mechanisms, IS code-based Design, Stability analysis, Testing methods. Design of reinforced soil retaining walls supporting sloped backfill, bridge abutments.

Unit 2

Slope stability analysis: Finite and infinite slopes- Modes of failures- In-situ slope stabilization- Design of reinforced slopes- Embankments on soft soils

Facing elements: Construction procedure, design of Geosynthetics wrap around faced wall, geogrid reinforced soil walls, geocell wall, gabion wall

Unit 3

Drainage facilitation by geosynthetics: Accelerated consolidation of soft clays using geosynthetics - Geosynthetic encased stone columns for load support- Filtration - Erosion control. Natural geosynthetics and their applications - Geosynthetics for construction of municipal and hazardous waste landfills.

Text book(s)

Koerner, R. M.(2012). Designing with Geosynthetics, 6th Edition,Vol. 1 and 2,Xlibris corp., 914 p.

Giroud, J.P.(1984)."Geotextiles and Geomembranes. Definitions, Properties and Design," Selected Papers, Revisions and Comments, 4th ed., IFAIPublishers, 325 p.

T.W. Lambe and Whitman, "Soil Mechanics", Wiley, 2008.

Shukla, S.K. and Yin, J.-H. (2006). Fundamentals of Geosynthetic Engineering. Taylor and Francis, London, UK.

Reference(s)

Holtz, R. D., Christopher,B. R. and Berg, R. R.(1997) Geosynthetic engineering, Bitech publishers Ltd., 452p.
Hausmann, M. R.(1990).Engineering Principles of Ground Modification, McGraw-Hill Publishing Company, New York, 632 p.
Ingold, T.S.(1982). Reinforced Earth, Thomas Telford Ltd., London, 141 p.
Das, B.M., "Principles of Geotechnical Engineering", CL Engineering, 2013

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA - Can be Quizzes, Assignment, Projects and Reports

Transportation Engineering

19CIE461	PAVEMENT DESIGN	L -T-P-C: 3-0-0-3

Prerequisite(s): 19CIE214 Transportation Engineering I

Course Objectives

Introduce to the quality assessment procedures for pavement materials
To explain the stress analyses and design methods of flexible and rigid pavements
To explain the role of various joints in a rigid pavement and its design

Course Outcome
CO1: Evaluate the constituents of flexible and rigid pavements
CO2: Analyse the stresses in flexible pavement
CO3: Design the structure of a flexible pavement
CO4: Analyse the stresses in rigid pavement
CO5: Design the structure of a rigid pavement

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	3								1	3		
CO2	2	2	3	2								1	3		
CO3	2	2	3	2								1	3		2
CO4	2	2	3	2								1	3		-
CO5	2	2	3	2								1	3		2

Syllabus

Unit 1
Introduction - Types and component parts of pavements, factors affecting design and performance of pavements, functions and significance of different layers of a pavement. Test conducted to assess the properties of subgrade soil, aggregate and bitumen. Design of bituminous mixes by Marshall method.

Unit 2
Stress analyses and methods of flexible pavement design - stresses and deflections in homogeneous masses. Burmister's 2-layer, 3-layer and multi-layer theories. Wheel load stresses - ESWL of multiple wheels, repeated loads and EWL factors - empirical, semi-empirical and theoretical approaches for flexible pavement design. Design of flexible pavements as per IRC.

Unit 3
Stresses analysis and methods of rigid pavement design - types of stresses and causes, factors influencing stresses, general conditions in rigid pavement analysis. Types of stresses - wheel load stresses, warping stresses, friction stresses, combined stresses. Functions of various types of joints in cement concrete pavements – design of longitudinal, contraction and expansion joints as per IRC recommendations. Pavement evaluation and rehabilitation.

Text book(s)

Yoder and W Nitezak, "Principles of Pavement Design", John Wiley, 1975.
Khanna S. K. and Justo, C E G, "Highway Engineering", Nem Chand and Bros, 2017.

Reference(s)

Yang. H. H., "Pavement Analysis and Design", Pearson Education, 2010.
David Croney, "The Design and Performance of Road pavements", McGraw Hill, 1997.
Haas R., Hudson W. R., and Zaniewski, J., "Pavement Management System", McGraw Hill Book Co, 1994.
IRC 37- 2018, "Guidelines for the Design of Flexible Pavements"
IRC 58-2015, "Guidelines for the Design of Plain Joined Rigid Pavements for Highways"
IRC 81-1991, "Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique".

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE462	URBAN TRANSPORTATION PLANNING	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE214 Transportation Engineering I

Course Objectives

To explain the urban travel characteristics and concept of travel demand
To explain the different methods adopted for estimating the number of trips generated
Introducing to forecasting the probable zones to which the generated trips are being distributed
To explain methods for proportioning of trips shared across public and private modes
To discuss the various methods to forecast the number of trips distributed across alternate routes

Course Outcome

CO1: Evaluate urban transport problems using the travel demand concept
CO2: Develop trip distribution and trip generation models
CO3: Estimate mode choice and develop traffic assignment models

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1					1						3	3	2
CO2	3	3		2	1								3	3	2
CO3	3	2			1	1							3	3	2

Syllabus

Unit 1

Urban Transportation Planning Process & Concepts - Transportation problems, urban travel characteristics, evolution of transportation planning process, concept of travel demand. Demand function - Independent variables, travel attributes, assumptions in demand estimation. Sequential, recursive and simultaneous processes.
Transportation Survey and Analysis - Definition of study area, zoning, types and sources of data. Type of surveys - Road side interviews, Home interview surveys.

Unit 2

Trip Generation Analysis - Trip classification, factors influencing productions and attractions, trip rate analysis, multiple regression models, category analysis.
Trip Distribution Analysis - Trip distribution models, Growth factor models, Gravity models, Opportunity models.

Unit 3

Mode Split Analysis: Mode choice behaviour, Trip end and trip interchange models, Probabilistic models, Utility functions, Logit models.
Traffic assignment – Elements of transportation networks, Minimum Path Algorithms. Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment.

Text book(s)

Kadiyali, L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.
Hutchinson B. G., "Principles of Urban Transportation System Planning", McGraw Hill, 1974

Reference(s)

O' Flaherty C. A., "Traffic Planning and Engineering", Elsevier India, 2006.
Khisty C. J. and Iall. B. K., "Transportation Engineering - An Introduction", Prentice Hall, 2002.
Bruton M.J., "Introduction to Transportation Planning", Hutchinson of London, 1992.
Papacostas, C S, and Prevedouros. P. D, "Transportation Engineering and Planning", Prentice Hall, 2009.
Dicky J. W., "Metropolitan Transportation Planning", Taylor & Francis, 1983.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE463	TRAFFIC ENGINEERING AND MANAGEMENT	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE214 Transportation Engineering I

Course Objectives

- The components of a traffic stream
- Data collection through traffic surveys
- The fundamental relationships of traffic flow
- Capacity estimation of different types of intersections
- The contributory factors and analyses of accidents
- The traffic flow at a microscopic level

Course Outcome

CO1: Understand the road traffic components and their characteristics in traffic engineering
CO2: Conduct different types of traffic engineering studies and perform basic statistical analysis of traffic data
CO3: Use speed-flow relationships and analyse the capacity of different kinds of intersections
CO4: Understand elements of road safety and approaches to accident studies
CO5: Use different distribution models and analyse traffic flow characteristics

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										1	3		
CO2	3	3	1	3			1	1				1	3		
CO3	2	2	1	2			2	1				1	3		2
CO4	3	2	1	2			2	1				1	3		2
CO5	3	3	1	3		2	2	1				1	3		2

Syllabus

Unit 1
Introduction - Objectives and scope of traffic engineering - Components of road traffic: vehicle, driver and road. Road user and vehicle characteristics and their effect on road traffic. Traffic manoeuvre. Traffic Surveys - Objectives, methods, equipment's used for data collection, analysis and interpretation. Traffic Forecast: General travel forecasting principles, different methods of traffic forecast

Unit 2
Concept of Design vehicle units and determination of PCU under mixed traffic conditions. Traffic Stream Characteristics - Relationship between Speed, Flow and Density. Determination of design hourly volume. Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalised intersections

Unit 3
Accident Analysis - Analysis of individual accidents and statistical data, Methods of representing accident rate. Factors in traffic accidents - influence of roadway and traffic conditions on traffic safety.
Shock waves, Queuing theory and applications. Probabilistic Aspects of Traffic Flow -Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models.

Text book(s)

Elena S. Prassas, Roger P. Roess, William R. McShane, "Traffic Engineering", Pearson, 2010.
Kadiyali, L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.

Reference(s)

O' Flaherty C. A., "Traffic Planning and Engineering", Elsevier India, 2006.
Fred L. Mannering, Scott S. Washburn, and Walter P. Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley, 2011.
Pignataro, L., "Traffic Engineering - Theory and Practice", Prentice Hall, 1973.
Institute of Transportation Engineers, "Transportation and Traffic Engg. Hand Book", 6th edition, 2009.
IRC-SP41, Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas, 1994.
Leonard Evans, "Traffic Safety", Science Serving Society, 2004.
Michael, A. P. Taylor, William Young, and Peter W. Bonsall, "Understanding Traffic Systems", Ashgate Publishing, 2000.
Mike Slinn, Paul Matthews, Peter Guest, "Traffic Engineering Design - Principles and Practice", Butterworth-Heinemann, 2005.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

Environmental Engineering

19CIE471	ADVANCED ENVIRONMENTAL ENGINEERING	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE302 Environmental Engineering I, 19CIE311 Environmental Engineering II

Course Objectives

To discuss the various air pollutants and their control strategies
To discuss the waste water treatment options for removal of nitrogen and phosphorus
To discuss the waste water treatment options for removal of emerging contaminants

Course Outcome
CO1: Analyze the air pollutants and select the most appropriate technique for the treatment of air pollutants
CO2: Analyze the waste water quality and design the treatment unit for removal of nitrogen and phosphorus
CO3: Analyze the quality of water and design the treatment unit for removal of emerging contaminants

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3					1				2		
CO2	3	3	3	3	1		1			1			2		
CO3	3	2	3		1				1		1		2		

Syllabus

Unit 1
Instrumental methods for analysis of contaminants in air, water and soil - colorimetry,
Chromatography, spectroscopy, electrochemical probes
Indoor and outdoor air pollution – meteorology-influence of solar radiation and wind fields - lapse rate and stability conditions - characteristics of stack plumes - effective stack height.
Characteristics and health effects of various air pollutant particulates (PM2.5, PM10) and gaseous pollutants (CO, NOx, SOx, etc)- their behaviour in atmosphere – monitoring.
Photochemical reactions - secondary pollutants.
Control devices for Particulate and Gaseous pollutants – applications.

Unit 2
Advances in waste water treatment – Aerobic Suspended growth Process - Process for biological nitrogen removal – design criteria – anoxic, aerobic process design – sequencing batch reactor (SBR) – process analysis - Process for biological phosphorus removal – design criteria.
Aerobic attached growth Process – Rotating biological contactor, Activated Biofilter – Fluidized bed bioreactor (FBBR) design criteria.
Anaerobic suspended and attached growth process - Up flow anaerobic sludge blanket reactor.

Unit 3
Tertiary treatment – emerging contaminants removal - disinfection of waste water- waste water recycling – Water reuse. Advances treatment units – Removal of organic and inorganic colloidal and suspended solids – Removal of dissolved organic constituents – Removal of dissolved inorganic constituents – Filtration – Membrane filtration – Adsorption - Distillation processes

Text book(s)

Metcalf and Eddy, "Waste Water Engineering Treatment Disposal Reuse", Tata McGraw Hill, 2002.

Reference(s)

Clarence, J. Velz, "Applied Stream Sanitation", Krieger Pub Co., 1984.
C. S Rao, "Environmental Pollution Control Engineering", New Age Publications, 2006.
Nevers, Noel De, "Air Pollution Control Engineering", McGraw-Hill, 1999.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE472	INDUSTRIAL WASTE TREATMENT	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE302 Environmental Engineering I, 19CIE311 Environmental Engineering II

Course Objectives

To discuss the characteristics of Industrial wastes and pollution prevention strategies
To discuss the Preliminary treatment of industrial waste water from different industries
To discuss the Effluent generation and treatment for textile, paper, dairy and fertilizer industry,

Course Outcome

CO1: Understand the characteristics of Industrial wastes and develop a holistic view on pollution prevention strategies
CO2: Analyze and design the Preliminary treatment unit for industrial waste waters.
CO3: Analyze and design the treatment scheme for textile, paper, dairy and fertilizer industry

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			3			2		3				2		
CO2		3	3						2		2				
CO3	2	3	3	2	3					2					

Syllabus

Unit 1
Nature and characteristics of Industrial wastes - prevention versus control of industrial pollution - Linkage between technology and pollution prevention - tools for clean processes - reuse, recycle, recovery, source reduction, raw material substitution, toxic use reduction and process modification - separation technologies as tools for waste minimization - Flow sheet analysis - Energy and resource audits - waste audits.

Unit 2
Preliminary treatment of industrial waste water – volume reduction – strength reduction – neutralization – equalization and proportioning.
Treatment of industrial waste - suitability of different techniques - disposal of industrial waste.

Unit 3
Effluent generation from textile industry – paper industry – dairy – fertilizer – thermal power plants - effluent characteristics - treatment.
Membrane process, ion exchange process, Reverse osmosis, Ultra filtration, electrolysis.
Study of damages caused by industrial pollution in India.

Reference(s)
Nelson Leonard Nemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007
Gerard Kiely, "Environmental Engineering", McGraw Hill, 2009.
Sincero A. P. and Sincero G. A., "Environmental Engineering - A Design Approach", Prentice Hall, 1996.
Mahajan S. P., "Pollution Control in Process Industries", Tata McGraw Hill, 2001.
Babbitt H. E, "Sewerage & Sewage Treatment", Nabu Press, 2010.
Abbasi S. A, and Ramasami E, "Biotechnical Methods of Pollution Control", Universities Press (India) Ltd., 1999.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

Hydraulics & Water Resources Engineering

19CIE473	GROUND WATER HYDROLOGY	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE 314 Hydrology & Water Resources Engineering

Course Objectives

Introduce to the groundwater system
To explain the basic principles and movement of ground water
To elaborate the use of groundwater flow properties in the well design

Course Outcome

CO1: Understand the basics of groundwater and analyse movement of groundwater in aquifer.
CO2: Estimate the aquifer parameters and groundwater resources for different hydro-geological boundary conditions
CO3: Comprehend the types, design principles and construction of wells.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1													
CO2	3	1													
CO3	3	1	3											1	

Syllabus

Unit 1
Occurrence of ground water: origin - rock properties affecting ground water vertical distribution - geologic formations as aquifers -types of aquifers - aquifer parameters-ground water basins - springs - Laplace equation - potential flow lines - flownet – flownet for anisotropic soils- seepage under a dam - groundwater contours- determination of flow direction- steady unidirectional flows in aquifers- confined and unconfined - aquifer with percolation- steady radial flow towards a well- well in uniform flow - steady flow with uniform discharge- partially penetrating wells- steady flow in leaky aquifer.

Unit 2
Unsteady flow-general equation- Cartesian and polar coordinate- unsteady radial flow in to a well - confined, unconfined and leaky aquifers -–multiple well system - pumping tests - non equilibrium equation for pumping tests - Thies' method - Jacob method - Chow's method -characteristics well losses –step draw down test- well near aquifer boundaries -determination of boundaries from pumping test. Image wells for various boundary conditions- Cavity well and open well- yield tests-pumping and recuperation test.

Unit 3
Tube wells: design - screened wells - gravel packed wells - well loss-selection of screen size - yield of a well - test holes - well logs - methods of construction - dug wells -shallow tube wells - deep wells - gravity wells - drilling in rocks - screen installation - well completion - well development - testing wells for yield - collector - orradial wells - infiltration galleries - well point system - failure of tube wells
Ground water investigation methods.

Text book(s)

Raghunath, H.M., "Ground Water", New Age International, 2007.
Karanth, K. "Groundwater Assessment, Development and Management", Tata McGraw Hill, 2003.

Reference(s)

Todd, D.K. and Mays.L.W., "Ground Water Hydrology", Wiley India, 2011.
Garg S.P., "Ground Water and Tube wells", Oxford & IBH, 1993.
Raghunath H. M., "Hydrology : Principles, Analysis and Design", New Age International Publishers, 2006.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE474	WATER RESOURCES SYSTEMS PLANNING AND DESIGN	L-T-P-C:3-0-0-3

Prerequisite(s): 19CIE 314 Hydrology & Water Resources Engineering

Course Objectives

To impart the knowledge about planning, design, and operation of water resources systems using mathematical optimization methods and models.
Exposure to the basic economic analysis and operations research techniques to develop the solutions for various surface and groundwater resources allocation decision making.

Course Outcome

CO1: Understand the water resources systems and express it using mathematical models.
CO2: Formulate and solve various optimization models of water resources planning and management problems.
CO3: Identify the advantages and limitations of various modeling methods and algorithms used in water resources planning and management.
CO4: Use the simulation and optimization models for planning and management decision making

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													
CO2	3	2												3	
CO3	2		3												
CO4	3	3	2	3										3	

Syllabus

Unit 1
Water systems engineering –scope and approach.
Issues and the systems planning approach- water system dynamics- water resource development alternatives – Water systems planning objectives- Constraints and Criteria – Economic and Econometric principles
Hydrologic input analysis, Demand analysis, System elements & Subsystem planning - Stochastic planning and management - Design and management issues.

Unit 2
Optimization methods and their application in Water resources systems. Linear programming and Dynamic programming models. Problem formulation for water resources systems – Multi objective planning – Large scale system analysis- Case studies.

Unit 3
Ground water system planning – Conjunctive surface and groundwater development- Hierarchical approach- Water quality management planning- Regional planning- Policy issues.

Reference(s)

Vedula S. and Mujumdar P P, "Water Resources Systems: Modelling techniques and analysis", Tata – McGraw Hill, 2007.

S K Jain, V P Singh, "Water Resources Systems Planning and Management", Elsevier Science, 2003

Maass. A. et.al., "Design of Water Resources Systems", Harvard University Press 2013.

M. C. Chathurvedi , "Water Resources Systems: Planning & Management", Tata McGarw Hill Publications, 1987.

Louks D P et.al, "Water Resources System Planning and Management: An introduction to methods, models and applications", UNESCO, Paris, 2017.

Goodman. A.S. and Major. D.C., "Principles of Water Resources Planning", Prentice Hall, 1984.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

PROFESSIONAL ELECTIVE COURSES (Without Prerequisites/open to all)

19CIE475	ENVIRONMENTAL IMPACT ASSESSMENT	L-T-P-C: 3-0-0-3

Prerequisite(s): Nil

Course Objectives

To highlight the evolution of Environmental impact assessment methods
To introduce the Impact assessment methods for various projects
To explain the various components for preparing the EIA document

Course Outcome

CO1: Understand the background of Environmental impact assessment in US and India

CO2: Analyze the factors and perform Impact assessment methods for various projects including water, power related projects

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1					3		2		2		
CO2	3	3	3	1	3		2			2				2	

Syllabus

Unit 1

Concept of environment, Concept of environmental impact, Environmental impact assessment (EIA) – definitions, terminology and overview, Evolution of EIA in the USA, Key features of the National Environmental Policy Act and its implementation and the Council on Environmental Quality (CEQ) guidelines, Role of the USEPA, Evolution of EIA in India, Sustainable development, Generalised EIA process flow chart, Screening, Initial environmental examination (IEE), Scoping, Public participation.

Unit 2

Environmental baseline, Impact assessment methods – checklists – matrices - quantitative methods – networks - overlay mapping. Introduction to impact prediction and evaluation, Factors to be considered while assessing the impacts of water related projects, power projects, waste water treatment facilities etc. Major features of the EIA notification in India, Present status and procedures of EIA in India.

Unit 3

Prediction and assessment of impacts of developmental activities on surface water, land and soil, groundwater, air, biological environment etc.

Prediction and assessment of visual impacts, Socioeconomic impact analysis, Evaluation of alternatives, Preparing the EIA document, Environmental impact statement (EIS), Environmental monitoring, Environmental audit (EA).Case studies.

Reference(s)

Larry W Canter, Environmental Impact Assessment, McGraw Hill, Inc, 1995.
Betty Bowers Marriot, Environmental Impact Assessment: A Practical Guide, McGraw Hill, Inc, 1997.
Barrow, C. J., Environmental and Social Impact Assessment – An Introduction, Edward Arnold, 1997.
Evan. K. Paleologos and Ian Lerche, Environmental Risk Analysis, McGraw Hill Inc, 2001.
Peter Morris (ed.) and Riki Therivel (ed.), Methods of Environmental Impact Assessment, Routledge, 2001.
UNEP, Environmental Impact Assessment Training Resource Manual, 2002.
Website of the Ministry of Environment and Forests, Govt. of India and the USEPA.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE476	REMOTE SENSING AND GIS	L-T-P-C: 3-0-0-3

Prerequisite(s): Nil

Course Objectives

Explain the basic concepts of Remote Sensing and EM Spectra and the different types of satellite and sensors.
Expose to the concepts of Photogrammetry and its applications
Illustrate Energy interactions (with atmosphere and surface features) and Interpretation of satellite images
Explain different components of GIS and its applications
Develop knowledge on using GIS data and working with GIS software.

Course Outcome

CO1: Understand principles and identify the components of remote sensing and EMR.
CO2: Schematize the process of data acquisition of satellite images and their characteristics
CO3: Understand the principles and identify the components of Photogrammetry and Thematic maps
CO4: Visualize the Remote sensing digitally with digital image processing techniques.
CO5: Apply Remote sensing and GIS in different engineering contexts

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3										1			
CO2	3	3	1		2							1			
CO3	3	3										1			
CO4	3			2								1			
CO5				2	3		2			1		2	2		

Syllabus

Unit 1
Introduction, Basic concepts and principles of remote sensing; Definition components of remote sensing- energy sensor, interacting body – active and passive remote sensing – platforms - EMR interaction with earth surface material, radiance, irradiance, incident, reflected, absorbed and transmitted energy – reflectance – specular and diffused reflection surfaces – spectral signature – spectral signature curves – EMR interaction with water, soil and earth surface. Application; Meteorology, land use, networking, hydrological studies, soil studies and coastal zone analysis.

Unit 2
Photogrammetry; Aerial and Terrestrial; photo interpretation. Sensors; Radar imaging; colour scanners; thematic mapper. Geographic information system – components of GIS – hardware, software and organisational context – data – spatial and non-spatial maps – types of maps – projection- types of projection – data input- digitiser, scanner, editing – raster and vector data structures – comparison of raster and vector data structure.

Unit 3

Analysis using raster and vector data – retrieval, reclassification, overlaying, buffering - data output – printers and plotters. Open source software's.GIS and remote sensing applications – urban applications – water resources – urban analysis – watershed management – resources information system – hazard mitigation.

Text book(s)

Lillesand, Kiefer and Chipman, "Remote Sensing and Image Interpretation", Wiley student edition, 2015.
A.M.Chandra and S.K. Gosh, "Remote Sensing and GIS", Atlantic, 2008.

Reference(s)

Anji Reddy, "Remote sensing and Geographical systems", BS Publications, 2012.
LRA Narayana, "Remote Sensing and its applications", Universities Press, 1999
J.V.S.Murthy, "Watershed management", New Age International, 1998.
Wurbs, R.A., and James, W.P., "Water Resources Engineering", Pearson Education India, 2015.
M G Srinivas (Edited by), "Remote sensing applications",Narosa Publishing House, 2001.
Burrough P A., "Principles of GIS for land resource assessment", Clarendon Press, 1994.
Michael N. Demers, "Fundamentals of geographic information system", Wiley student edition, 2012.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports

19CIE477	TRANSPORTATION SYSTEM MANAGEMENT AND CONTROL	L-T-P-C: 3-0-0-3

Prerequisite(s): Nil

Course Objectives

To explain different types of intersections and traffic control devices
To elucidate the concept of Transportation System Management
To explain the need for traffic management and various strategies adopted for an effective traffic management

Course Outcome

CO1: Understand the need for channelization and compare the different forms of intersections.
CO2: Analyse and Design of signalized intersections
CO3: Compare the different methods for traffic demand management.
CO4: Suggest alternatives for effective traffic management

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	1								1	3		
CO2	3	2	3	1								1	3		
CO3		2	3	1		1						1	3		
CO4		2	3	1		1						1	3		

Syllabus

Unit 1
Traffic Engineering Facilities and Control: Control of Traffic Movements through Time Sharing and Space Sharing Concepts – Design of Channelizing Islands - T, Y, Skewed, Staggered, Roundabout, Mini-Round about and other At-Grade Crossings and Provision for Safe Crossing of Pedestrians and Cyclists; Grade Separated Intersections, their warrants.

Traffic Control Devices: Traffic Signs and Signals, Principle of Signal Design, Webster's Method, Redesign of Existing Signals including Case Studies; Signal System Coordination.

Unit 2
Combination and Interactions, Input Assessment and Evaluation, Monitoring and Surveillance, Study of following TSM Actions with respect to: Problems Addressed, Conditions for Applications, Implementation Problems, and Evaluation and Impact Analysis. Public Transportation and HOV Treatment, Toll discounts for Car Pools during Peak periods, Park and Ride, Carpooling, Exclusive Bus & Two-wheeler Lanes, Priority at Ramp Terminals, Bus Transfer Stations, Limited Skip & Stop Bus Services & Shared Rides.

Unit 3
Demand Management: Staggered Working hours, Flexible Work hours, High Peak Period Tolls, Shuttle Services, Circulation Services and Extended Routes.
Traffic Operations Improvements: On-Street, Parking ban, Freeway Ramp Control and Closure, Travel on Shoulders, One-way Streets, Reversible Lanes, Traffic Calming, Right Turn Phase, Right Turn Lanes, Reroute Turning Traffic.

Text book

Kadiyali, L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.

Reference(s)

Institute of Transportation Engineers, "Transportation and Traffic Engineering Hand Book", 6th edition, 2009.
Salter, R.J., "Highway Traffic Analysis and Design", Palgrave Macmillan, 1996.
Louis J. Pignataro, Edmund J. Cantilli, "Traffic Engineering – Theory and Practice", Prentice Hall, 1973.
IRC- SP41-1994: Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	
End Semester		50

- CA – Can be Quizzes, Assignment, Projects, and Reports